

ΥΠΟΥΡΓΕΙΟ ΕΘΝΙΚΗΣ ΠΑΙΔΕΙΑΣ ΚΑΙ ΘΡΗΣΚΕΥΜΑΤΩΝ  
ΠΑΙΔΑΓΩΓΙΚΟ ΙΝΣΤΙΤΟΥΤΟ

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## ΑΓΓΛΙΚΑ ΕΙΔΙΚΟΤΗΤΑΣ

ΤΕΧΝΙΚΑ ΕΠΑΓΓΕΛΜΑΤΙΚΑ ΕΚΠΑΙΔΕΥΤΗΡΙΑ

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Ειδικότητα: Μηχανών και Συστημάτων Αυτοκινήτου

### Λύσεις στις ασκήσεις

(Βιβλίο του καθηγητή)

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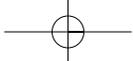
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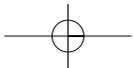
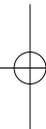
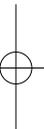
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# UNIT 1

## Qualities and qualifications needed for a car mechanic

### 1. Reading comprehension

1. don't need academic qualifications
2. nine years
3. a vocational school
4. observation and experience
5. Mathematics and physics
6. English
7. car engine
8. maintenance and repair
9. polite
10. technological developments in the field of car mechanics

### 2. Vocabulary practice

**2A** Free. Ask the students to find more examples.

<b>2B</b>	a - 6	f - 3	k - 8
	b - 1	g - 5	l - 12
	c - 7	h - 10	m - 15
	d - 2	i - 11	n - 14
	e - 4	j - 13	o - 9

### 3. Useful phrases

1. academic qualifications
2. nine-year compulsory education
3. attend special subjects
4. vocational training

5. observation and experience
6. theoretical knowledge
7. (a) technician working in this field
8. operation manual
9. you should be well aware/informed of
10. the components of the car engine
11. complicated technical problems
12. technological developments

#### 4. Language functions

Let the students develop their own sentences. Here follow some suggestions:

- (To be) a car mechanic (you) *should be polite.*
- (To be) a car mechanic (you) *should have politeness.*
- (To be) a car mechanic (you) *must be able to read manuals.*
- (To be) a car mechanic (you) *should be honest.*
- A car mechanic *doesn't need to go to university.*
- A car mechanic *mustn't be irresponsible.*
- A car mechanic *has to be responsible.*
- A car mechanic *can't be clumsy.*
- To be a car mechanic you *need to be properly trained.*

#### 5. Use of English

- |                     |                  |
|---------------------|------------------|
| 5A 1. qualification | 12. construction |
| 2. education        | 13. suitability  |
| 3. attention        | 14. regularity   |
| 4. knowledge        | 15. maintenance  |
| 5. training         | 16. repair       |
| 6. occupation       | 17. persistence  |
| 7. observation      | 18. politeness   |
| 8. requirement      | 19. performance  |
| 9. achievement      | 20. deal         |
| 10. application     | 21. failure      |
| 11. operation       | 22. obligation   |

- |                         |                   |
|-------------------------|-------------------|
| <b>5B</b> 1. mechanical | 8. competitive    |
| 2. occupation           | 9. reliable       |
| 3. skilled / skil(l)ful | 10. dealer        |
| 4. suitable             | 11. Technological |
| 5. knowledge            | 12. cooperative   |
| 6. maintenance          | 13. politely      |
| 7. successful           |                   |

## 6. Writing activity

Help the students fill in the CV form with the required information and encourage them to write their own application letter, as they are asked to do in this activity.

# UNIT 2

## Vehicles on wheels

### Warm up

pollution levels

necessary tools

mechanical device

farm machinery

internal combustion

car plants

urban environment

electric power

exhaust fumes

poisonous smog

### 1. Reading comprehension

1. False

2. True

3. False

4. False

5. False

6. Don't know

7. True

8. True

9. True

### 2. Vocabulary practice

1. motor-bike

2. lorries

3. buses

4. tractor

5. coach

6. Vans

7. jeep

8. (family) saloon

9. hatchback

10. estate car

11. open-top convertible

12. Sports cars

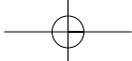
13. Fire engines

14. ambulance

15. tankers

16. transporters

17. Pick-up trucks

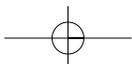
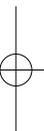


### 3. Language functions

Using the patterns given in the students' book you could suggest an open-top convertible for a photojournalist, a pick-up truck or a van for a farmer and a station-wagon for a plumber.

### 4. Use of English

- |                                  |                 |
|----------------------------------|-----------------|
| 1. is designed                   | 5. is used      |
| 2. are manufactured              | 6. is developed |
| 3. is expected                   | 7. are equipped |
| 4. are emitted – are transformed | 8. are called   |



# UNIT 3

## The development of the car engine

### Warm up

#### The correct alternatives.

1-b 2-c 3-b 4-b 5-c 6-b 7-a 8-a 9-b 10-c

### 1. Reading Comprehension

#### 1A The correct order of the headings.

- § 1 Heat engines. (3)
- § 2 The first experiments with I.C.E. (6)
- § 3 Early developments in internal combustion engines.(5)
- § 4 An I.C.E. on wheels and the car industry. (2)
- § 5 Types of internal combustion engines. (1)
- § 6 The development and importance of modern car industry. (4)

#### 1B The answer to the questions.

1. The mechanical energy produced by heat engines is in the form of rotary motion.
2. In the external combustion engines, combustion takes place outside the engine/ externally. In the internal combustion engines, on the other hand, combustion takes place inside the engine/ in the combustion chamber/ internally.
3. Gunpowder.
4. The German mechanical engineer Karl Benz in 1888.
5. They are categorized as reciprocating, such as the piston engines used in most modern cars, and rotary, such as the Wankel engines.
6. They mostly use (diesel-) oil.
7. The economical growth after World War II which was accompanied by an increase in demand for motor cars, and the development of more efficient mass-production techniques.
8. It is of great importance because it influences the employment, investment, (foreign) trade, as well as the environment.

## 2. Vocabulary Practice

### 2A Identifying the defined item.

- |                               |                         |
|-------------------------------|-------------------------|
| 1. heat engines               | 5. illuminating gas     |
| 2. fuel                       | 6. reciprocating engine |
| 3. gunpowder                  | 7. rotary engine        |
| 4. internal combustion engine | 8. passenger car        |

### 2B Replacing words in the text with their synonym.

#### First paragraph

1. type    2. energy    3. classified    4. takes place    5. typical

#### Second paragraph

1. started    2. tried    3. built

#### Third paragraph

1. primary    2. occurred    3. important    4. nearly

#### Fourth paragraph

1. introduced    2. successful    3. rapid    4. cars

#### Fifth paragraph

1. principal    2. parts    3. employed    4. trucks

#### Sixth paragraph

1. growth    2. was accompanied    3. efficient    4. impact    5. trade    6. major

### 2C Matcing.

- 1-c    2-e    3-a    4-b    5-d

### 2D The Greek equivalent terms.

- |                          |                      |
|--------------------------|----------------------|
| 1. motion                | 5. trade             |
| 2. combustion            | 6. investment        |
| 3. auto-ignition of fuel | 7. impact; influence |
| 4. mass production       | 8. demand            |

### 3. Language functions

#### Classifying

##### Suggested answers.

1. An electric drill is a type of power(ed) tool.
2. Tools may be classified / grouped / categorised into hand tools and machine tools.
3. Metals are grouped / divided into ferrous and non-ferrous.
4. Internal combustion engines belong to the heat engines.
5. Heat engines can be categorised into ICEs and ECEs.
6. Reciprocating and rotary engines are classed / categorised as internal combustion engines.
7. A triangle is an example / a kind of geometrical shape.
8. Wankel and Otto engines are classed / grouped / categorised as ICEs.
9. Car engines are divided / classified into petrol and diesel-oil engines.
10. Oxygen is a form / kind / type of gas.

### 4. Use of English

#### Simple Past Tense in Active and Passive Voice

##### IN THE ACTIVE VOICE

#### 4A Forming active interrogative and affirmative sentences in the S. Past tense.

1. When did experiments with internal combustion start? They started in the 17th century.
2. What kind of fuel did the various inventors try in the first ICEs? They tried gunpowder.
3. When did Huygens design the first ICE ? He designed it in 1678.
4. Did Huygens (manage to) build his engine? No, he didn't (manage to) build it. / He never built it.
5. Did the development of petroleum products influence the construction of the ICEs? Yes, it did.
6. When / Where did Etienne Lenoir construct / build his engine? He constructed / built it in 1860 in Paris.
7. When did the most important event in the history of ICE occur? It occurred in 1876, when Otto made / developed the first marketable four-cylinder ICE.
8. When did the combination of engine with vehicle take place? It took place in 1885.

