FORWARD IN ENGINEERING

A coursebook for vocational schools in the field of mechanical engineering

Klara Bilić Meštrić
Ivana Špiranec

Vocations:

Mechanical computer technician
Heavy vehicle and mobile equipment service technician
Automotive technician
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Suradnica: Anita Dremel
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Ovaj priručnik izrađen je kao dio projekta “Engleski i njemački jezik u strojarstvu i prometu interaktivno – EDSIPI@” koji je sufinancirala Europska unija. Sadržaj ove publikacije isključiva je odgovornost Strojarske i prometne škole i partnera.
PREDGOVOR

Priručnik za strani jezik u struci *FORWARD in engineering* rezultat je projekta Engleski i njemački jezik u strojarstvu i prometu interaktivno – Edsipi®. Kako bismo kreirali suvremene nastavne materijale za izvođenje predmeta Strani jezik u struci, Strojarska i prometna škola Varaždin je sa partnerskim školama (Škola za cestovni promet Zagreb, Srednja škola Zlatar, Strojarska tehnička škola Fausta Vrančića i Srednja strukovna škola Velika Gorica) pokrenula ovaj projekt, provela analizu te izradila metodologiju na temelju koje je osmišljen priručnik te njegova interaktivna inačica.

Budući da naši učenici sve češće sudjeluju u programu Erasmus+ te pohađaju praktičnu nastavu u inozemstvu, za to su im neophodna znanja stranih jezika u struci. Ulaskom Hrvatske u Europsku Uniju i stvaranjem novih uvjeta na tržištu rada, ukazuje se potreba za sve većom otvorenošću prema inozemnim partnerima i tržištima, te za sve suvremenijim digitalnim kompetencijama. Stoga su nam potrebni upravo ovakvi funkcionalni nastavni materijali.

Priručnik *FORWARD in engineering* namijenjen je učenicima srednjih škola za sektor strojarstva, a posebno je prilagođen za sljedeća zanimanja: strojarski računalni tehničar, tehničar za vozila i vozna sredstva, te vozač motornog vozila, i to tijekom sve tri odnosno četiri godine. Priručnik je koncipiran na način da su neke teme zajedničke svim zanimanjima, dok su neke nastavne jedinice specifične za pojedino zanimanje. Iz tog razloga za priručnik je izrađena matrica izvođenja nastavnih jedinica u skladu s nastavnim planom i programom. Pritom smo se posebno trudili postići usklađenost i kontinuitet, dakle, teme koje se obrađuju u ovom priručniku obrađuju se nakon usvajanja istih tema na materinskom jeziku. Smatramo da će priručnik biti koristan i za predavanja u sklopu cjeloživotnog obrazovanja jer će koristiti polaznicima kao i svima onima koji žele usvojiti stručnu terminologiju.

Nadamo se da ćete prepoznati vrijednost ovog priručnika, da će Vam biti od koristi i olakšati Vam usvajanje novih strukovnih znanja. Učenje i poučavanje jezika struke za sve nas veliki je izazov, ali kao što je rekao Aristotel „*Korišteni učenja su gorki, ali su plodovi slatki.*”

Naposljetu, zahvaljujemo svima koji su sudjelovali u ovome projektu, dakle, školama partnerima i njihovima ravnateljima, nastavnicima struke, nastavnicima stranog jezika, autoru priručnika za strojarstvo na hrvatskom jeziku profesoru Živku Kondiću, suradničkim tvrtkama, analitičarima i metodičarima, informatičarima tvrtke Entropia te posebno Mariu Jankoviću, urednici Miji Šavrljugi, dizajnerima, lektorima i recenzentima, Irmi Dračić te Verici Koprivi Kozjak.

Anita Borovec, voditeljica projekta i autorice priručnika
IZVATCI IZ RECENZIJA

„Priručnik na engleskom jeziku za područje strojarstva, *Forward in engineering*, pisan je jasno i razumljivo te je sažeto obuhvatio potrebe učenja stranog jezika u struci s ciljem poboljšanja jezičnih kompetencija učenika koje nameće tržište rada. …

Unatoč složenosti procesa izvođenja nastave stranog jezika u struci, jasno definiranog u okviru teorije kurikuluma kao cjelovitog i sveobuhvatnog suvremenog promišljanja odgojno-obrazovnog procesa, kroz strukturu i formu sadržaja priručnika na engleskom jeziku za područje strojarstva vrlo se vješto i svrhovito, kroz slijed suvremenih i zanimljivih tekstova, zadataka i pitanja za ponavljanje svake lekcije zasebno, definira i strukturira vođenje nastave, kako bi se kroz etape nastavnog procesa provela opća načela nastavne organizacije te time uspješno svladali ishodi definirani kroz ciljeve nastavnog sadržaja. …

Sam priručnik, zbog objedinjavanja jezgrovitih sadržaja strukovnih pojmova, primjenu neće imati isključivo u nastavi engleskog jezika za područje strojarstva, već će primjenu naći i u predmetima struke kao dopunu realizaciji nastavnih sadržaja.

Slijedom navedenog, predloženi priručnik na engleskom jeziku za područje strojarstva ocjenjujem iznimno korisnim te smatram kako u potpunosti odgovara namijenjenoj svrshi.”

Ana Marketin Sedlar, dipl. ing.

„Priručnik je metodički vrlo dobro strukturiran jer odgovara zahtjevima struke u tematskom i terminološkom smislu, a u jezičnom smislu uključuje raznovrsne tipove materijala i zadataka koji su prilagođeni uzrastu, razini jezika i psihofizičkim sposobnostima učenika. Njihov sadržaj i raznolikost potiče motivaciju i znatiželju učenika. Opće je obilježje priručnika originalni pristup autorica koji se očituje u raznovrsnim sadržajima, korištenju širokog spektra literature, suvremenim materijalima, primjerenim rješivim zadacima, te upotrebi tehnologije i interneta. Priručnik je multidiscipliniran i multimedijalnog je karaktera. Vizualno je atraktivan i napredan u smislu tehnologije. …

Priručnik *Strani jezik u struci* u sektoru strojarstvo u potpunosti odgovara predmetnom kurikulumu za nastavni predmet Strani jezik u struci. Nastavne cjeline i teme u priručniku slijede potrebe jezika i struke. Originalan je s obzirom na metodologiju prema kojoj je izrađen, pristupu autorica obradi stručnih tema te interaktivnom dijelu koji uključuje. … Povrh svega, s obzirom na nedostatak jednog takvog djela koje u potpunosti zadovoljava zahtjeve jezika i struke, slijedi potrebe predmetnog kurikuluma i vodi ka postizanju posebnih jezičnih kompetencija u svrsi struke, ovaj priručnik nesumnjivo predstavlja izuzetno vrijedan doprinos literaturi ovakvog karaktera i namjene.”

Ines Jelovčić, mag.sc., prof eng. i tal. jezika i književnosti
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What is terminology?

1 Why is it important for you to learn terminology related to your field?

2 What makes up terminology? Complete the table with the types of terminology.
   - semi-technical vocabulary
   - academic vocabulary
   - ‘pure’ technical vocabulary

| a | makes up 20% of terminology. |
|   | Turning, milling, and extrusion are metal forming processes. |
|   | Riveting and soldering are used to create permanent joints. |
|   | What is welding? |

| b | general English words that have gained new meanings in technical context |
|   | cure people = liječiti ljude |
|   | cure rubber = vulkanizirati gumu |
|   | cure concrete = njegovati beton |
|   | cure meat = konzervirati meso |

| c | mainly refers to verbs used in different disciplines |
|   | Scientists analyse phenomena, test hypotheses and formulate theories. |
|   | Engineering branches into many subdivisions. |
|   | Short arc results in a porous weld. |
|   | Mechanical engineers are concerned with the design of tools and devices. |

3 What is the difference between standard terminology and technical jargon? When is it appropriate to use which? Which of the terms below belong to jargon? Discuss in class.

prtljažnik / gepek = boot
vjetrobransko staklo / šoferšajba = windscreen
4 Write down your own examples.

a 3 pure technical terms
b 3 academic verbs
c 3 general English words that have acquired a new meaning in technical context

Annealing involves heating the workpiece to reduce stress. Bearing may be defined as a device that reduces friction. Fashion designers design clothes, mechanical engineers design machines, and civil engineers design buildings. You can grind coffee, but you can also grind metal.

5 Match the words to get collocations (words that often occur together).

carry out / set / solve / formulate / assess / put forward / meet

a ______________ statements formulirati tvrdnje
b ______________ research provesti istraživanje
c ______________ ideas iznijeti ideje
d ______________ problems riješiti probleme
e ______________ tight deadlines završiti što u kratkom roku
f ______________ knowledge ocijeniti znanje
g ______________ goals odrediti ciljeve

6 Noun-noun compounds are the most frequent type of words in technical vocabulary. Look at the examples below and underline the noun which identifies the object in question?

carbon steel coal field water purification system car crash

7 What is the difference in meaning between the linking words in colour? Discuss in class.

a A lot of studying results in good grades.
b Good grades result from a lot of studying.

8 What do you need technical English for? Discuss in class.

- To be able to read about engineering in English.
- To learn new terminology.
- To learn about grammar.
- To be able to fill in the forms in my future job.
- To be able to talk to customers in my future job.
- To be able to work abroad.
What is engineering?

1. What does it mean that engineers *have / get the knack for something*? Discuss in class.

2. Match the photos to the engineers. What do you know about all these engineers? Discuss in class.
   - a. Gustave Eiffel
   - b. Faust Vrančić
   - c. Henry Ford
   - d. Ferdinand Porsche
   - e. Edith Clarke
3 Read some facts about the engineers in Task 2. Match the engineer to the correct paragraph.

a He implemented Da Vinci’s parachute. He was famous for his book on mechanics Machinae Novae. __________________

b He was an automotive engineer who created the first gasoline-electric hybrid vehicle. __________________

c He did not invent the automobile. He did not invent the assembly line. But he innovated them in a way to affect our lives today. __________________

d He was a French engineer who designed and oversaw the construction of the Eiffel Tower. __________________

e She was the first female electrical engineer, and the first female professor of electrical engineering at the University of Texas. __________________

4 Match the jobs to their descriptions.

automotive technician / heavy vehicle and mobile equipment service technician / mechanical CAD technician

a __________________ Computer-aided design software is the main tool in my work. I use it to design machine parts. To be able to do that, I had to learn about technological processes, design and material forming processes. You can work in engineering, but I found a job in manufacturing industries. I also prepare cost estimates and create assembly instructions and maintenance manuals for service and repair technicians.

b __________________ I’ve always had a tremendous interest in cars! My part of job is to inspect, maintain and repair cars, and I love it. My job also includes working with computer diagnostic programs to inspect the car, testing cars on the road, replacing damaged parts of the vehicle and assessing car damage in case of an accident. Sometimes I offer advice to customers who want to buy a new car.

c __________________ In my job I maintain and repair vehicles and machinery used in construction, farming and rail transportation. I perform scheduled maintenance, such as cleaning and lubricating parts, diagnose malfunctions, replace worn parts, test components, disassemble and reassemble equipment, etc. I often use screwdrivers, pliers, and wrenches to repair small parts.
5 What is the main difference between scientists and engineers? Complete the text.
a __________ create the theories, b __________ implement them. c __________ observe
the world, notice different phenomena, test their predictions and formulate theories, whereas d
__________ are problem solvers. e __________ test different materials, and f __________
use them to create new things. g ____________ work with tight deadlines and enhance our lives in
practical ways.

6 Read the text to answer the questions.

What is engineering?
The word engineering is derived from the Latin word ‘ingeniare’ which means to design or create.
It is the applied science that deals with the design and development of structures and machines.
Engineering branches into many subdisciplines, such as mechanical, civil, electrical, aeronautical,
marine, oil, medical engineering, etc. Engineers create something out of nothing. They are
problem solvers who optimize efficiency, safety and costs. In their work they first identify the
problem, come up with the solution, test it and finally assess and analyze the results. Mechanical
engineers constantly develop, maintain, upgrade, repair and innovate new devices. They often
have to meet tight deadlines while trying to improve the quality of our everyday life.

a  What is the main objective of engineering?
b  Which subdisciplines are mentioned in the text?
c  How do engineers approach a problem?
d  What does a mechanical engineer do?

7 Underline all the verbs in the text in Task 6. Which verb tense is used in the text?

8 Complete the sentences with the correct commonly confused word. Make any necessary
changes.

1 application / appliance
a Theories need ________________ in practice.
b I can’t imagine my life without household ________________.
c Have you already filled in your job ________________?
d Computer programmers have developed another ________________.

2 concerned with / concerned about
a Parents are ________________ their children.
b Civil engineers are ________________ the design and construction of different structures.

3 motion / movement
a There was a sudden ________________ of his head as he saw her.
b Newton formulated three Laws of ________________.
4 cost / price
a They are developing a new device at a _________________ of 80,000 kuna.
b What is the _________________ of that car?

5 discover / invent / innovate
a Engineers constantly _________________ devices.
b Cook _________________ Hawaii.
c Chinese _________________ the first computer – the abacus.

9 Translate the verbs. Then complete the table.

<table>
<thead>
<tr>
<th>CROATIAN TRANSLATION</th>
<th>VERB</th>
<th>NOUN</th>
</tr>
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<tbody>
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<td>improve</td>
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</tbody>
</table>

10 Project work. Do research on a famous engineer or scientist. Prepare a 5-minute presentation.
Types of lines and technical drawings

1. Complete the text.
visible / means / details / specifications / styles / hidden / dimensions / shape components /
draftsperson / object
A technical drawing is a ____________ of communicating ideas in engineering. It shows the way how ____________ should be assembled. A drawing is made by a ____________ or a
drafting technician. There are two types of drawing: two-dimensional representation specifies two ____________ of an object, whereas a three-dimensional representation makes all three
dimensions ____________. A technical drawing contains ____________, dimensions, material,
manufacturing ____________, etc. In technical drawing it is important to use different line
__________ and widths as they are used to determine ____________ in the drawing.
For instance, solid lines show the ____________, whereas broken lines show ____________
information.

2. Complete the table. Draw the one type of line that is missing.
dashed thin line / thin line / dashed thick line with dots / free hand

<table>
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<td>long thin line with double dots</td>
<td></td>
</tr>
</tbody>
</table>
3. Now complete the table in Task 2 with the words below.


4. The figure below shows a technical drawing of a valve. Match the valve parts to the names.

seat / handwheel / bonnet / body / seal / disc / gasket 2x / stem / gland nut

a ________________________________
b ________________________________
c ________________________________
d ________________________________
e ________________________________
f ________________________________
g ________________________________
h ________________________________
i ________________________________
j ________________________________

5. Complete the dialogue.

a Unfortunately, this time we can’t mount some parts.
b Could you please send me the drawing of all the valve parts!
c Thanks!
d No, unfortunately, it isn’t. I can’t assemble the valve.

A: ___________________________________________

B: Of course I can. But, isn’t it all clear from the two-dimensional drawing?

A: ___________________________________________

B: But you have already assembled it once. Why don’t you simply do it like the last time?

A: ___________________________________________

B: I see. OK, I’ll send you the drawing. In fact, you’ll get a three-dimensional drawing!

A: ___________________________________________

B: You’re welcome!
6 Complete the table with words referring to measurement.

<table>
<thead>
<tr>
<th>CROATIAN</th>
<th>NOUN</th>
<th>ADJECTIVE</th>
<th>VERB</th>
</tr>
</thead>
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<tr>
<td>thickness</td>
<td></td>
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</tr>
</tbody>
</table>

7 Complete the sentences.

a What is the **w**________ of this room? How **w**________ is this room?
b Can you measure the **t**________ of this wall?
c This car is 3 metres in **l**________. Do we need to **l**________ it more?
d How **l**________ is that truck, and what is its **w**________?
e What is the **t**________ of this piece of polymer?
f How much does this piece of material **w**________?

8 What does the picture show - **shapes** or **solids**? How do you pronounce them? Discuss in class.
9 Complete the sentences using the picture in Task 8.
   a Polygons may be classified into ________________________________.
   b There are three types of parallelograms: ____________________________.
   c There are ___________ types of triangles: ____________________________.
   d Octagon is a polygon with ________________________________.
   e Rectangle is a ________________ with ______________________________.

10 Here are some types of solids. How do you pronounce them? Translate them into Croatian.

11 Project work. Create a poster with pictures of shapes and solids.
1. Complete the table with the words relating to shapes.

<table>
<thead>
<tr>
<th>NOUN</th>
<th>ADJECTIVE</th>
<th>NOUN</th>
<th>ADJECTIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>circle</td>
<td></td>
<td>cone</td>
<td></td>
</tr>
<tr>
<td>square</td>
<td></td>
<td>cube</td>
<td></td>
</tr>
<tr>
<td>rectangular</td>
<td></td>
<td>prismatic</td>
<td></td>
</tr>
</tbody>
</table>

2. Choose an object in your classroom and describe its shape, dimensions and material. Your classmates should try to guess the object.

   a. It is ______________ in shape.
   b. It is ______________ high, ______________ thick and ______________ wide.
   c. It is made of ______________.

3. Look at the picture and complete the sentences.

   a. ______________ a symmetrical open curve
   b. ______________ a completely round flat shape
   c. ______________ a curve shaped like the path of an object falling back to the earth
   d. ______________ an oval shape, it looks like a circle squeezed on two sides
4 Match the names of the technical curves to the pictures. Then translate the terms.

a helix _________________________
b cycloid _________________________
c spiral _________________________
d involute _________________________

5 Complete the text to get a definition of dimensioning and scale.

diameter / size / holes / assemble / line / widths / extension / arrowheads

Dimensioning is the process of defining the ____________, form and location of components in a drawing so that the workman can manufacture and ____________ the parts of a machine accurately. A dimension consists of a dimension ____________, and ____________ line. A location dimension locates ____________, whereas a size dimension defines radius, ____________, lengths, ____________ and thickness. ____________ must always touch the projection line.

6 Mark the dimension line, dimension arrow and extension line on the drawings.
7 Some of the drawings in Task 6 are incorrect. Correct the statements below.
   a  Dimension lines may cross each other.
   b  Extension lines should not cross each other.

8 Complete the dialogue.

   wrongly / should / shape / noticed / square / dimension number / error
   A: What is the __________ of the girder that we are making for the French?
   B: Circular. You can see it in the drawing. Take a closer look at the __________.
   A: The drawing says that the shape is __________, and you say it’s circular.
   A: No, it should be circular. Wait a minute. Let me check! Ah, yes! There’s a mistake in the
   drawing. It __________ be circular. I dimensioned it __________.
   A: Ok, so circular shape it is.
   B: It’s a good thing that you have __________ it. Thanks.
   A: Not at all. What matters is that we spotted the __________ on time!

9 Match the drawing tools to the pictures.

   a  a pair of compasses  d  template  g  slide rule
   b  drawing table       e  eraser       h  ruler
   c  protractor          f  T-square     i  French curve
10 Define the tools in English.
Example: A pair of compasses is a tool which is used to draw circles.

a drawing table
b protractor
c template
d eraser
e T-square
f slide rule
g ruler
h French curve

11 Match the terms to the figures.

a addition
b subtraction
c multiplication
d division
e equation
f fraction
g root
h power

☐ 10-5=5
☐ 2+2= 4
☐ 3/5
☐ $\sqrt{2}$
☐ 5x5=25
☐ 30:6=5
☐ $4^6$
☐ (a+b) (a-b) = c

12 Project work. Prepare a poster with photos of tools that you will need in your future career. Present your poster in class.
Unit 3

Scale and documenting

1 Complete the text.

specification / instructions / ratio / handling / manufacturing / use / distance

Scale refers to a ____________ which compares a measurement on a map to the actual ____________ between locations identified on the map.

Technical documentation may be defined as any type of documentation that describes ____________ and functionality of a technical product that is under development or ____________. Technical documentation may include: ____________ of components, data sheets of components, ____________ standards, test methods, ____________ for handling the part and costs.

2 Complete the dialogue.

size / dimension / scale / fit / drawing / format

Teacher: For homework, create a technical ____________ of your wardrobe.
Pupil: What ____________ should we choose?
Teacher: It depends on the ____________ of the wardrobe. It should ____________ nicely into A4 format, and the scale shouldn’t be less than 1:100.
Pupil: Should we ____________ it as well?
Teacher: Of course!

3 Put the dimensioning in order 1-3.

☐ placing the vertical features in the top view
☐ dimensioning horizontal features in the top view
☐ dimensioning vertical features in the front view

4 Match the terms to the definitions.

front view / top view / side view / datum feature / datum

a ____________ can be either left hand or right hand view
b ____________ is the view of an object directly from above
c ____________ is the view of the face of a building
d ____________ is a virtual ideal plane, line point, or axis
e ____________ refers to a physical feature of a part
5 Complete the instructions for dimensioning.
not over-dimension / include / avoid / mark / dimension

In the dimensioning process, the pupil should place all the measurements correctly. To be more precise, they should...

a _______________ the dimensions for height, width and depth.
b _______________ all the necessary dimensions,
c _______________ where the shapes are shown,
d _______________ dimensioning hidden lines,
e _______________ because it can cause confusion.

6 Complete the text on geometry and circle. Then use the photos below to complete the paragraph about triangles.
mathematics / points / lines / centre / earth / diameter / measurement / radius

The word geometry is derived from the Greek word geo which means _______________ and metria which means _______________. It is a branch of _______________ that deals with measurement and relationships of _______________ and _______________ in space.

A circle is a shape with all points equidistant from its _______________. The distance across a circle through the centre is called the _______________. The _______________ refers to the distance from the centre of a circle to any point on the circle.

A triangle is a shape bounded by _______________ sides. There are many types of triangles. In an _______________ triangle all angles are less than 90°.
An _______________ triangle possesses one angle greater than 90°. An _______________ triangle has three equal angles, whereas a scalene triangle has three _______________ angles. _______________ triangle has two equal sides and two _______________ angles. Finally, a right angle triangle has an angle of _______________°.

7 Project work. Create a mini bilingual dictionary using the words from this unit.
On the lines, drawings, curves, dimensions, and scales

1. Complete the text on technical drawing.

A technical drawing is a ___________ of communicating ideas in engineering. It shows the way how ___________ should be assembled. A drawing is made by a ___________ or a drafting technician. There are two types of drawing: two-dimensional representation specifies two ___________ of an object, whereas a three-dimensional representation makes all three dimensions ___________. A technical drawing contains ___________, dimensions, material, manufacturing ___________, etc. In technical drawing it is important to use different line ___________ and widths as they are used to determine ____________ in the drawing. For instance, solid lines show the ___________, whereas broken lines show ___________ information.

2. Complete the table with the words below. Then draw the missing type of line.

dashed thin line / thin line / dashed thick line with dots / free hand

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SHAPE</th>
<th>ENGLISH TERM</th>
<th>CROATIAN TERM</th>
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<tr>
<td>K</td>
<td>______</td>
<td>long thin line with double dots</td>
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</tbody>
</table>
3 Complete the table with the Croatian translations.
uska crta-točka-crta
široka crta-točka-crta
uska crtkana
široka puna
uska crta-dvije točke-crta
uska puna prostoručna
široka crtkana
uska puna
uska crta-točka-crta a široka na krajevima
uska puna ravna cik-cak

4 Complete the table with words referring to measurement.

<table>
<thead>
<tr>
<th>CROATIAN</th>
<th>NOUN</th>
<th>ADJECTIVE</th>
<th>VERB</th>
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<td>thickness</td>
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</tr>
</tbody>
</table>

5 Complete the sentences.

a What is the w___________ of this room? How w___________ is this room?
b Can you measure the t___________ of this wall?
c This car is 3 metres in l___________. Do we need to l___________ it more?
d How l___________ is that truck, and what is its w___________?
e What is the t___________ of this piece of polymer?
f How much does this piece of material w___________?
6 Look at the picture and complete the sentences.

a ____________ a symmetrical open curve
b ____________ a completely round flat shape
c ____________ a curve that shaped like the path of an object falling back to the earth
d ____________ an oval shape, it looks like a circle squeezed on two sides

7 Match the names of the technical curves to the pictures. Then translate the terms.

a helix ______________
b cycloid ______________
c spiral ______________
d involute ______________

8 Complete the definitions of **dimensioning** and **scale**.

Dimensioning is the process of defining the ____________ form and location of components in a drawing so that the workman can manufacture and ____________ the parts of a machine accurately. A dimension consists of a dimension ____________, and ____________ line. A location dimension locates ____________, whereas a size dimension defines radius, ____________, lengths, ____________ and thickness. ____________ must always touch the projection line. Scale refers to a ____________ which compares a measurement on a map to the actual ____________ between locations identified on the map.
9 Mark the dimension line, dimension arrow and extension line on the drawings.

10 Some of the drawings in Task 9 are incorrect. Correct the statements below.
   a Dimension lines may cross each other.
   b Extension lines should not cross each other.

11 Match the terminology to the definitions.
   front view / top view / side view / datum feature / datum
   a _____________ can be either left hand or right hand view
   b _____________ is the view of an object directly from above
   c _____________ is the view of the face of a building
   d _____________ is a virtual ideal plane, line point, or axis
   e _____________ refers to a physical feature of a part

12 Project work. Create a poster with pictures of shapes and solids.

KEY WORDS
thin line • thick line • technical drawing • dimensioning • scale • basic elements of dimensions
1. Complete the text.

standard / size / instance / seven / measure / used / measurement / system

SI refers to the modern metric system of ____________ which is a universal language of science. Measurement refers to the process of determining ____________, length, or amount. The International System of Units (SI) consists of ____________ SI base units for seven base quantities. A unit is a quantity used as a ____________ measure and is defined by convention. SI derived units are defined using seven base quantities via a ____________ of quantity equations. There are also SI derived units with special names and symbols, as well as SI prefixes that are ____________ to form decimal multiples of SI units. Precisely, standard refers to ____________ adopted by convention. Besides SI, there are also other standards, for ____________ US Customary System and British Imperial System. Can you now explain the difference in meaning between measure and measurement?

2. Complete the table.

<table>
<thead>
<tr>
<th>PHYSICAL QUANTITY</th>
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<th>SYMBOL ABBREVIATION</th>
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<td>candela</td>
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</tbody>
</table>

3. What is the main difference between alternating current (AC) and direct current (DC)? Which of the two can be transmitted to long distances? What type of electricity was invented by Tesla? Discuss in class.
4 Match the SI-derived quantities to the definitions.

specific volume / acceleration / velocity / mass density / area / volume / luminance

a __________ the measurement of space calculated by multiplying length and width
b __________ the amount of space occupied by a solid, liquid or gas
c __________ speed
d __________ derived quantity expressed in candela per square metre
e __________ an increase in speed
f __________ derived quantity expressed in kilograms per cubic metre
g __________ derived quantity expressed in cubic metres per kilogram

5 Match the names of famous inventors to their photos. What do you know about them? Discuss in class.

a Isaac Newton  
b Ernst Werner von Siemens  
c Marie Skłodowska Curie  
d Blaise Pascal
6 Read about the famous inventors in Task 5. Match the text to the inventor.

a  He was born in France in 1623. Before he turned 13, he had proven the 32\textsuperscript{nd} proposition of Euclid and discovered an error in Descartes’ geometry. At 16, he began writing a study of the entire field of mathematics. At that time, he began designing a calculating machine - \textit{pascaline}, which he perfected at the age of 30.

b  She was born in Poland in 1867. She was the first woman to win a Nobel Prize, and the only woman to win the award in two different fields – physics and chemistry. Her efforts led to the discovery of polonium, radium and finally X-rays. She was a pioneer in the field of radioactive research.

c  He was born in England in 1642. His book \textit{Philosophiae Naturalis Principia Mathematica}, first published in 1687, laid the foundations for classical mechanics. He formulated the laws of motion and universal gravitation. He stated that the Earth is shaped as an oblate spheroid.

d  He was born in Germany in 1816. He invented a telegraph that used a needle to point to the right letter, instead of using Morse code. Based on this invention he founded the famous electrical and telecommunications company.

7 Now underline all the verbs in Task 6. Which \textbf{verb tense} is used? Why? Discuss in class.

8 Complete the collocations with the verbs in Task 6.

a  \underline{invented} a telegraph
b  \underline{founded} a telecommunications company
c  \underline{discovered} an error
d  \underline{wrote} a study
e  \underline{designed} a calculating machine
f  \underline{won} a Nobel prize
g  \underline{laid} foundations
h  \underline{stated} the Laws of motion

9 \textbf{Who said the quotes below?} Discuss them in class.

\begin{quote}
God always takes the simples way.
Quality is not an act, it is a habit.
Art without engineering is dreaming. Engineering without art is calculating.
I have not failed. I’ve just found 10,000 ways that won’t work.
\end{quote}
10 Complete the table with the metric prefixes.

<table>
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<tr>
<th>NAME</th>
<th>ABBREVIATION</th>
<th>FACTOR</th>
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</thead>
<tbody>
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<td>$10^3$</td>
</tr>
<tr>
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<td>μ</td>
<td>$10^6$</td>
</tr>
<tr>
<td>n</td>
<td>n</td>
<td>$10^9$</td>
</tr>
</tbody>
</table>

11 Complete the collocations with the verbs below.

- resist / convert / withstand / conserve / apply 2x / generate / store / reduce

a __________, __________, __________ force
b __________, __________, __________, __________ energy
c __________, __________ pressure

d Complete the sentences with some of the verbs in Task 10.

a Can this building __________ seismic forces?
b Power plants __________ energy.
c We can __________ mechanical energy into electrical.
d You need to __________ pressure if you don’t want the material to break.
e If you __________ force to a body, it will move.

13 Project work. Do research on other famous scientists after whom units were named, for instance Weber, Ohm, Volt, Joule, Farad, Coulomb, etc. Prepare a poster or a PowerPoint presentation.
Measuring and labelling shapes and location

1. Complete the text.
   allowable / language / feature / tolerancing / tolerance / location / variation

   Geometric dimensioning and _______________ is a system for defining and communicating engineering tolerances. It uses a symbolic _______________ on engineering drawings that explicitly describe nominal geometry and its allowable _______________. All dimensions must have a _______________. Every _______________ on every manufactured part is subject to variation. Therefore, the limits of _______________ variation must be specified. Tolerancing specifications define the allowable variation for the form and _______________ compared to the datum reference.

2. Complete the text.
   deviations / plane / waviness / roughness / pattern / irregularities

   Surface finish is the nature of a surface as defined by the 3 characteristics: lay, surface _______________, and waviness. It comprises the small local _______________ of a surface from the perfectly flat ideal or a true _______________. Lay is the direction of the predominant surface _______________ ordinarily determined by the production method used. Surface roughness is a measure of the finely spaced surface _______________. _______________ is the measure of surface irregularities with spacing greater than that of surface roughness.

3. Draw the symbols below.
   a material removal allowed   b material removal required   c material removal not allowed

4. Translate into English.
   a tolerancije oblika
   b tolerancije položaja
   c referentni element
   d hrapavost
5 Complete the geometric tolerance reference table.
circular run-out / cylindricity / flatness / symmetry / angularity / concentricity / circularity / straightness / positional tolerance / okomitost / obris / usporednost / ploha

<table>
<thead>
<tr>
<th>CROATIAN</th>
<th>GEOMETRIC CHARACTERISTIC</th>
<th>SYMBOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>pravocrtnost</td>
<td>a</td>
<td>—</td>
</tr>
<tr>
<td>ravnost</td>
<td>b</td>
<td>□</td>
</tr>
<tr>
<td>kružnost</td>
<td>c</td>
<td>○</td>
</tr>
<tr>
<td>cilindričnost</td>
<td>d</td>
<td>θ</td>
</tr>
<tr>
<td>e</td>
<td>profile of a line</td>
<td>—</td>
</tr>
<tr>
<td>f</td>
<td>profile of a surface</td>
<td>—</td>
</tr>
<tr>
<td>g</td>
<td>perpendicularly</td>
<td>&lt;</td>
</tr>
<tr>
<td>h</td>
<td>parallelism</td>
<td>⊥</td>
</tr>
<tr>
<td>nagib</td>
<td>i</td>
<td>/\</td>
</tr>
<tr>
<td>smještaj</td>
<td>j</td>
<td>⊙</td>
</tr>
<tr>
<td>koncentričnost</td>
<td>k</td>
<td>⊙</td>
</tr>
<tr>
<td>simetričnost</td>
<td>l</td>
<td>*</td>
</tr>
<tr>
<td>udar</td>
<td>m</td>
<td>*</td>
</tr>
</tbody>
</table>

6 What type of measurements do the photos show? Discuss in class.

7 Project work. Create a poster on the geometric tolerancing reference. Use English and Croatian terminology and symbols.

KEY WORDS
tolerance of shape • tolerance of location • datum reference • roughness
What is energy?

1. Describe the photos. Discuss in class.
2 Read the text. Then choose the correct options.

What is energy?
Energy is the power derived from the usage of chemical or physical resources. Energy cannot be created or destroyed. Joules are units of energy. There are different energy resources available in our environment. These resources may be categorized into renewable and non-renewable energy resources. Renewable energy resources are replenished with time, and therefore cannot be depleted. For instance, solar, wind, hydropower, geothermal and biomass are renewable or alternative energy resources. They are mainly considered non-polluting, except biomass which is considered polluting. On the other hand, fossil fuels, i.e. oil, gas and crude oil are considered non-renewable or conventional energy resources. Their main drawback is the fact that they are not eco-friendly. Their use leads to the emission of carbon dioxide into the air, which is a major pollutant. Energy resources are used to generate different forms of energy, for instance electrical, mechanical, optical, kinetic, thermal or chemical energy. We convert energy forms from one form to another, for example mechanical to electrical energy. This process is called energy conversion.

1 Energy is ____________ derived from the usage of different resources.
   a unit          b capacity          c power

2 The ____________ of energy are joules.
   a forms          b units          c power

3 There are electrical, mechanical, optical, thermal and chemical energy ____________.
   a forms          b resources          c units

4 Biomass, geothermal, solar, wind and hydropower are renewable energy ____________.
   a resources          b forms          c power

5 Renewable energy sources cannot be ____________.
   a stored          b conserved          c depleted

6 Fossil fuel is a ____________ energy resource.
   a alternative          b non-renewable          c renewable

7 Biomass is a ____________ renewable energy resource.
   a non-polluting          b eco-friendly          c polluting

8 Carbon dioxide is a ____________.
   a pollution          b pollutant          c polluter

9 Factories and vehicles are major ____________.
   a polluters          b pollutants          c pollution

10 The Law of conservation of energy states that energy cannot be created or ____________.
   a generated          b destroyed          c stored

11 Different energy resources are used to create different energy ____________.
   a units          b resources          c forms

3 What tense are the verbs in colour in Task 2? Are they in active or passive voice? Discuss in class.
4 Mark the energy sources as renewable (R), or non-renewable (NR).

- biomass ☐ uranium ☐ natural gas ☐
- nuclear power ☐ magma ☐ wind power ☐
- propane ☐ rapeseed oil diesel ☐ tides ☐
- hydropower ☐ solar power ☐ petroleum ☐
- coal ☐

5 Complete the table. Translate the verbs.

<table>
<thead>
<tr>
<th>NOUN</th>
<th>VERB</th>
<th>CROATIAN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>store</td>
<td></td>
</tr>
<tr>
<td></td>
<td>pollute</td>
<td></td>
</tr>
<tr>
<td></td>
<td>deplete</td>
<td></td>
</tr>
<tr>
<td>conservation</td>
<td>categorize</td>
<td></td>
</tr>
<tr>
<td></td>
<td>generate</td>
<td></td>
</tr>
<tr>
<td>emission</td>
<td></td>
<td></td>
</tr>
<tr>
<td>conversion</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6 Complete the sentences with the words from Task 4. Make any necessary changes.

a Vehicles __________ harmful gases and thus cause __________.

b We are facing ozone __________ today.

c Explain the Law of __________ of energy!

d Turbines __________ mechanical energy to electrical. This process is called energy __________.

e The process of gathering energy for later use is called energy __________.

f Energy may be __________ as power.

g We __________ electricity using different energy resources.

7 Project work. In pairs, conduct an in-depth research on one energy resource that you are interested in. Prepare a PowerPoint presentation or a poster.
8 Study the verb forms in colour in Task 2. They are all passive forms. Complete the sentences with the present simple passive or modals in passive form.

a Paper (make) __________________________ out of wood.

b Fossil fuel (consider) ________________________ non-renewable energy resource.

c Energy (cannot / destroy) ________________________ or created.

d Renewable energy resources (replenish) ________________________ with time.

e That problem (can / approach) ________________________ in different ways.