9. What did Diesel construct and patent in 1892? He constructed and patented an ICE that used oil instead of petrol and employed the auto-ignition of fuel.
10. Why did the demand for motor cars increase after World War II? It increased because of the economical growth and the development of more efficient mass-production techniques.

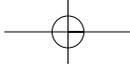
#### 4B Forming active negative and affirmative sentences in the S. Past tense.

1. They didn't start in the 15th century. They started in the 17th century. (*example*)
2. The development of the various petroleum products didn't lead to the construction of the ICEs. It led to the construction of the ICEs.
3. Lenoir didn't use natural gas as a fuel for his engine. He used illuminating gas.
4. Eugene Langen didn't make a diesel engine in cooperation with August Otto. He / They made a gas(oline) / petrol engine.
5. Benz didn't build the first marketable ICE. (It was) Otto (who) built it. / Otto did.
6. Daimler didn't put his engine on a tricycle. Benz did / (It was) Benz (who) put his engine on a tricycle.
7. The French Bouton and Trepardoux didn't build diesel engines at about 1875. They built steam vehicles.
8. The Duryea brothers didn't start their motor manufacturing company in America 20 years before Benz. They started it 7 years after him.
9. Karl Diesel didn't patent an engine that used petrol instead of oil as a fuel. He patented an engine that used oil instead of petrol.
10. The first cars didn't appear on the streets of Europe by 1930. They appeared by 1900.

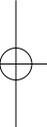
#### IN THE PASSIVE VOICE

#### 4C Forming passive sentences in the Simple Past Tense.

1. The first potatoes were brought from America in the 15th century. (*example*)
2. The right to use Daimler's engine in vehicles was given to the Peugeot firm in 1890.
3. The first American car-manufacturing company was established by the Duryea brothers.
4. The first oil-driven engine was made by Diesel in 1892.
5. 2,500 cars were made by Benz's car-manufacturing company by 1900.
6. Mass production was not invented by Henry Ford. A musket production was standardized by Eli Whitney in North America, as early as 1798.
7. All British vehicle companies were merged to form British Leyland in the 1960s, which became Rover in 1986, and was bought by BMW in 1994.



8. How many cars were manufactured in Japan last year?
9. The carburettor was not adjusted properly.
10. When were the first catalytic converters installed?
11. Before World War I, the world trade in cars was dominated by the Americans.



# UNIT 4

## New developments in the car industry

### 1. Listening Activity

The text to be read to the students.

**Note** The **words in the parentheses** are the **wrong** words to be underlined in the Ss' book. So, the teacher should be very careful, when reading the text to the Ss, **not** to **read** them, too. The **correct words** to read are the **bold-typed** words before the words in italics.

The two oil **crises** (*crimes*) of the 1970s that were accompanied by **increases** (*decreases*) in the price of oil, as well as the concerns about the environmental **pollution** (*delusion*) have had a major impact on the **motor** (*rotor*) industry.

In an effort to develop energy-**saving** (*solving*) vehicles, car manufacturers have drastically reduced the weight of their cars by using **lighter** (*tighter*) materials in their construction, such as lightweight steel, aluminium, **plastics** (*elastics*), and magnesium. They have also reduced the **size** (*rise*) of their models. Front-wheel drive technology, which allows more passenger and cargo **space** (*place*) in the interior of smaller cars, has been adopted by **carmakers** (*canmakers*) worldwide, replacing the rear-drive arrangement which was commonly used in the motor industry's earlier **days** (*bays*).

In an attempt to reduce dependence on oil, new **types** (*tyres*) of fuel have been used. Such fuels are the butane, the natural gas and the bio-gas. Their use, however, is limited as they are **highly** (*rightly*) explosive. Among alternatives to petrol engines, Wankel and diesel engines **appeared** (*appealed*) the most promising. The Wankel rotary engine, however, remained a **low-** (*raw-*) production as it was less fuel-efficient. The production of Diesel V-8, V-10 and V-12 engines, which appeared in the **late** (*date*) 70s and were used increasingly during the early 80s because of the engine's **superior** (*inferior*) fuel economy, also remained low due to the concern that diesel exhaust may **contain** (*complain*) carcinogens.

In addition, the increasing environmental concerns over the **harmful** (*useful*) gas emissions led up to the use of unleaded fuel and the installation of emission **controls** (*petrols*) and catalytic converters to all cars produced after 1985.

**Suggestion** Some of the phrases to be translated into English, those in paragraphs 1-2 and 3-4 in Exercise **2A**, as well as the comprehension questions 1-5 in Exercise **2B** (in the “Reading comprehension” section of this unit) correspond to the listening text, so the teacher could use them as a follow-up activity to it.

## 2. Reading comprehension

### 2A Greek - English equivalent terms and phrases.

#### 1st and 2nd paragraphs

1. πετρελαϊκές κρίσεις: oil crises
2. ανησυχίες σχετικά με τη μόλυνση του περιβάλλοντος: concerns about the environmental pollution
3. οχήματα που εξοικονομούν ενέργεια: energy saving vehicles
4. τεχνολογία (αυτοκινήτων) με μπροστινή / πίσω κίνηση: front / rear drive technology
5. χώρος επιβατών και φορτίου: passenger and cargo space
6. ...υιοθετήθηκε από τους κατασκευαστές αυτοκινήτων σε ολόκληρο τον κόσμο: ... has been adopted by car manufacturers worldwide

#### 3rd and 4th paragraphs

1. σε μια προσπάθεια μείωσης της εξάρτησης από το πετρέλαιο...: in an attempt to reduce dependence on oil...
2. ανάμεσα στα πιθανά υποκατάστατα / τις πιθανές εναλλακτικές λύσεις υποκατάστασης της βενζινομηχανής...: among alternatives to petrol engines...
3. ... φαίνονταν οι πιο πολλά υποσχόμενοι / ελπιδοφόροι: ... appeared the most promising
4. η παραγωγή του παρέμεινε σε χαμηλά επίπεδα: its production remained a low production
5. βλαβερές εκπομπές καυσαερίων: harmful gas emissions
6. αμόλυβδη βενζίνη: unleaded gasoline / fuel
7. ...εγκατάσταση συστημάτων ελέγχου εκπομπών καυσαερίων και καταλυτών: ... installation of emission controls and catalytic converters

#### 5th and 6th paragraphs

1. ... να εξαλείψει τις βλαβερές επιπτώσεις των εκπομπών καυσαερίων στο περιβάλλον: ...to eliminate the harmful effect(s) of gas emissions on the environment

2. επαναφορτιζόμενη μπαταρία: rechargeable battery
3. αυτοκίνητα πόλης: city cars
4. για να ξεπεραστούν τα μειονεκτήματα: to overcome the drawbacks
5. υβριδικά οχήματα καυσίμου-μπαταρίας: fuel-cell hybrid cars / vehicles
6. ηλεκτρικός κινητήρας: electric motor

7th and 8th paragraphs

1. το πρώτο υβριδικό αυτοκίνητο μαζικής παραγωγής προωθήθηκε / λανσαρίστηκε στην αγορά: the first mass produced hybrid car was launched
2. λογισμικό / πρόγραμμα ηλεκτρονικού υπολογιστή: computer software
3. πηγή ενέργειας / ισχύος: power source
4. το αυτοκίνητο επιταχύνει: the car is accelerating
5. το αυτοκίνητο ξεκινά: the car is pulling away
6. μέγιστη ταχύτητα: maximum speed
7. το αυτοκίνητο φρενάρει: the car is braking
8. ... αποτελεί / είναι μια μεγάλη πρόκληση: ... (it) is a great challenge
9. Τα οικολογικά αυτοκίνητα θα συμβάλλουν σε ένα καθαρότερο περιβάλλον: The "green" cars will contribute to a cleaner environment.

**2B The answers to the questions.**

1. The oil crises of the 70s that were accompanied by increases in the price of oil and the concerns about the increasing environmental pollution.
2. The increases in the price of oil made manufacturers reduce the size and weight of their cars so as to become lighter and thus more energy saving. To reduce the size, they have adopted the front-wheel drive technology, while to reduce the weight, they have started using lighter materials, such as lightweight steel, aluminium, plastics and magnesium. They have also tried new types of fuel, such as the butane, natural gas and bio-gas and other types of engines, such as the diesel and Wankel rotary engines.  
To eliminate the impact of gas emissions on the environment, modern cars use unleaded fuel and have been equipped with emission controls and catalytic converters. Research is being made on new fuel sources, such as the liquid and pure hydrogen and the development of a clean hydrocarbon fuel. Car manufacturers have also constructed electric and fuel-cell hybrid cars.
3. Because it allows more passenger and cargo space in the interior of cars, and as a result, it makes the construction of smaller (and consequently lighter) cars possible.