9 Do the crossword puzzle.

ACROSS
1 The flow of electricity.
8 The reduction in the amount of ozone gas.

DOWN
1 CO2
2 Conventional energy resources are not eco-___________.
3 Large quantity of something, e.g. ab__________ supplies.
4 A type of resource derived from hot water springs or magma.
5 A large facility that generates electricity.
6 Vehicular pollution is caused by _____________.
7 Use up something completely.

KEY WORDS
renewable energy • non-renewable energy • fossil fuels • pollution
Materials in mechanical engineering

1 What is the difference between material and matter? Complete the sentences with the correct word. Discuss in class.

a _______________ refers in general to physical substance that everything in the universe consists of.

b Objects are composed of different _______________ that possess certain physical and chemical properties.

2 Translate the materials into Croatian.

a stainless steel  i  plastics
b lead j  thermosetting plastics
c iron k  aluminium

d alloy l  composite
e thermoplastic elastomer m  glass
f brass n  copper
g cast iron o  thermoplastic material
h ceramics

3 What materials do the photos show? Discuss in class.

a  b  c

a  b  c

d  e  f
4 Match the definitions to some of the material in Task 2.

a ____________ soft reddish metal used for making electric wires
b ____________ a hard, transparent material used for making windows
c ____________ a material formed by mixing metal with another substance
d ____________ light, silver grey metal used for making tubes, foils
e ____________ material made by firing clay at a high temperature
f ____________ an alloy of steel that does not easily corrode or rust
g ____________ a mix of polymers with elastomeric and thermoplastic properties
h ____________ a heavy soft, grey metal, used in the past for water pipes
i ____________ a material that is permanently hard and cannot be reshaped
j ____________ a material made of two or more materials with different properties that remain separate

5 Project work. Do some research and prepare a quiz on 5 interesting facts regarding engineering materials. Test how much your classmates know about these facts.

6 Read the text to fill in the classification tree below. Then underline all the verbs in the text.

**Engineering materials** may be divided into metals, composites and non-metals. Metals are further divided into ferrous and non-ferrous. Ferrous metals and alloys contain iron or steel, whereas non-ferrous materials contain aluminium, copper, etc. Polymers, composites and ceramics may be classified under non-metals. Polymers are further divided into plastics and rubber. Finally, thermoplastics and thermosets are categorised as plastics.

![Classification Tree](image)
7 Read the text to find the examples.

Pick & Mix’ Smart Materials for Robotics

Researchers have successfully combined multiple functions into a single smart life-like material for the first time. This ‘designer’ material can be used in the robotics, automotive, aerospace, and security industries.

Scientists from the University of Cambridge combined various materials into a single material with multiple functions: movement, recall of movement and sensing – similar to muscles in animals. The researchers picked and mixed two different types of smart materials: an ionic electro-active polymer (i-EAP), and a two-way shape memory polymer (SMP).

The new material is highly resistant to cracks. We can use it to create multi-functional artificial muscles, which can move and sense. The movement in these hybrid materials is controlled by light, temperature, chemicals, electric field or magnetic field. These various stimuli are used to make the materials change colour, emit light or energy, and finally change shape.

a application of a new material

b its life-like properties

c two materials that were picked and mixed

d stimuli that trigger new properties

e new properties

8 Complete the table with the verbs in Task 7.

<table>
<thead>
<tr>
<th>Verb Type</th>
<th>Present Simple</th>
<th>Past Simple</th>
<th>Present Perfect</th>
<th>Modal verbs</th>
<th>Present Simple passive</th>
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<tr>
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<tr>
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<td>Modal verbs</td>
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</tr>
<tr>
<td>Present Simple passive</td>
<td>1</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modal verbs in passive voice</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
9 Complete the text. Some prepositions are used more than once.

into / of / from / ∅ / to / with / on

Steel consists ___________ iron and iron carbide. The Eiffel Tower is made ___________ metal. The properties of carbon steel depend ___________ the percentage of carbon it contains. Copper can resist ___________ corrosion well. We paint metal to prevent it ___________ corrosion. If we add carbon ___________ steel, it is provided ___________ new properties. If we remove carbon ___________ steel, it is not as hard. Which material is capable ___________ resisting wear? What metals is brass composed ___________?

10 Match the 4 main categories of engineering materials to their descriptions.

composites / ceramics and glasses / polymers / metals and alloys

<table>
<thead>
<tr>
<th>MATERIAL CATEGORY</th>
<th>DESCRIPTION AND PROPERTIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>• inorganic materials</td>
</tr>
<tr>
<td></td>
<td>• consist of metallic and non-metallic elements bonded together</td>
</tr>
<tr>
<td>b</td>
<td>• crystalline structure</td>
</tr>
<tr>
<td></td>
<td>• good thermal and electrical conductivity</td>
</tr>
<tr>
<td>c</td>
<td>• consist of a matrix and a reinforcement, e.g. fiber</td>
</tr>
<tr>
<td></td>
<td>• embedded in plastics; combine the best properties of its constituent parts</td>
</tr>
<tr>
<td>d</td>
<td>• organic materials</td>
</tr>
<tr>
<td></td>
<td>• consist of long molecular chains of carbon</td>
</tr>
</tbody>
</table>

11 Match the 4 types of materials to the products.

a composites    b ceramics and glasses    c polymers    d metals and alloys

---

KEY WORDS
matter • engineering material • material property
Material properties

1. Circle the material properties that are new to you. Look them up in a dictionary. Are these words nouns, verbs or adjectives? Discuss in class.

   scratch-resistant  weldable  stiff  tough  strong
   brittle  ductile  flammable  soft  machinable
   corrosion resistant  castable  malleable  durable  conductive
   smooth  wear-resistant

2. Match the material properties from Task 1 to their definitions.

   a. ______________ ductile — that can be made into a thin wire
   b. __________________ hard but easily broken
   c. __________________ that is easily set on fire
   d. __________________ likely to last for a long time without breaking or getting weaker
   e. __________________ that can be welded
   f. __________________ that can be formed by casting
   g. __________________ that can be shaped with a machine
   h. __________________ that can be shaped of formed by hammering or pressure
   i. __________________ that is resistant to scratches
   j. __________________ rigid or inflexible
   k. __________________ that is resistant to wear
   l. __________________ that allows heat or electricity to pass through
   m. __________________ that does not rust easily
   n. __________________ that is not easily damaged or broken
   o. __________________ material that is both strong and ductile
   p. __________________ not hard
   q. __________________ opposite of rough
3 Complete the table.

<table>
<thead>
<tr>
<th>ADJECTIVE</th>
<th>NOUN</th>
</tr>
</thead>
<tbody>
<tr>
<td>hard</td>
<td></td>
</tr>
<tr>
<td>tough</td>
<td></td>
</tr>
<tr>
<td>strong</td>
<td></td>
</tr>
<tr>
<td>machinable</td>
<td></td>
</tr>
<tr>
<td>weldable</td>
<td></td>
</tr>
<tr>
<td>conductive</td>
<td></td>
</tr>
<tr>
<td>corrosion resistant</td>
<td></td>
</tr>
<tr>
<td>durable</td>
<td></td>
</tr>
<tr>
<td>brittle</td>
<td></td>
</tr>
<tr>
<td>malleable</td>
<td></td>
</tr>
</tbody>
</table>

4 Fill in the letters to get the correct material property. Use adjectives and nouns in Task 3.

a Materials that are brittle, and not d__________________.

b The lack of d__________________ may be defined as brittleness.

c Copper is a corrosion r__________________ material.

d Hard materials are not easily m__________________.

e Material h__________________ is tested by Brinell’s test.

f Materials that easily crack are not w__________________.

g Materials that have scratch-r__________________ are used for cars.

h The most heat-r__________________ non-metal is ceramics.

i C__________________ is the property of materials that allow electricity to pass through.

j Aluminium is s__________________, lightweight, and also highly c__________________.

5 Complete the sentences.

acquires / gains / possesses / have / withstand / prevent

a Toughness is the ability to resist or ___________________ repeated bendings.

b A material that can be easily hammered ___________________ the property of malleability.

c When normalized, steel ___________________ increased hardness and decreased ductility.

d An insulator is a material used to ___________________ heat, electricity of sound from passing through.

e A material can ___________________ poor, good or excellent insulating properties.
6 Have you ever heard of these modern and smart materials? Do some research on the materials you are not familiar with. Then translate the materials into Croatian.

- a photochromic material
- b thermochromic paint
- c electrotexile
- d shape memory wire
- e ferrofluid
- f smart putty
- g d3o
- h light diffusing acrylic
- i electrochromic glass

7 Which materials are shown in the photos? Discuss in class.
Making vehicles safer with new material

Car’s crash components can spell the difference between life and death. Their job is to absorb energy in a collision in order to protect the driver inside. Vehicles used to be mainly made of steel. However, modern cars are now built from a mixture of steels, aluminium and fibre-reinforced plastics. In 2010, researchers found a way for the automotive industry to mass-produce a particularly safe class of materials known as thermoplastic fibre composite components. First of all, a new material is lighter, and also it performs much better in crash tests. Thermoplastic components reinforced with textile structures absorb the enormous forces generated in a collision without splintering. Secondly, when they reach the end of their useful life, they can be shredded, melted down and reused to produce high-quality parts. Finally, its advantage is also the cost, which is 50 percent lower than for thermoset material.

a The purpose of car crash components is ________________________________.

b In the past __________________________________ was used to make cars, but nowadays ____________________________________ are used.

c A new material that can make vehicles safer is ________________________________.

d New material has better properties, i.e. it is ____________________________________.

9 Find synonyms in Task 8.

a crash

b strengthened

c huge

d breaking

e torn into small pieces

f opposite of poor quality

10 Project work. Prepare a poster with photos of different materials. Under each photo write the name of the material in English, and 3 properties of each material.
Steels

1. What are the applications of steel? Look at the photo and discuss in class.

2. List the main reasons for the widespread use of steel.
   a. __________________________
   b. __________________________
   c. __________________________

3. Match the types of steel to its definitions.
   structural steel / high-carbon steel / low-carbon steel / stainless steel / tool steel / high-speed steel
   a. __________ steel with the lowest percentage of carbon
   b. __________ a type of tool steels that is commonly used in tool bits and cutting tools
   c. __________ construction material with a specific shape and mechanical properties
   d. __________ steel with the highest percentage of carbon
   e. __________ steel that can be made into tools and used for shaping other materials
   f. __________ a type of steel that has excellent corrosion resistance
4 Choose the correct option.

1 Steel is an alloy of iron with maximum 2 percent of ________.
   a carbon           b manganese         c copper

2 Stainless steel contains up to 30 percent of chromium, and also ________.
   a carbon           b nickel            c manganese

3 The most widespread kind of steel is ________ due to its excellent corrosion resistance.
   a carbon steel     b alloy steel       c tool steel

4 Galvanized steel is coated with ________ to protect it against corrosion.
   a nickel           b chromium          c zinc

5 The three top steel producers in the world are ________, the United States and Japan.
   a Canada           b China             c Germany

5 Read the text to answer the questions below.

New discovery paves the way for using super strong nanostructured metals in cars

Today, the body of an ordinary family car consists of 193 different types of steel. The steel for each part of the car has been carefully selected and optimised. It is important, for example, that all parts are as light as possible because of the fuel consumption, whereas other parts of the car have to be super strong in order to protect passengers in a collision.

Super strong nanometals are beginning to play an important role in making cars lighter than ever. They enable them to stand collisions without fatal consequences for the passengers. A PhD student at Risø DTU has discovered a new phenomenon that will make nanometals more useful in practice.

The research task of the young student, Tianbo Yu, is to determine the stability in new nanostructured metals. Nanostructured metals are indeed very strong, but also tend to become softer, even at low temperatures. This is due to the fact that microscopic metal grains of nanostructured metals are not stable - a problem of which Tianbo Yu’s discovery now provides an explanation.

The fine structure consists of many small metal grains. The boundaries between these metal grains can move, also at room temperature. Tianbo Yu’s has now shown that the boundaries of the grains can be locked, and that his solution is technologically feasible. This has paved the way for car components to be made of nanometals.

a How many types of steel are used today to produce a car?

b Car parts have to be lightweight and strong at the same time. Explain why.

c What is the main role of super strong nanometals?

d What is the main drawback of nanometals?

e How can that flaw be overcome?
6 Complete the table with the **passive forms** of the verb *to be*.

<table>
<thead>
<tr>
<th></th>
<th>Present Simple</th>
<th>Present Continuous</th>
<th>Past Simple</th>
<th>Past Continuous</th>
<th>Present Perfect Simple</th>
<th>Modal verbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(will, can, must, should, would, have to, may)</td>
</tr>
</tbody>
</table>

7 Transform the sentences into passive form. Study the examples below.

**Examples**

- Civil engineers *consider* costs, materials and soil before building.  
  Costs, materials and soil *are considered* before building.

- Luckily, my boss *dealt with* that problem in time.  
  Luckily, that problem *was dealt with* in time.

- They *will supply* energy by sub-sea transmission lines.

- We *have already mounted* a new device.

- IBM *is firing* employees because of the crisis.

- We *divide* energy into renewable and non-renewable.

- Tesla *invented* alternating current.

- Chinese *were using* abacus for counting.

- We *may define* geometry as the measurement of areas, volumes and distances.

8 **Project work.** Create a poster with the passive forms of the verb *to be* for your classroom.
1 Complete the definitions.

gold / heavy metals / sintering / pressure / aluminium / noble / sintered / copper / light metal

a A ________________ is any metal of relatively low density, such as aluminium, magnesium, titanium, etc. The most widespread type is ________________.

b ________________ are metals the density of which is higher than 5000 kg/m³, such as copper, nickel, zinc, lead, tin, chromium, tungsten, etc. The most commonly used type is ________________.

c ________________ metals are highly resistant to corrosion and oxidation. These are silver, platinum, ________________, etc.

d ________________ materials are obtained by the method of powder metallurgy. ________________ includes compacting and forming a solid mass of material by heat or ________________ without melting it to the point of liquefaction.

2 Read the text to answer the questions below.

**Metal properties and uses**
The way that metal atoms are arranged to make a crystal lattice gives metals particular properties. The uses we make of metals depend on these properties. Most metals are very strong. They have high melting points and they have high heat and electrical conductivity. They are also malleable, which means they can be beaten or pressed into thin sheets. The uses we make of metals are related to their properties:

- Car bodies are made from steel, which is mostly iron, because it is a very strong material that is easy to press into the required shape.
- Electrical wiring is made from copper because it is a very good conductor of electricity.
- The filament of a light bulb is made from tungsten because this metal does not melt at the very high temperature needed to make it white hot.

Metals have their characteristic properties because of their giant structure. In a metal crystal, the atoms are in a regular arrangement and strongly bonded together. Strong metallic bonding makes metals hard, but allows layers of atoms to slide so that the metal is malleable. The layers of atoms also allow an electric current to pass through.

The extensive use of metals is having an effect on our environment. For instance, waste material from metal extraction is often simply dumped ruining the landscape. Toxic metal compounds leach out of waste material to pollute the environment, killing wildlife.

a What type of atomic structure do metals possess?

b What are the most common metal properties?

c Why are electrical wires made of copper?

d Why is the filament of a light bulb made of tungsten?

e What makes metals hard?

f How does the use of metals affect our environment?
3 Complete the collocations in Task 2.

required / electrical / metal 2x / waste / metallic / melting / car / electric

a __________________________ properties  
b __________________________ point  
c __________________________ conductivity  
d __________________________ body  
e __________________________ shape  
f __________________________ bonding  
g __________________________ current  
h __________________________ material  
i __________________________ extraction

4 Look at the photos of the atomic structure of a metal and a polymer. How do they differ? How is that reflected in their properties? Discuss in class.

5 Complete the sentences.

properties / effect / which / lattice / pollute / melting / pressed / conductivity

a The way that metal atoms are arranged to make a crystal ________________ gives metals particular properties.  
b The uses we make of metals depend on these ________________.  
c Most metals have high ________________ points, and high electrical ________________.  
d They are also malleable, ________________ means they can be beaten or ________________ into thin sheets.  
e The extensive use of metals is having an ________________ on our environment.  
f Toxic metal compounds leach out of waste material to ________________ the environment.

6 How to manage waste and protect the environment? Match the collocations.

a reduce  
b refill  
c reuse  
d recycle  
e repair  
f recharge  
g replace plastic bags with

☐ cotton bags  
☐ materials  
☐ cartridges  
☐ broken machines  
☐ waste  
☐ batteries  
☐ plastic bottles
### Generally on engineering materials in mechanical engineering

1. **Translate the materials into Croatian.**

<table>
<thead>
<tr>
<th>English</th>
<th>Croatian</th>
</tr>
</thead>
<tbody>
<tr>
<td>a stainless steel</td>
<td></td>
</tr>
<tr>
<td>b lead</td>
<td></td>
</tr>
<tr>
<td>c iron</td>
<td></td>
</tr>
<tr>
<td>d alloy</td>
<td></td>
</tr>
<tr>
<td>e thermoplastic elastomers</td>
<td></td>
</tr>
<tr>
<td>f brass</td>
<td></td>
</tr>
<tr>
<td>g cast iron</td>
<td></td>
</tr>
<tr>
<td>h ceramics</td>
<td></td>
</tr>
<tr>
<td>i plastics</td>
<td></td>
</tr>
<tr>
<td>j thermosets</td>
<td></td>
</tr>
<tr>
<td>k aluminium</td>
<td></td>
</tr>
<tr>
<td>l composite</td>
<td></td>
</tr>
<tr>
<td>m glass</td>
<td></td>
</tr>
<tr>
<td>n copper</td>
<td></td>
</tr>
<tr>
<td>o thermoplastic materials</td>
<td></td>
</tr>
</tbody>
</table>

2. **Match the definitions to some of the materials in Task 1.**

<table>
<thead>
<tr>
<th>English</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>soft reddish metal used for making electric wires</td>
</tr>
<tr>
<td>b</td>
<td>a hard, transparent material used for making windows</td>
</tr>
<tr>
<td>c</td>
<td>a material formed by mixing metal with another substance</td>
</tr>
<tr>
<td>d</td>
<td>light, silver grey metal used for making tubes, foils</td>
</tr>
<tr>
<td>e</td>
<td>material made by firing clay at a high temperature</td>
</tr>
<tr>
<td>f</td>
<td>an alloy of steel that does not easily corrode or rust</td>
</tr>
<tr>
<td>g</td>
<td>a mix of polymers with elastomeric and thermoplastic properties</td>
</tr>
<tr>
<td>h</td>
<td>a heavy soft, grey metal, used in the past for water pipes</td>
</tr>
<tr>
<td>i</td>
<td>a material that is permanently hard and cannot be reshaped</td>
</tr>
<tr>
<td>j</td>
<td>a material made of two or more materials with different properties that remain separate</td>
</tr>
</tbody>
</table>
3 Complete the table on four main categories of engineering materials.

composites / ceramics and glasses / metals and alloys / polymers

<table>
<thead>
<tr>
<th>MATERIAL CATEGORY</th>
<th>DESCRIPTION AND PROPERTIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>• inorganic materials</td>
</tr>
<tr>
<td></td>
<td>• consist of metallic and non-metallic elements bonded together</td>
</tr>
<tr>
<td>b</td>
<td>• crystalline structure</td>
</tr>
<tr>
<td></td>
<td>• good thermal and electrical conductivity</td>
</tr>
<tr>
<td>c</td>
<td>• consist of a matrix and a reinforcement, e.g. fiber embedded in plastics</td>
</tr>
<tr>
<td></td>
<td>• combine the best properties of its constituent parts</td>
</tr>
<tr>
<td>d</td>
<td>• organic materials</td>
</tr>
<tr>
<td></td>
<td>• consist of long molecular chains of carbon</td>
</tr>
</tbody>
</table>

4 Match the 4 types of materials to their photos.

a composites  b ceramics and glasses  c metals and alloys  d polymers
Read the text to complete the classification tree below. Then underline all the verbs in the text.

**Engineering materials** may be divided into metals, composites and non-metals. Metals are further divided into ferrous and non-ferrous. Ferrous metals and alloys contain iron or steel, whereas non-ferrous materials contain aluminium, copper, etc. Polymers, composites and ceramics may be classified under non-metals. Polymers are further divided into plastics and rubber. Finally, thermoplastics and thermosets are categorised as plastics.

---

**ENGINEERING MATERIALS**

```
/ \                                      / \  
metals  \___________ \___________  \___________  non-metals
  |                        |                        |
  |                        |                        |
  |                        |                        |
  |                        |                        |
  |                        |                        |
  |                        |                        |
  |                        |                        |
polymers                |                        |
  |                        |
  |                        |
  |                        |
  |                        |
  |                        |
  |                        |
  |                        |
```

---

Match the types of steel to the definitions.

structural steel / high-carbon steel / low-carbon steel / stainless steel / tool steel / high-speed steel

a __________________ steel with the lowest percentage of carbon
b __________________ a type of tool steels that is commonly used in tool bits and cutting tools
c __________________ construction material with a specific shape and mechanical properties
d __________________ steel with the highest percentage of carbon
e __________________ steel that can be made into tools and used for shaping other materials
f __________________ a type of steel that has excellent corrosion resistance

7 Circle the material properties that you do not understand. Look them up in a dictionary. Are the words **nouns**, **verbs** or **adjectives**?

scratch-resistant   brittle   machinable   durable   weldable   ductile
 corrosion resistant conducve stiff  flammable  castable smooth
tough                soft     malleable wear-resistant strong
8 Complete the sentences.
gold / heavy metals / sintering / pressure / aluminium / noble / sintered / copper / light metal

a A _______________ is any metal of relatively low density, such as aluminium, magnesium, titanium, etc. The most widespread type is _______________.
b _______________ are metals the density of which is higher than 5000 kg/m³, such as copper, nickel, zinc, lead, tin, chromium, tungsten, etc. The most commonly used type is _______________.
c _______________ metals are highly resistant to corrosion and oxidation. These are silver, platinum, _______________, etc.
d _______________ materials obtained by the method of powder metallurgy. _______________ includes compacting and forming a solid mass of material by heat or _______________ without melting it to the point of liquefaction.

9 Match the definitions to the material properties in Task 7.

a _______________ that can be made into a thin wire
b _______________ hard but easily broken
c _______________ that is easily set on fire
d _______________ likely to last for a long time without breaking or getting weaker
e _______________ that can be welded
f _______________ that can be formed by casting
g _______________ that can be shaped with a machine
h _______________ that can be shaped of formed by hammering or pressure
i _______________ that is resistant to scratches
j _______________ rigid or inflexible
k _______________ that is resistant to wear
l _______________ that allows heat or electricity to pass through
m _______________ that does not rust easily
n _______________ that is not easily damaged or broken
o _______________ material that is both strong and ductile
p _______________ not hard
q _______________ opposite of rough

10 Project work. Choose one of the projects.

a Prepare a poster with photos of different materials. Under each photo write the name of the material in English, and add 3 properties of each material.
b Do research on the 5 Rs of waste management and prepare a PowerPoint presentation.
What do you use computers for?

1. **What do you use computers for?** Tick the statements that are true for you. Compare your answers to your classmates’.

   * I use a computer to...
   - browse the Internet to find interesting information
   - google famous people
   - read newspaper
   - check emails
   - play computer games
   - listen to music
   - write homework
   - watch movies
   - use AutoCAD to make drawings
   - chat with my friends on Facebook

2. **Match the types of computers to the photos.**

   - tablet PC
   - smartphone
   - laptop
   - wearable computer
   - mainframe
   - desktop PC

3. **Match the types of computers to their descriptions.**

   - This is the most powerful sort of a computer which can support multiple users at the same time, and process a large amount of data.
   - This type is used as a personal computer at home. It has its own processing unit (CPU), keyboard and monitor.
   - It is a type of a computer that is transported easily, but works as fast as a desktop PC.
   - It looks like a book. You can write on its screen using a special digital pen.
   - It is worn on the user’s body, it is mobile and runs on batteries.
   - A mobile phone and a handheld computer that can do everything a PC can do.
4 Read the text to complete the classification tree below.

Each computer consists of hardware and software. Software is a set of computer programs that perform some task on a computer system. Hardware refers to electronic and mechanical devices attached to the computer. We can see and touch hardware parts. Hardware consists of the CPU, the main memory and the peripherals. The heart of a computer is the CPU, which processes data. The main memory is a program that contains all the instructions which are controlled by CPU. The main memory branches into RAM or random access memory, and ROM or read only memory. Peripherals refer to input, output and storage devices. Input devices are keyboard, mouse, joystick, lightpen. The monitor, printer and scanner are considered output devices. Finally, storage devices are DVD drive and hard disk.

5 What is AutoCAD? Do you know how to use it? Complete the text.

AutoCAD is a commercial soft__________ application for 2D and 3D computer-ai__________ design (CAD) and drafting. It was devel__________ and marketed by Autodesk. It was first released in December 1982. AutoCAD is used by archi__________, project managers, engi__________, graphic designers, and other professionals.

6 Complete the sentences.

are classified into / branches into / include / is a type of / consists of

a A computer ________________ hardware and software.
b Mechanics ________________ statics and dynamics.
c Peripherals ________________ three subtypes.
d Input devices ________________ a keyboard, a mouse, a joystick, and a lightpen.
e A scanner ________________ output device.

7 Project work. Do research on Google, facebook, AutoCAD or any other computer-related topic. Prepare a PowerPoint presentation and present it in class.
7 MATERIAL PROCESSING

Casting

1 Read the text to complete the definition of casting.

Casting is a manufacturing process in which mo__________ materials are poured into a mo__________ where they solidify. It is used for mass pr__________ of different products. Casting may be categorized depending on the mould ma__________ (sand, ceramics, plaster), or the pouring method (gravity, vacuum). For instance, sand casting includes pouring a molten me__________ into a mould cavity made of sa___________. Die casting refers to forcing metal into the mould at high pr___________. In centrifugal casting, the molten material moves towards the mould walls due to centrifugal f___________, etc. Moulds can be open or cl___________. Also, there are expendable moulds that are used only on___________, and permanent moulds that can be reused.

2 Which types of casting are shown in the photos? Discuss in class.

3 Study the classification of the casting processes. Then match the Croatian to the English terms.

<table>
<thead>
<tr>
<th>EXPENDABLE CASTING</th>
<th>NON-EXPENDABLE OR PERMANENT CASTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>• sand casting</td>
<td>• die casting</td>
</tr>
<tr>
<td>• shell-mould casting</td>
<td>• centrifugal casting</td>
</tr>
<tr>
<td>• ceramic casting</td>
<td>• gravity casting</td>
</tr>
<tr>
<td>• plaster-mould casting</td>
<td></td>
</tr>
<tr>
<td>• investment casting</td>
<td></td>
</tr>
<tr>
<td>• vacuum casting</td>
<td></td>
</tr>
</tbody>
</table>

a lijevanje u jednokratne kalupe
b lijevanje u stalne kalupe
c precizni lijev
d gravitacijski lijev
e lijevanje u pješčani kalup
f tlačni lijev
g lijevanje u keramički kalup
h lijevanje u kalup od gipsa
i centrifugalni lijev
j vakuumsko kalupljenje
k lijevanje u školjkasti kalup
4 Match the terms to the definitions. Then translate the terms into Croatian.
foundry / moulder / pouring / castability / mould / casting / furnace / molten metal

a ____________ metal that has become liquid because of intense heat
b ____________ an object shaped by pouring a liquid into a mould
c ____________ a structure with intense heat that melts metal
d ____________ a factory that produces metal castings
e ____________ a hollow form that gives shape to something in a molten state
f ____________ a person who makes moulds
g ____________ the process of filling the mould with a molten metal
h ____________ the ease of forming a quality casting

a _______________ e _______________
b _______________ f _______________
c _______________ g _______________
d _______________ h _______________

5 Complete the table.

<table>
<thead>
<tr>
<th>VERB</th>
<th>NOUN</th>
</tr>
</thead>
<tbody>
<tr>
<td>solidify</td>
<td></td>
</tr>
<tr>
<td>melt</td>
<td></td>
</tr>
<tr>
<td>cast</td>
<td></td>
</tr>
<tr>
<td>shape</td>
<td></td>
</tr>
<tr>
<td>mould</td>
<td></td>
</tr>
<tr>
<td></td>
<td>pressure</td>
</tr>
<tr>
<td></td>
<td>liquid</td>
</tr>
</tbody>
</table>

6 Complete the dialogue.

expendable / casting / moulds / diesel / ready / design

A: I want you to make an engine block!
B: Well, engine block is very complicated to ____________. Therefore, we’ll have to use ____________.

A: Do we have ____________ ready?
B: No, we’ll have to make them using an ____________ mould because they are rather complex.
A: When will the moulds be ____________?
B: In 24 hours.
A: That’s fine! Use iron cast!
B: Why iron cast? Aluminium cast is much better.
A: Yes, but in this case we are making it for a ____________ engine.
B: I see. Then, iron cast is a much better solution.
Chip formation

1 Read the text to complete the table below.

Materials processing refers to different methods used to transform raw material into industrial material. They can be performed by hand, or using a machine. Chipless forming processes make use of different stresses (tension, compression) in order to deform the material and get the desired shape. During forming no material is removed, for instance forging, extrusion, rolling and sheet metal working fall into this category. Materials can be formed in a solid or liquid state. Chip formation or material removal processes involve material removal either by a sharp cutting tool (turning, milling, drilling), abrasive particles (grinding), or by different energy forms. Joining processes unite different materials, for instance by means of bolts, rivets; or by welding and soldering. Finishing processes include the application of an additional layer to the surface to increase its durability and resistance. For instance, honing and lapping.

<table>
<thead>
<tr>
<th>TYPE OF PROCESS</th>
<th>DEFINITION</th>
<th>EXAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
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<tr>
<td>2</td>
<td></td>
<td></td>
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<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2 Translate into Croatian.

a material processing
b chipless forming processes
c tension
d compression
e forging
f extrusion
g rolling
h sheet metal working
i chip formation
j cutting tool
k joining process
l bolt
m rivet
n welding
o soldering
p finishing process
q honing
r lapping
s stress
3 Complete the text.

lathe / plasma / saw / ultrasonic / remove / tough

Chip formation is performed by cutting tools, i.e. tools used to ________________ material from the workpiece. These tools must be hard, ________________ and wear resistant so that they do not fracture at high temperatures. They may be classified into two main groups: hand tools (______________, cutting snips), and machine tools (______________, drill, milling machine). There are also new methods available nowadays, such as ________________ machining, water jet cutting and ________________ cutting.

4 Match the terms to the photos of tools.

a milling machine  b plasma cutter  c saw  d lathe  e cutting snips  f drill
5 Put the process of making holes in a piece of metal in order.
   □ Locate the centre of the hole.
   □ Use centre automatic, centre punch or ball-pee hammer to strike each hole.
   □ Use a pair of compasses or circle template to outline the edges of a hole.
   □ Clamp the workpiece.

6 What do the photos below show? Discuss in class.

   a
   b
   c
   d

7 Find the translation of the words below in Task 5.
   a ocrtati _________________________
   b obilježiti _________________________

8 Project work. Prepare a poster with different machines and tools used in chip formation.

KEY WORDS
chipless forming • chip formation • cutting tool • to outline / strike a hole
Chip formation performed by hand tools

1 Translate the processes of chip formation into Croatian.
   a sawing
   b scraping
   c shearing
   d slotting
   e drilling
   f filing

2 Match the processes in Task 1 to their definitions.
   a __________________ Boring holes in hard materials.
   b __________________ Removal of material in order to change surface characteristics of
       the workpiece, for instance roughening of machine tools. This
       method is today replaced by grinding.
   c __________________ Cutting performed by a thin blade of metal with a series of sharp teeth.
   d __________________ Removing particles using a rasp or a file.
   e __________________ Creating grooves, internal and external threads.
   f __________________ The most common cutting processes which is performed by
       applying a shearing force using a chisel.

3 What is the difference between a rasp and a file? Complete the definitions with the correct tool.
   Then match the tools to the photos below.
   a A __________________ is a tool used for rapid material removal in wood and other soft materials.
   b A __________________ is a tool used to cut fine amounts of material from a metal or wooden
       workpiece. It is covered with a series of sharp, parallel teeth. They’re made of hardened steel.
4 Match the tools to the photos.
   a hand saw    b slotting tool    c hand scrapers    d drill

5 Complete the table.

<table>
<thead>
<tr>
<th>VERB</th>
<th>NOUN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>shearing</td>
</tr>
<tr>
<td></td>
<td>filing</td>
</tr>
<tr>
<td></td>
<td>slotting</td>
</tr>
<tr>
<td></td>
<td>drilling</td>
</tr>
<tr>
<td></td>
<td>scraping</td>
</tr>
<tr>
<td></td>
<td>sawing</td>
</tr>
</tbody>
</table>
6 Look at the parts of a hand saw below. Match them to the definitions.

![Diagram of a hand saw with labeled parts: handle, back, toe, heel, blade or sawplate, teeth or toothline.]

a the end of the saw blade
b the widest part of the saw blade
c the part that you hold when using a saw
d the part that performs the cutting
e the top of the saw plate
f opposite of back

7 Create verbs with the suffixes below.

-ate / -en / -y / -ize / -er

a special_____
  i losses_____
b modi_____
j classifies_____
c fast_____
k length_____
d activ_____
l autom_____
e calibr_____
m optim_____
f pressur_____
n low_____
g purif_____
o verif_____
h tight_____
p strength_____
8 Make collocations with some of the verbs in Task 7.

a ______________________ the screw
b ______________________ steel
c ______________________ the seat belt
d ______________________ the lever

9 Project work. Create a collocations mind map with all the verbs in Task 7.

KEY WORDS
sawing • scraping • shearing • slotting • drilling • filing
Types of machining

1. Translate the machining processes into Croatian.

   a. turning _____________________________
   b. milling _____________________________
   c. planing _____________________________
   d. drilling _____________________________
   e. extrusion _____________________________
   f. drawing _____________________________
   g. grinding _____________________________

2. Read the text. Then complete the table below with the machining processes.

Manufacturing is the process of converting raw materials into products. Processes for metal forming may be classified into six major groups: casting, mechanical processing, welding, machining, powder and fibre metal forming and electroforming. **Machining** is one of the ways to manufacture new parts. It refers to a process in which a piece of a raw material is cut into a desired shape by using a machine. It is mainly used to shape metal, but it can also be used on materials such as wood, plastics or ceramics. Let us have a look at some of the machining processes. **Turning** is an engineering machining process in which a cutting tool, typically a non-rotary tool bit moves linearly while the workpiece rotates. It is performed by a lathe operator who supervises the working of a turning machine. **Milling** is the machining process of cutting with a multi-tooth tool called milling machine which rotates. **Drilling** refers to making holes using a drill, whereas **grinding** includes cutting with a rough wheel or grinding machine to finish a surface. **Extrusion** is a process of forcing a billet through a die opening by compression. Finally, **drawing** includes the reduction of cross-section of a bar by pulling it through a die. It is used to make small components, such as wires used for cables. The selection of the right method is crucial in metal forming processes. For instance, milling, planing and grinding are used to obtain flat surfaces. For tubular shapes, extrusion and drawing are used. Casting and forging are used to machine very large parts, whereas investment casting is used to obtain very small parts.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>shaping a workpiece with a machine</td>
</tr>
<tr>
<td>2</td>
<td>a non-rotary tool shapes a piece of material that rotates</td>
</tr>
<tr>
<td>3</td>
<td>cutting using a multi-tooth tool which rotates</td>
</tr>
<tr>
<td>4</td>
<td>making holes</td>
</tr>
<tr>
<td>5</td>
<td>cutting with a rough wheel to finish the surface</td>
</tr>
<tr>
<td>6</td>
<td>forcing a material through a die by compression</td>
</tr>
<tr>
<td>7</td>
<td>making wires by pulling a piece of metal through a small hole</td>
</tr>
</tbody>
</table>
3 Write the appropriate method of production in Task 2.

<table>
<thead>
<tr>
<th>SHAPE</th>
<th>METHOD OF PRODUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>flat surfaces</td>
<td></td>
</tr>
<tr>
<td>tubular shapes</td>
<td></td>
</tr>
<tr>
<td>very large parts</td>
<td></td>
</tr>
<tr>
<td>very small parts</td>
<td></td>
</tr>
</tbody>
</table>

4 Match the machining processes to the photos.

a turning  
b milling  
c planing  
d drilling  
e grinding  
f extrusion

5 Complete the table. Then translate the verbs.

<table>
<thead>
<tr>
<th>VERB</th>
<th>NOUN</th>
<th>CROATIAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>machining</td>
<td></td>
<td></td>
</tr>
<tr>
<td>turning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>drilling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>grinding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>drawing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>casting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>forging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>extrusion</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6 Order the key stages of the aluminium extrusion process of a billet or semi-finished product.