4. They are highly explosive.
5. Because the Wankel engine is not enough fuel-efficient / energy saving. As for the diesel engines, there is a possibility that the diesel exhaust gases may contain carcinogens.
6. That they are powered by both an ICE and an electric motor. So, they can use their electric motor in the cities eliminating the harmful emissions, (like the electric cars), and their ICE / fuel engine outside the cities or when they run at high speed, which enables them to go faster than the electric cars. Their batteries are smaller allowing more passenger and cargo space in the interior of cars and, as their motor is charged by the ICE, they don't need external charging.
7. It is powered by both a petrol engine and an electric motor. It can use either the one or the other depending on the driving conditions. The choice of the power source used is controlled by a computer. When the petrol engine is used, the car can reach a maximum speed of 160 km. The battery of the car is charged by the petrol engine and when the car is braking. As a result, the battery is not very large, so the car has enough space for five passengers and their luggage. The price of the car is almost the same as that of a family saloon.

### 3. Vocabulary practice

#### 3A Definitions

##### a. Verbs

1 - g    2 - e    3 - a    4 - f    5 - b    6 - d    7 - c

##### b. Nouns

**Group A:** 1-d    2-f    3-e    4-b    5-a    6-c

**Group B:** 1-f    2-d    3-a    4-c    5-b    6-e

#### 3B Pairs of antonyms

##### Group A

maximum – minimum	frequent – rare
quick; rapid – low	front – rear
practical – impractical	high – low
expensive – cheap	new – old

**Group B**

leaded – unleaded

superior – inferior

light – heavy

harmful – harmless

small – big; large

external – internal

early – late

interior - exterior

**3C Pairs of synonyms.**

effort – attempt

cell – battery

disadvantage – drawback

space – room

impact – effect,

advance – development

luggage – baggage

aim – purpose; goal

**3D Prepositions.**

1. on – with – of

7. over – on

2. in – to

8. in – of – for – to

3. about – on

9. to – for

4. by – of

10. by – in

5. in – to – with

11. of – in

6. at

**4. Use of English****Simple Present Perfect Tense****4A Using the correct verbs.**

1. ...has ... known...?

6. Have you ever visited...?

2. ...hasn't replaced...

7. ... have sold...

3. ... has taken...

8. ... has gone....

4. Have you finished...?

9. Have you ever thought...?

5. ...has just arrived

10. ... have never driven

**4B Choosing the correct verb tense.**

1. studied – finished – has gone

4. Have you seen – I haven't – met

2. did you go

5. have known – were – lived

3. left – has (recently) found

6. found – has gone

## Simple Future Tense

### 4C Using the appropriate verb.

1. will take
2. will replace
3. will switch off
4. will pass
5. will phone
6. will do
7. will not / won't fly
8. will increase
9. will ... arrive?
10. won't buy
11. will fall – will last
12. will finish

### 4D Forming the verbs in the correct tense and form.

1. have ... been...
2. will not fail
3. comes – took / has taken
4. will emerge – will disappear
5. didn't have
6. have (just) sold – will buy
7. did ... go
8. will finish
9. Have ... (ever) checked - bought
10. misses – arrives – will fire
11. will go
12. have lived – got – lives – have (recently) moved
13. will get
14. Do ...know – operates?

# UNIT 5

## The petrol reciprocating engine

### A. The structure of the petrol reciprocating engine

#### TASK 1



#### A. The upper engine: το επάνω μέρος του κινητήρα or

##### The cylinder head: κυλινδροκεφαλή

upper half: πάνω μισό της κυλινδροκεφαλής

lower half: κάτω μισό της κυλινδροκεφαλής

cylinder head cover: κάλυμμα καπάκι κυλινδροκεφαλής

gasket: φλάντζα, τσιμούχα

oilways: αύλακες λίπανσης

twin camshafts: διπλοί εκκεντροφόροι άξονες

bearing: κουζινέτο

camshaft carrier: φορέας εκκεντροφόρων αξόνων

valves assembly: συγκρότημα/σύστημα βαλβίδων και πιανόλας

valve: βαλβίδα

valve tappet: πλήκτρο βαλβίδας, καπελότο

valve guide: οδηγός βαλβίδας

valve spring: ελατήριο βαλβίδας

spark plug: σπινθηριστής, μπουζί

spark-plug well: θήκη, υποδοχή του μπουζί

#### B. Lower engine: το κάτω μέρος του κινητήρα

sealing gasket: εμφρακτικό παρέμβυσμα, τσιμούχα, φλάντζα

cylinder block: συγκρότημα κυλίνδρων, το μπλοκ της μηχανής

cylinders: κύλινδροι

pistons: έμβολα, πιστόνια

piston rings: ελατήρια, δακτύλιοι στεγανότητας εμβόλου

connecting rod: διωστήρας, μπιέλα

connecting-rod cap: καπάκι διωστήρα / μπιέλας

intermediate section: μεσαίο, ενδιάμεσο τμήμα / μέρος

crankshaft: στροφαλοφόρος άξονας  
 flywheel: σφόνδυλος, βολάν  
 oil sump / oil pan: ελαιολεκάνη, κάρτερ

**TASK 2**



**A. Upper engine**

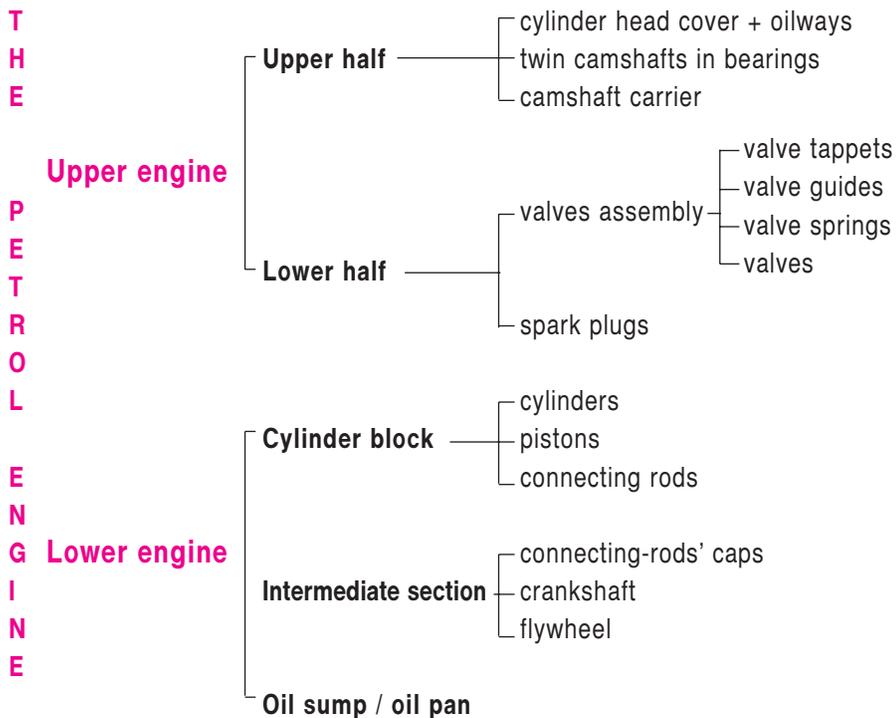
First paragraph: camshafts - valves - spark plugs  
Second paragraph: valve tappets - valve springs - valve guides - valves - head  
Third paragraph: assembly  
Fourth paragraph: cover

**B. The lower engine**

First paragraph: cylinder block - section - crankshaft - oil pan / oil sump  
Second paragraph: cylinders. - pistons. - connecting rods - crankshaft. - bearings  
Third paragraph: motion - flywheel  
Fifth paragraph: oil sump / oil pan

**1. Reading comprehension**

**1A The diagram completed.**



**1B The answers to the questions.****a) About the upper engine**

1. It is made of aluminium.
2. They have two camshafts which are located in the upper part of the cylinder head. Each camshaft is installed in six bearings / bearing caps on the camshaft carrier, over the valves assembly.
3. It functions as a cover for the valves and the spark plugs. (The underside of its cover is equipped with oilways which supply the camshafts and valves assembly with oil).
4. By means of a cover located over their wells.

**b) About the lower engine**

1. By (means of) a sealing gasket.
2. It is made either of cast iron or of aluminium.
3. The motion of the pistons is reciprocating and that of the crankshaft rotary.
4. To / They connect the crankshaft to the pistons.
5. By means of the flywheel.
6. To reduce friction.
7. It is located at the bottom of the engine, under the crankshaft, and it contains the oil which is pumped inside the engine to lubricate its moving parts.