☐ extruding hot billet through a die  
☐ cooling the billet  
☐ sawing  
☐ placing aluminium billet into the furnace  
☐ heating a die  
☐ aging profiles in the oven  
☐ stretching

7 Project work. Find photos of different machining processes and create a poster.

KEY WORDS

turning • milling • planning • drilling • drawing • grinding
Cutting fluids

1. How do you translate fluid into Croatian? What do fluids include?

2. Read the text to answer the questions below.

A cutting fluid is a type of coolant and lubricant designed for metalworking processes. Metal cutting generates heat due to friction. In order to remove heat more rapidly, reduce the temperature of the blade, reduce friction and tool wear, cutting fluids are used. Cutting fluids may include oils, oil-water emulsions, gels, air, aerosols or mists, and finally gases. Water is a good conductor of heat but has drawbacks as a cutting fluid, for instance it boils easily, promotes rusting of machine parts, and does not lubricate well. In general, cutting fluids usually fall into one of four categories, such as straight oils, soluble oils, semi-synthetic fluids, synthetic fluids. Besides cooling, a cutting fluid lubricates the surfaces in contact, increases the durability of cutting tool, reduces the roughness of the surface, reduces bending and thermal deformation of the workpiece, and flushes away chips from the cutting zone.

Flooding, spraying, dripping, misting and brushing are some of the methods of applying cutting fluids. High-pressure and high-volume pumping to force a stream of liquid directly into the heated area has also for long been used for metal cutting. However, today other methods of machining are being developed in order to protect environment by reducing the use of lubricants. For instance, dry machining refers to the use of a lubrication system that uses compressed air. On the other hand, near dry machining or minimum quantity lubrication process (MQL) uses a minimum quantity of oil delivered to the cutting surfaces through an atomized spray. The near-dry machining process ensures lubrication of the tool and cutting surface and enhances the life of a tool.

a. What is a cutting fluid?
b. What are cutting fluids used for?
c. Why isn’t water used as a cutting fluid?
d. What are the four main categories of cutting fluids?
e. What are the seven methods of applying cutting fluid?
f. What are the advantages of dry machining and near dry machining?
3 Choose the odd one out.

a oils  gels  mists  water
b straight oils  soluble oils  gases  synthetic fluids
c casting  flooding  spraying  brushing
d aerosol  MQL  dry machining  near dry machining

4 Look at the photo below and explain in what way these two methods of coolant application differ. Discuss in class.

5 Complete the table. Then translate the verbs into Croatian.

<table>
<thead>
<tr>
<th>VERBS</th>
<th>NOUNS</th>
<th>CROATIAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>coolant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lubricant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>conductor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>rust</td>
<td></td>
<td></td>
</tr>
<tr>
<td>deformation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>heat</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6 Complete the dialogue.

need / here / amount / container / sign / add / delivery
A: I checked the ________________ of a coolant at the milling machine. We have to ________________ some into it. Do you have any supplies?
B: Of course, how much do you ________________?
A: Two litres will do it.
B: Do you have a suitable ________________ and a ________________ note?
A: Yes, I do. Here you are the bottle and the delivery note. Please, ________________ it.
B: ________________ you are! Thank you for your promptness!

7 Project work. Find out more about types of coolants and methods of coolant application. List the advantages and disadvantages. Then present them in class.
Metal finishing processes

1. What is the purpose of metal finishing processes? Complete the definition.
   workpieces / finish / machined / lapping / accuracy
   Metal finishing processes are used to obtain good surface _______ and high dimensional _______. It is applied on _______ that have already been _______ using other methods. Some of the finishing processes are honing, _________, superfinishing, and grinding.

2. Match the processes to their definitions.
   a superfinish  b honing  c lapping  d grinding

   - The oldest method of obtaining fine finish. It is an abrasive process that uses loose abrasive between lap and the workpiece. It can be performed manually using abrasive grains, or by machine using an abrasive wheel.
   - Using a special tool, rotary and reciprocating movements are carried out upon the workpiece which is at rest. It is usually performed on automobile cylindrical walls. The tool is called a hone.
   - The abrasive stone is applied to remove a thin layer off the workpiece until the desired superfinish is obtained.
   - A process performed by a rotating abrasive wheel which removes metal from the surface of an object.

3. Now match the processes to the photos below.
   a superfinish  b honing  c lapping

   ![Photo 1](image1.png)  ![Photo 2](image2.png)  ![Photo 3](image3.png)
4 Complete the dialogue.

a Have you repaired the block of your engine so far?
b How old is your car?
c That is the problem then! You’ll have to hone it!
d Have you maybe noticed any oil leakage?

A: I’ve noticed that my car consumes more oil than usual!
B: ____________________________________________________________
A: No, I don’t think so.
A: ____________________________________________________________
B: 10 years.
A: ____________________________________________________________
B: No, I haven’t.
A: ____________________________________________________________
B: Oh, no! That probably costs a lot!!

5 Project work. Record two classmates acting out the dialogue in Task 4. Then listen to this recording in class. Repeat after each sentence.

6 Complete the sentences. You may use some of the prepositions more than once.

at / for / to / of / from / to / in / with

a Gases tend _________ disperse.
b A gas consists _________ molecules in motion.
c Can you set this body _________ motion?
d Civil engineers are concerned _________ building structures.
e High traffic load inevitably results _________ pollution.
f When heated, steel is provided _________ new properties.
g If you remove metal _________ this it won’t corrode.
h Brass is made _________ zinc and copper. He prefers zinc _________ copper.
i This machine can operate _________ high speeds.
j They are being late due _________ delay in traffic.
k You’ve improved in comparison _________ the last year.
l This company is comprised _________ 4 main parts.
m They are in need _________ mechanical engineers.
n Could you please deal _________ that problem?
o This material is not appropriate _________ this structure.
p Everybody can easily distinguish metal _________ plastics.

KEY WORDS
metal finishing processes • superfine • honing • lapping • grinding
Sheet metal: cutting, straightening, bending, punching, and clinching

1. What is sheet metal? Complete the definition.

foil / cut / thin / copper / bent / plates / bodies / forms / thickness

Sheet metal is a type of metal formed by an industrial process into a __________, flat piece. It is one of the fundamental __________ used in metalworking. Sheet metal can be __________ and __________ into a variety of shapes. Its __________ varies. For instance, extremely thin pieces are considered __________ or leaf, and pieces thicker than 6 mm are considered __________.

Different metals can be made into sheet metal, such as aluminium, __________, steel or nickel. Sheet metal is used for car __________, airplane wings, roofs, etc.

2. Which two types of sheet metal do the photos show?

![Image a](image.png)  ![Image b](image.png)

3. Match the types of sheet metal forming to the descriptions.

a. cutting  b. bending  c. clinching  d. straightening  e. punching

- It is a simple joining technique without additional element and without heat. It includes connecting two or three layers of sheet metal using a cold-forming process. It requires a toolset consisting of a punch and a die.

- This is often the cheapest way to create holes in sheet metal. This process is performed on a punch press. Most punch presses are mechanically operated, but simple punches are often hand-powered.

- A sheet metal may be levelled using a conventional flattening technique. The part that needs to be levelled is heated and then hammered into a flat condition. Also, rolling machines and straightening presses may be used.

- Changing the geometry of the part, the volume remains the same. The force which is applied to a piece of sheet metal brings about bending at an angle. It is performed on a press brake. The workpiece is placed between the upper tool- the punch, and the lower tool- the die.

- Aviation snips and tin snips are good for cutting soft sheet metals such as tin, aluminium and brass. You can also use power shears, bend saw, stationary nibbler, plasma, water jet and lasers to perform the cutting.
4 Complete the table.

<table>
<thead>
<tr>
<th>SHEET METAL PROCESS</th>
<th>TOOLS USED</th>
</tr>
</thead>
<tbody>
<tr>
<td>bending</td>
<td>a</td>
</tr>
<tr>
<td>straightening</td>
<td>b</td>
</tr>
<tr>
<td>cutting</td>
<td>c</td>
</tr>
<tr>
<td>clinching</td>
<td>d</td>
</tr>
<tr>
<td>punching</td>
<td>e</td>
</tr>
</tbody>
</table>

5 Which piece of equipment is shown in the photos?

6 Project work. Look at the photos of hammers and dollies. Do research on the hammer-on-dolly method. Then prepare a PowerPoint presentation.
Types of mechanical fasteners

1  The photo below shows one of the most used fasteners - a bolt. Identify the nut, thread, head of a bolt, and washer.

![Image of a bolt, nut, and washer]

2  Choose the correct answer.
   1  A washer is used
      a  to wash the bolt.
      b  to prevent the nut from sinking as it is turned.
      c  to loosen the nut.
   2  As opposed to joints with rivets which are permanent, joints with bolts
      a  are removable which means they can be disassembled.
      b  are removable which means they can’t be disassembled.
      c  are removable which means they can’t be disassembled without damage.
   3  Threads can be
      a  prismatic and spherical.
      b  square, metric, and unified.
      c  long and short.

3  What is the difference between a bolt, a stud, and a screw. Look at the photos and complete the definitions.

![Image of bolt, screw, and stud]

a  A __________________________ is a threaded fastener mated with a nut.

b  A __________________________ is an externally threaded headless fastener. It does not need a nut and washer to hold it in place.

C  A __________________________ has internal threads.
4 Match the terms.

a spajanje spojkama  □ Hirth joint
b vijčani spoj  □ bolted joint
c spoj perom  □ revolute joint
d spoj zatikom  □ pinned joint for fastening
e spoj svornjakom  □ cotter joint
f spoj klinom  □ tongue-and-groove joint

5 Read about the types of mechanical fasteners to answer the questions below.

Bolts, rivets, pins, keys, cotters and other fasteners are used for mechanical joining. Bolted joints consist of fasteners that capture and join other parts, and are secured with the mating of screw threads. There are many types of pinned joints. One of the types is pinned joint for fastening which holds together two or more component parts without frictional connection. A revolute joint (pin joint or hinge joint) provides single-axis rotation function used in many places, such as door hinges, folding mechanisms, and other uni-axial rotation devices. Cotter joint consists of a cotter passing through a hole to fix parts tightly together. Typical applications are in fixing a crank to its crankshaft. Hirth joint or Hirth coupling is a type of mechanical connection named after its developer Albert Hirth. It is used to connect two pieces of a shaft together. It is characterized by tapered teeth that mesh together on the end faces of each half shaft. Tongue-and-groove joint is a method of fitting similar objects together, edge to edge. Each piece has a slot or a groove cut all along one edge, and a thin, deep ridge - the tongue, on the opposite edge.

a State the main types of mechanical fasteners.
b What is the difference in application between revolute and pin joints?
c What is the difference between cotter joint and tongue-and-groove joint?
d What is the main purpose of Hirth joint?

6 What types of joints are shown in photos below? Discuss in class.

7 Translate the collocations into Croatian.

a tighten with a bolt
b tighten the bolt
c loosen the bolt
d turn the bolt
e unscrew the bolt
f force the screw out
g permanent joints
h removable joints
Using riveting and soldering to join parts together

1. Look at the photo below, and identify the parts of a rivet. Write: head, shank, tail.

2. What is the difference between hot and cold riveting? What tools are used to perform them? Discuss in class.
3 Read the text to answer the questions below.

Joining of two or more machine parts using a rivet is called riveting. Each rivet consists of a head, shank and a tail. There are various types of rivet heads, for instance a snap head, countersunk and conical head. The machine parts that are to be riveted are firstly provided with holes. During riveting, the holes overlap and the rivet is inserted into the holes. The head of the rivet is fastened firmly, while the tail of the rivet is formed into a second head using pneumatic pressure. As the rivet cools down, it draws together firmly the riveted parts. Besides riveting in hot condition, two parts may be riveted using a hammer, which is called cold riveting. In general, riveting is considered a permanent joint, i.e. it could not be dismantled. Riveted joints branch into two main categories: lap joint and butt joints. Riveting is largely a manual process, which means that it takes a lot of time. Therefore, bolted joints have almost completely replaced riveting.

a What is riveting?
b How is hot riveting performed?
c Why is riveting considered a permanent joint?
d What are two main types of riveted joints?
e Why is riveting almost completely replaced by bolted joints?

4 Match the types of soldering to their descriptions.

a hard soldering
b brazing
c soft soldering
d silver soldering

☐ It refers to joining small intricate parts having low melting points. It uses tin-lead alloy as filler material. The melting point of the filler material should be below 400°C. A gas torch is used as the heat source.

☐ It refers to the process of connecting two pieces of metals by expanding into the pores of the workpiece opened by high temperature. The filler material has a temperature above 450°C.

☐ It is a type of hard soldering that uses silver as filler material. It is appropriate for making tools.

☐ The process of joining two pieces of metals by using brass alloy as filler material. It is capable of creating extremely strong joints.

5 Complete the sentences on soldering.

microelectronics / solder / lower / melt / drawback / Egypt

a It is one of the oldest processes. It was used in __________________________ 5,000 years ago.
b Soldering requires __________________________ temperatures than welding.
c Because of lower temperatures, the metal does not __________________________.
d Since the __________________________ is metal, it conducts electricity.
e The main __________________________ of soldering is the high cost of the solder material.
f It is the best method for the fabrication of __________________________.
6 Match the soldering equipment to the photos.

a) soldering iron  
b) safety glasses  
c) clamp  
d) side cutters  
e) wet sponge  
f) solder

7 Put the dialogue in order.

☐ Please, do have a look!
☐ Well, from what I see, sheet metal on your bumper support was joined using electric resistance welding. The best way to join it again is using riveting.
☐ Sheet metals may be joined together using different methods. Let me have a look at your bumper.
☐ What about soldering?
☐ I need help. Sheet metal on the bumper of my car is broken. Can you fix it?
☒ No, that’s out of the question. Soldering may cause the whole bumper to break!
8 Complete the table.

<table>
<thead>
<tr>
<th>VERB</th>
<th>NOUN</th>
<th>CROATIAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>cool</td>
<td>cooling</td>
<td>hlađenje</td>
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<tr>
<td>heat</td>
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<td>weld</td>
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<td>solder</td>
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<td>rivet</td>
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<td>compress</td>
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<td>pressurise</td>
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<td>lubricate</td>
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<td>forge</td>
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<td></td>
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<tr>
<td>cast</td>
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</tbody>
</table>

9 Project work. Find interesting videos on different types of soldering. Prepare handouts with questions for your classmates. Watch the videos in class and answer the questions.
Welding

1. Complete the definition of **welding**.

   fusion / seam / laser / pressure / weld / electric arc / metals / semi-molten

   **Welding** is the joining of ______________________ with or without ______________________, after heating them to a plastic or ______________________ state, or the joining of metals by ______________________. **Welding by pressure** involves different types, such as ultrasonic, friction, diffusion, explosive and ______________________ welding. Electric arc welding further branches into spot, butt and ______________________ welding. **Welding by fusion** may be divided into gas welding, ______________________ welding, plasma welding, and electric resistance welding. The ladder is subdivided into MIG/MAG, TIG, REL and EPT welding. The main objective of a welder is to obtain a perfect ______________________.

2. Translate into English using the words in Task 1.

   a. zavarivanje taljenjem
   b. zavarivanje pritiskom
   c. plinsko zavarivanje
   d. zavarivanje laserom
   e. zavarivanje plazmom
   f. elektrolučno zavarivanje
   g. elektrotporno zavarivanje
   h. zavarivanje trenjem
   i. difuziono zavarivanje
   j. zavarivanje eksplozijom
   k. zavarivanje ultravukom
   l. zavar
   m. zavarivač
3 Match the gas welding equipment to the photos.

- a tip
- b flux
- c torch
- d apron
- e goggles
- f gloves
- g pressure regulator
4 Read the text. Then correct the statements below.

Oxy-fuel welding or gas welding uses fuel gases and oxygen to weld and cut metals. Pure oxygen is used to increase the flame temperature and allow localized melting of the workpiece material in a room environment. This type of welding is mainly used for welding pipes and tubes.

In MIG/MAG welding process heat is produced by forming an arc between a metal electrode and the workpiece. The electrode then melts to form the weld bead. MIG stands for Metal Inert Gas, whereas MAG stands for Metal Active Gas.

Arc welding uses a welding power supply to create an electric arc between an electrode and the base material in order to melt the metals at the welding point. Arc welding processes may be manual, semi-automatic, or fully automated. The welding region is usually protected by some type of shielding gas, vapour, or slag.

Gas tungsten arc welding (GTAW) or tungsten inert gas (TIG) welding is an arc welding process that uses a non-consumable tungsten electrode to produce the weld. The weld area is protected from atmospheric contaminants by an inert shielding gas, and a filler metal is normally used. Even though GTAW method is rather slow, it produces high-quality welds, and is applicable on a wide range of materials.

In electric resistance welding heat to form the weld is generated by the electrical resistance of material. It is a method that causes little pollution, but equipment costs are high, and it is restricted to thin materials.

a MIG/MAG welding is largely used for welding pipes and tubes.

b MIG stands for Metal Active Gas.

c Slag is commonly used to protect the welding region in oxy-fuel welding.

d The main advantage of MIG/MAG method is the creation of high-quality welds.

e Filler metal is used in arc welding.

f Little pollution is caused by arc welding.

g In TIG welding, a consumable electrode is used.

5 Translate into English. Use the words in Task 4.

a troska  ____________________________

b kisik  ____________________________

c volfram  ____________________________

d plemeniti plin  ____________________________

e zagađivalo  ____________________________

f taljenje  ____________________________

g netopiva elektroda  ____________________________
6 Complete the sentences.

- inert / fuel / manual / increase / contaminants / active / generated / automated / metal
- Gas welding uses ________________ gases and oxygen to weld and cut metals.
- Pure oxygen is used to ________________ the flame temperature.
- MIG stands for Metal ________________ Gas, whereas MAG stands for Metal ________________ Gas.
- Arc welding processes may be classified into ________________, semi-automatic, or fully ________________.
- In gas tungsten arc welding (GTAW) the weld area is protected from atmospheric ________________ by an inert shielding gas, and ________________ is normally used.
- In electric resistance welding, heat to form the weld is ________________ by the electrical resistance of material.

7 Write compounds to match the definitions.

- ________________ temperature of the flame
- ________________ material of the workpiece
- ________________ region that is welded
- ________________ costs of equipment
- ________________ welding by means of gas
- ________________ welding by means of metal active gas
- ________________ regulator of pressure

8 Project work. Do research on one type of welding. Prepare a PowerPoint presentation for your class.
Welding defects

1 Translate the warping defects into Croatian.
   a distortion ________________________________
   b cracked welds ____________________________
   c warping _________________________________
   d incomplete penetration _____________________
   e poor fusion _______________________________
   f porous welds ______________________________
   g undercutting ______________________________

2 What types of welding defects do the photos show? Discuss in class.

3 Choose the odd one out.
   1 Porous welds may be caused by _______.
      a a short arc         b an incorrect current  c overheating
   2 Incomplete penetration may be caused by _______.
      a too low a current  b a short arc         c too large an electrode
   3 Warping may be a result of _______.
      a faulty clamping of parts  b too low a current  c the shrinkage of weld metal
   4 Poor fusion may result from _______.
      a incorrect speed      b an improper current  c an improper welding technique
   5 Distortion is caused by _______.
      a a wrong electrode   b uneven heating       c improper sequence
   6 Cracked welds are a result of _______.
      a a wrong electrode   b uneven heating       c disbalance between weld and part sizes
   7 Undercutting may be a result of _______.
      a an improper electrode  b too high a current c a rigid joint
4 Choose the correct option.
   a Short arc results in / results from a porous weld.
   b Too low current may cause / may be caused by incomplete penetration.
   c Incorrect speed may result in / may result from poor fusion.
   d Distortion causes / is a result of uneven heating.

5 Read the paragraph below to answer the questions.

Strength of the weld is influenced by different factors, for instance the choice of the welding method, the amount of input energy, the weldability of the base material, filler material, flux material or the design of the joint. These factors may be generally classified into metallurgical and technological. Some of the cracks are not visible, but some are invisible to the naked eye. Destructive and non-destructive testings are used to verify whether a weld is free of defects. For instance, one type of non-destructive testing is dye penetrant inspection (DPI). It is a widely applied and low-cost inspection method used to locate surface-breaking defects in all non-porous materials (metals, plastics, or ceramics).

   a State some of the factors that may influence the quality of the weld.
   b How can we classify these factors?
   c What are the two types of welding cracks?
   d What two kinds of testing are mentioned?
   e What does DPI stand for, and when is it applied?

6 Put the dialogue in the correct order.

- Well, yes. If there are errors, cracks might have occurred. Their detection by DPI would ease the process of removal.
- All the welds were carried out according to WPS parameters that had been enclosed with the pipeline documentation.
- Well, welding was carried out in a demanding position, so there is a possibility of error.
- By visual inspection of this particular weld, I have noticed a welding defect. How is that possible?
- That defect should be removed. Maybe we should carry out DPI first? What do you say?
- OK, let’s do it. Which parameters were used in the welding process?

7 Choose the correct definitions of the compounds.
   a Friction device is a device that causes / reduces friction.
   b Absorption loss is loss caused by / that causes absorption.
   c Diamond tool is a tool with a diamond bit / is a tool made of diamond.
   d Metal cutter is a metal tool / a tool intended for metal.
   e Hand tool is a tool operated by hand / size of the hand.

KEY WORDS
welding defects • visible • non-visible
Types of adhesive bonding

1. Match the terms to the definitions.

- adhesion ☐ a material that glues pieces together
- adhesive ☐ to stick to something
- adhere ☐ gluing pieces together

2. Match the types of adhesive bonding to the photos.

- a sealing
- b structural adhesion
- c cylindrical bonding

3. Translate the abbreviations into Croatian.

- a i.e. __________________________
- b e.g. __________________________
- c etc. __________________________
4 Read the text about adhesive bonding to answer the questions.

Adhesive or glue bonding is a technique that includes applying an intermediate layer to connect substrates of different materials. Adhesives may be organic or carbon-based, and inorganic ones that do not contain carbon. Also, they may be structural or non-structural. Structural adhesives support heavy loads, whereas non-structural adhesives do not. Most adhesives exist in liquid, paste, or granular form. Their bonding strength varies with respect to the type of adhesive material, coating thickness, bonding temperature, tool pressure, etc. The choice of adhesive depends on the materials to be bonded.

Adhesive bonding is based on two important processes. Cohesion is defined as the internal strength of an adhesive as a result of a variety of interactions within the adhesive. Adhesion is the bonding of one material to another, i.e. adhesive to a substrate. Adhesives include sealants, glues, hot melts, solvents, etc. Adhesive bonding has many advantages. Let us mention some of them:

- They allow joining materials of different sizes and composition.
- The use of adhesives eliminates corrosion.
- There is no deformation or damage in the structure of the materials.
- It increases fatigue resistance and resistance to impacts.
- It allows homogenous distribution of tensions and thus eliminates fractures.

Adhesive bonding also has some disadvantages, such as low resistance to temperature. Also, time is needed to prepare surface before bonding, and for an adhesive to solidify. Finally, it may pollute the environment, and affect our health.

a What types of adhesives are mentioned?
b What is the difference between organic and inorganic adhesives?
c What does bonding strength depend on?
d What two processing enable bonding?
e State 3 advantages of adhesive bonding.
f State 3 disadvantages of adhesive bonding.

5 Translate into Croatian.

a adhesion bonding
b cohesion
c sealant
d composition
e fatigue resistance
f resistance to impacts
g fracture
h structural adhesive

6 Read the advantages and disadvantages of adhesive bonding. Then correct the mistakes.

Adhesive bonding:
a does not allow joining materials of different sizes.
b eliminates corrosion.
c decreases fatigue resistance.
d increases resistance to impacts.
e allows homogeneous distribution of tensions.
f does not take a lot of time to solidify.
g may pollute the environment.
h may cause deformation in the structure of the materials.

KEY WORDS
adhesive bonding • adhesive • glue • adhesion • cohesion
Modern engineering wonders

1 Have you heard of the structures mentioned below? Where are they situated? Why are they considered wonders? Discuss in class.

the Delta Works / the Bailong Elevator / Nürburgring / the Three Gorges Dam / Burj Khalifa

2 Match the wonders to the photos.

a the Delta Works  
b the Bailong Elevator  
c Nürburgring  
d the Three Gorges Dam  
e Burj Khalifa

3 Complete the text.

The Delta Works / The Bailong Elevator / Nürburgring / The Three Gorges Dam / Burj Khalifa

a __________________________ will be the largest hydroelectric dam in the world, almost 183 metres high and holding 39.64 billion cubic metres of water behind 2.83 million cubic metres of concrete. This engineering wonder will eventually provide as much as 10% of China’s power needs.

b __________________________ is the world’s largest exterior elevator. At the height of 335 metres, this elevator looms high midway up a cliff overlooking a valley far below. It is mostly made of glass, affording passengers a dizzying view to the depths below.
c 828 metres tall, ____________________________ is the tallest skyscraper in the world situated in Dubai. Everything about the structure is record-breaking: highest number of stories in the world, highest outdoor observation deck, highest occupied floor, tallest service elevator, and longest elevator travel distance.
d Then ____________________________ are the best and largest storm barriers in the world. The works consist of dams and levees. They were designed after the floods of 1953 and offer protection to the land surrounding the Rhine-Meuse-Scheldt delta. With the Delta Works, the chances of another flood have been reduced to once every 4,000 years.
e ____________________________ is the longest racing track in the world. The loop is 20.8 km long. The track was nicknamed The Green Hell. Can you guess why?

4 Find synonyms in Task 3.
a ____________________________ floor
b ____________________________ a structure that uses water to generate electricity
c ____________________________ opposite of interior
d ____________________________ a structure built over a river or sea that connects the mainland
e ____________________________ a structure that reinforces the banks of a river and prevents flooding
f ____________________________ 30.48 centimetres

5 Which of the wonders has impressed you most? Discuss in class.

6 Create your own list of modern engineering wonders. Compare it with your classmates. Explain your answers.

1 ____________________________  2 ____________________________  3 ____________________________

7 Complete the quiz.

$279,000 / 60 tonnes / 20 cm / 330,000 m³ / 10 million / 100 mph / 38 km

a The Channel Tunnel is ____________________________ long.
b Maintenance of the Eiffel Tower requires applying ____________________________ of paint every seven years.
c About ____________________________ workers died during the construction of the Great Wall of China.
d Terrafugia flying cars cost around ____________________________.
e A flying car can drive not more than ____________________________.
f Around ____________________________ of concrete was used in the construction of Burj Khalifa.
g The level of sea water at the Pacific side of the Panama canal is ____________________________ cm higher.

8 Project work. Choose one technological achievement that intrigues you most, and prepare a PowerPoint presentation.
Section view of 3D objects

1. Match the terms to the definitions.
   - Hatching / longitudinal section / horizontal cross section / cross section / section view hatch line / vertical cross section
   - a __________________ the intersection of a 3D body with a plane
   - b __________________ when the intersecting plane is parallel to the base of the solid
   - c __________________ drawing parallel lines closely together to create the illusion of a shade
   - d __________________ a line used to create the illusion of a shade
   - e __________________ when the intersecting plane is perpendicular to the base of the solid
   - f __________________ section of a figure after cutting it
   - g __________________ section cut along the long axis of a structure

2. Match the types of cross sections to the pictures.
   - a hatched cross section
   - b perpendicular cross section
   - c parallel cross section

Figure 1
Figure 2
Figure 3
3 Complete the sentences.

a Any cross section of a sphere is a _____________________________.

b A horizontal cross section of a cone is a _____________________________.

c A vertical cross section of a cone is a _____________________________.

d A horizontal cross section of a cylinder is a _____________________________.

e A vertical cross section of a cylinder is a _____________________________.

f Hatched lines are drawn at ____________________________ degrees.

4 What do the photos below show? Discuss in class.

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5 Look at the figures below to answer the questions.

![Figure 1](image1)

![Figure 2](image2)

a After cutting it vertically, what is the cross section of the given rectangular prism in Figure 1?
b Calculate the area of cross section of Figure 2.

6 Read the email. Then answer the questions.

**From:** tom.brown@zrhtn.rjr
**To:** peter.spencer12@zrhtn.rjr
**Subject:** cross section of threaded holes ASAP

Dear Mr Spencer,

I need some additional information on the machine part that is currently being produced. As I can see from the drawing, that machine part has 6 threaded holes. However, the drawing does not specify how deep they are. I suppose they are not all equally deep...? I would be grateful if you could send me the cross sections of these 6 holes as soon as possible.

Thank you in advance.

Kind regards,

Tom Brown

a What is the problem?
b What is the request?
7 Write an email to your business partner. The subject of the email: There is no cross section of the smallest valve in the drawing.

From:
To:
Subject:

8 Complete the sentences with the correct modal verbs.

must / have to 2x / can’t 2x / mustn’t / can / should

a You __________________________ smoke here. It is prohibited.
b You __________________________ smoke here. It is allowed.
c Workers __________________________ wear a hard hat at the site.
d On this road we __________________________ drive 80 kph. That is recommended speed.
e On this road we __________________________ drive less than 40 kph. It is prohibited.
f We __________________________ use this exit if we want to escape fire.
g We __________________________ wear goggles while welding to protect our eyes.
h You __________________________ enter here. It is not allowed.
How to highlight details in a technical drawing?

1. What do we use in order to highlight details in a technical drawing? Look at the drawings and decide which detail is highlighted correctly.

2. Match the questions to the instructions.
   a. How many details can a drawing show?
   b. Do we need to name these details?
   c. Why are some parts in a drawing shown separately?
   d. How do we name such details?

   Because it is not possible to show all the details in the main drawing. In some cases you need to specify the dimensions of some smaller part. If you include all that in the main drawing, it might be unclear. That’s why they are shown separately.

   Of course. You should use a circle to mark the detail you want to highlight, and also you should name it.

   By letters. Use capital letters.

   All the details that are needed. However, it should be done in a clear and precise way not to create confusion. You can also use partial view that simply includes the drawing that needs to be highlighted.

3. Answer the questions.
   a. What types of view can be shown in a technical drawing?
   b. How do we highlight details in a technical drawing?
   c. What is the purpose of hatching?
   d. What types of section views are there?
4 Do the crossword puzzle.

**ACROSS**
4 ___________ is used to name details in a technical drawing.
5 We highlight details in a technical drawing by a ___________.
6 The intersection of a 3D body with a plane.
7 Drawing parallel lines closely together to create the illusion of a shade.
8 A line used to create the illusion of a shade.
9 When the intersecting plane is parallel to the base of the solid.

**DOWN**
1 Section cut along the long axis of a structure.
2 Section of a figure after cutting it.
3 When the intersecting plane is perpendicular to the base of the solid.

**KEY WORDS**
technical detail • highlight • hatching • technical drawing
Can you follow instructions?

1. What does the photo show? Have you ever used it? What is it used for? Discuss in class.

2. Complete the instructions.

   press / unplug / switch / loosen / plug / adjust 3x / tighten / sure / select

How to set up your stationary bike?

a. You should first ______________ the seat! How? ______________ the fastener and choose the right height for you. After you have done that, ______________ the fastener firmly. What is the appropriate height? Make ______________ your knees bend slightly during the ride.

b. ______________ the handlebars correctly so that you are in a comfortable position.

c. Finally, ______________ the pedal straps, but not too tightly!

d. ______________ it in!

e. ______________ the START button on the display and ______________ the right level!

f. Enjoy your ride! Don’t forget to ______________ it off! In some cases, people ______________ the wires to prevent falling while walking around the flat.
3 Complete the instructions. Think of situations in which these instructions would be useful. Discuss in class.

expose / operate / avoid / place / attempt / spill / insert

a _______________________________ contact with eyes!
b Do not _______________________________ it to excessive heat!
c Do not _______________________________ to service the device on your own!
d Do not _______________________________ any object into the device!
e Never _______________________________ tall furniture onto the device!
f Do not _______________________________ food or liquids onto it!
g Do not _______________________________ it if some parts are missing!

4 Project work. Prepare instructions for setting up a gadget.

KEY WORDS
instructions • tighten • loosen • adjust
1. Match the questions to the answers.
   a. Why is it relevant to measure it?
   b. What causes surface roughness?
   c. What methods can be used to measure surface roughness?
   d. How do we categorize the instruments for measuring surface roughness?
   e. What is surface roughness?

   Surface roughness is a measure of the finely spaced surface irregularities.

   The measurement of surface roughness is necessary in order to maintain high product performance. It is quantified by assessing height, depth and interval of a workpiece.

   Firstly there is linear roughness measurement which measures a single line on the sample surface. Secondly, we can measure areal roughness which measures an area of the surface.

   The instruments for measuring surface roughness can be broadly divided between contact and non-contact types.

   Well, there is a wide range of factors that affect the surface. For instance, poor quality of the material used, method of finish, motor vibrations during machining, and also poor quality of the tool edge.

2. Look at the photo below and decide what letters P, W, R show.
   a. profile of roughness
   b. primary profile
   c. profile of waviness

   ![Graphs of P, W, and R](image)
3 What is the difference between arithmetical mean roughness \((R_a)\) and maximum height \((R_z)\)? Match the symbols to the definitions.

a _______ averages all peaks and valleys of the roughness profile and then neutralizes the few outlying points so that the extreme values have no significant impact on the final results.

b _______ averages only the five highest peaks and the five deepest valleys. In other words, extreme values have a much greater influence on the final value.

4 Zero conditional. Complete the sentences with the correct form of the verbs in brackets.

a When you _______ (heat) water to 100°C, it _______ (boil).

b You _______ (get) wetter if you _______ (run).

c When you _______ (mix) hydrogen and oxygen, you _______ (get) water.

d If you _______ (heat) ice, it _______ (melt).

e If you _______ (freeze) water, it _______ (become) a solid.

f If you _______ (mix) copper and steel, you _______ (create) brass.

g If you _______ (add) more carbon to steel, it _______ (get) softer.

h If you _______ (drive) a hybrid car, you _______ (cause) less pollution.

i If you _______ (want) to straighten metal part on your car, _______ (use) hammer-and-dolly method.

j Every object _______ (persist) in its state of rest or uniform motion unless it is compelled to change that state by forces impressed on it.

k If you _______ (apply) a too large electrode in welding, it _______ (result in) incomplete penetration.

5 There is one incorrect sentence in Task 4. Find it and write it down correctly.

________________________________________________________________________

6 Find a sentence in Task 4 that refers to Newton’s Law of Motion. Translate it into Croatian.

________________________________________________________________________

7 Paraphrase the sentences using unless.

a If you don’t walk faster, you don’t get wetter.

________________________________________________________________________

b If you don’t heat water to 100°C, it doesn’t boil.

________________________________________________________________________

c If you don’t drive a hybrid car, you cause more pollution.

________________________________________________________________________

8 Project work. Find more information on Laws of Motion. Who formulated them? How many laws are there? Prepare a PowerPoint presentation.

KEY WORDS
surface • roughness • mean roughness • maximum height
ISO system of tolerances

1. Complete the sentences.

variation / internal / tolerance / allowable / manufactured / zero line

a. All dimensions must have a ________________.
b. Every feature on every ________________ part is subject to ________________.
c. The limits of ________________ variation must be specified.
d. The Croatian system differs external from ________________ measurement.
e. System of tolerances also includes deviation, ________________ and tolerance zone.

2. Read the text to answer the questions below.

Mass production of parts incurs huge costs. Therefore, it is crucial that all the parts that have to be assembled do not require any additional processing. However, it is impossible to create two machine parts that have completely the same dimensions. That is why industrial production allows limits of deviation, i.e. allowable variations or tolerances. There are two types of measurement — external and internal. External measurement requires a measurement tool that measures the whole machine part, whereas internal measurement requires the tool to be inserted into the machine part to perform the measurement.

a. Why do we need a system of tolerances?
b. What is the difference between external and internal measurement?

3. First conditional. Complete the sentences with the correct form of the verbs in the brackets.

a. If it ____________ (rain), we ____________ (not go) on a trip.
b. If you ____________ (break) a mirror, you ____________ (have) 7 years of bad luck.
c. If you ____________ (invite) me to the party, I ____________ (come).
d. What ____________ (you / do) if she ____________ (not come) to the party?
e. If you ____________ (send) him an email, he ____________ (reply) as soon as possible.
f. If you ____________ (change) your tyre quickly, we ____________ (be) on time.
g. We ____________ (pass) the exams with an A if we ____________ (study) hard.
h. If the weather ____________ (be) nice, we ____________ (go) hiking.
i. You ____________ (fall) if you ____________ (not watch) your step.
j. Before I ____________ (leave), I ____________ (finish) my homework.
What are the most awesome tech gadgets?

1. Match the 21st-century technological advancements to the photos. Discuss what you know about them, and the possibilities for their applications.

   a) 3D printer  
   b) fusion reactor  
   c)  
   d) flying car  
   e) cobot  
   f) Hoverbike  
   g) wearable technology
2 Choose the correct option. Check your answers on the Internet.

1 What can’t you 3D print?
   a Blood vessels.  b Bone.  c Heart.  d Ear cartilage.

2 Hoverbike is a ________.
   a bike  b helicopter  c motorcycle  d car

3 Aeromobil flying car of the future will fly as fast as ________.
   a 115 mph  b 120 mph  c 124 mph  d 130 mph

4 The purpose of nanomaterials is not to make vehicles ________.
   a stronger  b heavier  c lighter  d electromagnetically invisible

5 ________ can conduct electricity better than copper and transmit heat better than diamond, and they rank among the strongest materials known.
   a Carbon nanotubes  b Dendrimers  c Nanogold  d Composites

6 Cobot stands for ________.
   a robot website  b company robot  c cope with a robot  d collaborative robot

7 Wearable technology does not imply ________.
   a tech togs  b wearable devices  c tech resistant to wear  d fashion electronics

3 Read the text. Then complete the sentences.

Technology is moving ahead at a high pace. Technological advancements make our life more comfortable and easier. Let us mention some of them. Scientists have been struggling hard to obtain energy from fusion reactors. Fusion reactions involve the fusion of atomic nuclei releasing infinite amounts of energy, which is why this type of energy generation is considered the most efficient one. For instance, the Sun is considered the biggest natural fusion reactor. However, it is hard to keep atoms stable and obtain energy in that way. Exoskeleton is a mobile machine powered by motors and hydraulics that enable the movement of limbs. It is used to increase the strength of a person who wears it, for instance soldiers, fire-fighters, nurses, etc. Google glasses refer to an optical head-mounted display. With the blink of your eye you can open and close the applications. Many would agree that nanotextiles are materials of the future. They have nano-enabled properties, for instance stain resistance, UV protection, shrink resistance, high strength, self-cleaning properties, and they are also hydrophobic. Finally, there are MEMS or Micro-Electro-Mechanical Systems. These are miniaturized electro-mechanical elements that outperform their macroscale counterparts. What are their applications? Find it out yourself!

a The biggest fusion reactor is ________________.

b The amount of energy that can be obtained by fusion is ________________.

c Exoskeleton is powered by ________________.

d By ________________ you can open an application in Google glasses.

e Stain and shrink resistance and self-cleaning are ________________ properties.

f A material that does not attract water is called ________________.

g MEMS stands for ________________. 
4 Match the terms to the photos.

a nanotextile   b fusion reactor   c Exoskeleton   d Google glasses

5 Study the list of technological achievements that we use in everyday life. Imagine what life had been like before they were invented.

car / mobile / computer / radio / plane / AutoCAD / Internet / alternating current

a Before ________ was invented, people used to ________________________________.

b Before ________ was invented, people couldn’t ________________________________.

6 Project work. Choose a gadget that impresses you most, and prepare a PowerPoint presentation on it.

KEY WORDS

- tech gadget
- 3D printer
- cobot
- nanotextile
- fusion reactor
13 MACHINE ELEMENTS

Unit 28 MCT Y2

Machine elements

1. Translate into Croatian.
   a. bearing
   b. axle
   c. seal
   d. sensor
   e. belt
   f. clutch
   g. brake
   h. lubricant
   i. piston
   j. camshaft
   k. cylinder
   l. crankshaft

2. What do the photos below show? Discuss in class.

   a. [Image of a bearing]
   b. [Image of a clutch]
   c. [Image of a sensor]
   d. [Image of a wheel]
3 Read the text to answer the questions below.

A machine is a motorized tool that uses energy to perform an action. It consists of machine elements, i.e. elementary components of a machine. Machine elements may be categorized into structural components, mechanisms and finally control components. Bearing, axles, seals and fasteners belong to structural components, whereas belts, clutches or brakes may be classified under mechanisms. Finally, control components refer to buttons, switches and sensors. Machine elements may have different purposes. For instance, general purpose elements such as nuts, bolts, keys, bearings, shafts, etc. perform different functions and may be used in different machines, whereas special purpose elements are used in the specific type of machine, e.g. piston, camshaft, crankshaft, cylinder.

a What is a machine?
b Define a machine element.
c What three types of machine elements are there?
d What are two kinds of machine elements regarding their purpose?

4 Match the sentence beginnings and endings.
   a Bearing, axles, seals and fasteners belong
   b Belts, clutches or brakes may be
   c Control components refer to
   d General purpose elements are
   e Machine elements that
   f Special purpose elements are used
      ☐ classified under mechanisms.
      ☐ may be used in different machines are general purpose elements.
      ☐ in the specific type of machine, e.g. piston, camshaft, crankshaft, cylinder.
      ☐ nuts, bolts, keys, bearings, shafts.
      ☐ to structural components.
      ☐ buttons, switches and sensors.

5 Choose the odd one out. Explain your answers.

   a bearing    axle    seal    clutch
   b nuts       bolts   piston  keys
   c šaraf      vijak   obujmica dlijeto
6 Match the standard Croatian term to the technical jargon.

dlijeto / obujmica / klin s osiguračem / poluga za vađenje čavala / ključ sa čegrtaljkom / vijak / vjetrobransko staklo / prtljažnik

bolčna / pajser / šoferšajba / šelna / šarač / gepek / gedora / štemajzl

a ___________________________   ___________________________  chisel
b ___________________________   ___________________________
c ___________________________   ___________________________
d ___________________________   ___________________________
e ___________________________   ___________________________
f ___________________________   ___________________________
g ___________________________   ___________________________

7 Translate into Croatian.

a crowbar ___________________________

b clamp ___________________________

c screw ___________________________

d windscreen ___________________________

e clevis pin ___________________________

f hex socket ___________________________

g boot ___________________________

8 What is the difference between standard terminology and technical jargon? When should each be used? Discuss in class. Then think of more examples of technical jargon.
9 Do the crossword puzzle.

ACROSS
2 elements that are used in different machines
5 a machine element that reduces friction between moving parts
6 a machine element that detects changes in the environment
7 a machine element that prevents motion
8 an elementary component of a machine

DOWN
1 a motorized tool that uses energy to perform an action
3 elements that are used in the specific type of a machine
4 a machine element that converts reciprocating motion into rotational motion

KEY WORDS
machine element • bearing • axle • general purpose elements
Machine elements for permanent joints

1 What type of joints do the photos below show? Match the joints to the photos. Discuss in class.
   a adhesive bonding  b riveted joints  c coupling

2 Read the text to complete the sentences below.

A machine is built using either sliding or fixed joints. The fixed joints be either permanent or detachable. It is crucial to choose the right type of mechanical joint depending on the application. Permanent joints are preferred in cases where the load is high and it is crucial that the parts do not separate. It is impossible to disassemble permanent joints without damaging the components. On the other hand, non-permanent joints can be disassembled without damaging the components. Welded, soldered, riveted, glued and coupled joints are main types of permanent joints. Welding includes melting metals and joining them using a filler material. Soldering also melts two materials, but it does not involve melting the workpieces. Applying an intermediate layer to connect substrates of different materials is called glue bonding. Riveted joints use rivets to fasten two materials. For instance, the Eiffel Tower is one of the most famous examples of riveted joints. Finally, coupling is a type of joint used to connect two shafts together. The primary objective of coupling is to connect two pieces of rotating equipment.

   a Permanent joints are mostly used when ________________________________________.

   b Non-permanent joints can be disassembled without ________________________________________.

   c Welding includes melting of metals using a ________________________________________.

   d Soldering does not involve ________________________________________.

   e Applying an intermediate layer to connect different materials is called ________________________________________.

   f The Eiffel Tower is a fine example of ________________________________________.

   g Coupling connects ________________________________________.

3 Find synonyms in Task 2.
   a opposite of temporary ________________________________________

   b opposite of assemble ________________________________________

   c ruin ________________________________________

   d material that is being processed ________________________________________
4 What do the photos below show? Discuss in class.

5 Choose the correct answer.
1 In the construction of the Titanic over _______ were used.
   a 1 million rivets
   b 2 million rivets
   c 3 million rivets
2 The Eiffel Tower contains _______ rivets.
   a 1.5 million
   b 2.5 million
   c 3.5 million
3 The best paid underwater welder in the US gets an annual salary of over _______.
   a $50,000
   b $70,000
   c $100,000

6 Underline the idioms in the news headings below.
   a Writing’s on the wall for metals!
   b The government is planning to go green for less green.
   c Testing engineering materials is my cup of tea!
   d You won’t get stuck in a rut if you choose a job in automotive industry.

7 Now match the idioms in Task 6 to their meanings.
   a I like it!
   b They will be no longer used that much.
   c It is not a routine job.
   d Use eco-friendly technologies for less money.

8 Project work. Find interesting facts on different types of permanent joints on the Internet.

KEY WORDS
welding • soldering • adhesive bonding • riveting • coupling
Machine elements for detachable joints

1 The photo below shows one of the most used fasteners - a bolt. Identify the **bolt**, **nut**, **thread**, **head of a bolt**, and **washer**.

2 **Choose the correct answer.**

   1 A washer is used ____________________.
      a to wash the bolt
      b to prevent the nut from sinking as it is turned
      c to loosen the nut

   2 As opposed to joints with rivets which are permanent, joints with bolts ____________________.
      a are removable, which means they can be disassembled
      b are removable, which means they can’t be disassembled
      c are removable, which means they can’t be disassembled without damage

   3 Threads can be ____________________.
      a prismatic and spherical
      b square, metric and unified
      c long and short
3 What is the difference between a **bolt**, a **stud**, and a **screw**. Match the terms to the photos, and complete the definitions.

![Bolt](image1.png)  ![Screw](image2.png)  ![Screw](image3.png)

a A ___________________ is a threaded fastener mated with a nut.

b A ___________________ is an externally threaded headless fastener. It does not need a nut and washer to hold it in place.

c A ___________________ has internal threads.

4 **Match the English to the Croatian terms.**

spajanje spojkama / vijčani spoj / spoj perom / spoj zatikom / spoj svornjakom / spoj klinom

- a Hirth joint
- b bolted joint
- c revolute joint
- d pinned joint for fastening
- e cotter joint
- f tongue-and-groove joint

5 **Read about the types of mechanical fasteners. Then answer the questions below.**

Detachable joints in machine elements can be disassembled without damaging the parts as opposed to permanent joints. Bolted joints consist of fasteners that capture and join other parts, and are secured with the mating of screw threads. There are many types of pinned joints. One of the types is pinned joint for fastening which holds together two or more component parts without frictional connection. A revolute joint (pin joint or hinge joint) provides single-axis rotation function used in many places, such as door hinges, folding mechanisms, and other uniaxial rotation devices. Cotter joint consists of a cotter passing through a hole to fix parts tightly together. Typical applications are in fixing a crank to its crankshaft.

Hirth joint or Hirth coupling is a type of mechanical connection named after its developer Albert Hirth. It is used to connect two pieces of a shaft together. It is characterized by tapered teeth that mesh together on the end faces of each half shaft. Tongue-and-groove joint is a method of fitting similar objects together, edge to edge. Each piece has a slot or a groove cut all along one edge, and a thin, deep ridge - the tongue, on the opposite edge.

a What is the main characteristic of a detachable joint?
b What is the difference in application between revolute and pin joints?
c What is the difference between cotter joint and tongue-and-groove joint?
d What is the main purpose of Hirth joint?
6 What types of joints are shown in photos below? Discuss in class.

![Image of a bolt and a coupling](image1.jpg)

![Image of a bolt and a coupling](image2.jpg)

![Image of a bolt and a coupling](image3.jpg)

![Image of a bolt and a coupling](image4.jpg)

7 Translate the collocations into Croatian.

- a tighten with a bolt
- b tighten the bolt
- c loosen the bolt
- d turn the bolt
- e unscrew the bolt
- f force the screw out
- g permanent joints
- h removable joints
Machine elements for rotary motion and power transmission

1. Explain the different meanings of the verbs drive in the collocations below. What is the purpose of a drive in a machine?
   a. drive a car       b. drive a turbine blade     c. drive a machine

2. Match the types of drive to the photos. When do you use which? Discuss in class.
   a. belt drive       b. chain drive            c. gear drive

3. Read the text and choose the correct answer.
   Transmissions are mechanisms / machines that transmit electrical / mechanical energy over a distance. Transmissions of rotary / translatory motion may be of three types: gear transmissions, belt drives and chain drives. Belt drive is the most expensive / the cheapest way to connect two or more rotating shafts. Chain drive / gear drive is most commonly used to convey power to the wheels of a vehicle. They are rather expensive and require a lot of maintenance / maintain. Chain drive / gear drive uses toothed gears to transmit motion from one axle to another.

4. Translate into English.
   a. kružno gibanje
   b. prijenos snage
   c. lančani prijenos
   d. zupčani prijenos
   e. remenski prijenos
   f. osovina
   g. vratilo
5 Translate into Croatian. What is the purpose of a **bearing**?
   a roller bearing
   b ball bearing
   c plain bearing
   d thrust bearing

6 Match the types of bearings to the photos.
   a roller bearing
   b ball bearing
   c plain bearing
   d thrust bearing

![Bearings Photos](image-url)
7 Read the text on bearings. Then choose the correct answer.

It is proven that things tend to roll / slide better than roll / slide. This is the key concept adjusted / applied to bearings. Bearings are the reason why electric motor spins so smoothly / roughly. A bearing is a device that increases / reduces friction and thus enables relative motion / movement between two parts. The most common material used for bearings is stainless steal / steel.

8 Match the terms to the photos. What are their applications?

- a crankshaft
- b camshaft
- c coupling

9 Translate into English.

- a koljenasta osovina
- b bregasta osovina
- c spojka

10 What is the difference between a drive shaft and an axle? Complete the definitions.

a ___________ is a mechanical component that transmits rotary motion between two parts. They can be both stationary and rotary and their purpose is to transmit torque and rotation. On the other hand b ___________ supports rotary members only and transmits torque. In cases of vehicles, an axle is most commonly called a shaft.
11 Complete the table.

<table>
<thead>
<tr>
<th>VERB</th>
<th>NOUN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>motion</td>
</tr>
<tr>
<td>transmit</td>
<td>rotation</td>
</tr>
<tr>
<td>support</td>
<td>drive</td>
</tr>
</tbody>
</table>

12 Complete the sentences. Use some of the prepositions more than once.

at / for / to / of / from / to / in / with

a Gases tend _______ disperse.
b A gas consists _______ molecules in motion.
c Can you set this body _______ motion?
d Civil engineers are concerned _______ building structures.
e High traffic load inevitably results _______ pollution.
f When heated, steel is provided _______ new properties.
g If you remove metal _______ this it won’t corrode.
h Brass is made _______ zinc and copper. He prefers zinc _______ copper.
i This machine can operate _______ high speeds.
j They are being late due _______ delay in traffic.
k You’ve improved in comparison _______ the last year.
l This company is comprised _______ 4 main parts.
m They are in need _______ mechanical engineers.
n Could you please deal _______ that problem?
o This material is not appropriate _______ this structure.
p Everybody can easily distinguish metal _______ plastics.

13 Project work. Create a poster with photos of axles, shafts, various types of bearings, types of drive, and similar. Present it in class.
Machine elements that transform types of motion

1. What is a mechanism? Which types of mechanisms exist? Complete the text.

   Mechanism is a device that _______ one type of motion into another. It consists of _______ components. Two connected moving components form a kinematic _______. Kinematic pairs differ regarding the degrees of _______ that are allowed by the connection. There are _______ main types of mechanisms: lever, spatial and screw mechanisms. Furthermore, transmissions that transform rotary motion into continuous _______ motion are powered by screw drives, rack-and-pinion drives, worm-rack drives and half-nut-worm drives.

2. Translate into English.
   a. mehanizam
   b. kinematički par
   c. šest stupnjeva slobode
   d. gibanje
   e. vijčani mehanizam
   f. krivuljni mehanizam
   g. polužni mehanizam

3. Match the types of mechanisms to the photos.
   a. screw mechanism   b. lever mechanism   c. spatial mechanism
4 Complete the definitions of the types of mechanisms.
   screw mechanism / lever mechanism / spatial mechanism
   a To transmit the torque of camshafts into the translationary movement of a valve we use _______________________.
   b In bicycles, ______________________ is most commonly used.
   c To achieve huge axial forces at small torques we use _______________________.

5 Match the sentence parts to get facts about different kinds of mechanisms.
   a In spatial mechanism, at least one part moves in a
   b In a screw mechanism, screw shaft rotates through a threaded hole, while
   c Lever mechanism consist of levers that rotate around
     ○ one axis.
     ○ the nut moves linearly along the shaft.
     ○ way that shapes a curve.

6 Translate the sentences in Task 5.
   a _______________________.
   b _______________________.
   c _______________________.

7 Make questions to match the answers in colour.
   a Scientists create theories.
   b Engineers solve problems, test different materials and create new things.
   c Newton formulated three Laws of Motion.
   d Newton formulated three Laws of Motion.
   e Mechanical engineers have developed another useful gadget.
   f Gas welding uses fuel gases and oxygen to weld and cut metals.
   g Gas welding uses fuel gases and oxygen to weld and cut metals.
   h The choice of the welding method and the filler material influence the strength of the weld.
   i Non-destructive tests are used to verify whether a weld is free of defects.

8 Project work. Do research on rack-and-pinion drives, worm-rack drives and half-nut-worm drives. Prepare a PowerPoint presentation.
Heat treatment

1 What is heat treatment? Read the text. Use the words in colour from the text to translate the terms into English.

Heat treatment refers to metalworking processes, such as heating and cooling, which are used to change the properties of alloys. It involves different techniques, for instance tempering (martempering, austempering), annealing, precipitation strengthening, normalizing, and quenching.

a toplinska obrada
b hlađenje
c zagrijavanje
d legura
e svojstvo
f popuštanje
g stepenasto martenzitno kaljenje
h izotermičko beznito kaljenje
i precipitacijsko očvrsnuće
j meko žarenje
k normalizacija
l kaljenje

2 Choose the correct word in the text.

Tempering involves heating / cooling the metal to some temperature below the critical point for a certain period of time, and then allowing it to cool / warm up in the air. It is performed after hardening, to reduce some of the excess hardness / stress. Quenching involves the rapid heating / cooling of a workpiece to obtain certain material properties. Annealing involves heating the workpiece to reduce hardness / stress. For instance, when annealed, steel gains increased / decreased ductility and softness. On the other hand, when normalized, steel gains increased / decreased hardness, and decreased ductility. Finally, when tempered, steel gains increased / decreased toughness and ductility, and increased / decreased hardness.
3 Match the English to the Croatian terms.
mekoća / tvrdoća / čvrstoća / naprezanje / žilavost
a hardness ________________
b toughness ________________
c strength ________________
d softness ________________
e stress ________________

4 Complete the table.

<table>
<thead>
<tr>
<th>VERB</th>
<th>NOUN</th>
<th>ADJECTIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>hardness</td>
<td></td>
</tr>
<tr>
<td></td>
<td>softness</td>
<td></td>
</tr>
<tr>
<td></td>
<td>strength</td>
<td></td>
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<tr>
<td></td>
<td>annealing</td>
<td></td>
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<tr>
<td></td>
<td>tempering</td>
<td></td>
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<tr>
<td></td>
<td>quenching</td>
<td></td>
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<tr>
<td></td>
<td>treatment</td>
<td></td>
</tr>
</tbody>
</table>

5 Complete the sentences with adjectives or adverbs.
dangerous / dangerously / slow / slowly / careful / carefully / quick / quickly
a Quenching involves cooling materials _____________ to obtain certain material properties.
b Tempering involves heating the material, and then cooling it _____________ in the air.
c Tempering involves _____________ cooling of the material in the air.
d Welding could be _____________ if it is not performed by a _____________ welder.
e Welding should be performed _____________ to avoid injury.

6 Complete the table.

<table>
<thead>
<tr>
<th>ADJECTIVE</th>
<th>ADVERB</th>
</tr>
</thead>
<tbody>
<tr>
<td>easy</td>
<td></td>
</tr>
<tr>
<td>safe</td>
<td></td>
</tr>
<tr>
<td>nice</td>
<td></td>
</tr>
<tr>
<td>horrible</td>
<td></td>
</tr>
<tr>
<td>good</td>
<td></td>
</tr>
<tr>
<td>fast</td>
<td></td>
</tr>
<tr>
<td>hard</td>
<td></td>
</tr>
</tbody>
</table>
Corrosion and metals

1 Answer the questions.
   a What is corrosion?
   b What causes corrosion?
   c What types of corrosion are there?
   d How can we prevent it or slow it down?

2 Complete the text.

   Corrosion refers to _________ (1) natural pro_________ (4) that causes _________ (3) destruction _________ (2) materials most commonly due _________ (2) chemical reaction with oxy_________ (3). There are th_________ (3) types of corrosion: chemical, electrochemical _________ (3) thermal. Corrosion can be slowed _________ (4) by some techni_________ (4). For instance, we can clean the surface, app_________ (2) a protective coating, sealant_________ (2) paint; perform galvanization or electrical insu_________ (6).

3 Complete the sentences.

   rust / corrosion resistant / corrosive / corrode / corrosion resistance

   a Some materials easily ______________________.

   b If a material is ______________________, we say that it possesses the property of ______________________.

   c A ______________________ substance damages the materials.

   d ______________________ is the most familiar type of corrosion.

4 Complete the sentences.

   conductive / conductors / semi-conductors / conductivity / conduct

   a Materials that ______________________ electricity are said to be ______________________.

   b ______________________ do not conduct electricity as good as ______________________.

   c Copper possesses the property of ______________________.
5 Complete the sentences. Make any necessary changes.

- **heighten / widen / loosen / fasten / lessen / tighten / straighten / lengthen / weaken / sharpen / worsen / enlarge / ensure / lower**

  a. Treatment will ________________ the pain.
  b. Traffic has finally ________________.
  c. How to ________________ warped timber?
  d. ________________ your seat belts!
  e. That fence needs to be ________________ if you don’t want your neighbours to see you.
  f. ________________ your pencils.
  g. ________________ the lever if you want to start the machine.
  h. That machine part is too small. It has to be ________________.
  i. First, you need to ________________ the screw. If it is too tight, ________________ it a bit.
  j. The weather ________________, and temperatures fell.
  k. Have you ________________ that the order arrives on time?
  l. They’re planning to ________________ and ________________ our classroom.

6 Choose the correct word. Make any necessary changes.

1. **specification / specimen**
   - a. A workpiece is a _________________.
   - b. A _________________ is an exact measurement or plan about how something is to be made.

2. **oversee / overlook**
   - a. Accidents happen when safety checks are _________________.
   - b. Supervisors ________________ the works on the assembly line.

3. **result from / result in**
   - a. High traffic load ________________ air pollution.
   - b. Air pollution ________________ high traffic load.
7 Read the three emails below dealing with orders. Match the types of orders to the emails.
   a information on shipment
   b reply to the customer’s order
   c problems with shipment

Hello John,

Thank you for ordering from XMBL. Our mission is to ship orders as soon as possible every business day.
If you have any further questions about the machine part you have ordered, or any comments regarding our service, please reply to this email. We value your feedback.

Kindest regards,

XMBL staff

Dear Mr Rodney,

Your order was shipped 3 days ago. It is scheduled to be delivered in 5 days’ time. You have ordered a high-quality machine part, and we hope you will be satisfied with it. However, make sure to follow the instructions for use and handling. Here is a link that provides all the necessary information: www.machineparts.com.

Sincerely,

Mark Peterson
Customer Service Manager

Dear Mrs Brown,

We were not able to deliver the postal package you sent on 3 June because the recipient’s address is incorrect. You can either send us the correct address or collect the package at our office.

Kindest regards,

HTRZR staff

8 Project work. Write an email in which you apologize for sending the wrong product to your loyal customer.
16 READING GRAPHS

Unit 34/35

MCT Y2

HVET Y2

AMT Y2

Say it with a graph!

1. Study the pie chart, and complete the sentences below. What was the situation with energy consumption in Croatia in 2010?
   a. The most used energy resource in 2010 was ____________________________.
   b. The most used type of renewable energy resource was ____________________________.
   c. The least used type of renewable energy resource was ____________________________.
   d. The total percentage of renewable energy resources used in 2010 was ____________________________.

![Pie chart showing energy consumption]

Total World Energy Consumption by Source (2010)

2. Match the synonymous verbs used for reading graphs. There is one verb that you do not need.
   increase / decrease / drop / rise / go down / go up / remain constant / climb

   a. ____________________________

   b. ____________________________
3 The graph shows the recycling rates of waste in the US from 1960-2013. Complete the sentences below using prepositions.

![Graph showing recycling rates from 1960 to 2013.]

- **a** The amount of recycled waste has increased ____ 6.4% ____ 87.2% from 1960 to 2013.
- **b** In other words, the amount of recycled waste has risen ____ 80.8% over the years.

4 Do research on waste recycling in Croatia. Then draw your own graph.

**KEY WORDS**
- graph
- increase
- decrease
- remain constant
- rise
- drop
Chipless forming processes

1. What are chipless forming processes? What types of chipless forming processes are there? Read the text.

Chipless forming processes make use of different stresses (tension, compression) in order to deform the material and get the desired shape. During forming no material is removed, for instance forging, extrusion, rolling, stamping, deep drawing, and sheet metal working fall into this category.

2. Translate into English. Find the terms in Task 1.

   a. obrada deformiranjem
   b. naprezanje
   c. kovanje
   d. duboko vučenje
   e. valjanje
   f. istiskivanje
   g. prešanje/ utiskivanje
   h. deformiranje lima
   i. oblikovanje

3. Complete the sentences.

   rolling / forging / sheet metal / extrusion / drawing / stamping

   a. _____________ may be formed using cutting, straightening, bending, punching, etc.
   b. _____________ refers to making wires by pulling a piece of metal through smaller holes.
   c. _____________ involves shaping a material by forcing it through a die.
   d. _____________ is a process of shaping metal object by heating it in a furnace, and then hammering it.
   e. _____________ includes shaping a material by cutting it with a die or mould.
   f. _____________ is a metal forming process in which a workpiece is passed through one or more pairs of rolls to reduce the thickness.
4 What processes are shown in the photos below? Discuss in class.

5 Complete the table.

<table>
<thead>
<tr>
<th>VERB</th>
<th>NOUN</th>
<th>ADJECTIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>drawing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>extrusion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>forging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>stamping</td>
<td></td>
<td></td>
</tr>
<tr>
<td>rolling</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The process of assembling a new product

1 What sells a product? Study the factors below and discuss in class.
   advertisement producers   good-quality   market demand

2 What do you know about the people in the photos? Match the people to their sayings. Discuss in class.

☐ Things should be made as simple as possible, but not any simpler.
☐ Action is the foundational key to all success.
☐ All companies have great engineering and sales people. There must be a gravitational force to pull it together.

3 Put the stages of the **development of new technology** in order.
   ☐ test the product to **verify** whether it fits performance requirements
   ☐ start the production
   ☐ design and **develop** the product
   ☐ come up with a new idea
   ☐ construct a prototype

4 Complete the text on the **manufacturing process**.
   market / large-scale / factory / finished products / efficiency / assembly lines / analyse / workshop

Manufacturing process takes place in a _______________. Factories are equipped with _______________ where raw materials turn into _______________. Some parts need to be finished in the _______________. People involved in production constantly _______________ and assess the production process in order to achieve the highest possible _______________. _______________ production demands constant analysis of the _______________ in order to be cost-efficient.
5 Complete the definitions with the words in Task 4.

a __________________________ productivity
b __________________________ material used for production
c __________________________ evaluate
d __________________________ accomplish
e __________________________ requires
f __________________________ to pay off

6 Answer the questions with a partner.
   a What is assembly?
   b Who may perform the assembling of new products?
   c How can we divide assembly operations?

7 Fill in the letters.

The assembly process
The process of assembling a new product is carried __________________________ (/3) in accordance with some technical and economical regulations. It consists __________________________ (/2) a seri __________________________ (2) of activities that may be done by a person or a mac __________________________ (4). Assembly operations may __________________________ (/2) divided into handling, control, adjusting, additional processes and finally join __________________________ (3).

8 Match the terms to the photos. There are two terms that you do not need.
   a store       b assembly line       c raw materials       d batch of products
9 Match the parts of the sentences.

TIPS ON SELLING PRODUCTS EFFECTIVELY

<table>
<thead>
<tr>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
<th>f</th>
<th>g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Force is not</td>
<td>It’s about them, not you! Ask yourself: What’s in it</td>
<td>Try to be as</td>
<td>Offer different</td>
<td>Ask questions to</td>
<td>Meet your buyers with a direct</td>
<td>Stop selling the product and</td>
</tr>
</tbody>
</table>

- find out more about your customer.
- helpful as you can.
- effective in sales!
- start selling the people behind it- sell your team!
- solutions.
- and informative conversation.
- for them?

10 Translate the linking devices into Croatian.

<table>
<thead>
<tr>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
<th>f</th>
<th>g</th>
<th>h</th>
<th>i</th>
<th>j</th>
</tr>
</thead>
<tbody>
<tr>
<td>in order to</td>
<td>in comparison with</td>
<td>as opposed to</td>
<td>however</td>
<td>whereas</td>
<td>in accordance with</td>
<td>etc.</td>
<td>on the contrary</td>
<td>regarding</td>
<td>therefore</td>
</tr>
</tbody>
</table>

[Image of light bulbs with one lit]
11 Complete the sentences.

in order to / in comparison with / as opposed to / however / whereas / in accordance with / etc. / on the contrary / regarding / therefore

a  ______________________ sustain living plants, the planted roof must have soil.
b  Romans were the first ones to build stone paved roads, ______________________ the Arabs later on built roads that were covered with tar. Their building techniques were simple.  ______________________, they were effective.
c  Conventional energy resources are cheaper ______________________ alternative ones.
d  ______________________ the use of green rooftops, it may be said that they are more eco-friendly.
e  All the design procedures must be ______________________ ISO standards.
f  Istanbul is built on shaky grounds, ______________________ it may be completely ruined by a future earthquake.
g  Biomass, for instance firewood and crop residues, is a renewable energy resource. What surprises most is that it is not eco-friendly, ______________________ – it is polluting.
h  Mechanical engineers construct machines, tools, ______________________.
i  Rolls Royce cars are more expensive ______________________ Fiat cars.

12 Project work. Watch a video on the Rolls Royce assembly line on YouTube and describe the steps that you see.
Motor fleet

1. Translate the vehicles into Croatian.
   a. car
   b. van
   c. truck
   d. e-bike
   e. forklift
   f. bus
   g. train
   h. trailer
   i. tractor
   j. bullet-proof vehicle
   k. bulldozer
   l. locomotive
   m. combat vehicle
   n. racing car
   o. crane
   p. convertible
   q. military ambulance
   r. motorcycle

2. Which types of vehicle are shown in the photos? Discuss in class.

   a. [Image of an e-bike]
   b. [Image of a forklift]
   c. [Image of a bulldozer]
   d. [Image of a tank]
   e. [Image of a crane]
   f. [Image of a convertible]
3 Complete the table with the vehicles in Task 1.

<table>
<thead>
<tr>
<th>OFF-ROAD VEHICLES</th>
<th>RECREATIONAL VEHICLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPECIAL VEHICLES</td>
<td>RAILWAY VEHICLES</td>
</tr>
<tr>
<td>DEFENCE VEHICLES</td>
<td></td>
</tr>
</tbody>
</table>

4 Translate into Croatian.

- **a** headlights __________________________
- **b** tail lights __________________________
- **c** fog light ____________________________
- **d** brake light __________________________
- **e** exhaust ______________________________
- **f** bonnet ________________________________
- **g** boot _________________________________
- **h** bumper ______________________________
- **i** indicator ____________________________
- **j** hubcap _______________________________
- **k** tyre _________________________________
- **l** windscreen __________________________
- **m** wing _________________________________
- **n** number plate __________________________
- **o** steering wheel ________________________

5 Label the car parts in the photos below. Use the words in Task 4.

- **a**
- **b**
6 Choose three famous car makes. What do you associate these makes with? Why? Discuss in class.

7 Discuss the questions.
   a What’s your favourite car make? Explain your answer.
   b Are cars a necessity or a luxury?
   c Have you ever been in a car accident?
   d Describe your ideal car?
   e Are people too young to drive a car at the age of 18?

8 Read what the colour of your car reveals about your personality.

<table>
<thead>
<tr>
<th>Colour</th>
<th>Personality Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>organised, calm, reliable</td>
</tr>
<tr>
<td>Green</td>
<td>the least materialistic, easy going</td>
</tr>
<tr>
<td>Red</td>
<td>impulsive, energetic, fiery, high-speed personality</td>
</tr>
<tr>
<td>Yellow / orange</td>
<td>happy, sporty, young</td>
</tr>
<tr>
<td>Silver / grey</td>
<td>relaxed, organised, less impulsive, stick to routine</td>
</tr>
<tr>
<td>Black</td>
<td>creative, imaginative, stylish, elegant, mysterious</td>
</tr>
<tr>
<td>White</td>
<td>young, energetic, socially outgoing</td>
</tr>
</tbody>
</table>

9 Translate into Croatian.
   a engine
   b ABS
   c air-conditioning
   d automatic transmission
   e central locking
   f tachograph
   g four-wheel drive
   h horn
   i clutch
   j airbag
   k cruise control
   l caterpillar tracks
10 Cross out the two items that do not belong to car equipment.

engine   ABS  air-conditioning  automatic transmission
central locking  tachograph  four-wheel drive  hornclutch
airbag  cruise control  caterpillar tracks

11 Discuss the following issues related to modern transport.

polution  traffic jams  fuel  accidents  maintenance costs

12 Complete the conversation.

a How many kilometres are on the odometer?
b How much are you asking for it? Is the price negotiable?
c Are you a single owner?
d Has the vehicle ever been involved in an accident?
e What’s the condition of a vehicle?
f Do you have service records for the vehicle?
g Why are you selling the car?

Buying a second-hand car

I am buying a new one!

About 190,000 km.

It’s in good shape. It runs like a top!

Yes, I’m the original owner.

No, never.

Of course. Take a look at it! Here it is. It has been serviced regularly.

Not much. No worries… We can negotiate...

13 Complete the sentences. Make any necessary changes.

reverse / do / overtake / get into / pull out / accelerate / lose control

a Let’s _____________ the car and go for a ride.
b The car was _____________ over 150 kilometres per hour when the accident happened.
c Please do not _____________ anymore! Decelerate! Slow down!
d Before _____________ another vehicle, make sure it is safe.
e The driver _____________ of the vehicle and crashed into another car.
f Do you know how to _____________ your car correctly?
g He _____________ the car right in front of me! That can be dangerous!

14 Project work. Create a poster that includes photos and terminology related to: car parts, car makes, types of vehicles, car equipment.
Driving licence

1 Discuss the questions in class.
   a What age is the most appropriate for young people to start driving?
   b What age is it allowed to start driving in Croatia? What about other countries in the EU, in the world?
   c What is the role of guardians of new drivers? Are they necessary?

2 What does a British photocard licence contain? Tick the items that appear on it.

   - name
   - surname
   - address
   - date and place of birth
   - licence valid from ... to
   - registration plates
   - issuing authority
   - category
   - type of the vehicle
   - photo of the person
   - licence number
   - telephone number

3 Fill in letters to get collocate with driving licence.
   a app ____ for your first driving licence
   b chan ____ the address, name or photo on your driving licence
   c a ____ higher categories to your driving licence
   d exch ______ your paper driving licence for a photocard licence
   e ren ____ your driving licence
   f repl ____ a lost, stolen or damaged driving licence
4 Which identity documents are needed to apply for the first driving licence in Croatia? Tick the odd one out.

☐ one photo
☐ confirmation of payment for the application
☐ certificate of driver’s road test
☐ valid passport
☐ medical report not older than 6 months

5 Which institution in Croatia issues a driver’s licence? Discuss in class.

6 What is the purpose of a vehicle licence? Tick the odd one out.

☐ It provides information about the car, i.e. registration plates and car owner.
☐ It provides information on the vehicle categories that the driver can drive.
☐ It serves as a proof that the vehicle is technically safe.