**2. Vocabulary Practice****2A Matching.**

1 – c (εγκαθιστώ),

2 – e (προστατεύω)

3 – a (διανέμω, μοιράζω),

4 – g (λειτουργώ),

5 – b (προμηθεύω, παρέχω)

6 – d (δια- / ξε-)χωρίζω),

7 – f (σφραγίζω, φράζω)

**2B Pairs of synonyms.****A. Verbs**

guarantee - assure; secure

supply - provide; give

connect - link; join

reduce - decrease; lessen

include - contain; comprise

install - fix; locate

**B. Nouns – Adjectives**

axle; shaft - rod

part; compartment - section

double - twin

oil pan - oil sump

basic; essential - main

component; element -part

convert - change; transform      straight - direct  
 function - act; work; operate  
 transfer - transmit; carry

## 2C Pairs of antonyms.

distribute - gather; collect      lower - upper  
 separate - join; link      reduce - increase  
 bottom - top

## 2D Word formation

### a. Derivatives

Verb	Noun	Verb	Noun
cover	cover	move	move; movement; motion
convert	conversion	connect	connection
distribute	distribution	install	installation
function	function	supply	supply
protect	protection	guarantee	guarantee
pump	pump	lubricate	lubrication
spark	spark	seal	seal
transfer	transfer; transference	reduce	reduction

### b. The prefix trans-

1. **trans-** = b) across; on the other side of; beyond

2. **Words beginning with trans-**

**Suggestion** Help the students produce as many words as possible by providing them with the second part of the word or its Greek equivalent.

transatlantic, transcontinental, transcribe, transcript, transcription, transference, transfigure, transfiguration, transform, transformation, transformer, transfuse, transfusion, translucent, translucency, transistor, transit, transition, translate, translation, translator, transmission, transmit, transmitter, transoceanic, transparent, transparence, transparency, transportation

### 3. Language functions

**Either ... or... and neither ... nor...**

**The sentences competed.**

- .....ή ... ή.../ ...είτε... είτε...
- .....ΟΥΤΕ ...ΟΥΤΕ

#### Practice

Either ... or ... in sentences: 2, 5, 6, 9, 11

Neither ... nor ...in sentences: 1, 2, 3, 4, 6, 7, 8, 10

### 4. Use of English

**The S. Present tense in Active and Passive Voice (for general truths)**

#### IN THE ACTIVE VOICE

**4A Producing affirmative, interrogative or negative active sentences in S. Present.**

- Does a ship's engine use petrol as a fuel ? No, it uses diesel oil.
- Do electric car batteries need frequent recharging?
- Car emissions pollute the environment seriously.
- As the pistons reciprocate, the connecting rods pivot from side to side and turn the crankshaft.
- Does the increase in the number of valves result in better combustion?
- Do the valves operate with the help of the crankshaft? No, they don't. They operate with the help of the camshafts.
- Oil flows through the moving parts of the engine to lubricate them.
- Catalytic converters reduce the amount of harmful exhaust gases that are released into the atmosphere.
- The upper half of the cylinder head also functions as a cover for the valves assembly and the spark plugs.
- Do fuel-cell hybrid cars cost a lot? No, they cost a little more than a family saloon.
- When a hybrid car runs at low speed, it uses its battery.
- An electron doesn't carry a positive electric charge. It carries a negative one.

**IN THE PASSIVE VOICE****4B Forming the verbs in the parentheses appropriately.**

- |                          |                           |
|--------------------------|---------------------------|
| 1. is made               | 7. is not self-ignited    |
| 2. is charged            | 8. are ... influenced...? |
| 3. are installed         | 9. are fitted             |
| 4. ... is ... prevented? | 10. is not allowed        |
| 5. are not used          | 11. ...are ... protected  |
| 6. is transferred        | 12. are operated          |

**B. Extra information about the engine's components****TASK****The components the information in the paragraphs refers to.**

- Paragraph 1 refers to the valves.  
 Paragraph 2 refers to the pistons.  
 Paragraph 3 refers to the connecting rods and the gudgeon pin.  
 Paragraph 4 refers to the oil sump / oil pan.  
 Paragraph 5 refers to the flywheel and the starter motor.  
 Paragraph 6 refers to the camshafts.  
 Paragraph 7 refers to the crankshaft.

**The gaps completed.**

- |                                     |                                      |
|-------------------------------------|--------------------------------------|
| 1. valves, valves                   | 5. flywheel, flywheel, starter motor |
| 2. piston, piston                   | 6. camshaft                          |
| 3. connecting rods, connecting rods | 7. crankshaft, crankshaft            |
| 4. oil sump/pan                     |                                      |

**1. Reading comprehension****1A Matching.**

- 1-f (μέταλλο ή ελαστικό)  
 2-g (χυτό σφυρήλατο ατσάλι)  
 3-d (σφυρήλατο ατσάλι)

- 4-e (πρεσαρισμένος χάλυβας / χυτό αλουμίνιο)
- 5-b (χυτοσίδηρος ή βαμμένο ατσάλι)
- 6-a (κράμα χάλυβα υψηλής αντοχής σε θερμική καταπόνηση)
- 7-c (κράμα ελαφρού αλουμινίου)

### 1B The sentences corrected.

**Note** *The correct words are given in bold-typed letters.*

1. The valves are opened and closed with the help of the **(twin) camshaft(s)**.
2. Since each piston must reciprocate inside the cylinder about **100** times per second when the car runs at maximum speed, it must be strong and **light**.
3. On their upper end, the connecting rods are linked to **the pistons** by means of the **gudgeon pins** and on their lower end, they are bolted to their **caps**.
4. As it flows through the moving parts of the engine to lubricate them, the oil (absorbs part of the heat produced by combustion and **cools the engine**) / **decreases / lowers** the temperature of the engine.
5. One side of the flywheel is bolted to the **crankshaft**; the other side is connected to the **clutch**; the gear teeth at the outer edge of the wheel are engaged to the **starter motor**.
6. The **starter motor** draws power from the **(storage) battery** and sets the engine in motion **before** combustion can take place in one of the cylinders and power is developed.
7. The twin camshafts are driven by the crankshaft by means of the **timing belt / a chain or a single toothed rubber belt**, which also drives the **coolant** pump.
8. Between the connecting rods and the camshaft there are **six** main bearings of the **low**-friction type.

### 1C The answers to the questions.

1. The installation of more than two valves per cylinder improves the breathing of the engine and results in better combustion of the fuel-air mixture, which improves the efficiency of the engine.
2. They fill the gap between the piston and the cylinder wall and prevent the pressure of combustion from escaping past the piston in the cylinder, which would cause loss of power.
3. They allow the pistons to move up and down while the connecting rods pivot from side to side turning the crankshaft. ( In this way, the reciprocating motion of the piston is converted to the rotary motion of the crankshaft).

4. To help the oil that is collected in it (*after lubricating the moving parts of the engine*) release part of the heat it has absorbed (*while flowing through the engine*) in the surrounding air. / To permit the easy cooling of the oil that lubricates the moving parts of the engine and is collected in it.
5. It is started by the starter motor which is engaged to the gear teeth that are on the outer edge of the flywheel. As soon as the ignition switch is turned on / closed (*when the key is turned*), the starter motor is actuated. As it starts rotating, it turns the flywheel, which (*being bolted to the crankshaft*) turns the crankshaft, which moves the pistons. One of the pistons, moving upwards, compresses the fuel/air mixture in the cylinder. The fuel is ignited by a spark and the engine starts operating.
6. It is maintained thanks to the automatic belt tensioner.
7. To permit them to rotate freely.
8. The inner of the two spline joints drives the oil pump; the outer joint carries the timing belt pulley and the vibration damper.

## 2. Vocabulary practice

### 2A Gap filling.

- |               |                 |
|---------------|-----------------|
| 1. horizontal | 6. edge         |
| 2. vertical   | 7. saw          |
| 3. inclined   | 8. vibration    |
| 4. angles     | 9. casing       |
| 5. surface    | 10. surrounding |

### 2B Matching.

- 1 - g    2 - c    3 - e    4 - b    5 - f    6 - a    7 - h    8 - d

### 2C The defined items.

- |                      |                              |
|----------------------|------------------------------|
| 1. The clutch        | 6. The timing belt           |
| 2. The starter motor | 7. The oil pump              |
| 3. The gudgeon pin   | 8. The spline joints         |
| 4. The coolant pump  | 9. The timing-belt tensioner |
| 5. The bearings      | 10. The vibration damper     |

**Their Greek equivalent.**

- |                                     |                                      |
|-------------------------------------|--------------------------------------|
| 1. συμπλέκτης, αμπραγιάζ            | 6. ιμάντας (χρονισμού) εκκεντροφόρου |
| 2. μοτέρ εκκίνησης, μίζα, εκκινητής | 7. αντλία λαδιού                     |
| 3. πείρος εμβόλου                   | 8. σύνδεσμοι καρέ με αυλακώσεις      |
| 4. αντλία νερού                     | 9. εντατήρας ιμάντα εκκεντροφόρου    |
| 5. κουζινέτο                        | 10. αποσβεστήρας κραδασμών           |

**2D Prepositions.**

- |             |            |
|-------------|------------|
| 1. per      | 6. of      |
| 2. into     | 7. of      |
| 3. with, on | 8. by      |
| 4. per      | 9. through |
| 5. from     | 10. at, of |

**3. Language functions****Expressing how something is done (the means or instrument)****Practice**

- |  |                                   |
|--|-----------------------------------|
| 1. by means of / via                             | 8. by / with the help of          |
| 2. with the help of / by - through / by means of | 9. by means of / with the help of |
| 3. by  | 10. by means of                   |
| 4. by / by means of                              | 11. by means of / via             |
| 5. via / by means of                             | 12. via / through / by means of   |
| 6. via / through                                 | 13. via / by                      |
| 7. by - by means of / by                         |                                   |

**4. Use of English****Wh\_ questions****4A Pair work**

- Example*
- When did the experiments with internal combustion start?  
They started in the 17<sup>th</sup> century.
- Who built the first marketable ICE?  
Nikolaus August Otto in 1876.
- What vehicle did Karl Benz use to install his engine?  
He used a tricycle.

5. Where was Karl Diesel from?  
He was from Germany.
6. When did the first cars appear on the streets of Europe?  
They appeared in the beginning of the 20th century / By 1900.
7. Which part of the engine does the crankshaft belong to?  
The crankshaft belongs to the (intermediate section of the) lower engine / cylinder block.
8. How is the reciprocating motion of the pistons converted to the rotary motion of the crankshaft?  
By means of the connecting rods (and the gudgeon pins).
9. How many main bearings does a crankshaft have?  
It has six.
10. How is the camshaft driven?  
It is driven by the crankshaft by means of the timing belt.
11. What is the function of the valve tappets?  
To keep / They keep the valves in contact with the camshaft and at a steady / fixed distance from it.
12. How do the valves operate?  
They operate with the help of the twin camshafts through the hydraulic tappets.
13. Where are the spark plugs located?  
On the top of each cylinder.

#### 4B Asking questions.

1. What do the piston rings fill?  
What has the technician just installed?
2. Who has just installed the new oil sump?  
What has the technician just installed?
3. What / Which part of the engine transmits the power of the engine to the clutch?  
Where does the flywheel transmit the power of the engine (to)?
4. What are the valve tappets filled with?  
What is filled with oil?
5. Who started the American motor company?  
What did the Duryea brothers start?
6. Whose car / What will they take to the Smith's car-repair workshop?  
Where will they take George's car?
7. Who employed Paul?  
Who did the Personnel Manager employ?

8. What will cost me / you 230,000 drachmas?  
How much will the repair cost me / you?
9. Who sold his car for 3 million drachmas?  
What did your uncle sell?  
How much did your uncle sell his car?
10. Who should have bought a pick-up truck?  
What (kind of car) should he have bought?
11. What (type of fuel) does the engine of trucks, trains and ships operate on?
12. Who is discussing the matter with the Production Manager in his office?  
Who is the Personnel Manager discussing the matter with?  
What is the Personnel Manager discussing with the Production Manager in his office?  
Where is the Personnel Manager discussing the matter with the Production Manager? / Where are the Personnel and the Production Managers discussing the matter?
13. Who arrived at work an hour late today?  
Where did John arrive (an hour) late today?  
When did John arrive at work (an hour late)?  
How late did John arrive at work today? / How late was John at work today?
14. What must / should I check before my trip to Spain?

# UNIT 6

## The valves and their tappets

### 1. Reading comprehension

#### 1A The answers to the questions.

1. They are operated / opened and closed with the help of the camshafts, by means of the hydraulic tappets. When the camshaft lobe operates on a valve tappet, the valve is pressed down and opens the port in the engine cylinder (either to let air enter the engine or to let the burnt gases out). When a valve tappet is in contact with the base cycle of the cam, the valve spring draws the valve upwards closing the port in the engine cylinder.
2. It means that the cam(shaft) lobe presses the tappet down.
3. They secure the correct operation of the valves by maintaining a steady / always the same / the correct distance between the valves and the camshaft.
4. There is one tappet for each valve, so their number depends on the number of valves that the engine has / is fitted with.
5. No, they don't. They are self-adjusting.
6. The tappet includes a cylinder inside which there is a piston, a spring and a non-return valve. There is a series of holes in the tappet's side – *through which (holes) the oil enters the tappet* – a slot in the top of the tappet (cylinder) – *through which (slot) the oil enters the (tappet) cylinder-*, and a hole at the bottom of the cylinder – *through which (hole) the oil leaves the tappet and flows to the valve.*
7. The oil comes from the camshaft carrier oilways, enters the tappet flowing through a groove and a series of holes in the tappet's side, passes through a slot in the top of the tappet cylinder and flows into the piston, which is under the slot, and so it enters the tappet cylinder. It (the oil) leaves the tappet cylinder through a hole at the bottom of the cylinder and flows to the valve, that is in contact with the tappet, lubricating it.
8. By means of the spring in the tappet cylinder that pushes the tappets upwards.
9. The lower part of the piston in the tappet's cylinder is in contact with the valve

(guide); so, when the tappet is operated by the cam(shaft) lobe, the piston presses the valve down to open the port in the engine's cylinder.

The non-return valve prevents the oil in the tappet cylinder from escaping back to the camshaft carrier oilways when the camshaft is operating the tappet/ when the cam(shaft) lobe presses the tappet down (and the oil pressure in the tappet cylinder is higher than the oil pressure in the engine).

10. When the holes in the tappet's side and the non-return valve in the tappet's cylinder are open. This happens when the tappet is in contact with the base cycle of the camshaft, that is, when the oil pressure in the tappet cylinder is lower than the oil pressure in the engine.

### 1B Joining parts of sentences.

1 - b      2 - a      3 - a      4 - b      5 - b      6 - a

### 1C The paragraphs completed.

#### 1st paragraph

- |             |            |
|-------------|------------|
| 1. tappets  | 6. spring  |
| 2. valves   | 7. up      |
| 3. contact  | 8. lobe    |
| 4. distance | 9. located |
| 5. piston   | 10. oil    |

#### 2nd paragraph

- |            |           |
|------------|-----------|
| 1. oilways | 4. enters |
| 2. groove  | 5. under  |
| 3. slot    |           |

#### 3rd paragraph

- |             |              |
|-------------|--------------|
| 1. rotates  | 6. increases |
| 2. down     | 7. engine    |
| 3. holes    | 8. closes    |
| 4. oil      | 9. open      |
| 5. camshaft |              |

#### 4th and 5th paragraphs

- |               |                    |
|---------------|--------------------|
| 1. spring     | 6. tappet cylinder |
| 2. base cycle | 7. spring          |
| 3. opens      | 8. close           |
| 4. higher     | 9. lobe            |
| 5. non-return |                    |

## 2. Vocabulary Practice

### 2A Matching.

**GROUP A (Verbs):** 1-e 2-b 3-g 4-c 5-d 6-f 7-a  
**GROUP B (Nouns, adjectives):** 1-c 2-e 3-f 4-b 5-a 6-d

### 2B Gap filling.

- |                                |             |
|--------------------------------|-------------|
| 1. prevents                    | 6. slot     |
| 2. solid                       | 7. grooves  |
| 3. contact - lobe              | 8. maintain |
| 4. adjust - hydraulic - ensure | 9. draw     |
| 5. admits - flow               |             |

### 2C English terms.

- hydraulic tappet / the piston in the tappet cylinder
- burnt gases
- self- adjusting
- non-return valve
- cam(shaft) lobe
- solid

## 3. Use of English

### Second Conditional

#### B. The correct alternatives.

1. a, c                      2. b, d, e                      3. a, c

#### C. The table (gap filling)

**USE:** present - future  
 unreal - improbable - imaginary  
 suggestion - advice

**STRUCTURE:** If + Past tense, → would, could, might + infinitive

#### D. Filling the gaps with the correct verb tense.

- didn't close - would escape
- didn't draw - would remain
- had - might get

4. weren't fitted - wouldn't be
5. woke up - could catch, wouldn't be
6. passed - might go
7. didn't rise, - would / might construct
8. didn't pollute, - might not experiment
9. used, - would decrease
10. weren't concerned, - wouldn't remain
11. didn't pivot - wouldn't become
12. had - would / might buy