7 Fill in the form with your personal information.

<table>
<thead>
<tr>
<th>PERSONAL INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Name</td>
</tr>
<tr>
<td>Surname</td>
</tr>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>Date of Birth</td>
</tr>
<tr>
<td>Place of Birth</td>
</tr>
<tr>
<td>Current Address, Street</td>
</tr>
<tr>
<td>City</td>
</tr>
<tr>
<td>Postcode</td>
</tr>
<tr>
<td>Country</td>
</tr>
<tr>
<td>Email</td>
</tr>
<tr>
<td>Mobile phone</td>
</tr>
<tr>
<td>Fax</td>
</tr>
</tbody>
</table>
8 Complete the dialogue.

a See you soon. Thank you.
b Yes, it is. What other documents do I need?
c Oh, it’s a lot of documents. I have to collect them first and take a photo.
d I need an application form for a driving licence.
e Thank you.

A: ____________________________________________

B: Is it your first driving licence?
A: ____________________________________________

B: First, you need to fill in this form. Here you are.
A: ____________________________________________

B: Then we shall need one photo, certificate of driver’s road test, medical report not older than 6 months and confirmation of payment for the application.
A: ____________________________________________

B: Yes, your photo is obligatory!
A: ____________________________________________

B: You’re welcome.

9 Second conditional. Complete the sentences.

a If I could buy any car I wanted, I ________________________________.

b If my English were better, I ________________________________.

c If I had more time, I ________________________________.

d If I lived in Australia, ________________________________.

e If I were ____________________, I ________________________________.

f If my parents were __________, I ________________________________.

g If I could choose my job now, ________________________________.

h If I could choose any other city to live in, I ________________________________.

10 Project work. Write 5 beginnings of sentences in the second conditional. Ask your classmates to complete them.
Documents for vehicle inspection

1. What do the photos show? Who performs car inspections? Discuss in class.

   a. road te_______ (2) the vehicles
   b. insp_______ (3), main_______ (4) and rep_______ (3) the cars
   c. repl_______ (3) parts of the vehicle
   d. per_______ (4) oil changes and lubrications
   e. adv_______ (3) customers
   f. foll_______ (2) a checklist when performing regular inspe_______ (5)
   g. diag_______ (4) and anal_______ (3) the performance of a vehicle

3. Discuss the questions in class.
   a. Is periodic motor vehicle inspection obligatory in Croatia?
   b. How often is it required?
   c. What is the role of inspection stations?
   d. Are new vehicles in Croatia exempt from inspection for the first time?

   Vehicle documentation consi_______ (3) of technical and operational requirements. Technical documentation consists of manu_______ (3) for inspecting and repa_______ (5) a vehicle, a catalogue and pri_______ (3) for original ________ (/3) spare parts, technical data, etc. On the other hand, operational documentation is issued duri_______ (2) the car inspe_______ (5). It contains a car repair ord_______ (2) with a damage checklist, delivery note, and ________ (/1) repair receipt.
5 Match the types of forms to the documents.  

- a vehicle inspection report  
- b repair receipt  
- c repair order

**FORM 1**

<table>
<thead>
<tr>
<th>Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address</td>
<td>Phone</td>
</tr>
<tr>
<td>Odometer Reading</td>
<td></td>
</tr>
<tr>
<td>Make and Model</td>
<td></td>
</tr>
<tr>
<td>License number</td>
<td></td>
</tr>
<tr>
<td>Motor</td>
<td></td>
</tr>
</tbody>
</table>

- ☐ Lubricate  
- ☐ Change Oil  
- ☐ Wash  
- ☐ Polish

<table>
<thead>
<tr>
<th>Labour Description</th>
<th>Amount</th>
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</table>

<table>
<thead>
<tr>
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<th>Amount</th>
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<tbody>
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</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
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Total Amount

**FORM 2**

<table>
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<th>Customer</th>
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<tbody>
<tr>
<td>Contact</td>
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</tr>
<tr>
<td>Address</td>
<td>Customer number</td>
</tr>
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<td>Payment</td>
<td>Phone</td>
</tr>
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</table>

<table>
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<th>Total</th>
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<td>Parts changed</td>
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<tr>
<td>Parts serviced</td>
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<tr>
<td>Total</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>FORM 3</td>
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6 **Project work.** Imagine you have just inspected a car. Fill in the forms in the previous task after you have conducted your regular car inspection.

KEY WORDS  
technical vehicle documentation • operational vehicle documentation
Car inspection

1 What do the photos below show? Discuss in class.

2 Discuss the questions in class.
   a What is the purpose of a regular car inspection?
   b What does regular car inspection consist of?
   c What happens if a vehicle does not pass the inspection?

3 Fill in the letters.

Large amount of car own_______ (3) often feel annoyed when they have impor_______ (4) things to do and the car sudd_______ (4) stops working. In this situation they have _______ (/2) call the car repa_______ (2) centre to have their car chec_______ (3) and repaired. The inven_______ (4) of the complete vehicle inspection offers _______ (/1) lot of convenience _______ (/2) the car owner.

Some of _______ (/3) vehicle inspection systems _______ (/3) designed for car inspection and _______ (/5) are also others that can be used _______ (/2) check cars’ condition through the handheld VAG diagnostics code scan_______ (3). This device lets you read diagnostic trouble codes (DTC) so that you can _______ (/3) an insight into the condition _______ (/2) your car in advance and prevent accidents be_______ (4) they occur. Another option _______ (/2) to use a small camera to check _______ (/3) bottom side of the car wit_______ (4) entering it. Novel vehicle inspection systems save ti_______ (2) for both the car owners and the repair ce_______ (4).

4 Answer the questions on the text in Task 3.
   a What is the benefit of a regular car inspection?
   b What is the main advantage of VAG diagnostics code scanner?
5 What do the photos below show? Discuss in class.

(a) [Image of exhaust pipes]

(b) [Image of seatbelt]

(c) [Image of windshield wiper]

(d) [Image of tire]

6 Match the testing methods to their descriptions.

a emission testing
b roller brake testing method
c safety inspection

c
- This is a method that makes possible the dynamic assessment of the brakes in a motor vehicle while the vehicle itself is in a static condition.
- It includes checking the headlights, accessory lights, directional signals, foot brake, parking brake, steering and windshield wipers.
- Older vehicles are tested to check the amount of harmful gases they emit since they extensively pollute the environment. Carbon dioxide is the most commonly checked pollutant.
7 Match the items on the vehicle inspection checklist to their descriptions.
windshield wipers / exhaust system / brakes / exterior / engine / belts / steering and suspension /
tyres / safety lights / batteries / fluid levels / hoses

**VEHICLE INSPECTION CHECKLIST**

- Inspect tyre thread, pressure and tyre wear.
- Check voltage, secure battery tie-downs and conduct a charge/discharge load test.
- Check the brake fluid and evaluate wear on the drum, brake pads and rotors.
- Examine the power steering belt, power steering fluid level, power steering pump and check for fluid leaks.
- Complete exterior inspection.
- Inspect headlights, brake lights, hazard lights and turn signals.
- Examine the windshield and wiper blades.
- Engine inspection for leaks, damage and maintenance check will be completed.
- Check the oil levels, coolant levels and washer fluid levels.
- Inspect the belt operations.
- Check hoses for leaks and other issues.
- Examine the exhaust manifold and catalytic converter for damage, cracks and leaks.

8 Complete the sentences.

a The purpose of brakes is to ____________________________.

b Clutch is used to ____________________________.

c The role of windshield wipers is to ____________________________.

d Exhaust system emits ____________________________.

e Belts are used by ____________________________ to ____________________________.
9 Complete the sentences.

- pollute / pollutant / polluters / polluting / non-polluting / pollution

a Harmful gases cause ________________ of our environment.

b CO₂ is a major ________________, whereas factories and people are ________________.

c Is there such a source of energy that is ________________?

d Biomass is renewable resource, but it is ________________.

e Do vehicles ________________ our cities?

10 Translate into English.

a ispitivanje onečišćenja okoliša

b ispitivanje kočnih svojstava vozila

c zagađenje

d zagađivalo

e zagađivač

f nezagađujuć

KEY WORDS

car inspection • emission testing • brakes testing
Car service and car inspection

1. Answer the questions. Discuss in class.
   a. What is the difference between regular and non-obligatory car inspection?
   b. What type of car inspection is needed if you are buying a second-hand car?
   c. Where can you have your car inspected, and where do you have it serviced?
   d. What do the photos below show – a car service centre or a car inspection centre?

2. Answer the questions. Discuss in class.
   a. What three types of car service are there?
   b. What factors influence the frequency of car service?
   c. How often do you need to change oil and oil filter?
   d. How often do you need to have your car fully serviced?
   e. What does full service refer to?

3. Read the text. Do you agree with all the facts? If not, what would you change?

   The type of service required on your car depends on the age of your car and the amount of kilometres it has on the clock. Oil and filter are advised to be changed every 15000 kilometres, but that also depends on the quality of oil used in your car. Interim service should be done every 6 months, whereas you should do full service every 12 months. During interim service they check car brakes, suspension and steering. On the other hand, full service covers checking up on wheel alignment, bearings, fuel filters, and spark plugs.

4. Translate into English.
   a. obvezni tehnički pregled
   b. stanica za tehnički pregled
   c. servis vozila
5 Do the quiz on car facts. Choose the correct answer.

1 There are over ___________ cars currently in use on Earth.
   a 1 billion    b 2 billion    c 3 billion

2 About ___________ cars are produced every day.
   a 155,000    b 165,000    c 175,000

3 It would take about ___________ to get to the Moon by car at 95 kph.
   a 6 months    b 8 months    c 10 months

4 The average car has about ___________ parts.
   a 10,000    b 20,000    c 30,000

5 Ethanol, which is used as fuel, is produced from ___________.
   a rapeseed oil    b sunflower    c sugar cane

6 It is a criminal offense to drive around in a dirty car in ___________.
   a Russia    b Argentina    c Nepal

7 There are more cars than people in ___________.
   a Milan    b New York    c Los Angeles

8 The vehicle with the highest mileage covered ___________.
   a 4,586,630 km    b 4,686,630 km    c 4,786,630 km

9 ___________ of a car’s lifetime is spent parked.
   a 92%    b 95%    c 97%
6 Discuss the questions in class.

a Have you ever been in a racing car? What about your classmates?
b What are the differences between a road car and a racing car?

7 Read the text on F1 cars. Choose the correct word. What fact has impressed you most?

The cars used in F1 championships are quite / quiet different from usual cars. About 80,000 components come together to make an F1 car. F1 car engines completes / complete their life in about two hours / clocks of racing. Just compare this with normal engines which go on serving us faithful / faithfully for decent 20 years. When an F1 driver steps on a brake of his car, he experiences huge antiacceleration / deceleration. It could be compared to a regular car driving through a brick wall at / with the speed of 300kph. The brake discs in an F1 car have to withstand the operating temperature of approximately 1,000 degrees Centigrade. They are made of carbon fibre which is much harder than steel / steal, and has a higher melting point. An F1 car can accelerate from 0 to 160 kph, and decelerate back to 0 in just four seconds. An F1 car weights / weighs around 550 kg. Most racing cars have their tyres filled with nitrogen since it has a more consistent pressure compared to normal air. Road car tyres can last between 60,000 and / to 100,000 km. On the other hand, racing tyres are / is designed to last only 90 to 120 km. Pit stop crews take only 3 seconds for / to refuel and change tyres.

8 Project work. Prepare a PowerPoint presentation on your favourite car or car make.
Health and safety

1. Complete the sentences.
   
   a. In case of death risk, workers should ________________________________.
   
   b. Everyone should intervene the moment ________________________________.

2. What do the photos show? When is each piece of safety equipment obligatory? Discuss in class.

   a. [Photo of a hard hat]
   
   b. [Photo of a work boot]
   
   c. [Photo of high-visibility vests]
   
   d. [Photo of ear defenders and earplugs]
   
   e. [Photo of safety goggles]
   
   f. [Photo of safety gloves]
3 Match sentence beginnings to endings.

WORKPLACE SAFETY INSTRUCTIONS
a Do not start up or
b Do not perform work without wearing
c Do not carry out work if you do not have the right
d Do not start work without a valid
e Do not pass under a load while
f Do not enter a confined space

☐ work permit.
☐ tools for the job.
☐ until it has been checked.
☐ shut down equipment without using the appropriate written procedure.
☐ lifting is taking place.
☐ task-specific protective clothing.

4 Fill in the letters of instructions for workplace safety. Then match some of the instructions to the photos below.

a Expl____ve material!
b Flamm____material!
c Wear safety hel____!
d Wear respi____!
e Wear eye and hand prote____!
f Stack correct____!
g Over____hazard!
h No smok____!
i Electric shock ri____!
j Suspended lo____ risk!
k No admit____!
l Do not____ mobiles!

5 Fill in the letters.

CAR REPAIR SHOP DOS AND DONT’S

You must not du_____ (2) waste antifreeze on land or disch____ (4) it into sanitary sewer, storm drain or sep____ (3) system because ____ (1/2) may contain hazardous levels ____ (2) heavy metals. Antifreeze should be recycled. Ke____ (1/2) your shop dry. Oil and antifreeze may conta____ (6) water and aquatic ecosys____ (4). Used aerosol cans should ____ (1/2) disposed off in trash or recycled as scrap metal only ____ (1/2) they are completely emp____ (2). Spent brake washing solvent is very likely to be a hazar____ (4) waste. Make ____ (4) that hazardous waste has proper disposal. Used rags and paper tow____ (3) are very likely to be hazardous waste if they are contaminated ____ (1/2) gasoline or solvent. Mineral spirit is commonly used ____ (1/3) part cleaning because it quickly dissolves oil and gre____ (3). However, it evaporates quickly, and it is tox____ (2). Therefore, use aqueous cleaners that are l____ (3) polluting instead ____ (1/2) mineral spirit to clean parts ____ (1/4) grease, oil and lubricants. Finally, make sure to treat flam____ (5) material appropriately in ____ (1/5) to prevent fire in your car repair shop.
6 Translate into English.
   a zaštitna radu _______________________________
   b zaštitna od požara _______________________________
   c zaštitna okoliša _______________________________

7 Fill in the letters. Add examples of these types of waste.

   Examples
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

8 Complete the collocations. How to manage waste and protect the environment? How do you contribute to waste management?
   cotton bags / materials / cartridges / broken machines / waste / batteries / plastic bottles

   a reduce _______________________________
   b refill _______________________________
   c reuse _______________________________
   d recycle _______________________________
   e repair _______________________________
   f recharge _______________________________
   g replace plastic bags with _______________________________
9 Fill in the letters to get collocations. Then write 5 sentences using the collocations.

POLLUTION

mini ___ e
redu ___
pre ___ t
avo ___

lim ___
cau ___
cont ___ l

a _______________________________________________________________________

b _______________________________________________________________________

c _______________________________________________________________________

d _______________________________________________________________________

e _______________________________________________________________________

10 Project work. Do research on the 5 Rs of waste management and prepare a PowerPoint presentation.
Car diagnostics, sensors, and actuators

1. Answer the following questions in pairs. Discuss your answers in class.
   a. When do people usually bring cars in for an engine diagnostics?
   b. What is the role of computer unit within the modern vehicle?
   c. Do you know what the ECU stands for?
   d. Do you know what a Lambda-sensor measures?

2. Read the text and translate the words in colour into Croatian.

**Electronic Engine Management: Perfectly Regulated Engine Functions**

Engine Control Units (ECU) coordinate all engine functions and ensure reduced consumption and fewer emissions and dynamic driving characteristics. Along with mixture formation, fuel injection, ignition, and the electronics control start/stop systems.

During vehicle operation, the control unit constantly monitors and diagnoses all components that affect system security and emission performance. In this way, engine management is at the heart of several linked individual components; managing their ideal coordination.

Modern vehicles are being equipped with more and more electronic components. Therefore, there has also been an increase in the number of sensors installed in vehicles. These sensors act as the “sensory organs” of a vehicle to record a wide range of different parameters. The result is that nowadays there are hardly any vehicles at all on the road, which are not equipped with sensors.

a. consumption
b. emissions
c. mixture
d. injection
e. ignition
f. vehicle
g. monitor
h. diagnose
i. affect
j. emission
k. equipped
l. sensors
m. record
3 Complete the text of a diagnostics software commercial.

rain / valves / brakes / diagnostic / vehicle

**Develop your business!**

“With Multi-Diag, give your customers a wide choice of diagnostics services and packages: servicing (resetting, error readout), tyres (electronic ____________), brake pads (electronic parking ____________), windscreen (__________ detector), engine (Injector codes), alignment (__________ with ESP). By combining Multi-Diag with your daily jobs, your ____________ tool becomes a full-scale profit centre!”

4 Match the English to the Croatian words.

- a coolant  □ bregasto vratilo
- b camshaft  □ kisik
- c throttle  □ gas
- d oxygen  □ podešavanje
- e exhaust  □ tekućina za hlađenje
- f trigger  □ ispuh
- g adjustment  □ okidanje

5 Which sensor does what? Match the sensors to their functions in the engine system. Look up new words in a dictionary.

- a Coolant Temperature Sensor (CTS)
- b Camshaft Position Sensor (CMP)
- c Oxygen Sensor (Lambda-sensor)
- d Throttle Position Sensor (TPS)

□ Measures the percentage of oxygen in the exhaust, and tells the computer whether the fuel/air mixture is too rich or too lean.

□ Measures the temperature in the cooling system, so the computer may make adjustments based on the engine’s operating temperature.

□ Monitors the position of the accelerator pedal and throttle linkage so the computer can make accurate air/fuel mixture adjustments.

□ Monitors the rotation of the engine and tells the computer exactly when to trigger the fuel injectors or the ignition spark.

6 Answer the questions. Look up new words in a dictionary.

- a How do we call all automotive devices that are operated by outputs from the ECU (Engine Control Unit)?
- b How do we call actuator, which injects fuel into the intake manifold, to which the computer tells exactly when and how much fuel to inject in order to produce the needed amount of power?

**Find out more!**

**Engine diagnostics**

An engine diagnostics is a test which is performed to learn more about why an engine is not functioning properly. The engine diagnostics is used to gather data, which can be utilized in the repair of the vehicle.

**Sensor**

An energy conversion device which measures some physical quantity (e.g. air pressure) and converts it to an electrical quantity (e.g. voltage).

**Actuator**

A device that performs an action in response to an electrical signal sent from the control unit.
Control and repair of valve train and fuelling systems

1. Look at the picture and write down the Croatian words for the parts of the valve train system.
   - a. valve
   - b. camshaft
   - c. push rod
   - d. valve spring
   - e. toothed ring

2. Cross out the parts that are not related to the fuel system.
   - • fuel tank
   - • fuel injectors
   - • brakes
   - • water pump
   - • fuel filter

3. Choose the correct word and complete the text. Then translate the words-expressions in colour.
   Fuel __________________________ (ignition / injection) is not new technology. It’s been around for nearly as long as the auto ______________________ (business / industry), although it had been economically impractical for mainstream automobiles until the 1980s. Simply put, fuel doesn’t ______________________ (burn / flicker) efficiently unless it is atomized into as perfect a cloud as possible. Early engines used a controlled drip into the cylinders, and the advent of the carburettor helped advance internal ______________________ (combustion / kindling) practicality. The carburettor served on for at least 80 years, but its limitations (poor atomization, high emissions, etc.) made it obsolete for modern requirements. Fuel injection was the only answer. Today’s engine ______________________ (management / policy) systems combine all the functions (ignition, timing, cooling, fuel delivery) into computer-controlled operations that work incredibly well, allowing engines to develop maximum power with (tiniest / minimum) ______________________ fuel. When you next get into your cold car and are able to instantly ______________________ (start / move) your engine and drive away ______________________ (smoothly / sleekly), thank those who developed fuel injection. Without them we’d still be setting chokes, cranking constantly, warming the engines for several minutes and stalling at stop signs, not to mention belching out smoke and pollution.
4 Answer the questions about the text.
   a When was the fuel injection technology invented?
   b When was it introduced to mainstream automobiles?
   c What is the ultimate goal of today’s engine management system?

5 Complete the table with the verbs from Task 3. Then choose 3 verbs to make your own sentences.

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<td>atomization</td>
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<td>pollution</td>
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6 Match the acronyms to the explanations. Do you know which acronym belongs to which car brand?
   a TDI      ○ Turbodiesel Common Rail Injection
   b CDTI     ○ Diesel Common-Rail Injection
   c dCI      ○ High Pressure Direct Injection
   d HDI      ○ Common Rail Diesel Turbo Injection
   e TDCi     ○ Turbodiesel Direct Injection

7 Look at the following made up car brand acronyms. Do you agree with them? Do you know any similar ones in Croatian?
   a FERRARI  Fragile, Expensive Rides Repel All
   b FIAT     Failure In Automotive Technology
   c SAAB     Sadly Absent, Always Broken

8 Complete the text.

   tuning / away / operating / repairing / fuel

A carburettor takes the _______________ and mixes it with air without computer intervention. While simple in _______________, they tend to need frequent _______________ and rebuilding. This is why most new cars have done _______________ with carburettors in favour of fuel injection which does not need often _______________.

KEY WORDS
valve train system * fuel injection
Control and repair of lubrication, cooling and exhaust systems

1. Look at the picture below and cross out the parts which do not belong to the automotive exhaust system.
   - a oxygen sensor  c radiator  e catalytic converter  g exhaust pipe
   - b muffler       d coolant      f oil pump

2. Complete the sentences.
   a Oil pump is an important part of the automotive __________________ system.
   b Radiator and coolant are important parts of the automotive __________________ system.

3. Read the text. Underline the parts of the cooling system.

   If it’s a hot day or you are driving in severe conditions, it’s possible your engine will run a little hotter. Turning off the air-conditioning while uncomfortable, will allow your car to run a little cooler. If the thermostat needle moves in to the red range, it’s time to pull over. Sometimes, rolling down the windows and running the heater on high will allow you to carry on with your trip or at least get you to a garage. The heater is basically another smaller radiator which is designed to extract heat from the engine coolant. This extra help sometimes can save you on a super hot day... although it’s no picnic in the driver’s seat.

4. Explain what the phrasal verbs below mean in English. Translate them into Croatian.
   a pull over ____________________________
   b turn off ______________________________
   c carry on ______________________________
5 Complete the text with the correct form of the verb in the brackets.

Volkswagen’s own staff ________________ (warn) the company four years ago that the use of on-board software to cheat emission tests could be potentially illegal, according to a German newspaper report. Frankfurter Allgemeine Zeitung ________________ (say) the VW board had been handed an internal memo showing a company engineer ________________ (warn) about dubious emissions practices in 2011.

Separately, Bild am Sonntag ________________ (claim) parts supplier Bosch had warned VW not to use its software illegally as far back as 2007. VW, the world’s largest auto manufacturer by sales, has been grappling with an escalating fallout after US regulators revealed that the carmaker ________________ (cheat) emissions tests by using “defeat devices” - on-board software that can detect when vehicles ________________ (test) and manipulate their performance.

The firm later ________________ (admit) that the software was installed in up to 11 million of its vehicles, most of them sold in Europe. The scandal ________________ (force out) chief executive Martin Winterkorn and Matthias Mueller, the former head of Porsche, ________________ (take over) the reins.

6 Complete the text with one word only. What automotive system is the text about?

Your car’s ________________ system carries away the gases created when the fuel and air are burned in the combustion chamber. These gases are harmful to humans and our environment. Frequent checks of your ________________ system is a must to provide for you and your family’s safety. Make sure there are no holes in the ________________ system or in the passenger compartment where exhaust fumes could enter.

7 Cross out the sentences which are not true.

Oil in the automotive engine lubrication system...
- lubricates.  • reduces noise.  • controls friction.
- transports heat. • reduces harmful gases. • mixes with fuel.
- transmits power. • reduces wear.  • dampens shock.

8 Complete the sentences. Choose the correct word and make any necessary changes.

a An oil pressure regulator ________________ (ensure / mean) that the oil pressure level is maintained properly.

b The oil filter ________________ (remove / keep) any dust particle present in oil and ________________ (take / supply) oil to the oil lines.

c In a modern engine oil ________________ (withstand / take) a much higher pressure between components.

d The oil pump ________________ (give / receive) power from the engine through belt and pulley system.
Fuels

1 Match the names of the fuels to their definitions. Some names are synonyms or British English and American English variations of fuel names.

- gasoline / diesel fuel / oil /petroleum / petrol

a An oily, thick, flammable, usually dark-coloured liquid that is a form of bitumen or a mixture of various hydrocarbons, occurring naturally in various parts of the world and commonly obtained by drilling: used in a natural or refined state as fuel, or separated by distillation into gasoline, benzene, kerosene, paraffin, etc.

b A volatile, flammable liquid mixture of hydrocarbons, obtained from petroleum, and used as fuel for internal-combustion engines, as a solvent, etc.

c Any fuel used in diesel engines, whose fuel ignition takes place, without a spark, as a result of compression, usually a combustible petroleum distillate.

2 Complete the text with the correct preposition or conjunction.

Octane rating tip
Putting “Super” ______________ the tank will not get you any more performance or gas mileage ______________ specifically recommended ______________ your cars manufacturer. If your owner’s manual says put in 87 octane, do it. You are throwing money ______________ the window if you are filling ______________ “Super” or “Super Plus” and you only need “Regular”.

3 Discuss the following questions in class.

a What does the words Super, Super Plus and Regular refer to?

b What do expressions put in and fill up mean in the text?

c Explain what the word octane means.

d What is your experience with different types of fuel?

4 Translate the following words into Croatian.

a octane number

b anti-knock rating

c Regular fuel

d Super fuel

e Super Plus fuel

f self-ignition

g combustion
5 Test your memory! Read the text twice, then cover it and answer the questions below.

**Octane Number**
The octane number indicates the fuel’s “anti-knock rating”. This is determined according to RON (Research Octane Number) under specific test conditions using precisely defined test engines. Regular fuel has the lowest rating at 91 RON, followed by Super fuel with 95 RON and, at the top end, Super Plus with the highest rating of 98 RON. The higher the octane number, the higher the self-ignition temperature of gasoline/petrol and the lower the knock tendency during combustion (self-ignition temperature of regular fuel 450-550 °C, Super fuel 480-700 °C).

a What does the octane number indicate?
b What does RON stand for?
c Which fuel has the lowest anti-knock rating?
d What is the relation between the octane number and the temperature of gasoline/petrol and the knock tendency?
e At what temperature do fuels self-ignite?

6 Complete the sentences.
1 The Cetane Number (abbreviated CN) refers to the combustion quality of _______.
   a diesel fuel   b regular petrol   c oil
2 The Cetane Number represents the time delay between the start of injection process and the point where _______.
   a the exhaust gas comes   b the fuel ignites   c the fuel is mixed with air into the atmosphere

7 Match the words to form free or hyphenated compound nouns. Then translate the words into Croatian.
   a anti-knock   b self   c Cetane   d regular
   a ___________________________   c ___________________________
   b ___________________________   d ___________________________

8 Complete the sentences and learn more about engine fuel.
   a In gasoline, the quality of the fuel is denoted by its O________________________ N________________________.
   b In a d________________________ engine the fuel is injected at high pressure into the combustion chamber and, rather than delaying the onset of c________________________, since there is no spark plug present, the intention is to encourage burning of the fuel rather than delay it.
   c In describing the property of the fuel, instead of Octane Number, compression-ignition engine engineers refer much more to the C________________________ N________________________ of the fuel, which is a measure not of anti-knock but of ignition delay in the engine.
Product design and construction

1. Read the text from a student who designed the Bugatti W16 engine. Make sure you understand all the words in colour. Use a dictionary if necessary.

   **My design process**
   I first began studying and researching the W16 engine and how it works relative to the more common and simpler types of engines. I began the **modelling process** on Fusion 360: first beginning the piston head, oil rings, connecting arm, etc. Before moving on to the crankshaft I needed to study how exactly the 16 pistons are positioned relative to each other and the crankshaft in the way that allows them to move cleanly and efficiently. This was definitely one of the most mathematically difficult processes I have ever gone through. I could not find very much info. Regarding the **angle calculations** for the positioning of the pistons and I had to go through a lot of trial and error. After successfully solving the mathematical dilemma, I modelled the entire crankshaft, duplicated my piston 16 times, and finally moved each piston into its **carefully calculated position** along the crankshaft. In the **final stage** of my project, I completed the tedious task of **adding in** the hundreds of joints needed for my model to **fully function** and rendered it. I hope you found my model and my brief **design process** interesting or helpful. If you have any questions or comments, feel free to email me at: kooatc@gmail.com.

2. Order the product design phases chronologically according to Task 1.
   - studying and researching
   - beginning of modelling
   - calculations
   - trial and error
   - final stage of modelling

3. Discuss the following questions in the class.
   - What was his first step in the designing process?
   - What was mathematically the most difficult process to him?
   - What did he find to be tedious?
   - What software tool did he use for the product design?
4 Choose the odd one out. Explain your answers.
   a designing    • modelling    • well    process
   b first        • last        • last    stage
   c carefully    • good        • correctly calculated
   d successfully • poorly       • bad    solved
   e move        • cleanly      • efficiently • efficacy

5 Translate the collocations and phrases from Task 1 into Croatian.
   a modelling process __________________________
   b move cleanly ________________________________
   c angle calculations __________________________
   d carefully calculated position __________________
   e final stage _________________________________
   f fully function ______________________________
   g adding in __________________________________
   h design process ______________________________

6 Complete the sentences using the collocations and phrases from Task 5.
   a Such differences may be due to differing requirements of the model’s end users, or to conceptual or aesthetic differences among the modellers and to contingent decisions made during the ________________________________.
   b There are several different methods for slope ________________________________.
   c This model will not ______________________ until all its issues are successfully solved.
   d Once the design is brought close to the ________________________________, full-scale, 1/1 clay models are made.

7 Imagine you were a product designer. What would you like to design? Which of the product design phases would be the most tedious for you? Discuss in class.
Static and dynamic material testing

1. **Connect the English and Croatian words for mechanical properties of materials.**
   - a. strength  
   - b. elasticity  
   - c. tensile strength  
   - d. elongation  
   - e. hardness  
   - f. fracture toughness  
   - g. impact resistance  
   - h. stress rupture  
   - i. fatigue  
   - j. creep
   
   -  vlačna čvrstoća  
   -  procijepni lom  
   -  produženje  
   -  tvrdoća materijala  
   -  otpor na udar  
   -  čvrstoća materijala  
   -  elastičnost  
   -  zamor materijala  
   -  žilavost  
   -  puzanje materijala

2. **Read the text to answer the questions below.**

   Mechanical testing reveals the properties of a material when force is applied **dynamically or statically**. A mechanical test shows whether a material is suitable for its intended application by measuring properties such as **elasticity**, **tensile strength**, **elongation**, **hardness**, **fracture toughness**, **impact resistance**, **stress rupture** and the **fatigue** limit.

   - a. What is the difference between dynamic and static testing of materials?
   - b. Give an example of a standardized mechanical test of materials.

3. **Match the types of mechanical testing to the photos.**

   [Photo a] [Photo b] [Photo c]
4 Read the text about a course and complete the text with the correct form of the verbs. Which tense will you use? Explain your answer.

observe / make / perform / learn / study

Recently we __________________ about static materials testing. We __________________ the basics of static testing including mechanical properties, load/elongation test curves, different types of testing, stress and strain, modulus, yield. We __________________ testing with live demonstrations on computerized materials test instruments. We ______________ and ______________ tensile, compressive and shear tests and learn to interpret test curves and calculated results.

5 Which course is the text about?
   a Introduction to Microelectronics  
   b Introduction to Materials Testing  
   c Introduction to Mechatronics

6 Match the types of materials testing to the definitions.

<table>
<thead>
<tr>
<th>Tensile Testing</th>
<th>Shear Testing</th>
<th>Fatigue Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>a _______________ is performed on materials to simulate the progressive and localized structural damage that occurs when a material is subjected to cyclic loading.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b _______________ is one of the most common ways of measuring material strength. It involves the linear stretching of a material until failure or some critical value is achieved.</td>
<td></td>
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</tr>
<tr>
<td>c _______________ is performed when forces are applied parallel to the upper and lower faces of the object under test. It is usually made on fasteners, such as bolts, machine screws and rivets.</td>
<td></td>
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</tr>
</tbody>
</table>

7 Transform the definitions from Task 5 from passive to active voice using the subject we.

a We perform __________________ on materials to simulate the progressive and localized structural damage that occurs when we subject a material to cyclic loading.

b ________________________________________________________________

b ________________________________________________________________

b ________________________________________________________________

c ________________________________________________________________

b ________________________________________________________________

b ________________________________________________________________
Manufacturing process

1 Match the English words and phrases to the Croatian translations.
   a manufacturing (fabrication) process  ☐ tehnološki process
   b casting  ☐ odljevak
   c forging  ☐ otkivak
   d manufacturing process planning  ☐ razrada tehnološkog procesa
   e semi-finished product of U-, T-, C- L-profiles  ☐ profilni pulproizvod materijala
   f sheet metal  ☐ lim
   g standard  ☐ normativ materijala
   h welding  ☐ zavarivanje

2 Read the text to complete the sentences.

The fundamental idea of manufacturing or production is to create, (or produce), something that has a useful form. This form is most likely predetermined and calculated, with a certain physical geometry. Usually this geometry has certain tolerances that it must meet in order to be considered acceptable. A tolerance outlines the geometric accuracy that must be achieved in the manufacturing process. The “tightness” of the tolerances, or in other words, the allowed variance between the manufactured product and the ideal product, is a function of the particular application of the product.

   a In manufacturing process, the geometry and the form of the product is predetermined and ____________________________.

   b Physical geometry of the acceptable manufactured product must fall within certain ____________________________.

   c A tolerance in manufacturing process outlines to what level the geometric accuracy must be ____________________________.

   d The allowed variance between the manufactured product and the ideal product is in other words the “tightness” of the ____________________________.

   e The “tightness” of the tolerances by manufacturing the product depends on its particular ____________________________.

3 Match the names of the manufacturing process to their descriptions. Use a dictionary if necessary.

   a Material removal.  ☐ Rolling, casting, forging, extrusion.
   b Primary forming processes.  ☐ Welding, soldering and brazing.
   c Joining.  ☐ Grinding, surface finishing, polishing.
   d Finishing.  ☐ Cutting, drilling, shearing material.
4 Match the manufacturing processes to the pictures.

welding / bending / grinding / machine cutting

- a 
- b 
- c 
- d

5 Complete the sentences with the words from Task 4. Which form of the verb is used to describe the various processes?

a By ________________________________, the workpiece is held ________________________________ and is traversed to wheel.

b By ________________________________, a ________________________________ rod and tungsten ________________________________ are used and molten metal is produced.

c ________________________________ splits a ________________________________ from the workpiece.

d By ________________________________, the workpiece is inserted between the ________________________________ and the ________________________________ rolls.

6 Put the sentences in the right order.

☐ All such operations involve a tool being in contact with the workpiece.

☐ The pieces of unwanted material are being known as chips.

☐ Some of the most common ways of cutting metals involve machine tools, the operations being known as machining.

☐ The machining results in the removal of unwanted metal from the workpiece.
Manufacturing process documentation

1 Translate into Croatian.
   a manufacturing documentation
   b manufacturing process plan
   c technical drawing
   d operation sheet
   e works order

2 Complete the text.
   amount / charts / raw material / operations / tooling / operation sheet

   **Operation sheet**
   The purpose of an operation sheet is to set out the most economical sequence of operations required to produce a finished object or process from the _________. Operation sheets also serve a number of other very important functions:
   - they determine the size and _________ of material required. From this information, the material can be ordered in advance and appropriate material stock levels can be maintained;
   - any _________ such as jigs, fixtures and gauges can be ordered or manufactured in advance so that they will be available when required;
   - knowing the machines or plant which are to be used enables machine-loading _________ to be updated so that delivery dates to customers will be realistic;
   - the sequence of _________ listed will enable work to be progressed through the factory in an efficient manner;
   - the inclusion of estimated times for manufacture on the _________ enables a cost of manufacture and hence selling price to be established.