# UNIT 7

## The four-stroke engine operation cycle

### 1. Reading comprehension

- 1A**
1. Nikolaus August Otto.
  2. Yes, they do.
  3. Four strokes. Two upwards and two downwards.
  4. On the induction stroke.
  5. When the valves open, while at the same time air enters the cylinder.
  6. No, they remain closed.
  7. The compression stroke. In the combustion chamber.
  8. On the power stroke.
  9. The Top Dead Centre.
  10. On the exhaust stroke.
- 1B**
- |                           |                |
|---------------------------|----------------|
| 1. four-stroke            | 5. compression |
| 2. two, down              | 6. vaporizes   |
| 3. air, ignited, expelled | 7. spark plug  |
| 4. close, camshaft        | 8. shut, open  |
| 5. compression            |                |

### 2. Vocabulary practice

- 2A** gasoline – petrol  
 ignited – set on fire  
 expelled – forced out  
 induction – inlet/intake  
 inject – force (a liquid, gas etc) into  
 vaporize – cause a (liquid) to be changed into vapour  
 shut – closed  
 expansion – the process of expanding/becoming larger

- 2B**
- |               |                   |
|---------------|-------------------|
| 1. invented   | 5. stroke         |
| 2. marketable | 6. compressing    |
| 3. expelled   | 7. rises          |
| 4. fuel       | 8. exhaust (pipe) |

- 2C**
- |       |       |       |
|-------|-------|-------|
| a - 4 | d - 7 | g - 8 |
| b - 6 | e - 3 | h - 5 |
| c - 1 | f - 9 | i - 2 |

### 3. Language functions

#### Suggested answers

- |                     |                   |
|---------------------|-------------------|
| 1. First            | 7. Then           |
| 2. after that       | 8. before         |
| 3. During           | 9. Next           |
| 4. while            | 10. At the moment |
| 5. at the same time | 11. When          |
| 6. As soon as       |                   |

### 4. Use of English

- |                   |                             |
|-------------------|-----------------------------|
| 1. work           | 6. take                     |
| 2. moves          | 7. Do (they) produce        |
| 3. are installing | 8. does (the seminar) start |
| 4. is using       | 9. is checking              |
| 5. restarts       | 10. Are (they) designing    |



cooled	≠	heated
start	≠	stop
operate	≠	stall
inlet	≠	outlet
cold	≠	hot
surplus	≠	shortage

### 3. Language functions

#### suggested answers

- (a-2) If/When you tighten the fuel line bolts to the fuel system, use a torque wrench.
- (b-4) If/In case some fuel gets in your eyes while changing the fuel filter, flush them with plenty of clear water.
- (c-1) If/when you maintain the fuel system, have a fire extinguisher within easy reach.
- (d-3) If/When/In case the pressure becomes too high the overflow valve opens.
- (e-6) If/In case/As long as there is a surplus of fuel, it returns to the fuel tank via the return pipe.
- (f-7) Provided/If/As long as/On condition that you use the suitable tools for fuel system maintenance, you'll have the desired result.
- (g-5) Don't install the new filter, unless you ensure that there is sufficient clearance between the fuel filter, lines and any other parts.

### 4. Useful Phrases

1. fuel must reach the injectors through a distribution system which consists of
2. to counteract negative pressure
3. non-return valve
4. when the engine is running / operating
5. the engine stalls
6. minimize the risk of fire
7. (it) maintains the fuel pressure
8. (it) is dependent on/depends on how long the injectors are open
9. the control module grounds the injectors
10. cold start
11. atomized fuel
12. in droplet form

# UNIT 9

## The engine-management system

### 1. Reading comprehension

#### 1A True - false sentences.

True sentences: 1, 5      False sentences: 2, 3, 4, 6

#### The false sentences corrected.

2. The ECU monitors **not** only the functions of the engine, **but of the other car systems, as well.**

Or: The ECU monitors the functions of **both** the engine **and the** other car systems.

3. The sensors are placed in **various positions in the car** and send the information they collect to the ECU in the form of electrical signals.
4. The various values that are stored in the memory of the microprocessor and according to which the ECU controls the operation of the engine and the other car systems **depend on the technical features of the car the ECU is fitted to (its size, model, etc).**
6. Engines equipped with an engine management system have a better performance, they consume **less** fuel and need **less** maintenance.

#### 1B The answers to the questions

1. The sensors are fitted in different positions around the car to monitor the functions / running conditions / performance of the engine and the operation of the various car systems. They send the information they collect to the ECU in the form of electrical signals. The electronic control modules, the ECU is connected to, control the operation of the engine and the related car systems responding to orders that are sent to them by the ECU in the form of electric signals.
2. The electronic control unit continuously receives electrical signals from the sensors which are fitted in different positions around the car. These signals inform it (*the ECU*) how the engine is running and the various car systems operate at each particular instant. The ECU processes these signals / compares these signals to the values stored in its memory and so, it "knows" exactly what it is needed so that the engine and the various systems operate

correctly. It, then, gives commands / orders (*in the form of electrical signals again*) to the various control modules it is connected to on what to do. The control modules carry out / execute the commands (*sent to them by the ECU*) and so, they control the functions of the engine and the operation of the related systems appropriately.

3. It means that the electronic control unit of each car model is programmed by the manufacturers differently to adapt to the requirements of this specific model. That is, it is programmed to compare the information received from the sensors (it is connected to) to (the) specific values stored in its memory by the manufacturers. These values differ from model to model, depending on its technical features/characteristics. The ECU also refers to these (specific) values in order to send the appropriate electrical signals / commands to the various (secondary) control modules to which it is connected, so as to control the operation of the / this specific engine and its related systems correctly.
4. It controls the amount of air and fuel that enter the combustion chamber, the correct time for injecting the fuel and for producing the spark that will ignite it in a cylinder, the operation of the fuel and oil pump, the temperature and speed (rpm) of the engine, the flow of coolant, the operation of the air-conditioning, etc.
5. It's a special program run by the electronic control unit which, by processing the signals sent (to the ECU) by the sensors, identifies any malfunction and stores information about it. In this way, it indicates / can indicate the faulty component or system and the kind of repair needed. A car fitted with an engine-management system is characterized by better performance and fuel economy, needs less maintenance and is more reliable compared to a similar one without it.

## 2. Vocabulary practice

### 2A Matching.

**Verbs:** 1 - e    2 - c    3 - a    4 - g    5 - d    6 - b    7 - f

**Nouns:** 1 - d    2 - e    3 - a    4 - c    5 - f    6 - b

### 2B Gap filling.

- |                        |                                       |
|------------------------|---------------------------------------|
| 1. malfunction         | 4. indicates                          |
| 2. monitors controls   | 5. sensor, refers, processes, instant |
| 3. adapted, management | 6. fitted, calculation(s)             |

**2C Groups of similar in meaning words.**

modern	faulty	appropriate
up to date	defective	proper
recent	imperfect	right
new	wrong	suitable
particular	fitted	reliable
definite	located	trustworthy
especial	fixed	dependable
specific	placed	

**2D Odd-one out**

- |              |           |
|--------------|-----------|
| 1. prevent   | 4. match  |
| 2. repair    | 5. define |
| 3. determine | 6. fix    |

**2E Word formation****a. The suffixes -able / -ible, -ive, -al and -ic / -ical**

Verb or noun	Adjective	Verb or noun	Adjective
environment	environmental	adjust	adjustable
adapt	adaptive	program	programmable
economy	economic, -ical	effect	effective
control	controllable	system	systematic
remove	removable	rely	reliable
progress	progressive	depend	dependable
inform	informative	person	personal
energy	energetic, -ical	permit	permissible, -ive
decide	decisive	expense	expensive, expendable
combustion	combustible	market	marketable
universe	universal	character	characteristic, -ical
convert	convertible	act	active

**Suggestion**

*It is advisable that the Teacher discusses with the Ss the meaning of the adjectives they have formed in relation to the suffix added to the verb or noun.*

**b. The prefixes un- and in-**

practical → impractical  
comfortable → uncomfortable  
reliable → unreliable  
perfect → imperfect  
appropriate → inappropriate  
pleasant → unpleasant  
responsible → irresponsible  
important → unimportant  
successfully → unsuccessfully

fortunately → unfortunately  
valuable → invaluable  
important → unimportant  
logical → illogical  
possible → impossible  
safe → unsafe  
polite → impolite  
controlled → uncontrolled  
regularly → irregularly

# UNIT 10

## The multi-point injection system

### 1. Reading comprehension

- 1A**
1. With the exactly correct proportion of fuel / air mixture.
  2. No. The proportion varies according to the operating conditions (such as the cold start, acceleration or idling).
  3. Yes, it does.
  4. Electronically. To ensure the precise timing of injection and the precise quantity of the injected fuel.
  5. Because the fuel pump provides constant pressure to the system, but the quantity of fuel needed for combustion differs according to the engine's running conditions.
  6. The computer.
  7. The diaphragm (damper / throttle) which is located in the inlet pipe.
  8. It depends on the way each driver presses the accelerator pedal.
  9. By the central control unit.