3 Complete the text.
   influence / description / pictorial / machined / standard / forging
   A technical drawing is a _________ representation of a part with dimensions and other data added. Together with various specifications, the drawing sets out a detailed _________ of the part that is to be made. The arrangement of dimensions shown on the drawing determines the shape and will have an _________ on how the part is made. The part may be produced from a casting or _________, or it may be a fabricated or welded structure or _________ from solid material. The material specification will include the type of material required together with any _________ parts such as nuts, bolts, washers, etc.
4 Complete the definition using the passive form of the verb in brackets.

A **manufacturing process plan** describes what ____________ (manufacture, present continuous), how it ____________ (manufacture, will future), what resources it ____________ (require, will future) and where it ____________ (produce, will future).

5 Fill in a typical **works order form** below with the appropriate descriptions (a - q).

- a Specifies the type of material to be used.
- b Specifies any special jigs, fixtures, tools and cutters that will be needed.
- c Identifies the personnel employed in the manufacture.
- d Includes any special variations required by a particular customer.
- e Specifies any heat-treatment and finishing process that may be required.
- f Specifies issue date for the order.
- g Provides the signature that gives the managerial authority for the work to be done.
- h Provides room for the actual dates to be inserted when the job was commenced, and when it finished.
- i Specifies the date by which the product is required.
- j Identifies the component to be made.
- k States the quantity of the product to be made.
- l Identifies the drawings to be used.
- m Specifies the personnel employed in the inspection of the product.
- n Specifies the destination of the product (stores, inspection department, etc.).
- o Specifies the quantity of material to be used.
- p Specifies the size of material to be used.
- q Specifies the result of the inspection report.

**Varazdin Engineering Co. Ltd**

<table>
<thead>
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<th>Date required</th>
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<tbody>
<tr>
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<td>Type</td>
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<tr>
<td>Tooling</td>
<td></td>
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<tr>
<td>Finish/Colour</td>
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<tr>
<td>Date commenced and Date finished</td>
<td>Operator</td>
</tr>
<tr>
<td>Inspection report</td>
<td>Inspector</td>
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<td>Special requirements</td>
<td></td>
</tr>
<tr>
<td>Destination</td>
<td>Authorised by</td>
</tr>
</tbody>
</table>

**KEY WORDS**
manufacturing documentation • manufacturing process plan • operation sheet
1 Translate the English terms into Croatian and read the definitions.

a Manufacturing lead-time
The amount of time each unit spends in the manufacturing process (sometimes called Throughput Time). This includes time spent actively being worked upon at each step of the process as well as any time spent waiting between steps. The concept of a lead-time applies to the total time spent in any process in which the start and finish are well-defined events.

b Cycle time
The average time between the completions of successive units. It is directly related to the output rate. A process with an output rate of 4 units per hour has a cycle time of 15 minutes.

c Pre-processing time
The time required to create a work order (discrete job) from the time you learn of the requirement. It is also known as “planning time” or simply “paperwork”.

d Variable time
The portion of processing time that is dependent on order quantity or some other factor.

2 Complete the text.

point / beginning / work item / finish / metrics

Lead-time and cycle time are two useful _____________________________ for understanding how long work takes to flow through your manufacturing workshop. Manufacturing lead-time, or the total time from the _____________________________ to the end of your process, is measured by tracking the start and _____________________________ times of a work item. Process designer may define “start time” as when a _____________________________ enters the workshop. Cycle time is how long it takes a process part to get from _____________________________ A to point B.
3 Make complex sentences using linking words in colour.

a Depending on
You choose to measure the economic value. / Both cycle time and lead-time can be applied directly to your process.

b If
You want to improve the delivery capabilities of your workshop team. / Your lead-time measurement can track the time it takes a work item to go from the commitment point to finishing.

c If ... then
You want to improve the performance of a section of your process — such as machining. / Measuring machining cycle time gives you more specific insight into the flow of work through that portion of your system.

d So
The flexibility between lead-time and cycle time allows you to improve specific components of your process. / You can better affect overall efficiency.

4 Read the text to complete the sentences with the words in colour.

Cycle time is a measure of the time required for a material, part or sub-assembly to pass through a manufacturing process following the release of an order to the manufacturing floor. Manufacturing cycle time consists of process time, inspection time, move time and queue time.

a ______________ is the period of time during which the product awaits transfer to a workstation, undergoes further inspection and subsequent manufacturing processes.

b ______________ is the time during which the quality of the product is confirmed.

c ______________ is the time during which work is performed on the product itself.

d ______________ is the time during which materials or works-in-process are moved from one workstation to another.
Tools and devices

1 Translate into Croatian.
   a tools
   b devices
   c hand tools
   d cutting tools
   e measuring tools
   f casting tools
   g pressing tools
   h forging tools

2 Read the text to answer the questions below.

One thing that distinguishes humans from animals is the **ingenuity** to devise tools and use them to achieve a **purpose**. The component parts of large machines that can be seen in manufacturing plants are made by other machines and these in turn are made by others. They are all ‘tools’, and one tool is necessary to make another; in other words, all tools are themselves **manufactured products**. Indeed, most products that are manufactured have evolved from what has gone before, and all stem from the natural materials and **resources** on the Earth. The challenge to the engineer’s ingenuity is to use these resources to the advantage of society. This can be done by understanding the **properties** of the natural materials and those materials that can be produced from them, such as ceramics, metals and plastics, before converting these into useful **artefacts**. Doing this efficiently and economically, with minimum waste of energy and materials is what manufacturing is all about.

a Who on the Earth has the ingenuity to devise tools and use them to achieve a purpose?
b How are the tools which are used to make parts of large machines in a manufacturing plant made?
c What do most of the manufactured products stem from?
d What should one understand before converting the natural materials and those materials that can be produced from them, such as ceramics, metals and plastic, into useful artefacts?
e In what way should those properties of materials be understood in manufacturing?

3 Complete the text.

```
extensively / operations / production / cutting machines / method
The most common cutting ______________ are carried out on electrically-driven machine tools. Hand tools, which include electric drills, orbital sanders and the like, are also used ______________. But hand tools, because of the limited number of items that can be produced economically, are not a viable manufacturing method for mass ______________. In industry, cutting was traditionally performed on large machines with a whole host of specialist names such as lathes, mills, shapers, and many others. Each type of machine was capable of one particular ______________ of cutting. Somewhat confusingly, these ______________ are collectively known as machine tools and the processes are known as machining.
```
4 Match the words in colour in Task 2 to their definitions.
   a ______________________ why you do something or why something exists
   b ______________________ someone’s ability to think of clever new ways of doing something
   c ______________________ an object that is made by a person, such as a tool or a decoration
   d ______________________ something that is made to be sold, usually something that is made by an industrial process
   e ______________________ a useful or valuable possession or quality of a country, organization, or person
   f ______________________ a quality in a substance or material, especially one that means that it can be used in a particular way

5 Match the English to the Croatian words.
   a drill ○ blanjalica
   b sander ○ bušilica
   c lathe ○ alatni strojevi
   d mill ○ brusilica
   e shaper ○ gnodalo
   f machine tools ○ tokarilica

6 Read the definitions.

Jigs and fixtures are production devices used to accurately manufacture duplicate and interchangeable parts.

a Jig is a work holding device that holds, supports, and locates the workpiece, as well as guiding the cutting tool for a specific operation. A jig is a type of device used to control the location and/or motion of another tool.

b Fixture is a work holding device that holds, supports, and locates the workpiece for a specific operation but does not guide the cutting tool. It provides only a reference surface or a device. What makes a fixture unique is that each one is built to fit a particular part or shape.
7 Match the tools to the photos.

a drill  b sander  c lathe  d mill  e shaper

8 Match the English to the Croatian words.

kokila / ukovanj / glodalo / tokarski nož / svrdlo

a lathe tool
b mill
c drill
d die
e mould

9 Complete the definitions.

lathe tool / mill / drill / die / mould

a ___________________ A device for cutting or moulding metal into a particular shape.
b ___________________ A hollow container used to give shape to molten or hot liquid material when it cools and hardens.
c ___________________ Any of various machines that modify the shape or size of a workpiece by rotating tools or the work.
d ___________________ A shaft-like tool with two or more cutting edges for making holes in firm materials, especially by rotation.
e ___________________ A machine used for working with wood, metal, etc. It holds the material and rotates it about a horizontal axis against a tool that shapes it.
10 Match the tools to the photos.

   a lathe tool    b mill    c drill    d die    e mould

11 Complete the text.

metal / cold / deformation / temperature / working

Manipulative processes involve the shaping of a material by means of plastic ____________ processes. Where the deformation takes place at a temperature in excess of the recrystallization temperature of the ____________ the process is said to be hot working. Where the deformation is at a ____________ below the recrystallization temperature the process is said to be cold working.

The main hot ____________ processes are rolling, forging, and extruding. The main ____________ working processes are: cold rolling, wire drawing, bending, deep drawing, impact extrusion, etc.

12 Match the words in colour in Task 11 to their Croatian translations.

   a kovanje
   b ekstruzija (ispresavanje)
   c hladno valjanje
   d izvlačenje žice
   e valjanje
   f duboko vučenje
   g tlačno isprešavanje
   h savijanje
13 Read the characteristics of the cold working processes. As compared to the hot working processes, write if the characteristic is an advantage (A) or a disadvantage (D).

a The metal used must be clean and scale-free. 

b There is better dimensional control. 

c Better surface finish is produced. 

d More energy is needed for plastic deformation. 

e Work hardening occurs. 

f Improved strength. 

g No heating is required. 

h Higher forces are needed for plastic deformation. 

i The resulting material has less ductility and toughness. 

j Better reproducibility. 

k Contamination is minimized. 

14 Read the text to answer the questions below.

Where casting is used to produce an almost finished-state product, a mould is used because it has the internal shape and form such as the one required of the product. However, the mould has to be designed in such a way that the liquid metal can flow to all parts easily and quickly. What also needs to be taken into account is the fact that the dimensions of the finished casting will be smaller than those of the mould due to shrinkage which occurs when metal cools from liquid state to room temperature.

a What internal shape and form does a mould have? 

b How should the mould be designed? 

c What are the dimensions of the finished casting compared to that of the mould?
Measurement tools

1 Answer the questions. Discuss in class.
   a What do you normally measure in your profession?
   b How do you do the measurements?
   c What measurement tools can you think of, both in English and Croatian?
   d Explain in your own words what measurement is.

2 Put the sentence in the right order to get the definition of measurement.
   ○ which can be compared with other objects or events
   ○ to a characteristic of an object or event
   ○ measurement is the assignment of a number

3 Read the text on the history of measurement. Match the paragraphs to the right countries.
   The USA / France / The UK and the USA / Egypt / England

   a One of the earliest types of measurement was that of length. These measurements were usually based on parts of the body. A well documented first example was the Egyptian cubit, which was derived from the length of the arm from the elbow to the outstretched finger tips. By 2500 BC this had been standardized in a royal master cubit made of black marble (about 52 cm). This cubit was divided into 28 digits (roughly the width of a finger) which could be further divided into fractional parts, the smallest of these being only just over a millimetre.

   b In England the units of measurement were not properly standardized until the 13th century, though variations (and abuses) continued until long after that. For example, there had been three different gallons (ale, wine and corn) up until 1824 when the gallon was standardized.

   c In the USA the first adopted system of weights and measures was that of the English, though a few differences appeared when the decisions were made at the time of standardization in 1836. For instance, the wine-gallon of 231 cubic inches was used instead of the English one (as defined in 1824) of about 277 cubic inches. The USA also took as their standard of dry measure the old Winchester bushel of 2150.42 cubic inches, which gave a dry gallon of nearly 269 cubic inches.

   d Even as late as the middle of the 20th century there were some differences in the UK and the US measures which were nominally the same. The UK inch measured 2.53998 cm, while the US inch was 2.540005 cm. Both were standardized at 2.54 cm in July 1959, although the USA continued to use ‘their’ value for several years in land surveying work, but today this is slowly being metricated.

   e In France the metric system officially started in June 1799 with the declared intent of being ‘For all people, for all time’. The unit of length was the metre, which was defined as being one ten-millionth part of a quarter of the Earth’s circumference. The production of this standard required a very careful survey to be done which took several years. However, as more accurate instruments became available, the ‘exactness’ of the standard was called into question. Later efforts were directed at finding some absolute standard based on an observable physical phenomenon. Over two centuries this developed into the SI. So maybe their original slogan was more correct than anyone could have foreseen then.
4 Use the prompts to make questions about the text in Task 3. Then answer the questions.
   a What / the earliest types of measurement concern

   b When / the units of measurement properly standardised in England?

   c Be / the UK inch and the US inch always the same?

   d When / the metric system in France officially start?

5 Use the prompts and cues to retell the history of measurement.

   • Egypt / ength / cubit
   • England / 13c. / gallon / 19c.
   • the USA / English / differences / gallon / cubic inches
   • the USA / the UK / inches / survey
   • France / metre / survey / years

6 Complete the table.

<table>
<thead>
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<th>NOUN</th>
<th>VERB</th>
<th>ADJECTIVE</th>
<th>ADVERB</th>
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<td>thickness</td>
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</table>
Basic pneumatics
Regulating and executing elements of pneumatic systems

1. Read the text below. What are the modern applications of pneumatics in industry or everyday life? Discuss in class.

The word pneumatics comes from the Greek word “pneumatikos” which means wind or breath. Pneumatics was discovered in the 17th century by the German physicist and engineer Otto. A pneumatic system is a system that uses compressed gas (air) to transmit and control energy. Today, pneumatic systems are widely used in our society, especially in the industry for driving automatic machines. They are used in controlling train doors, automatic production lines, mechanical clamps, etc.

2. Match the English to the Croatian words and phrases.

a fluid
b compressor
c directional valve
d execution component
e pneumatic circuit
f air conditioner
g pneumatic motor

☐ pneumatski sklop
☐ pneumatski motor
☐ fluid
☐ kompresor
☐ upravljački ventil
☐ izvršni element
☐ jedinica za pripremu zraka

3. Complete the text.

Fluid power is a term describing hydraulics and pneumatics technologies. Both ____________ use a fluid (liquid or gas) to transmit ______________ from one location to another. With hydraulics, the fluid is a _______________ (usually oil), whereas pneumatics uses a _______________ (usually compressed air). Both are forms of power ________________, which is the technology of converting power to a more useable form and distributing it to where it is needed.
4 Make complex sentences. Use the conjunctions below.

Whereas / But on the other hand / As opposed to / In contrast to / Then ... which

a. Pneumatic systems easily produce linear motion using pneumatic cylinders. / Electrical and mechanical methods must usually use a mechanical device to convert rotational motion to linear.

b. If overloaded, pneumatic motors will simply stall and not use any power. / Electric motors can overheat and burn out if overloaded.

c. Torque, force, and speed control with pneumatics often require simple pressure- or flow-control valves. / Electrical drive controls are more expensive and complex.

d. Pneumatic actuators can instantly reverse direction. / Electromechanical components often rotate with high momentum, which can delay changes in direction.

e. Pneumatic components can be made of thinner and lighter weight materials. / Hydraulic components are generally made of steel and ductile or cast iron.

5 Read the characteristics of the pneumatic system. Compared to other energy transmission systems, mark the advantages (A) and disadvantages (D) of the pneumatic system.

a. As air can easily be compressed, the moving speeds of the pistons are relatively uneven. ☐
b. The designs of pneumatic components are relatively simple. ☐
c. As the volume of air may change when compressed or heated, inaccurate supply of air to the pneumatic system may cause a decrease in overall accuracy. ☐
d. There is unlimited supply of air in our atmosphere to produce compressed air for the pneumatic system. ☐
e. Noise is produced when compressed air is released from the pneumatic components. ☐
f. Pneumatic components are extremely durable and cannot be damaged easily. ☐
g. As the cylinders of pneumatic components are not large, the pneumatic system cannot drive loads that are too heavy. ☐
6 Complete the text.

    execution components / control valves / compressor / pressure regulator / air lubricator / filter / air conditioner

A __________ is a machine that compresses air or other types of gas from a low inlet pressure (usually atmospheric) to a higher desired pressure level. This is accomplished by reducing the volume of the gas.

__________ consists from following components:

1 ___________ removes impurities from compressed air before it is fed to the pneumatic components.

2 The ____________ is used to adjust the desired pressure for the pneumatic system.

3 ___________ ensures proper lubrication of internal moving parts of pneumatic components.

Pneumatic ______________ provide rectilinear or rotary movement. Examples of execution components include cylinder pistons and the pneumatic motor. Directional ____________ ensure the flow of air between air ports by opening, closing, and switching their internal connections.

7 Do the quiz.

1 The __________ in temperature and humidity can impact negatively on the pneumatic system.
   a variable
   b variety
   c variations
   d invariable

2 Changes in the pneumatic system are designed for a __________ of reasons.
   a various
   b variety
   c vary
   d variable

3 However, there are __________ safety measures for operating the pneumatic system.
   a various
   b variety
   c variation
   d vary

4 However, results may __________, so the design of the pneumatic system is very important.
   a vary
   b variety
   c variation
   d variable
8 Complete the text with one word only. Then match the verbs to the prepositions. What phenomenon does the text describe?

The great advantage of pneumatics is that it allows using __________ for picking up and moving objects. __________ can be thought of as negative pressure. __________ is achieved by removing air (evacuating) from the volume between two parts, atmospheric pressure outside the volume pushes the parts together. For example, attempting to pick up a single sheet of paper or a raw egg presents a challenge with conventional grippers. But with a __________, evacuating a suction cup in contact with a sheet of paper or eggshell will cause atmospheric pressure to push the paper or egg against the cup, allowing it to be lifted.

a pick  ○ by
b think  ○ against
c remove ○ up
d achieve ○ of
e push   ○ from

KEY WORDS
pneumatic system • executing elements of pneumatic system • pneumatic motor • regulating elements of pneumatic system
Power transmission on road vehicles: clutch, gear, and differentials

1. Match the Croatian to the English words and phrases.
   a. kardansko vratilo  ☐ transmission
   b. mjenjač  ☐ clutch
   c. zamašnjak  ☐ Cardan shaft
   d. pogonski sklop  ☐ driveline
   e. prijenos snage  ☐ axle shaft
   f. potisna ploča  ☐ differential
   g. spojka  ☐ gear
   h. poluosovina  ☐ flywheel
   i. diferencijal  ☐ pressure plate

2. Label the parts of the transmission system.
3 Complete the text.

power / torque / vehicle / engine / transmission

The most powerful engine in the world is of little use unless the ________________ from the engine can be safely and effectively transmitted to the ground. This, then, is the primary function of the transmission and driveline. In addition to being able to transmit the ________________ and power from the engine, the transmission and driveline must also allow the vehicle to operate over a wide range of speeds – from a standstill to the maximum speed of the ________________. This implies that the system must inherently have some method of disconnecting the ________________ from the remainder of the driveline to allow the vehicle to remain stationary. Furthermore, the ________________ must also be designed to satisfy the conflicting requirements of quick acceleration, high speed, and adequate fuel economy.

4 Match the words to the definitions.

power / torque / vehicle / engine / transmission

a ________________ A force that causes something to rotate.
b ________________ The machinery that brings the power produced by the engine to the wheels of a vehicle.
c ________________ The rate at which energy is used.
d ________________ A machine that uses the energy from liquid fuel or steam to produce movement.
e ________________ A machine, usually with wheels and an engine, used for transporting people or goods on land.

5 Read the text on clutches. Explain the words in colour.

Clutches are designed to engage and disengage the transmission system from the engine when a vehicle is being driven away from a standstill and when the gearbox gear changes are necessary. The gradual increase in the transfer of engine torque to the transmission must be smooth. Once the vehicle is in motion, separation and take-up of the drive for gear selection must be carried out rapidly without any fierceness, snatch or shock.

6 Match the Croatian to the English words and phrases.

a disengage ☐ zakretni moment
b standstill ☐ mirovanje
c gearbox ☐ kutija mjenjača
d torque ☐ trzaj
e separation ☐ odvajanje
f take-up ☐ razdvojiti
g fierceness ☐ prihvat
h snatch ☐ naglost
7 Match the questions to the answers.

- Which characteristic should the transfer of torque have?
- When is the clutch used?
- How should separation and take-up of the drive for gear selection be carried out?
- What is the function of clutches?

a ______________________________
Clutches are designed to engage and disengage the transmission system from the engine.

b ______________________________
The increase in the transfer of engine torque to the transmission must be smooth.

c ______________________________
When a vehicle is being driven away from a standstill.

d ______________________________
It must be carried out rapidly without any fierceness, snatch or shock.

8 Read the text on the differential to answer the questions.

The differential has three functions:
1 to aim the engine power at the wheels,
2 to act as a final gear reduction in the vehicle, slowing the rotational speed of the transmission one final time before it hits the wheels,
3 to transmit the power to the wheels while allowing them to rotate at different speeds.

1 What does the differential transfer to the wheels?
   a The engine power.
   b The exhaust gases.
   c The coolant fluid.

2 What does the differential do to the rotational speed of the transmission?
   a It speeds the rotational speed up.
   b It slows the rotational speed down.
   c It keeps the rotational speed constant.

3 Which part of the transmission system allows the wheels to rotate at different speeds?
   a The gearbox.
   b The differential.
   c The clutch.
Power transmission in railway vehicles

1. Match the power transition terms to their Croatian translations.

   a. hydraulic transmission
   b. mechanical transmission
   c. electrical transmission
   d. transmission oil
   e. Cardan shaft
   f. change speed gear
   g. torque converter
   h. driveline
   i. coupler
   j. traction inverter
   k. friction coupling
   l. hydrodynamic gear
   m. torque
   n. diesel-electric drive

   hidraulični prijenos snage
   diesel-električni pogon
   ulje prijenosnika snage
   mjenjač
   zakretni pretvarač
   električni prijenos snage
   tarna spojka
   hidrodinamički mjenjač
   kardansko vratilo
   pogonski sklop
   mehanički prijenos snage
   spojka
   okretni moment
   pretvarač vuče

2. Read the text. Then translate the words in colour into Croatian.

Electric transmission converts the mechanical power of the engine(s) to electricity with electric generators and converts it back to mechanical power with electric motors. Electrical or electronic adjustable-speed drive control systems are used to control the speed and torque of the motors. If the generators are driven by turbines, such arrangements are called turbo-electric transmission. Likewise, installations powered by diesel-engines are called diesel-electric transmission. Diesel-electric arrangements are used on many railway locomotives, ships, large mining trucks, and some bulldozers. In these cases, each driven wheel is equipped with its own electric motor, which can be fed with varying electrical power to provide any required torque or power output for each wheel independently.

   a. _____________________________
   b. _____________________________
   c. _____________________________
   d. _____________________________
   e. _____________________________
   f. _____________________________
   g. _____________________________
   h. _____________________________
   i. _____________________________

3 Answer the questions on the text in Task 2.
   a How do we call the type of power transmission which converts the mechanical power of the engine(s) to electricity and converts it back to mechanical power?
   b How do we call a specific type of electric power transmission in which the generators are driven by diesel-engines?
   c In the cases of diesel-electric arrangements, how is each driven wheel equipped?

4 Complete the text on Voith GmbH, a global producer of power transmission systems.

   components / rail vehicles / gear units / driveline / locomotives

   Drive Systems for Rail Applications
   Urban railways or trams, metros, regional railcars, ____________ or high-speed trains and special rail vehicles: Voith offers drive components and systems solutions for all ____________.
   The Voith portfolio covers all ____________ of the drivelines: from a wide range of transmissions, diesel engines, Cardan shafts, and couplers to complete wheel sets, traction inverters, cooling systems, waste heat recovery systems, ____________, and energy absorption elements. No other supplier has such comprehensive overall competence in the ____________.
   Decades of experience and meticulous research make Voith an expert partner for individual requirements.

5 According to Task 4, are the statements below true (T) or false (F)? Correct the false ones.
   a Voith offers drive components and system solutions for all rail and road vehicles. T / F
   b Voith’s product portfolio offers a wide range of transmissions. T / F
   c There are plenty of global suppliers with comprehensive overall competence in rail driveline. T / F
   d Voith is an expert provider of rail vehicles because of the research that they have performed for many years. T / F

6 Match the questions to the answers.
   a How are optimum strength and wear characteristics of components ensured?
   b How do various transmission types differ?
   c What are the production capacities for gear units of your factory?
   d How are rail gear units optimized?
   e What are the advantages of fluid coupling?

   1 _______________________________________________________________________
   They differ by type, number, and arrangements of gears, motor position, as well as by coupling design.

   2 _______________________________________________________________________
   They are weight- and noise-optimized and allow speeds of over 400 km/h.

   3 _______________________________________________________________________
   Many of the components undergo special surface and hardness treatments.

   4 _______________________________________________________________________
   Worldwide, our factory has assembly capacities of over 10,000 gear units per year.

   5 _______________________________________________________________________
   The hydrodynamic mechanism of fluid coupling protects the drive system from damage even under extreme operating conditions.
Match the names of rail vehicles in Task 4 to the photos.

**KEY WORDS**
hydraulic transmission • mechanical transmission • electrical transmission
Otto engine: gasoline engine, petrol engine, spark-ignition engine

1 Answer the questions.
   a Does your family have a car? What type of engine powers it?
   b Do you know where the Otto engine is used? Is it very common?
   c What are the parts of the Otto engine?
   d How does the Otto engine work?

2 Match the types of engines to their definitions.
   a Otto (gasoline, petrol) engine ☐ An internal-combustion engine that generates power by burning fuel with ignition initiated by an electric spark.
   b Two-stroke engine ☐ The simplest Otto engine, used in mopeds, outboard engines, chainsaws, and even some small automobiles.
   c Four-stroke engine ☐ The piston moves in four strokes here. The widest use is in automobile industry.
   d Wankel rotary engine ☐ Operates similar to the four-stroke engine, but instead of pistons that move up and down in cylinders, the Wankel engine has an equilateral triangular orbiting rotor.

3 Read the text to check your answers in Task 1.

Gasoline engine is the first four-stroke-cycle engine, built by the 19th century German engineer Nikolaus Otto. It is an internal-combustion engine that generates power by burning a volatile liquid fuel (gasoline or a gasoline mixture such as ethanol) with ignition initiated by an electric spark. Gasoline engines can be built to meet the requirements of practically any conceivable power-plant application, the most important being passenger automobiles, small trucks and buses, general aviation aircraft, outboard and small inboard marine units, moderate-sized stationary pumping, lighting plants, machine tools, and power tools.

Four-stroke cycle
With the inlet valve open, the piston first descends on the intake stroke. An ignitable mixture of gasoline vapour and air is drawn into the cylinder by the partial vacuum thus created. The mixture is compressed as the piston ascends on the compression stroke with both valves closed. As the end of the stroke is approached, an electric spark ignites the charge. The power stroke follows, with both valves still closed and the gas pressure, due to the expansion of the burned gas, pressing on the piston head or crown. During the exhaust stroke, the ascending piston forces the spent products of combustion through the open exhaust valve. The cycle then repeats itself. Each cycle thus requires four strokes of the piston—intake, compression, power, and exhaust—and two revolutions of the crankshaft.
Two-stroke cycle
In the original two-stroke cycle (as developed in 1878), the compression and power stroke of the four-stroke cycle are carried out without the inlet and exhaust strokes, thus requiring only one revolution of the crankshaft to complete the cycle.
4 Answer the questions.
   a What are the parts of the Otto engine? Try to draw it from memory and name the parts of the engine structure.
   b How does the Otto engine work? Describe and compare four-stroke and two-stroke cycles.

5 What is a rotary engine? What does it look like? Read the text.

**Wankel rotary engine**
The rotary-piston internal-combustion engine was developed in Germany by Felix Wankel. Instead of pistons that move up and down in cylinders, the Wankel engine has an equilateral triangular orbiting rotor. The rotor turns in a closed chamber, and the three apaxes of the rotor maintain a continuous sliding contact with the curved inner surface of the casing. The major advantages of the rotary engine are its small space requirements and low weight per horsepower, smooth and vibrationless operation, quiet operation, and low manufacturing costs resulting from mechanical simplicity. The induction of fresh fuel mixture and exhaust are more effective because the ports are opened and closed more rapidly. Heat transfer and the resulting cooling requirement are low because the jacketed surface is small. Lower weight and a lower centre of gravity make it much safer in an automobile in the event of a collision. However, competitive fuel economies and the higher development and manufacturing costs of meeting emission standards have limited the use of the Wankel engine in production vehicles, with only the Mazda Motor Corporation marketing any substantial number.

**How a Wankel rotary engine works**

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6 Discuss the advantages and disadvantages of a rotary engine in Task 5. How would you correct its disadvantages? Can you describe how a rotary engine works?
7 Answer the questions.
   a Who invented the Otto engine and when?
   b What other names are used to refer to the Otto engine?
   c What happens in the intake stroke? What comes next?
   d What are the parts of the Otto engine?
   e How does a rotary engine differ from the Otto engine?
   f Where are different types of engines typically used?

8 Match the words to get collocations.

   spark / water / stroke / rotary / intake / internal

   a _______________________________ plug
   b _______________________________ combustion
   c _______________________________ port
   d compression _______________________________
   e _______________________________ engine
   f _______________________________ inlet

9 Translate into Croatian.

   a four-stroke cycle _______________________________
   b internal-combustion engine _______________________________
   c intake _______________________________
   d spark ignition _______________________________
   e equilateral _______________________________
   f piston _______________________________

KEY WORDS
Otto (gasoline, petrol) engine • Two-stroke engine • Four-stroke engine • Wankel rotary engine
Diesel engine

1. Discuss the questions. Then read the text to check your answers.
   a. Why is this engine called ‘diesel’?
   b. How are diesel engines different from petrol engines? Which one is more efficient?
   c. Where are diesel engines used?
   d. Are there any similarities between them?

2. Match the terms to the definitions.
   a. Diesel engine
   b. Plunger-type (in-line) pump
   c. Rotary (distributor) pump

   Any internal-combustion engine in which air is compressed to a sufficiently high temperature to ignite diesel fuel injected into the cylinder. It converts the chemical energy stored in the fuel into mechanical energy.

   It delivers fuel under momentarily high pressure to the injection valve of each cylinder at the right time and has an installed camshaft.

   It uses a single injection cylinder driven from an axial cam plate, which injects into the individual fuel lines via a rotary distribution valve.

Diesel engine, any internal-combustion engine in which air is compressed to a sufficiently high temperature to ignite diesel fuel injected into the cylinder, where combustion and expansion actuate a piston. It was invented by Rudolf Diesel in the 1890s. It converts the chemical energy stored in the fuel into mechanical energy, which can be used to power freight trucks, large tractors, locomotives, and marine vessels. Unlike the spark-ignition gasoline engine, the diesel engine induces only air into the combustion chamber on its intake stroke.
3 What is the structure of a diesel engine? Read the text and copy the parts of the diesel engine in your notebook.

**Four strokes**
The diesel engine gains its energy by burning fuel injected or sprayed into the compressed, hot air charge within the cylinder. The air must be heated to a temperature greater than the temperature at which the injected fuel can ignite. Fuel sprayed into air that has a temperature higher than the “auto-ignition” temperature of the fuel. However, at engine start-up, supplemental heating of the cylinders is sometimes employed. Diesel engines are sometimes called compression-ignition engines because initiation of combustion relies on air heated by compression rather than on an electric spark.

Like a gasoline engine, a diesel engine usually operates by repeating a cycle of four stages or strokes.

1 Intake: Air is drawn into the cylinder through the open-air inlet valve on the right as the piston moves down.

2 Compression: The inlet valve closes, the piston moves up, and compresses the air mixture, heating it up. Fuel is injected into the hot gas through the central fuel injection valve and spontaneously ignites. Unlike with a gas engine, no sparking plug is needed to make this happen.

3 Power: As the air-fuel mixture ignites and burns, it pushes the piston down, driving the crankshaft that sends power to the wheels.

4 Exhaust: The outlet valve on the left opens to let out the exhaust gases, pushed out by the returning piston.

4 Look at the structure of a diesel engine in Task 3. Describe the four strokes and the movement of the piston.
5 Read the text to answer the questions.

The most outstanding feature of the diesel engine is its efficiency. By compressing air rather than using an air-fuel mixture, the diesel engine is not limited by the pre-ignition problems that plague high-compression spark-ignition engines. The principal drawback of diesel engines is their emission of air pollutants.

a What are the advantages and disadvantages of a diesel engine?
b How can we reduce the drawbacks of diesel engines?

6 How do you know what type of fuel to tank at the petrol station? What happens if you use the wrong fuel? How is fuel introduced into the cylinder? Read the text. What types of fuel injecting are mentioned?

Precise control of fuel injection is critical to the performance of a diesel engine. Since the entire combustion process is controlled by fuel injection, injection must begin at the correct piston position. There were a number of ways in which a pump could be used. In England, the Vickers Company used what was called the common-rail method, in which a battery of pumps maintained the fuel under pressure in a pipe running the length of the engine with leads to each cylinder. From this rail (or pipe) fuel-supply line, a series of injection valves admitted the fuel charge to each cylinder at the right point in its cycle. Another method employed cam-operated jerk, or plunger-type (in-line) pumps to deliver fuel under momentarily high pressure to the injection valve of each cylinder at the right time. Earlier diesel pumps had an installed camshaft and used an in-line layout with a series of cam-operated injection cylinders in a line, rather like a miniature inline engine. Inline pumps still find favour on large multi-cylinder engines such as those on trucks, construction plant, static engines and agricultural vehicles. For use on cars and light trucks, the rotary pump or distributor pump was developed. It uses a single injection cylinder driven from an axial cam plate, which injects into the individual fuel lines via a rotary distribution valve.
7 Translate into Croatian.

a engine
b design
c construct
d in-line (plunger) pump
e rotary (distributor) pump
f injection
g camshaft
h valve
i common-rail
j efficiency

8 Complete the table.

<table>
<thead>
<tr>
<th>NOUN</th>
<th>ADJECTIVE</th>
<th>VERB</th>
<th>CROATIAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>rotor</td>
<td>required</td>
<td></td>
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<tr>
<td>design</td>
<td>mainten</td>
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</tr>
<tr>
<td>exhaust</td>
<td>inject</td>
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</table>

9 Complete the text.

internal-combustion / ignite / cylinder / combustion / injected / auto-ignition / compressed / piston

Diesel engine, any i _______________ engine in which air is c _______________ to a sufficiently high temperature to ignite diesel fuel injected into the c _______________, where c _______________ and expansion actuate a p _______________. The diesel engine gains its energy by burning fuel i _______________ or sprayed into the compressed, hot air charge within the cylinder. The air must be heated to a temperature greater than the temperature at which the injected fuel can i _______________. Fuel sprayed into air that has a temperature higher than the “a _______________” temperature of the fuel.
Piston and cylinder (engine) block

1. Answer the questions.
   a. What does an engine look like?
   b. Write down as many parts of an engine as you can think of.

2. The piston and the cylinder are very important in the engine structure. Answer the questions below. Then read the text to check your answers.
   a. What does the piston do?
   b. How does the piston move?
   c. How many pistons are there in a typical car engine?
   d. What is the piston connected to?

   A piston is a cylindrical piece of metal that moves up and down inside the cylinder. Most cars have more than one cylinder (four, six and eight cylinders are common). Piston rings provide a sliding seal between the outer edge of the piston and the inner edge of the cylinder. The rings serve two purposes: they prevent the fuel/air mixture and exhaust in the combustion chamber from leaking into the sump during compression and combustion, and they keep oil in the sump from leaking into the combustion area, where it would be burned and lost. Most cars that “burn oil” and have to have a quart added every 1,000 miles are burning it because the engine is old and the rings no longer seal things properly. The connecting rod connects the piston to the crankshaft. It can rotate at both ends so that its angle can change as the piston moves and the crankshaft rotates. The crankshaft turns the piston’s up and down motion into circular motion just like a crank on a jack-in-the-box does.

3. Have you ever poured oil into a car engine or seen someone do it? Why do we need to use motor oil? Discuss in class.

4. Translate into Croatian.
   a. piston
   b. cylinder
   c. edge
   d. cylinder block
   e. construction
   f. sleeve
   g. cast iron
   h. crankshaft
   i. coolant
   j. motion
5 What is the largest engine part that carries cylinders and pistons called? What material is it made of? Match the engine parts to their descriptions.

a cylinder block
b cylinder block construction
c engine blocks & pistons
d cylinder sleeves
e grey iron

☐ Cylinder blocks made of aluminium are lighter than cast-iron blocks of the same size. They usually have cast-iron liners that provide a hard-wearing surface for pistons and piston rings.

☐ The cylinder block is the largest part of the engine. Its upper section carries the cylinders and pistons. Normally, the lower section forms the crankcase, and supports the crankshaft.

☐ It is a cast iron that contains carbon in the form of graphite, plus silicon, manganese and phosphorus.

☐ They are used in engine blocks to provide a hard-wearing material for pistons and piston rings. The block can be made of one kind of iron that is light and easy to cast, while the sleeve uses another kind that is better able to stand up to wear and tear. A flanged, dry sleeve has a flange to fit a recess in the block. A wet sleeve has an outer surface directly exposed to coolant.

☐ The major engine components include the cylinder block, cylinder head, pistons, connecting rods and crankshaft.

6 Match the words to get collocations.

inner / connecting / combustion / engine / piston

a ________ edge
b ________ rings
c ________ components
d ________ chamber
e ________ rod

7 Write and role-play a dialogue in which a student asks a car mechanic to explain how the piston operates in the engine block.
Systems in car

1. What are the components of modern vehicles? How do different parts of vehicles work together? Read the text to check your answers.

The modern vehicle is made up of a variety of parts and components all working together to achieve a final product: “The Car”. These parts and components are assembled in groups to perform various tasks. These groups are referred to as systems. There are many systems that make up the modern vehicle, some working with others to perform a larger, sometimes more complex, task and others working individually in order to accomplish an individual job.

2. What functions or groups of tasks must be served in order for a car to operate? Do you know any of the car systems? What do the car systems do? Look at the picture of car systems and discuss in class.
3 Match the car systems to the descriptions.

a the cooling system  
b the lubrication system  
c the valve train  
d the ignition system  
e the electrical system  
f the electrical system also includes  
g the exhaust system  
h the drive train  
i the suspension system  
j the steering system  
k the braking system  
l the fuel systems

☐ Moves the burnt exhaust fumes safely and quietly away from the passenger compartment.
☐ Allows the vehicle to be brought to a stop safely. The braking system includes both a mechanical and hydraulic system.
☐ Is designed to isolate most of the vehicle from any road shock and keep the vehicle stable when driving straight or turning.
☐ Provides the voltage necessary to operate the many electrical components on the vehicle such as the vehicle’s lighting system.
☐ Is intended to allow the operating to control the direction of the vehicle with the least amount of effort.
☐ Provides the spark necessary to ignite the air/fuel mixture inside the engine in order for it to burn.
☐ Job is to store and supply fuel to the engine.
☐ Ensures that all the moving parts are kept well-oiled in order to provide a long serviceable life.
☐ The starting system and the charging system.
☐ Transmits the power of the engine to the drive wheels.
☐ Maintains the engine at an ideal operating temperature.
☐ Lets air and fuel in and out of the engine at the proper time.
4 List at least three tips for maintaining your car. Discuss in class.

5 What language form have you used to give advice/tips? Do you use the subject before the verb?

The imperative is used to give advice (and to give commands, invite, give directions etc.).
Example: Change your oil regularly and use the recommended weight of oil.

Advice (imperative form) can also be given in the negative form.
Example: Do not miss to check under the hood for the correct oil to be used.

6 Look at the list of tips for maintaining your car. Tick the correct sentences. Correct the incorrect sentences.

a Do not give your engine a chance to warm up before driving if possible. ☐
b Avoid “snake oil” additives advertised on late night TV. ☐
c Do not give the engine a minute or two to cool down before turning it off if you have a turbo-charged engine. ☐
d Discuss the benefits of buying used versus new if you have to replace your engine. ☐
e Do not be as descriptive as possible when trying to diagnose engine noises. ☐
f Make sure your mechanic knows if you changed oil brands or weight recently. ☐

7 Read the dialogue between a client and a car mechanic. Put the dialogue into the correct order. Then role-play the dialogue.

☐ Customer: What are the basic auxiliary systems?
☐ Car mechanic: The most important one actually.
☐ Customer: What does the engine consist of?
☐ Car mechanic: The crankcase, piston and valve train, and other auxiliary systems.
☐ Customer: What are auxiliary systems?
☐ Car mechanic: It is ‘the heart of the vehicle’ because without it the vehicle would be ‘dead’.

1 Customer: Engine is a very important part of the vehicle.
☐ Car mechanic: Injection system, lubrication system, engine cooling system, exhaust system etc.
☐ Customer: What does the engine actually do?
☐ Car mechanic: These are the systems necessary for engine operation.
8 Translate into Croatian.

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<tbody>
<tr>
<td><strong>a</strong></td>
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<td><strong>b</strong></td>
<td>crankcase</td>
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<tr>
<td><strong>c</strong></td>
<td>valve train</td>
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<td><strong>d</strong></td>
<td>lubrication</td>
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<td><strong>e</strong></td>
<td>engine cooling</td>
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<td><strong>f</strong></td>
<td>exhaust system</td>
</tr>
<tr>
<td><strong>g</strong></td>
<td>steering</td>
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<tr>
<td><strong>h</strong></td>
<td>braking</td>
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</tbody>
</table>

**KEY WORDS**
crankcase • valve train • lubrication • cooling • exhaust system
Otto and Diesel engines

1. What type of engines are Otto and Diesel engines? What are their similarities and differences? Write down as many similarities and differences between Otto and Diesel engines and then discuss in class.

<table>
<thead>
<tr>
<th>SIMILARITIES</th>
<th>DIFFERENCES</th>
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2. Read the text to check your answers in Task 1.

Mechanically, there are no major differences between spark ignition (Otto) engine and compression ignition (Diesel) engines. They are both internal combustion engines. The fundamental differences between the two types of engines are derived from the differences in their cycles. The spark ignition engine (Otto cycle) requires an ignition system to generate in the combustion chamber a spark between the electrodes of a spark plug, in order that the combustion can be initiated. The compression ignition engine (diesel cycle) uses high temperature and pressure obtained by compressing the air in the cylinder to begin combustion when the fuel is injected.

In most spark ignition engines (Otto cycle), air and fuel are introduced into the combustion chamber in the form of gaseous mixture. The mixture is carried into the carburettor, and the regulation of the quantity of mixture introduced is obtained by means of a butterfly valve. In compression ignition engines (diesel cycle), air is introduced into the chamber through ducts and the fuel is introduced directly by means of an injector.

3. Answer the questions.
   a. Do you know any other names used to refer to Otto and Diesel engines?
   b. What are the main differences between the two engines derived from?
   c. Specifically, how is combustion initiated?

4. Explain the changes that happened in the examples in Task 4. Then read the explanation below to check your answer. Notice that the same sentence elements are marked in the same way.

**PASSIVE VOICE : PRESENT SIMPLE**

Present simple passive is frequently used in technical English to describe processes and how things work. It is formed from the present passive of the verb TO BE (am, is, are) and the past participle of the main verb. Study the examples below.

**ACTIVE:** In petrol engines, the falling piston draws in the mixture of air and petrol.

**PASSIVE:** In petrol engines, the mixture of air and petrol is drawn in by the falling piston.

The object of the active sentence becomes the subject of the passive sentence.

The subject of the active sentence is at the end of the passive sentence in the form of the ‘by phrase’.

The verb of the active sentence is changed according to the rule TO BE + PAST PARTICIPLE (draws → is drawn).
Look at the verbs in colour in Task 2. What form are they in? Choose two sentences and translate them. Is the subject in them an active doer of action?

Complete the text with the passive form of the verbs in the brackets.
In diesel engines only air ____________ (draw) in by the falling piston. In petrol engine, the air and fuel mixture ____________ (ignite) using a spark plug and burns expanding and forcing the piston down. In diesel engine, fuel ____________ (inject) at a high pressure into the hot, compressed air in the cylinder, causing it to burn and force the piston down. No spark ____________ (require).

Describe the four strokes (take in air, compress air, combust air, exhaust fumes) of a diesel engine. Write a passive sentence for each stroke.

1

2

3

4

Underline the adjectives used to describe the differences between Otto and Diesel engines in the sentences below. Do you know what form they are in?

a Petrol engine is lighter in construction because it requires lighter flywheel.

b The compression ignition engine (diesel cycle) is usually heavier than a spark ignition engine (Otto cycle) of the same capacity.

c Petrol engines need less maintenance and also are cheaper compared to diesels.

d Diesel engine has a higher compression ratio/it is more efficient, and the fuel is cheaper compared to petrol.

e Diesel engines last longer than petrol engines.

f The diesel engine would be steady and carry heavier loads to longer distances.

g Diesel engines have better fuel efficiency compared to petrol due to the fact that they have higher compression ratio.

h Diesel engines don’t need an ignition system, which reduces their complexity. However, they are noisier and may require frequent maintenance as compared to petrol engines. In addition, they are more durable.

i Diesel engines give better mileage than petrol engines. Diesel is much cheaper than petrol.
Some of the adjectives in Task 8 are in base form and some in comparative form. Complete the table with the adjectives used in Task 2. Do not repeat the same adjectives. How is the comparative form of adjectives formed?

<table>
<thead>
<tr>
<th>COMPARISON OF ADJECTIVES</th>
<th>BASE FORM</th>
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<td>ONE-SYLLABLE AND ADJECTIVES ENDING IN -Y</td>
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Basics of hydraulics

1. Take a look at the two pictures below. What do they have in common? Discuss in class.

2. Do you know how fluids behave? How do fluids differ when compared to solids and gases? Can you compress fluids? Do you know what the prefix hydra- means? Discuss in class.

3. Read the text.

What is the connection between a water pistol and a gigantic crane? On the face of it, there is no connection at all. However, think about the science behind them and you will reach a surprising conclusion: water pistols and cranes use the power of moving liquids in a very similar way. This technology is called hydraulics and it is used to power everything from car brakes and garbage trucks to motorboat steering and garage jacks. The basic idea behind any hydraulic system is very simple: force that is applied at one point is transmitted to another point using an incompressible fluid. The fluid is usually an oil of some sort. The force is usually multiplied in the process.

Gases are easy to squash: everyone knows how easy it is to squeeze a balloon. Solids are just the opposite. However, liquids are an in-between state, a bit like solids in some ways and a bit like gases in others. Now, since liquids easily flow from place to place, you might think they would behave like gases when you tried to squeeze them. In fact, liquids are virtually incompressible - much like solids.

The fact that liquids do not compress easily is incredibly useful. If you have ever fired a water pistol (or a squeeze washing-up liquid bottle filled with water), you have used this idea already. If water were not incompressible, water pistols would not work properly. You would squeeze the trigger and the water inside would simply squash up into a smaller space - it would not shoot out of the nozzle as you would expect. In fact, the science of water pistols powers some of the world's biggest machines - cranes, tipper trucks, and diggers.

A simple hydraulic system consists of two pistons and an oil-filled pipe connecting them. If you apply a downward force to one piston, then the force is transmitted to the second piston through the oil in the pipe. Since oil is incompressible, the efficiency is very good - almost all of the applied force appears at the second piston. In most other hydraulic systems, hydraulic cylinders and pistons are connected through valves to a pump supplying high-pressure oil.
4 Answer the questions.
   a What is the similarity between how a crane and a water pistol function?
   b How do fluids behave?
   c What does a simple hydraulic system consist of?
   d Where is the technology of hydraulics used?

5 Can you think of some other everyday things that function according to this principle? Discuss in class.

6 Translate into Croatian.
   a incompressible
   b fluid
   c gas
   d solid
   e apply
   f gigantic
   g multiply
   h crane
   i high-pressure
   j transmit
   k nozzle
   l scientific

7 Complete the text.

   trigger / compress / nozzle / smaller / incompressible / properly

   The fact that liquids do not ______________ easily is incredibly useful. If you have ever fired a water pistol (or a squeeze washing-up liquid bottle filled with water), you have used this idea already. If water were not ______________, water pistols would not work ______________. You would squeeze the ______________ and the water inside would simply squash up into a ______________ space—it would not shoot out of the ______________ as you would expect.
Unit 64

Operating components of hydraulic systems

1 Write down as many things as you can remember about hydraulic systems. Discuss with a partner and try to explain how a syringe functions. What scientific fact is applied to enable this device to function?

2 Read the text.

Why does water squirt so fast from a syringe? You can’t really compress a liquid at all, so if you force the water up through the wide part of the syringe by pushing hard on the plunger at the bottom, where is that water going to go? It has to escape through the top. Since the top is much narrower than the bottom, the water emerges in a high-speed jet. Hydraulics runs this process in reverse to produce lower speed but more force, which is used to power heavy-duty machines. It is the same in a water pistol, which is effectively just a syringe shaped like a gun.

3 Translate the words and phrases from Task 2 into Croatian.

a squirt
b syringe
c plunger
d high-speed jet
e heavy-duty machines
f effectively

4 What are the basic parts of a hydraulic system? Read the text to find out.

Virtually, all-hydraulic circuits are essentially the same regardless of the application. There are six basic components required for setting up a hydraulic system:

1 A reservoir or tank to hold the liquid (usually hydraulic oil);
2 A pump to force the liquid through the system;
3 An electric motor or an engine, normally a small four-stroke gasoline engine, provides the power for the system;
4 Valves to control the liquid direction, pressure and flow rate;
5 An actuator to convert the energy of the liquid into mechanical force or torque, to do useful work. Actuators can either be cylinders which provide linear motion or motors which provide rotary motion;
6 Piping to convey the liquid from one location to another.

The extent of sophistication and complexity of hydraulic systems vary depending on the specific application. Each unit is a complete packaged power system containing its own electric motor or engine, pump, shaft coupling, reservoir and miscellaneous piping, pressure gauges, valves and other components required for operation.
5 Match the words and phrases to their functions in the hydraulic system.

- **a** pump
  - control the liquid direction, pressure and flow rate
- **b** electric motor
  - converts the energy of the liquid into mechanical force or torque, to do useful work
- **c** valves
  - forces the liquid through the system
- **d** actuator
  - conveys the liquid from one location to another
- **e** piping
  - provides the power for the system

6 Complete the table.

<table>
<thead>
<tr>
<th>NOUN</th>
<th>ADJECTIVE</th>
<th>VERB</th>
<th>VERB CROATIAN TRANSLATION</th>
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</table>
Look at the picture of the essential components of a basic hydraulic system and describe what each element does. Discuss in class.
Hot-water and steam boilers

1. Look at the picture. What does it show? Why is it important in our everyday lives? Discuss in class.

2. Answer the questions.
   a. Could you imagine living without hot water? Where is it used in your household?
   b. Has the supply of hot water ever stopped while you were in the shower? What could be the reasons for this? What would you do in this situation? Who would you call for help?

3. Answer the questions. Discuss in class.
   a. In what way is your home heated?
   b. Are there different types of boilers?
   c. What type of a boiler do you have?
   d. Do you know what its parts are?
   e. How does it operate?
   f. How often do we need to service our boilers?

4. Read the text to check your answers.

The boiler is an enclosed vessel in which water is heated and circulated, either as hot water or as steam, for heating or power.

Hot-water boilers distribute heat through small hot water pipes using a pump to heat baseboard, cast iron radiators, or radiant flooring systems. A residential hot water boiler is used to heat water for a hydronic heating system. A hydronic heating system maintains comfort in your home with hot water circulating to every room. The system consists of a boiler, pump and baseboards connected by water piping. The boiler heats water to temperatures between 120° and 210°, and the water is then pumped through the piping in the baseboards located around the outer perimeter of the home for a curtain of warmth, or in the floor in radiant systems. Residential boilers can be used in space conditioning, radiant, or snow melting applications, or with an indirect fired water heater for an almost endless supply of domestic hot water.

Steam boilers distribute steam through a network of pipes to heat the radiators in the home. Boilers, also known as hydronic heat systems, can run on gas, oil, electricity or alternative fuels such as wood pellets. Steam boilers are designed for low-pressure or high-pressure applications. Most steam boiler systems require saturated steam, which means the water and the steam in the vessel are at the same temperature.

Steam and hot water boilers are defined according to design pressure and operating pressure. Design pressure is the maximum pressure used in the design of the boiler for the purpose of calculating the minimum permissible thickness or physical characteristics of the pressure vessel parts of the boiler.
5 Answer the questions.
   a How do hot water boilers distribute heat?
   b What applications are steam boilers developed for?
   c What are steam and hot water boilers defined according to?
   d Where can residential boilers be used?

6 Match the words to get collocations. Then write your own sentences using the collocations.
   a water  ☐ pressure
   b wood  ☐ pipes
   c operating  ☐ thickness
   d permissible  ☐ pellets

7 Use the words below in your own sentences.
   a vessel

   b application

   c hot water

   d steam

8 Match the words and phrases to their translations.
   a hot-water boiler  ☐ radijatori od lijevanog željeza
   b high-pressure steam boiler  ☐ pogonski (radni) tlak
   c operating pressure  ☐ toplovodni kotao
   d cast iron radiators  ☐ zatvorena posuda
   e enclosed vessel  ☐ visokotlačni parni kotao
Basic heating systems

1. Answer the questions. Discuss in class.

   a. Is the room you are currently in heated? Do you know in what way?
   b. How is your home heated? What common ways of home heating do you know?
   c. Write several advantages and disadvantages of a particular heating system. How are different ways of heating your home reflected on your heating bill?

2. Match the beginning to the ending of the sentences.

   a. Old, primitive methods of individually heating a building or a room within it include
   b. The principal central systems that are used to heat a building
   c. In district heating,

   ☐ are classified as warm air, hot water, steam, or electricity.
   ☐ heat is distributed from a heating plant to buildings in a section (usually commercial) of a city.
   ☐ the open fire, the fireplace, and the stove.

3. Translate into Croatian.

   a. power plant
   b. utilize
   c. radiant
   d. portables
   e. ceiling
   f. shutoff
   g. furnace
   h. sporadic
   i. heat exchanger
   j. emit
4 Read the descriptions and match them to the appropriate heating system.

**Individual room heating**

**Individual central heating**

**Collective central (district) heating**

---

**a**
A heating plant for this heating system is often a combined heat and power plant. By co-producing heat and power in the same process, the heat that would otherwise be wasted in electricity production is utilized. This leaves tremendous energy savings of up to 30%.

---

**b**
Radiant models—such as portables, under-floor systems, heaters and ceiling panels—emit infrared radiation that heats up objects and people directly. They are designed for ultra-quick heating and are best for heating one or two people and sporadic use.

---

**c**
When the thermostat calls for heat, an oil or gas burner is activated and begins to heat up the water in the boiler.

---

**d**
When you are shopping for a portable electric space heater, look for models that offer advanced safety features like child-resistant controls and an overheat shutoff. Also consider models with energy-efficient options.

---

**e**
In essence, any energy source can be used in this heating system. Renewables such as biomass, solar energy and waste are becoming increasingly applied in district heating utilities either completely or as a complement to traditional fossil fuels.

---

**f**
In the warm-air system, air, heated in a furnace, rises through warm-air ducts and enters the rooms through outlets, while cooler air in the rooms passes into return ducts that lead back to the furnace.

---

**g**
Through a heating network, the heat-producing plant pumps heated supply water to consumers where it is used as room-/floor-heating and to generate domestic hot water. The domestic hot water gets heated in a heat exchanger in which the heated supply water transfers its heat to the water coming out of the taps.

---

**h**
Electric space heaters break down into two basic types: radiant or convection (with or without a fan). Which heater is right for you depends on what you are trying to heat.

---

**i**
The hot-water system has a boiler for heating the water that is sent through connecting pipes to radiators and convectors, the latter devices being metal enclosures containing hot-water pipes surrounded by metal fins.
5 Match the words to get collocations. Then write your own sentences using the collocations.

a space  

b power  

c heating  

d connecting  

e metal  

f hot-water  

g warm-air  

☐ ducts  

☐ pipes  

☐ systems  

☐ heaters  

☐ enclosures  

☐ network  

☐ plant  

6 Which heating system do you find the most efficient and environmentally friendly? Why? Discuss in class.
Basics of air-conditioning and ventilating

1 What is the connection between the words below and air-conditioning and ventilating? Discuss in class.

<table>
<thead>
<tr>
<th>air</th>
<th>humidity</th>
<th>effluvias</th>
<th>soot</th>
<th>cooling</th>
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</thead>
<tbody>
<tr>
<td>heating</td>
<td>dehumidifying</td>
<td>cleaning</td>
<td>airflow</td>
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</table>

2 Translate into Croatian.

a air
b humidity
c effluvium (pl. effluvia)
d soot
e cooling
f heating
g dehumidifying
h cleaning
i airflow

3 Answer the questions.

a Do you have an air-conditioner at home? Does it improve your life quality? What does it do? What functions does it have?
b Discuss with your partner and make a list of all the functions that air-conditioning can perform.

4 Read the list of functions of air-conditioning below and compare them with your list in Task 3b.

Air-conditioning, as originally defined, encompasses the following functions:

- to maintain a suitable degree of humidity in all seasons and in all parts of a building
- to free the air from excessive humidity during certain seasons
- to supply a constant and adequate ventilation
- to efficiently wash and free the air from all micro-organisms, effluvias, dust, soot, and other foreign bodies
- to efficiently cool the air of the rooms during certain seasons
- to either heat the rooms in winter or to help heat them
- to combine all the above desiderata in an apparatus that will not be commercially prohibitive in first cost or cost of maintenance
5 **Match the air-conditioning processes to their definitions.**
   a heating                  d dehumidifying                  f ventilating
   b cooling                  e cleaning                      g effectiveness
   c humidifying

   - The removal of water vapour to maintain space or process moisture content.
   - The process of removing particulate and bio-contaminants from the conditioned space.
   - The addition of thermal energy to maintain space or process conditions in response to thermal heat loss.
   - The process of achieving the desired thermal energy transfer, humidity control, filtration, and delivery of ventilation air to the breathing zone of the occupied space in accordance with required needs.
   - The removal of thermal energy to maintain space or process conditions in response to thermal heat gain.
   - The addition of water vapour to maintain space or process moisture content.
   - The process of providing suitable quantities of fresh outside air for maintaining air quality and building pressurization.

6 **Answer the questions.**
   a When do you feel the need to open the window?
   b Is it necessary to open the window frequently? Why?
   c Is window opening a type of ventilating? Is it enough in a shopping centre for example or in a coffee bar in which smoking is allowed?
   d What other ways of ventilating do you know?

7 **Look at the pictures below. They represent two common ways of ventilating. Match the pictures to the descriptions.**

   a Natural forces (e.g. winds and thermal buoyancy force due to indoor and outdoor air density differences) drive outdoor air through purpose-built, building envelope openings. Purpose-built openings include windows, doors, solar chimneys, wind towers and trickle ventilators. This type of ventilation of buildings depends on climate, building design and human behaviour.

   b Mechanical fans drive mechanical ventilation. Fans can either be installed directly in windows or walls, or installed in air ducts for supplying air into, or exhausting air from, a room. The type of mechanical ventilation used depends on climate.
Hybrid ventilation is a combination of the two ways of ventilating mentioned in Task 7. Complete the text.

Hybrid ______________ ventilation uses mechanical ventilation when the ______________ ventilation flow rate is too low. When natural ventilation alone is not suitable, ______________ fans can be installed to increase ventilation rates in rooms housing patients with airborne infection. However, this simple type of hybrid (mixed-mode) ventilation needs to be used with care. The ______________ should be installed where room air can be exhausted directly to the ______________ environment through either a wall or the roof. Problems associated with the use of exhaust fans include installation ______________ (especially for large fans), noise (particularly from ______________ fans), increased or decreased ______________ in the room and the requirement for non-stop electricity ______________. If the environment in the room causes thermal ______________, cooling or ______________ systems and ceiling fans may be added.

KEY WORDS
air-conditioning + ventilation (mechanical and natural)
Business correspondence

1 What does correspondence mean? What type of communication does it include?

2 Answer the questions.
   a Do you communicate with people via letters? Do you send and/or receive letters? Why or why not?
   b Has the way in which we send/receive letters changed? How has it changes? Why has it changed?
   c Why would you send a letter? What are the reasons? What would you want to achieve by doing this?

3 Read the sample business letter below. Then answer the questions.
   a What does this letter consist of? What are the main parts of this letter?
   b Why was this letter sent?
   c Who is the sender? Who is the recipient?
   d How many paragraphs are there? How do they differ?
   e How does the letter end?

Taylor, Inc.
694 Rockstar Lane
Durham, NC 27708

6123 Farrington Road
Apt. G11
Chapel Hill, NC 27514
January 11, 2005

Dear Ms. Jones,
I am seeking a position in your engineering department where I may use my training in computer sciences to solve Taylor’s engineering problems. I would like to be part of the department that developed the Internet Selection System but am unsure whether you have a current opening. I expect to receive a Bachelor of Science degree in Engineering from North Carolina State University in June and by that time will have completed the Computer Systems Engineering Program. Since September 2000, I have been participating, through the University, in the Professional Training Program at Computer Systems International in Raleigh. In the program, I was assigned to several staff sections as an apprentice. Most recently, I have been a programmer trainee in the Engineering Department and have gained a great deal of experience in computer applications. Details of the academic courses I have taken are included in the enclosed résumé. If there is a position open at Taylor Inc., please let me know whom I should contact for further information. I may be reached at my office (919-866-4000 ext. 232) or via email (brock@aol.com).
I look forward to hearing from you soon.

Sincerely,
Rebecca Brock
4 Underline and label the parts of the business letter in Task 3.
   a Heading  
   b Date  
   c Inside Address  
   d Subject  
   e Salutation  
   f Body of the letter  
   g Complimentary close  
   h Signature  

5 Match the essential parts of a business letter to their descriptions.
   a Heading  
   b Date  
   c Inside Address  
   d Subject  
   e Salutation  
   f Body of the letter  
   g Complimentary close  
   h Signature  

☐ It is merely a polite way of ending a letter. It must be in accordance with the salutation. E.g. Yours faithfully, Yours sincerely.
☐ It is a statement that indicates what the letter is about.
☐ includes the name and full address of the person or the firm to whom the letter is to be sent. This is written on the left hand side of the sheet.
☐ It is written in ink, immediately below the complimentary close.
☐ This comes after salutation. This is the main part of the letter and it contains the actual message of the sender. It is divided into three parts: opening part (draws attention of the reader to the previous correspondence), main part (contains the subject matter of the letter), concluding part (contains a statement of the sender’s intentions, hopes or expectations concerning the next step to be taken; the sender should always look forward to getting a positive response; terms like Thanking you, With regards, With warm regards may be used in the end).
☐ normally written on the right hand side corner after the heading.
☐ This is placed below the inside address. It is usually followed by a comma (,). E. g. Dear Sir/Madam, Dear Ms Smith, Dear Mr Smith, Dear Mrs Smith.
☐ usually contains the name and postal address of the business, Email address, Web-site address, Telephone Number, Fax Number, Trade Mark or logo of the business.

6 Choose one option and write a business letter. Include all the necessary parts.
   a Describe your favourite tourist destination in Croatia and invite your colleague to come and visit it. Write a letter.
   b Find an advertisement for a job or summer/winter school and apply for it. Write a letter.
Basic business and financial documents

1 Brainstorm the word document. Look at the pictures of various types of reports. Discuss in class.

2 Answer the questions.
   a When you buy a piece of furniture and need to collect it in the warehouse, do you get any documents? What kind of documents are they? What do they state or report on?
   b What do you think could be the names used to refer to documents witnessing the processes of delivery, receipt or return of certain goods?

3 Match the business documents to their definitions.
   a receipt
   b materials transfer note
   c invoice
   d delivery note
   e delivery order

☐ A written acknowledgment by a receiver of money, goods, etc., that payment or delivery has been made.
☐ A document issued by a seller to a buyer listing the goods or services supplied and stating the sum of money due.
☐ Order given by an owner of goods to a person in possession of them (the carrier or warehouseman) directing that person to deliver the goods to a person named in the order.
☐ A form that records the transfer of material from one accounting code to another.
☐ A document, usually made out in duplicate, that is given to the consignee of goods when they are delivered to him. The consignee, or his representative, signs one copy of the delivery note as evidence that the goods have been received.
4 In addition to the documents mentioned in Task 3, there are also business letters, written to apply for, complain about, report, thank, invite, etc. Do you think business letters are a type of business documents? Why or why not? Discuss in class.

5 Read the text to check your answers in Task 4.

**Business documents** are documents (on paper or electronic documents) that represent you in relation to external parties, such as letters, invoices, order sheets, credit notes and bills. Envelopes, advertising material and business cards are not deemed to be business documents. Business documents that relate to sales of goods consist of invoices, notes and bills issued by the seller, and of contract notes and settlement notes, including when the documents were issued on behalf of the seller.

**Financial documents**, also known as **financial statements**, are used for reporting financial information about a business in a standardized format and include a balance sheet, an income statement, and a cash flow statement.

6 Are the following sentences true (T) or false (F)? Explain your answers.
   a All financial documents are in a standardized format. **T / F**
   b Invoice relates to the sales of goods and is a financial document. **T / F**
   c Statement in this context means something that somebody says. **T / F**
   d Business cards are financial documents. **T / F**

7 Financial documents (statements) are connected with bookkeeping and accounting. Do you know any bookkeepers or accountants? Is it important to keep books? Why or why not?

8 Match the basic financial statements to their definitions.
   a The balance sheet
   b An income statement
   c Cash flow statement

☐ Depicts the revenue and expenses of a business over a particular period of time such as a month, financial quarter, or year. It will tell you whether you had a net profit for the period or suffered a net loss.

☐ Lists everything that your business owns, known as assets, and everything that your businesses owes, known as liabilities. It also tells you the net worth of your company by subtracting the value of the assets from the total liabilities owed.

☐ A financial statement that is often provided alongside the balance sheet and the profit and loss account (or income statement) that shows the sources and uses of cash within the reporting period.
9 Translate into Croatian.

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<td><strong>c</strong></td>
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<td>gross</td>
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<td><strong>h</strong></td>
<td>receipt</td>
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<tr>
<td><strong>i</strong></td>
<td>materials transfer note</td>
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<tr>
<td><strong>j</strong></td>
<td>delivery note</td>
</tr>
<tr>
<td><strong>k</strong></td>
<td>delivery order</td>
</tr>
</tbody>
</table>
Car body design and materials

1. Answer the questions.
   
   a. What is your favourite car colour? Explain your answer.
   b. What is the name of the car part that is painted? Do you know both English and Croatian terms for car body?
   c. What materials are used in designing car bodies? Does this decision depend on the car body style (supermini and mini cars, sedans, large cars, grand tourers, sports cars, muscle cars, convertibles, etc.)?

2. What is the relationship between the shape of things and their desired functions? There are many examples in your kitchen but also in your body (our organs and cells and what they do). Discuss in class.

3. The connection between shape and its desired functionality can be noticed in the case of car body parts as well. Look at the picture and translate the body parts into Croatian. Discuss in class.

Translation

________________________________________________________________________________________________________________________________________________________

________________________________________________________________________________________________________________________________________________________

________________________________________________________________________________________________________________________________________________________

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________________________________________________________________________________________________________________________________________________________
4 What materials are used in car body design? Discuss with a partner. Then read the text to check your answers.

Although the use of aluminium in cars has been increasing for the past two decades, progress has been limited in developing aluminium auto bodies. In fact, most aluminium substitution has come in the form of castings and forgings in the transmission, wheels, etc. Car manufacturers have developed all-aluminium cars with two competing designs: conventional unibody and the spaceframe. However, aluminium is far from being a material of choice for auto bodies. The substitution of aluminium for steel is partly influenced by regulatory pressures to meet fuel efficiency standards by reducing vehicle weight, and to meet recycling standards. The key obstacles are the high cost of primary aluminium as compared to steel and added fabrication costs of aluminium panels. Both the aluminium and the automotive industries have attempted to make aluminium a cost-effective alternative to steel.

5 Compare steel and aluminium by completing the table below. Use the information from Task 4 and concentrate on the costs, weight, and ecology.

<table>
<thead>
<tr>
<th>ADVANTAGES</th>
<th>DISADVANTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEEL</td>
<td>ALUMINIUM</td>
</tr>
</tbody>
</table>

6 Match the words to get collocations.

a regulatory ☐ effective
b fuel ☐ pressures
c aluminium ☐ efficiency
d cost ☐ obstacles
e fabrication ☐ costs
f key ☐ panels
Suspension, springs, and dampers (shock absorbers)

1. Answer the questions. Discuss in class.
   a. Have you ever taken a look under the car? What can you find there?
   b. What is the part that connects the wheels called? How does it operate, what are its functions?
   c. What is the name of the car part and system in charge of damping the vibrations and all kinds of shock that you can come across while driving?

2. Look at the picture and check some of the answers from Task 1. Are there any parts that you do not recognise? Discuss in class.

3. Put the dialogue into correct order.
   - Car mechanic: The problem might be in the stabilizer or the shock absorber. Maybe there is not enough oil in the shock absorber or the connection to the main body is loose.
   - Car mechanic: The problem is somewhere in the car suspension system. Have you noticed that your wheels are unbalanced?
   - Driver: There is some strange noise while I am driving. As if something is bumping. The driving has become uncomfortable.
   - Driver: Yes, I can feel it most in the front right wheel. Spring is not broken from what I can see.
4 Translate the words into Croatian.

a chassis
b damp
c spring
d shock absorber
e recoil
f suspension
g axle
h rectangular

5 Match the expressions to their definitions.

a suspension system, suspension
b shock absorber
c spring
d chassis

A device for damping sudden and rapid motion, as the recoil of a spring-mounted object from shock.

A mechanical system of springs or shock absorbers connecting the wheels and axles to the chassis of a wheeled vehicle.

The rectangular, usually steel frame, supported on springs and attached to the axles, that holds the body and motor of an automotive vehicle.

A device, such as a coil or strip of steel, that stores potential energy when it is compressed, stretched, or bent and releases it when the restraining force is removed.

6 Read the text to answer the questions.

Suspension serves to lessen the jarring of the automobile that is caused by irregularities in the roads travelled. Since the wheels of an automobile accelerate, stop, and steer it, the suspension must also serve to keep the wheels in close contact with the road surface at all times. On an automobile, springs and shock absorbers are mounted between the wheels and the frame. When the wheels hit a hole or a raised spot on a road, the springs absorb the resultant shock by expanding and contracting. To prevent the springs from shaking the frame excessively, their motion is restrained by shock absorbers, which are also known by the more descriptive term dampers. In order for a spring to expand and contract, it must pull apart and push together the ends of this shock absorber. However, the ends offer so much resistance that the motion of the spring quickly dies out. The ends are connected to a piston in an oil-filled chamber in the shock absorber’s inner tube. The piston can only move if it forces oil past it through valves. This arrangement creates a large resistance to any motion by the piston and consequently by the ends. On some automobiles, a type of hydraulic suspension is used to function both as a spring and as a shock absorber.

a What are the main functions of suspension in vehicles?
b Where are springs and shock absorbers mounted? How do they absorb shocks experienced while driving?
c What is the function of the piston?
The steering system in a car

1. How would you mime the action of driving? Has everyone used an imaginary steering wheel? Is steering then a very important function in a car? Discuss in class.

2. Do you have a driver’s licence? Was it difficult for you to learn to steer a car? Have you ever driven an older car? It used to be much harder to steer it and to manage the steering wheel than it is today. Do you know why? Discuss in class.

3. Read the text to answer the questions.

The direction of motion of a motor vehicle is controlled by a steering system. A basic steering system has 3 main parts: a steering box connected to the steering wheel, the linkage connecting the steering box to the wheel assemblies at the front wheels, and front suspension parts to let the wheel assemblies pivot. When the driver turns the steering wheel, a shaft from the steering column turns a steering gear. The steering gear moves tie rods that connect to the front wheels. The tie rods move the front wheels to turn the vehicle right or left. There are 2 basic types of steering boxes - those with rack-and-pinion gearing, and those with worm gearing. In both cases, the gearing in the steering box makes it easier for the driver to turn the steering wheel, and hence, the wheels.

a. How come that we can make a big heavy car turn by using only light movements?

b. Why is the steering system important?

c. How does the steering system function?

d. What is the steering box in charge of? Are there more types?

4. Complete the text.

   gear set / steering / rack / steering shaft / steering wheel / spindle / tie rod / rack-and-pinion steering

   ____________________________________________________________________________ is quickly becoming the most common type of
   ____________________________________________________________________________ on cars, small trucks and SUVs. It is actually a simple mechanism.

   A rack-and-pinion __________________________________________________________________ is enclosed in a metal tube, with each end of
   ____________________________________________________________________________ protruding from the tube. A rod, called a
   ____________________________________________________________________________, connects to each end of the rack. The pinion gear is
   attached to the __________________________________________________________________. When you turn the
   ____________________________________________________________________________, the gear spins, moving the rack. The tie rod at each end
   of the rack connects to the steering arm on the ____________________________________________________________________________.
5 Look at the picture below. Translate the parts important for making car steering work into Croatian. Use a dictionary if necessary.