**1B** 1 - a    2 - c    3 - b    4 - a    5 - b    6 - a

### 2. Vocabulary Practice

- 2A**
- |               |                         |
|---------------|-------------------------|
| 1. attempt    | 6. hose                 |
| 2. proportion | 7. constant             |
| 3. quantity   | 8. flow                 |
| 4. injector   | 9. widespread           |
| 5. precise    | 10. accelerator (pedal) |

**2B** 1. acceleration    2. idling / iddle (engine)    3. cold start

**2C** reduce    ≠    increase  
correct    ≠    wrong

cold	≠	hot
rich (mixture)	≠	weak (mixture)
differences	≠	similarities
constant	≠	instant(aneous)
receive	≠	send
inlet	≠	outlet
connected	≠	taken apart; disconnected
better	≠	worse

### 3. Language functions

- 3A**
- |                    |                     |
|--------------------|---------------------|
| 1. which           | 5. whose            |
| 2. which / that    | 6. who              |
| 3. when / in which | 7. where / in which |
| 4. of which        | 8. that / which     |

- 3B**
- The fuel system includes injectors *which / that* spray the required quantity of fuel on the cylinder head. (*defining*)
  - Each electromagnet uses a needle *which / that* allows the injector's valve to let the fuel flow or to stop it flow. (*defining*)
  - A diaphragm, which is called "*the throttle*", adjusts the mass of air needed for combustion. (*non-defining*)
  - He is the car mechanic *who / that* changed the return hoses of my car, because the old ones were worn out. (*defining*)
  - The central control unit, *which* also regulates all the car operations, adjusts the angle of the damper and the mass of the injected fuel. (*non-defining*)
  - I think Mr Kralis, *whose* service center is near the bus station, is the suitable technician for this job. (*non-defining*)
  - Car factories have their own authorized service centers *where* you can trust your car's maintenance. (*defining*)
  - This site, *where* the old car factory stood, has now become a car park. (*non-defining*)
  - You shouldn't buy models *whose* spare parts/ the spare parts *of which* are not easily found in the market. (*defining*)
  - The accelerator pedal, *which* is operated by the driver's foot, controls the speed of a motor vehicle's engine. (*non-defining*)



# UNIT 11

## The ignition system

### 1. Reading comprehension

#### 1A The answers to the questions.

1. The old ignition system was controlled mechanically by the rotating camshaft; the new one is controlled by the electronic control unit and has neither a distributor nor an ignition coil.
2. The ignition coil, the distributor (which consists of the rotor arm and the contact breaker) the HT cables and the spark plugs.
3. On modern cars, the ignition coil was first replaced by a single electronic ignition discharge module that supplies all the spark plugs with high tension current. Recently, instead of the/ this single ignition module, modern engines have been fitted with as many electronic ignition modules as the cylinders and the spark plugs. On these engines, each spark plug is fitted with its own ignition discharge module that supplies it with the necessary HT current controlled by the ECU.
4. To convert the low-tension current produced by the car's battery, to the high-tension current which is required to produce the sparks that ignite the fuel in the combustion chamber.
5. The production of the high-tension current that, directed to / flowing through each spark plug at the correct time, produces the spark that ignites the fuel/air mixture in the combustion chamber.
6. They are controlled by the ECU which, informed by the sensors about the engine's running conditions, adjusts the basic ignition timing and decides in which order the cylinders will fire, to provide for optimum combustion and operation. For example, if one cylinder begins to knock, the ignition is retarded for that cylinder until the knock stops; and if the engine is overloaded for a long period, to prevent knocking, the ignition may be retarded on all cylinders.
7. 20,000 – 30,000 Volt.
8. To prevent voltage leakage in the engine.

## 2. Vocabulary practice

### 2A Labelling the schematic diagram

1. battery - μπαταρία
2. ignition coil - πηνίο ανάφλεξης
3. high-tension cable / lead - καλώδιο υψηλής τάσης
4. contact breaker points - σημεία επαφής πλατινών
5. distributor - διανομέας, ντιστριμπιτέρ
6. rotor arm - ράουλο διανομέα
7. HT cables / leads - καλώδια υψηλής τάσης
8. spark plugs - σπινθηριστές / μπουζί

### 2B Matching.

**Verbs:** 1 - e    2 - c    3 - a    4 - f    5 - b    6 - d

**Nouns:** 1 - e    2 - d    3 - c    4 - b    5 - a

### 2C The English equivalent terms.

- |   |   |
|---|---|
| 1. ignition switch                      | 9. ignition advance                     |
| 2. ignition timing                      | 10. discharge                           |
| 3. step-up transformer                  | 11. the engine is over- revving         |
| 4. contact breaker                      | 12. the engine is overloaded            |
| 5. on/off switch                        | 13. the engine is idling                |
| 6. low-tension voltage / current        | 14. (the engine/a cylinder is) knocking |
| 7. electronic ignition discharge module | 15. throttle opening                    |
| 8. firing order                         |   |

### 2D Synonyms - Antonyms.

#### a. Synonyms

provide - give; supply  
 rotate - turn; spin  
 convert – change  
 produce – generate  
 require – need; demand  
 achieve – fulfil; succeed  
 interrupt – break; stop  
 correct – right; appropriate  
 component – element; part  
 operation – function

#### b. Antonyms

high - low  
 complicated - simple  
 charge - discharge  
 thick – thin  
 internally - externally  
 extend - shorten  
 retard - advance  
 dependent - independent  
 slow down – accelerate; rev  
 begin - stop

### 3. Listening Activity

#### The spark plug

##### The text to be read to the students.

The spark plug consists of two electrodes, a ceramic insulator and a metal casing. The first electrode, usually referred to as the centre electrode, is connected to the cable that carries the high-tension current which is required to ignite the fuel. The centre electrode passes down the centre of the ceramic insulator. The function of the ceramic insulator is to stop electricity from leaking to the metal casing which is around its lower part. The metal casing ends to a thread by means of which the spark plug is screwed into the cylinder head, at the top of the combustion chamber. The second electrode, known as side electrode, is fixed in the casing. The side electrode is earthed to the engine through the casing, thus completing the HT circuit.

The tip of the side electrode is separated from the tip of the centre electrode by a small air gap. As the HT current flows down the centre electrode, it jumps the air gap creating a spark, which produces the necessary heat to ignite the highly compressed fuel/air mixture in the combustion chamber.

#### STEP 2



##### The completed terms.

2. ceramic **insulator**    3. metal **casing**    5. centre **electrode**    6. side **electrode**

#### Follow up

##### The answer to the questions.

- It insulates the centre electrode and stops the HT current (*that this electrode carries*) from leaking to the metal casing and, through it, to the engine.
- The fuel is ignited by the heat produced by the spark, not by the spark itself.
- As the lower part of the metal casing is threaded, it functions as a screw by means of which the spark plug is fixed / screwed to the cylinder head, at the top of the combustion chamber,
  - It has the side electrode fixed in it, and
  - Because the casing is made of metal, it makes possible to earth the side electrode to the engine to complete the HT circuit.
- The HT current flows from the ignition coil or the electronic discharge module (*that has produced it / where it has been produced*) to the centre electrode of the spark plug (*which is fitted on the top of the cylinder that is going to fire*) through the HT cable connected to it (= *the centre electrode of this spark plug*). From the centre

electrode, the HT current flows to the side electrode. To do this, it jumps the small air gap that separates the tips of the two electrodes creating the spark that ignites the fuel in the cylinder.

**Note – Suggestion** *The answer to this question could be assigned to the students as a writing activity under the topic: “Describe the route of the TH current in the various ignition systems”. To help the teacher check the paragraphs of the students, a more complete answer describing the route of the HT current in the various ignition systems is given below.*

In the old ignition system, the HT current flows from the ignition coil (where it is produced) to the distributor (rotor arm) through an HT cable / the HT lead. From there, it is sent to the centre electrode of each spark plug (in the correct firing order) through the HT cable connected to it (= to the centre electrode / the spark plug). From the spark plug’s centre electrode, the HT current flows to the side electrode. To do this, it jumps the small air gap that separates the tips of the two electrodes and, in doing so, it creates the spark that ignites the fuel.

In the modern ignition system, on (the) cars (that are) fitted with a single ignition discharge module (that supplies all the spark plugs with HT current), the HT current flows from the ignition discharge module (that has produced it) to the centre electrode of the spark plug (of the cylinder that is going to fire) directed by the electronic module which has replaced the distributor. From the centre electrode, the HT current flows to the side electrode of the spark plug jumping the air gap that separates the tips of the two electrodes and so it creates the spark that ignites the fuel in the cylinder.