![Diagram of car steering system]

- **a** steering wheel
- **b** steering shaft
- **c** pinion
- **d** rack
- **e** tie rod
- **f** spindle
- **g** wheel

6 Put the dialogue into the correct order. Then act out the dialogue in pairs.

1. **Driver:** I think there is a problem with the steering system. It feels loose when I make turns.
2. **Auto mechanic:** It depends. If the steering shaft is in order, the repair is not very expensive. If the problem is in the steering shaft, it might cost a bit more.
3. **Driver:** Yes, it comes from below.
4. **Auto mechanic:** Is there any noise when you make a turn?
5. **Driver:** Can the steering shaft be fixed or a new one must be bought?
6. **Auto mechanic:** It can be several things. The problem might be in the steering shaft, the tie rod or the tie rod end.
7. **Auto mechanic:** The old one can be repaired if it is not worn. This is a cheaper solution. However, bring your car in and we will check.
8. **Driver:** Yes, there is a clicking sound.
9. **Driver:** How long does it take to fix this and is it expensive?
10. **Auto mechanic:** Where does that sound appear? Is it below the steering wheel?
Axle, shaft, wheel bearing, and tyres

1 Match the words to the pictures.
   a wheel bearing   b shaft   c axle

2 Match the terms to their definitions.
   a axle   b shaft   c bearing
   - A cylindrical piece of metal used to carry rotating machine parts, such as pulleys and gears, to transmit power or motion.
   - A machine part that supports another part which rotates, slides, or oscillates in or on it; a bar or shaft on which a wheel, pair of wheels, or other rotating member revolves.
   - A supporting member that carries a wheel and either rotates with the wheel to transmit mechanical power to or from it, or allows the wheel to rotate freely on it.

3 Translate into Croatian.
   a axle   b shaft   c bearing   d mechanical power   e transmit   f motion   g pulley   h cylindrical

4 What type of tyres do you or your parents use? When and how often do you change them?
   Describe the characteristics of the tyres used in different weather conditions. Discuss in class.
5 Look at the picture below. What does it show? Describe the differences in the design of different types of tyres. Discuss with a partner.

6 Match the description to the type of tyre.
   a Performance tyres or summer tyres
   b All-round or all-season tyres
   c Wet-weather tyres
   d Snow & mud or ice: special winter tyres
   e All-terrain tyres
   f Mud tyres

☐ Rather than use an even harder rubber compound than all-season tyres, these tyres actually use a softer compound than performance tyres. The rubber needs to heat up quicker in cold or wet conditions and needs to have as much mechanical grip as possible.

☐ These tyres are typically used on SUVs and light trucks. They are larger tyres with stiffer sidewalls and bigger tread block patterns. The larger tread block means the tyres are very noisy on normal roads but grip loose sand and dirt very well when you take the car or truck off-road.

☐ These tyres are designed for faster cars or for people who prefer to drive harder than the average consumer. They typically put performance and grip ahead of longevity by using a softer rubber compound. The extreme example are “slicks” used in motor racing.

☐ These come at the other end of the spectrum to performance tyres, obviously. They are designed to work well in wintery conditions on the roads. These tyres typically have larger and thus noisier tread block patterns. Mud & snow tyres typically either have ‘M&S’ stamped on the tyre sidewall. Snow & Ice tyres have a snowflake symbol.

☐ These tyres are at the extreme end of the all-terrain tyre classification. These have massive, super-chunky tread blocks and really should not ever be driven anywhere other than loose mud and dirt.

☐ These tyres are what you will typically find on every production car that comes out of a factory. They are designed to be a compromise between grip, performance, longevity, noise and wet-weather safety. These are neither excellent dry-weather, nor excellent wet-weather tyres, but are, at best, a compromise.
Electrical and safety equipment in cars

1 Answer the questions. Explain your answers. Discuss in class.
   a If you were in a position to buy a car, what car would you buy?
   b Does the equipment included influence the price of the car?
   c What is the basic equipment usually included? Is it all electric? What is luxurious equipment?
   d What equipment is safety-related?

2 What can you see when you sit behind the wheel of a car and you look at the dashboard? Use the pictures below for help. Discuss all the functions and pieces of equipment (electric and safety-related) that you can control from the driver’s position.

3 Do you think driving slowly contributes to safety? What is active and what passive safety? Discuss in class.
4 Read the text to answer the questions below.

Learning how to drive defensively makes sense, but accidents can and will happen. Luckily, modern cars are equipped with a number of devices that are designed to prevent accidents, and to keep the car’s driver and occupants safe if an accident does occur. These devices generally fall under two categories: active driving safety and passive driving safety.

**Active driving safety** refers to devices and systems that help keep a car under control and prevent an accident. These devices are usually automated to help compensate for human error -- the single biggest cause of car accidents. For example:
- Anti-lock brakes prevent the wheels from locking up when the driver brakes, enabling the driver to steer while braking.
- Traction control systems prevent the wheels from slipping while the car is accelerating.
- Electronic stability control keeps the car under control and on the road.

**Passive driving safety** refers to systems in the car that protect the driver and passengers from injury if an accident does occur.
- Air bags provide a cushion to protect the driver and passengers during a crash.
- Seat belts hold passengers in place so that they are not thrown forward or ejected from the car.
- Rollover bars protect the car’s occupants from injury if the vehicle rolls over during an accident.
- Head restraints prevent the driver and passengers from getting whiplash during a rear-end collision.

a What does active driving safety refer to?
b What is the single biggest cause of car accidents?
c What do anti-lock brakes enable?
d What does passive driving safety refer to?
e What do air bags and seat belts ensure?

5 Put the various devices in a car in order of importance for you. Explain your answers. Discuss in class.

- ☐ radio
- ☐ navigation
- ☐ air conditioning
- ☐ air bag
- ☐ central lock
- ☐ seat belt
- ☐ speedometer

6 Complete the table and translate the verbs into Croatian.

<table>
<thead>
<tr>
<th>NOUN</th>
<th>VERB</th>
<th>ADJECTIVE</th>
<th>VERB CROATIAN TRANSLATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>equip</td>
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<td>occupied</td>
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<td>sit</td>
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<td>restrain</td>
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<td>collide</td>
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<td>stable</td>
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</table>
The role and type of brakes and brake systems

1. Have you ever been stopped by the police? What can be the possible reasons for getting a fine? Can the police fine you for not having your brake system in order? Do you think they should? Why or why not? Discuss in class.

2. What happens when you push down on the brake pedal? What is the mechanism behind it? How is it possible to bring your car to a stop by only pushing the brake pedal lightly? Discuss in class.

3. Read the text to answer the questions.

We all know that pushing down on the brake pedal slows a car to a stop. However, how does this happen? How does your car transmit the force from your leg to its wheels? How does it multiply the force so that it is enough to stop something as big as a car? When you depress your brake pedal, your car transmits the force from your foot to its brakes through a fluid. Since the actual brakes require a much greater force than you could apply with your leg, your car must also multiply the force of your foot. It does this in two ways: mechanical advantage (leverage) and hydraulic force multiplication. The brakes transmit the force to the tires using friction, and the tires transmit that force to the road using friction also.

a. What is the force from your foot to the brakes transmitted through?

b. How is the force, you apply with your foot, multiplied?

c. How do the brakes transmit the forces to the tires and from the tires to the road?

4. Translate the words in colour in Task 3. If necessary, use a dictionary.
   
a. brake pedal
   
b. transmit
   
c. multiply
   
d. apply
   
e. mechanical
   
f. hydraulic
   
g. friction
   
h. leverage

5. There are different types of brakes. Which types do you know? How many brakes are there in a car? Discuss in class.
6 Describe the picture using the words in Task 3.

7 Unscramble the sentences.
   a the brake used / (drum or disc) / in an automotive vehicle; / for ordinary driving / Service brake / is / usually foot-operated.

   b that can be set by hand and, / Emergency brake / continues to hold / is the brake / once set, / until released; / in an automobile. / used as a parking brake

8 Translate into Croatian.
   a service brake
   b parking (emergency) brake
   c handbrake
   d foot operated
   e release
   f automotive vehicle

KEY WORDS
brake • service brake • emergency (parking, hand) brake
Basic parts of braking systems and supporting devices

1. What is inertia? How does it influence the design of the braking system in a car? Are there brakes on all wheels in modern cars? Are front or rear wheels more important when it comes to braking? Why? Is there a difference between small and big cars? Discuss in class.

2. Read the text to check your answers to the questions in Task 1.

Modern cars have brakes on all four wheels, operated by a hydraulic system. The brakes may be disc type or drum type. The front brakes play a greater part in stopping the car than the rear ones, because braking throws the car weight forward on to the front wheels. Many cars therefore have disc brakes, which are generally more efficient, at the front and drum brakes at the rear. All-disc braking systems are used on some expensive or high-performance cars, and all-drum systems on some older or smaller cars.

3. Look at the picture. What do you think it shows? Describe the process of braking shown in the picture.
4 Read the text to check your answer in Task 3.

A hydraulic brake circuit has fluid-filled master and slave cylinders connected by pipes. The master cylinder transmits hydraulic pressure to the slave cylinder when the pedal is pressed. When you push the brake pedal, it depresses a piston in the master cylinder, forcing fluid along the pipe. The fluid travels to slave cylinders at each wheel and fills them, forcing pistons out to apply the brakes. Fluid pressure distributes itself evenly around the system. The combined surface ‘pushing’ area of all the slave pistons is much greater than that of the piston in the master cylinder. Consequently, the master piston has to travel several inches to move the slave pistons the fraction of an inch it takes to apply the brakes. This arrangement allows great force to be exerted by the brakes, in the same way that a long-handled lever can easily lift a heavy object a short distance.

5 Answer the questions.

a What does pressing the pedal initiate?

b How much does the master piston move compared to the movement of the pedal?

c In what sense is lever mentioned in the text?
6 Look at the pictures. Then match the parts of brakes to the definitions.

- a types of brakes
- b drum brake
- c drum
- d brake lining
- e return spring
- f piston
- g wheel cylinder
- h brake shoe
- i brake pads
- j wheel hub
- k stud
- l disk
- m brake line
- n splash shield
- o disk brake

- Metal pin.
- Cylindrical part attached to the wheel, against which the brake shoes are pressed to stop the car.
- Part of the brake mechanism that returns the brake shoes to their initial position.
- Frictional part on the outside edges of the brake shoes.
- Apparatuses used to slow or stop a moving vehicle.
- Cylindrical part that transmits the pressure to and receives pressure from the brake shoes.
- Type of roller that applies a uniform pressure to the wheel then the brake is activated.
- Parts activated by the piston.
- Part on which the brake lining is mounted.
- Round, flat, piece of metal, pressed against the wheel to slow or stop the car.
- Mechanism that slows and stops a car by friction, by pressing brake shoes against a drum.
- Central part crossed by the axle.
- Protector that prevents dirt from fouling the braking system.
- System liquid-transporting tubes.
- Mechanism that slows and stops a car by friction, by pressing a disk against the wheel axle.
7 Acronyms are words formed from the initials of a group of words. Can you think of any acronyms used to refer to the devices that support the braking system in a car? Discuss in class.

8 Match the acronyms to their definitions.

- ABS (Anti-LOCK Braking System)
- BAS (Brake Assist System)
- ESP (Electronic Stability Program)
- TCS (Traction Control System)

a ______________   Additionally improves the lateral dynamics, thus ensuring stable driving in all directions.

b ______________   For vehicles, a sensor-control system found in braking systems which prevents wheel lockup while allowing the brakes to continue slowing the wheel.

c ______________   Helps limit tire slip in acceleration on slippery surfaces.

d ______________   An electronic system that interprets the braking behaviour of the driver and initiates the full braking effect when it identifies an emergency. This reduces the braking distance substantially.
Motor vehicle maintenance system

1. Look at the diagram of a dashboard. What information can it give you? Does it signal when something is not in order? What should you do when you see a signal light? What types of warnings does it give?

2. Which preventive measures can be taken when one of the dashboard lights signals a problem? Why should vehicles be maintained regularly?
3 Complete the descriptions of preventive and corrective maintenance.
   servicing / before / satisfactory / restoring / failure

**Corrective maintenance** is maintenance which is carried out after ____________ detection and is aimed at ____________ an asset to a condition in which it can perform its intended function.

**Preventive maintenance** refers to the care and ____________ by qualified personnel for the purpose of maintaining equipment and facilities in ____________ operating condition by providing for systematic inspection, detection, and correction of incipient failures either ____________ they occur or before they develop into major defects.

4 Complete the table with maintenance actions.
   a drawing up maintenance plans and associated reports
   b checking and monitoring of equipment
   c revisions / inspections
   d emergency interventions
   e mechanical repairs (welding, machining...)
   f spare parts supply and management
   g breakdowns
   h degradation analyses

<table>
<thead>
<tr>
<th>PREVENTIVE MAINTENANCE</th>
<th>CORRECTIVE MAINTENANCE</th>
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</table>
5 Read the text to answer the questions below.

It’s tempting to avoid car maintenance in tough economic times, but that is not a financially sound method to manage the big investment you have made in your vehicle. A well-maintained vehicle lasts longer, retains more of its resale value, pollutes less, and gets better mileage than one that has been neglected — to say nothing of being safer to operate. Neglect causes components to wear out faster than they would otherwise (poorly aligned tires, for example) and can result in minor problems growing into more expensive repairs (worn brake pads will eventually damage the more expensive rotors). While some people might relish a weekend tinkering with the family car, today’s technological advances under the hood and busier lifestyles find more consumers in search of dependable, trustworthy automotive service and repair.

a What are the main advantages of maintaining your vehicle regularly?
b What does the example of poorly aligned tires show?
c Do people often repair their cars themselves? Explain your answer.

6 Match the words to their definitions.

<table>
<thead>
<tr>
<th></th>
<th>sound</th>
<th>pollute</th>
<th>mileage</th>
<th>neglect</th>
<th>wear out</th>
<th>hood</th>
<th>dependable</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Lack of care.</td>
<td>Capable of being depended on; worthy of trust; reliable.</td>
<td>Free from defect, decay, or damage; in good condition.</td>
<td>To make or become unusable through long or heavy use.</td>
<td>The hinged metal lid over the engine of a motor vehicle.</td>
<td>To make unfit for or harmful to living things, especially by the addition of waste matter.</td>
<td>Total length, extent, or distance measured or expressed in miles.</td>
</tr>
</tbody>
</table>

7 Match the words to get collocations.

intervention / service / spare / brake / repair / maintenance

a ____________________________ plan
b ____________________________ parts
c ____________________________ pads
d emergency ____________________________
e automotive ____________________________
f mechanical ____________________________

KEY WORDS
maintenance • preventive maintenance • corrective maintenance
Tools and vehicle maintenance equipment

1. Complete the mind map with the tools needed for repairing a car.

2. Complete the tables with their categories.
   - a Universal tools
   - b Special service tools
   - c Hand tools
   - d Measurement tools
   - e Diagnostic equipment
   - f Universal workshop equipment

<table>
<thead>
<tr>
<th>Universal tools</th>
<th>Measurement tools</th>
<th>Diagnostic equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>• wrenches/ spanners</td>
<td>• bearing puller</td>
<td>• Vernier Calipers</td>
</tr>
<tr>
<td>• pliers</td>
<td>• cylinder liner puller</td>
<td>• micrometres</td>
</tr>
<tr>
<td>• screwdrivers</td>
<td>• spring tools</td>
<td>• kit for fuel injection</td>
</tr>
<tr>
<td>• hammers</td>
<td>• spring pneumatic tools</td>
<td>pressure measurement</td>
</tr>
<tr>
<td>• special knives</td>
<td></td>
<td>• oscilloscopes</td>
</tr>
<tr>
<td>• other hand tools</td>
<td></td>
<td>• multimeters</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• battery testers</td>
</tr>
</tbody>
</table>

- Special service tools are required for inspection and repair of vehicles of a particular producer.
- Several types of service tools have been designed with the purpose of improving work efficiency when general tools cannot be used, and promoting safety.

<table>
<thead>
<tr>
<th>Special service tools</th>
<th>Equipment tools</th>
<th>Communications tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>• exhaust gas analysers</td>
<td>• air-conditioning tools &amp; equipment</td>
<td>• hydraulic lift</td>
</tr>
<tr>
<td>• fuel pressure test equipment and turbocharger tester</td>
<td>• manual hydraulic jacks</td>
<td>• manual and special machines</td>
</tr>
<tr>
<td>• electrical test equipment and analysis of the communications network of vehicles</td>
<td>• pads</td>
<td>• brake controller</td>
</tr>
<tr>
<td></td>
<td>• special cranes for engines, gears, springs and the like press</td>
<td>• motor oil containers</td>
</tr>
<tr>
<td></td>
<td>• manual and special machines</td>
<td>• nipples</td>
</tr>
<tr>
<td></td>
<td>• brake controller</td>
<td>• oil filling pump</td>
</tr>
<tr>
<td></td>
<td>• motor oil containers</td>
<td>• car washing kit</td>
</tr>
<tr>
<td></td>
<td>• hydraulic lift</td>
<td>• exhaust removal tools</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• device for neutralization of exhaust gases</td>
</tr>
</tbody>
</table>
3 Match the hand tools to the photos.

- a locking pliers / Vise-GRIPS
- b square-tip screwdriver
- c a set of wrenches (AmE) / spanners (BrE)
- d cross-tip screwdriver (crosstip)
- e a set of combination wrenches
- f clamp crimping tool
- g stripping pliers
- h flat screwdriver
- i a set of ring wrenches

4 Translate into Croatian.

- a locking pliers / Vise-GRIPS
- b square-tip screwdriver
- c a set of wrenches (AmE) / spanners (BrE)
- d cross-tip screwdriver (crosstip)
- e a set of combination wrenches
- f clamp crimping tool
- g stripping pliers
- h flat screwdriver
- i a set of ring wrenches

5 Project work. Find photos and information on 3 more types of wrenches, pliers, and screwdrivers. Prepare a poster.

KEY WORDS
vehicle maintenance equipment
Car battery

1. Answer the questions. Discuss in class.
   a. What is the voltage of a car battery?
   b. How much does a battery for a car cost?
   c. What is a car battery made of?

2. Match the questions in Task 1 to the answers.
   - A normal price range for most batteries is $50 to $11.50 depending on the model car and whether it is a regular or a heavy-duty battery.
   - Voltage refers to the amount of electrical potential your battery holds. The standard automotive battery in today’s vehicles is a 12-volt battery. Each battery has six cells, each with 2.1 volts at full charge. A car battery is considered fully charged at 12.6 volts or higher.
   - Lead-acid batteries are made up of plates of lead and separate plates of lead dioxide, which are submerged into an electrolyte solution of about 38% sulphuric acid and 62% water. This causes a chemical reaction that releases electrons, allowing them to flow through conductors to produce electricity.

3. Translate into Croatian.
   a. battery
   b. sulphuric acid
   c. lead-acid battery
   d. lead-dioxide
   e. electrolyte solution
   f. hydrometer

4. Match the collocations.
   a. price
   b. model
   c. battery
   d. fully
   - charge
   - replace
   - depending on
   - range from

5. Write a dialogue between a car mechanic and a customer. Use the collocations in Task 4. Include the following topics: price, model, battery.

6a. When do we use verb forms such as I had my battery replaced? Explain the difference between the sentences below.

   I had my battery replaced.
   I replaced my battery.
6b Make sentences using the causative have (have + past participle) form.
   a I / battery / periodically / check

   b I / battery / top off / water / yesterday

   c I / my battery terminals / clean / and / inspect / recently

7 Complete the text on battery maintenance.
   indicator / optimum / resistant x2 / replacements / distilled / charger / inspect / terminals /
   invest / changes / from / insulation / fit / vent / on

   A QUICK 5-STEP GUIDE TO GETTING THE MOST OUT OF CAR BATTERIES
   a Keep the battery _______________ clean and _______________ regularly (i.e. monthly) for
     corrosion.

   b Keep the battery secure and free from vibration. Batteries that shake can become damaged and
     short circuited or can even cause damage to your car.

   c Insulate the battery _______________ extreme temperature _______________ with a car
     battery _______________ kit. These normally come with new cars; however, you can find
     _______________ specifically made to _______________ your car’s battery compartment. The
     sleeves are usually plastic or an acid _______________ /thermal _______________ material
     that insulates your battery but still allows it to _______________.

   d _______________ in a car battery _______________ that will maintain an _______________ charge level
     when your car is not in use or when you go _______________ vacation.

     One last recommendation:
     Check the car battery water level _______________ on a regular basis! Most car batteries
     will indicate if they need more water. It may never require water, but if so, only use
     _______________ water.
Alternator and starter

1. Complete the text on how the battery works.

   down / charging / plates / sulphuric / water / terminal / reaction / lead / opposite / battery

   If the power came from an ordinary _______ battery _______, it would soon run
   __________________. So cars have a rechargeable battery and a __________ system to keep it topped up. The battery has pairs of lead ______________ immersed in a
   mixture of ______________ acid and distilled ______________. Half of the plates are
   connected to each ______________. Electricity supplied to the battery causes a chemical
   ______________ that deposits extra ______________ on one set of plates. When the
   battery supplies electricity, exactly the ______________ happens: the extra lead dissolves off
   the plates in a reaction that produces an electric current.

2. Read the text on alternators. Explain the words in colour.

   The battery is charged by an alternator on modern cars, or by a dynamo on earlier ones. Both are
types of generator, and are driven by a belt from the engine. The alternator consists of a stator
inside which a rotor revolves. The rotor is an electromagnet supplied with a small amount of
electricity through carbon or copper-carbon brushes (contacts) touching two revolving metal slip
rings on its shaft. The rotation of the electromagnet inside the stator coils generates much more
electricity inside these coils.

3. Translate the parts of a car alternator into Croatian.

   a alternator
   b generator
   c stator (coils)
   d rotor
   e carbon or copper-carbon brushes (contacts)
   f slip rings
4 Read the text. Then match the headings to the paragraphs.

<table>
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<tr>
<th>Odd sounds</th>
<th>Weak or dead battery</th>
<th>Warning Light</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weird smells</td>
<td>Dim lights</td>
<td>Visual Cues</td>
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**a**
The alternator is part of the electrical system of your vehicle. Its key role is to provide power to operate the starter, ignition, and all of the electronic accessories in your car. If the alternator starts to die, you might notice your headlights and/or dashboard lights beginning to dim. Once the dash light or headlights dim, it is a clear indication of potential alternator malfunction. A waning alternator may cause other electronic accessories such as power windows and/or power seats to operate more slowly than usual.

**b**
Most modern cars have a dashboard warning light that alerts you when the alternator is on the fritz. Usually, the light will be shaped like a battery, although some might say ALT (short for alternator) or GEN (short for generator). This light may only trigger if you are using multiple electrical components. It is generally contingent on how much life your vehicle’s alternator has left and how much electricity your vehicle is using.

**c**
A car battery, by definition, has a finite life and will not last forever. As good as an alternator is at replenishing your car battery; it can only recharge it to the point that it has a decent amount of life left in it and is able to accept a charge. If the battery is really weak or dead, the alternator cannot bring it back to life. To troubleshoot whether the issue is the alternator or the battery, just charge the battery and restart the vehicle. If the battery is weak or dead, the car will continue to run but the lights will again become dim after a short time, indicating a problem with the charging system. If the vehicle has difficulty starting after the battery is fully charged, the problem is likely with the alternator.

**d**
An alternator works in conjunction with a system of belts. If a belt is not turning freely, the excess friction will cause the belt to heat up, which produces a burning rubber smell. If you catch a whiff of a smell similar to that of an electrical fire, this could indicate that the belt is slipping on the alternator pulley, causing poor alternator output. Tightening the belt often does the trick. If the situation arises where tightening your belt does not fix the strange smell and alternator output, you should have your alternator evaluated by a professional.

**e**
There are many different parts that spin inside your vehicle’s alternator to produce electrical current. If one of these parts becomes worn or breaks, this could cause a grinding or whining noise. Specifically, worn out bearings inside the alternator have been known to cause this type of noise. If the bushings that the alternator is mounted on have gone bad, a noise will be produced. Alternators are normally replaced as an assembly.

**f**
If you are experiencing problems with the electrical system, the alternator itself might be fine because the problem could be with one of the belts connected to the alternator. By doing a visual inspection of the engine compartment, you can determine if a belt is too loose or too tight. If a belt is cracked or worn, you should be able to spot that as well.
5 Match the questions to the paragraphs in Task 4. Then answer the questions.

a What can cause a grinding or whining noise? ☐
b How can you determine if a belt is too loose or too tight? ☐
c What produces a burning rubber smell? ☐
d What is the dimming of light or headlights a clear indication of? ☐

6 Project work. Prepare a dialogue with a partner. Imagine you are a car mechanic and a customer. The customer is experiencing certain problems with their car and they came to the car mechanic for advice. Use the prompts below.

- odd sounds
- weird smells
- warning light
- weak or dead battery
- dim lights
- visual cues
Electronic stability control system

1. Do you know what the following abbreviations stand for? In what situations do you think these systems are needed? Discuss in class.
   ABS  TCS  BAS

2. Match the definitions to the abbreviations in Task 1.
   a _________ blokiranje kotača pri kočenju
   b _________ brzo pojačanje sile pri kočenju
   c _________ kontrola proklizavanja kotača pri kretanju

3. Complete the text on car stability systems.
   at / of / on / during / by / from / of
   a _______________
   This system helps prevent brakes _________ locking and it monitors the speed _________ each wheel to detect locking. It is a system that allows braking and steering _________ the same time, and prevents skidding.
   b _______________
   This system interprets the braking behaviour _________ the driver and applies additional brake pressure when it identifies an emergency situation. This reduces the braking distance substantially.
   c _______________
   This system optimizes grip and stability of the car _________ the road _________ acceleration by measuring wheel rotation. It stops wheel spin _________ reducing engine power or temporarily applying the brakes to that wheel, allowing the car to accelerate smoothly, even on slippery surfaces.

4. Now match the abbreviations in Task 1 to the processes in Task 3.

5. Make questions to match the answers in colour.
   a ABS helps prevent brakes from locking and it monitors the speed.  
   What does ABS do? What’s the function of ABS?
   b ABS system helps prevent brakes from locking and it monitors the speed of each wheel to detect locking.
   c This system interprets the braking behaviour of the driver and applies additional brake pressure when it identifies an emergency situation.
   d This system optimizes grip and stability of the car on the road during acceleration by measuring wheel rotation.
6 Guess the numbers! Discuss your answers with your teacher.

Australian research shows that ESC reduces the risk of:

a  Single car crashes by ________ %
b  Single 4WD crashes by ________ %
c  Single car crashes in which the driver was injured by ________ %
d  Single 4WD crashes in which the driver was injured by ________ %

No other active safety device has such potential to reduce single car crashes.

7 Complete the text on ESC.

to / in / with / in / by / from / to

Evaluation studies have shown that ESC in cars can lead ____________ substantial reductions ____________ crashes, deaths, and serious injuries. A Swedish study in 2003 showed that cars fitted ____________ ESC were 22% less likely to be involved ____________ crashes than those without. There were 32% and 38% fewer crashes ____________ wet and snowy conditions respectively. In Japan, a study showed that electronic stability reduced crash involvement ____________ 30 to 35%. In Germany, one study indicated a similar reduction while another showed a reduction in ‘loss-of-control’ crashes ____________ 21% ____________ 12%. Research also shows a particularly high effectiveness for reducing serious crashes involving other loss of control situations such as skidding (33%), and rollover (59%).

8 Complete the text on the ESC system.

integral / every / necessarily / only / longitudinal / lateral / unlike / holistic / entire

ABS and Traction Control are ____________ components of an ESC system. ____________ car with ESC has ABS and Traction Control, those with ABS and Traction Control do not ____________ have ESC. ABS and Traction Control ____________ work in the driving (___________) direction. ESC can help drivers cope with sideways ____________ movements which create instability. ____________ ABS and Traction Control, ESC is a ____________ system that can control the ____________ movements of the car.

9 Answer the questions on the language used in Task 8.

b  What part of speech do the missing words belong to? When do we use these words?
c  Which adjectives are used to describe antonyms?
d  Which adjectives are used to describe synonyms?
Wheel alignment

1 Read the text to answer the questions below.

Wheel alignment (sometimes referred to as breaking or tracking) should be checked whenever new tires are installed, suspension components installed, when the vehicle has encountered a major road hazard or curb, and any time unusual tire wear patterns appear. Wheel alignment is the measurement of complex suspension angles and the adjustment of a variety of suspension components. It is a suspension-tuning tool which greatly influences the vehicle’s handling and tire wear. Wheel alignment consists of adjusting the angles of the wheels so that they are parallel to each other and perpendicular to the ground, thus maximizing tire life and ensuring straight and true tracking along a straight and level road. The primary static suspension angles that need to be measured and adjusted are caster, camber, and toe.

a Which 4 main reasons are stated for wheel alignment check?
b What is measured in wheel alignment?
c What is adjusted in wheel alignment?
d What is the main component of wheel adjustment?
e How should the wheels be positioned on a vehicle?
f What is the purpose of such positioning?

2 Match the words in colour in Task 1 to their translations.

a ___________________________ (pozitivni i negativni) nagib kotača
b ___________________________ zatur kotača
c ___________________________ trag kotača

3 Match the terms to the definitions.

a camber
b caster
c toe angle

☐ The angle of the wheel, measured in degrees. If the top of the wheel is tilted out, then the camber is positive, if it’s tilted in, then the camber is negative.
☐ The angle of the steering pivot, measured in degrees.
☐ It identifies the direction of the tires compared to the centreline of the vehicle.
4 Discuss the questions below. Then read the text.

a What else could be the problem if the car is drifting or pulling left or right before attempting to diagnose a front end alignment problem? Discuss in class.
b Read the text and check your answers. Have you discussed all of the suggestions in the text?
c Underline the expressions that describe tire problems and write them down.

Eliminate tire problems. Before attempting to diagnose an alignment problem, you need to be sure your tires are not causing steering problems you may be experiencing. Check the air pressure on all four tires, making sure to inflate them to the recommended pressure. Check to see that the tread (or tire pattern) and tire size are the same on both front wheels. You do not want to have a mud and snow tire on one side and a normal highway tire on the other. This, or any combination of different tire types or sizes, can cause the car to pull one way or the other.
Check to see if the tires are showing unusual wear or are damaged. Look over the tire completely. Does it look symmetrical, round? Are there chunks missing from the tread? Carefully feel around the tire with your hand to see if there are deformities or bulges, indicating the tread is trying to separate itself from the steel belts.

5 Complete the collocations in Task 4. Use the collocations to write a short dialogue.

a Eliminate tire ____________________.
b To ____________________ air pressure ____________________ tires.
c ____________________ tires to the recommended pressure.
d Tire ____________________ and tire ____________________ are the same on both wheels.
e Carefully feel ____________________ the tire with your hand.
Your dream job

1. Match the descriptions of people to their definitions.
   innovative / creative / careful / conforming / imaginative / analytical / independent / reserved / scholarly / authoritative / persuasive / adventurous / outgoing / energetic
   a. ____________ willing to take risks and try new things
   b. ____________ using skill and imagination to create works of art
   c. ____________ liking to meet new people, friendly
   d. ____________ behaving like the majority of people do
   e. ____________ giving attention to what you are doing so that you avoid doing something wrong
   f. ____________ using imagination
   g. ____________ having a lot of energy
   h. ____________ spending a lot of time studying, and thus having a broad knowledge
   i. ____________ using a logical method of thinking, and paying attention to details to get the whole picture
   j. ____________ making your own decisions without influence of others
   k. ____________ unwilling to express opinion
   l. ____________ using new ideas and ways of doing something
   m. ____________ expecting people to obey you, and do what you say
   n. ____________ able to convince people to do something

2. Use some of the adjectives in Task 1 to describe yourself. Then describe a classmate. Finally, compare your descriptions.

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<thead>
<tr>
<th>ME</th>
<th>MY PARTNER</th>
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3 Look at photos of some successful people. Who are they? Which adjectives do you think best describe their personalities?

a

b

c

d

e

f

4 Translate into Croatian.

a employer

b employee

c employment

d self-employed

e unemployed

f employ
5 Complete the text on career choices. Which group do you think you belong to? Explain your answer.

realistic / investigative / artistic / social / enterprising / conventional

In the 1950s, John L. Holland developed a theory of personality that focuses on career and vocational choice. It groups people on the basis of their suitability for six different categories of occupations. Therefore, RIASEC stands for realistic, investigative, artistic, social, enterprising, and conventional type of personality. Below are the descriptions of the 6 categories.

1 _______________ Organizers
People who like to work with data, have clerical or numerical ability, like structure, like carrying things out in detail or following other’s instructions. They may enjoy working at a desk or office. They are careful and conforming.

2 _______________ Creators
People who have artistic, innovative or creative abilities. They like to work in unstructured situations using their imagination and originality. They are creative and expressive.

3 _______________ Thinkers
People who like to observe, learn, investigate, analyse, research, evaluate or solve problems. They enjoy science or maths. They are analytical, reserved, independent and scholarly.

4 _______________ Persuaders
People who like to work with people. They are direct and persuasive. They lead or manage for organizational goals, or economic win. They are adventurous, outgoing, and energetic.

5 _______________ Doers
People who have mechanical ability, prefer to work with objects, machines, tools, plants, or animals. They like to work independently or outdoors. They are frank, hands-on and practical.

6 _______________ Helpers
People who like to help people. They inform, teach, train, develop or cure other people. They are skilled with words and concerned with the wellbeing of others. They are compassionate.

6 Discuss the topics below in class.
• developmentally disabled employees • minorities
• volunteering abroad • working abroad
Read the text. Which types of working environments are described? Discuss in class.

Ivan: In Croatia, it is not common that developmentally disabled individuals are employed, which is a tremendous waste of talent in my opinion. If we give them the opportunity, many developmentally disabled individuals will be extremely loyal, hard-working, punctual, reliable and productive employees who win the hearts of customers.

Petar: People coming from a different cultural background have different habits, behaviour, and ways of communication. For instance, when I lived and worked in Germany I remember that we first did business, and after that we went for a lunch. In Croatia, it is the other way around. First we have lunch, chit-chat, and tell jokes, and then finally we do business.

Klara: It is crucial to integrate minorities into culture in all the ways possible. If they are given the appropriate job, this is I think the best way. That will further encourage integration of their children into the working society of our country. This is the right way!

Antonela: One of the ways to learn about other people, but also to get to know yourself better, is by volunteering abroad. If you want to help those in need, see new countries and make a difference at the same time, this is a good choice. This type of work is unpaid, but it may prove the most useful experience of your life, and also a good point in your CV.

Jana: I spent a year working in China with people from all over the world. There were Australians, British, Polish, French, and people from other nationalities. It was a bit confusing at the beginning because we were very much different. But in the end, I learnt a lot about different cultures and made new friends. I am happy that I have become a more interculturally aware person!

Answer the questions below.

a What is a CV?

b What does punctual mean?

c What does interculturally aware exactly mean?

Project work. Prepare a PowerPoint presentation on a successful person you admire.
What is a CV?

1. What does the acronym CV stand for? Choose the correct answer.
   a) control vehicle   b) curriculum vitae   c) copy values

2. What should a CV or a résumé contain? Tick the correct answers.
   - [ ] a description of your ideal job
   - [ ] a description of your education and work experience
   - [ ] a description of your skills and interests

3. Complete the résumé.
   - address / education / name / interests / email / mobile phone / skills / work experience / date and place of birth

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- Fred Jameson
- 10 Regent Street
- 0923 8373 6353
- 12 May 1996, Edinburgh
- fredjames464@djdh.at
- Vocational Secondary School
- automotive technician
- 2011-2015
- apprentice in a car repair shop, 2 months
- cars, football, art
- bilingual in English, clean driving licence,
  AutoCAD
4 Now write your own CV.

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5 Complete the covering letter.

punctual / automotive technician / repair / interview / add / develop

Dear Mr Firth,

I am writing in response to your _____________ published on the website www.dhakohd.com on 19 September 2015, and would like to apply for the post of _____________ in your company.

I have just finished High School, and have only 2 months of working experience as an apprentice in a car _____________ shop. However, I am willing to learn and _____________ my skills.

I consider myself to be a communicative, responsible, organized, and _____________ person.

I would be grateful for the opportunity to meet you at an _____________.

I look forward to hearing from you.

Yours sincerely,

______________________________
FORWARD IN ENGINEERING
A coursebook for vocational schools in the field of mechanical engineering