On modern cars fitted with more than one discharge modules / as many electronic discharge modules as the spark plugs, the HT current flows from the discharge module that has produced it to the centre electrode of the spark plug it is dedicated to / to which it corresponds. It flows down this electrode / the centre electrode and jumps the small air gap that separates it from the tip of the side electrode, thus creating the spark that ignites the fuel in the combustion chamber / cylinder.

#### 4D Gap filling.

1. high-tension current,
2. centre electrode,
3. ceramic insulator,
4. air-gap,
5. side electrode

## 4. Language functions

### Expressing Purpose

#### Practice

#### Suggested answers.

1. You should check the oil level regularly to avoid a damage in the engine.
2. You can make some minor repairs yourself so as to save money for the computer you want to buy.
3. In order to pass the final examinations, you should study harder.
4. He drove smoothly so that he might / would reduce the fuel consumption.
5. To be at work on time, you must wake up earlier in the morning.
6. It is not allowed to smoke in petrol stations so as to prevent an explosion.
7. In order to reduce harmful gas emissions, manufacturers have fitted the cars with emission control systems.
8. The ECU processes the information received from the sensors so as to control the injection and ignition timing correctly.
9. To replace the valve easily, I need a valve spring compressor.
10. He ordered the spare part he needs by e-mail so that he would get it the soonest possible.
11. As the engine was overloaded, the ECU retarded the ignition on all cylinders to prevent knocking.

## 5. Writing activity

### 5A Translation.

1. The high-tension / voltage current which is / has been produced / generated by the ignition discharge module is directed / flows to the spark plug through a cable / lead with thick plastic insulation.
2. Every electrical appliance / device has / is fitted / is equipped with an on / off switch.
3. When the driver steps on / presses the accelerator pedal, the engine is revving / the engine speed is increased .
4. Sometimes, when the engine is overloaded, one of the cylinders may knock / start knocking.
5. In case of / at low battery voltage / If the battery voltage is low, the battery needs charging the soonest possible.

6. When the engine is running under steady load conditions and / as well as when it is idling, it doesn't need as rich a fuel / air mixture as it does / needs for a cold starting or when it is revving.
7. The throttle opening changes depending on the engine's running conditions.
8. The central control unit collects information about the engine's running conditions from / by the sensors to which it is connected. From these variables, it "knows" what the engine needs and controls / so as to control the functions of the fuel injection system and the ignition timing.

### **5B Definitions.**

*As all the information needed for this activity is included in the text, no key to this exercise was considered necessary.*

# UNIT 12

## Air pollution and the catalytic converter

### Warm up

1 - c    2 - a    3 - b    4 - c    5 - b    6 - c    7 - a

### 1. Reading comprehension

- 1A**
- Hydrocarbons (HC), carbon monoxides (CO) and oxides of nitrogen (NOX).
  - By fuels not completely burned.
  - Yes, it is. Because it's an anti-pollutant device.
  - In the exhaust system, between the exhaust manifold and the muffler.
  - As the hot gases pass through the converter, ..... converting the harmful substance to non – toxic ones. (*The complete answer is found in the 2nd paragraph.*)
  - To use it to make toxic gases more environmentally friendly.
  - No. Its ability to store oxygen drops as the TWC becomes older.
  - The engine control module (ECM).
  - To measure the content of oxygen in the exhaust gases and to ensure that this content is normal.
  - The cars' fuel tank restrictor and the small-size nozzle of the fuel pumps.
- 1B**
- water vapour, carbon dioxide
  - carbon dioxide, nitrogen oxides
  - upstream, downstream
  - lead, fuel
  - pumps, unleaded

### 2. Vocabulary practice

- 2A**
- |       |       |        |        |
|-------|-------|--------|--------|
| a – 2 | d – 1 | g – 4  | j – 11 |
| b – 6 | e – 7 | h – 9  | k – 12 |
| c – 5 | f – 3 | i – 10 | l – 8  |

- 2B**
- |               |           |
|---------------|-----------|
| 1. Pollutants | 4. signal |
| 2. leads to   | 5. pump   |
| 3. purified   | 6. equip  |

### 3. Language functions

#### 3A Suggestions

B: *(In order) to/so as to make* toxic gases more environmentally friendly.

B: *(In order) to/so as to avoid* dangerous emissions.

B: Its main function is *to measure* the content of the oxygen in the exhaust gases.

B: *To ensure* that the oxygen content is normal.

B: *So that/in order that* accidental use of leaded petrol will be/is prevented.

#### 3B Suggestions

- 1
  - Air pollution *leads to/results in/is responsible for* various diseases.
  - Various diseases occur, *because of/due to* the air pollution.
- 2
  - The use of leaded petrol is *responsible for/results in/leads to* the catalytic converters' damage.
  - The catalytic converters *were/are damaged because of/due to* the use of leaded petrol.
- 3 *As/since* the catalytic converter becomes older, its ability to store oxygen drops.
- 4 *Because of/due to* the excessive temperature, his car's TWC was destroyed.
  - The excessive temperature *led to/resulted in/was responsible for* his car's TWC destruction.
  - *As/since* the temperature was excessive, his car's TWC was destroyed.

### 4. Use of English

environmental, poisonous, continuous, harmful/harmless, catalytic, friendly, foggy, diagnostic, accidental, convertible, corrective, marketable

# UNIT 13

## Cooling system

### 1. Comprehension

- 1A**
- |          |                |
|----------|----------------|
| 1. true  | 6. false       |
| 2. true  | 7. true        |
| 3. false | 8. true        |
| 4. true  | 9. true        |
| 5. true  | 10. don't know |

- 1B**
1. radiator, expansion tank
  2. centrifugal pump
  3. diluted, water
  4. cooling, air
  5. fan relay, module

### 2. Vocabulary practice

- 2A**
- |           |   |         |         |   |             |
|-----------|---|---------|---------|---|-------------|
| useful    | ≠ | useless | behind  | ≠ | in front of |
| different | ≠ | same    | large   | ≠ | small       |
| rear      | ≠ | front   | inner   | ≠ | outer       |
| cooling   | ≠ | heating | include | ≠ | exclude     |

- 2B**
- |               |              |
|---------------|--------------|
| 1. thermostat | 5. ratios    |
| 2. Tank       | 6. corrosion |
| 3. radiator   | 7. Coolants  |
| 4. belt       | 8. drained   |

- 2C**
- |              |            |
|--------------|------------|
| 1. equip     | 6. mix     |
| 2. expand    | 7. require |
| 3. heat      | 8. control |
| 4. circulate | 9. press   |
| 5. prevent   | 10. ignite |

### 3. Language functions

#### 3A Suggested answers

1. equipped with
2. includes/consists of/is made up of
3. is equipped with/contains/includes
4. made of, are made of
5. part of

#### 3B Suggested answers

1. through/via
2. by/with the help of/by means of
3. by means of/by/with the help of
4. via/through
5. by means of/via/with the help of

### 4. Use of English

- 4A**
- |                  |                 |
|------------------|-----------------|
| 1. approximately | 6. slowly       |
| 2. normally      | 7. chemical     |
| 3. similar       | 8. mechanically |
| 4. electronic    | 9. electrically |
| 5. usefully      | 10. specific    |

- 4B**
1. The engine is equipped with a closed cooling system.
  2. The outer circuit includes the radiator and the expansion tank.
  3. Circulation is controlled by a centrifugal pump.
  4. The rear face of the pump is integrated with the cylinder block.
  5. The coolant does not normally require changing, excepting only when the cooling system is drained for repair.

### 5. Useful phrases

- |                            |  |
|----------------------------|--|
| 1. closed cooling system   | 5. pump bearings                         |
| 2. inner and outer circuit | 6. expansion tank                        |
| 3. centrifugal pump        | 7. mixture of coolant diluted with water |
| 4. timing belt             | 8. air conditioning system               |

# UNIT 14

## The diesel-oil engine

### 1. Reading comprehension

#### 1A The answers to the questions.

1. They are used in power plants / stations to produce electricity, in the various means of transport – such as trains, ships, trucks and some buses – as well as in a large number of private cars.
2. No, the mechanical parts of the two engine types are almost / practically the same.
3. a) They use different types of fuel: petrol / gasoline engines use gasoline / petrol, whereas diesel engines use diesel-oil.  
b) The fuel is ignited in a different way: in gasoline engines, it is ignited by means of a spark, while in diesel engines, the fuel is self-ignited when it intermixes with the high-temperature air in the combustion chamber.
4. No, they don't. Air is drawn in the diesel engine on the induction stroke, while the fuel is injected at the end of the compression stroke. At that time, the air has been so highly compressed by the piston in the combustion chamber, that its temperature has become very high, over the self-ignition point of the diesel oil. As a result, as soon as the fuel enters the combustion chamber and intermixes with the air, it is instantly ignited.
5. It means "top dead center", that is the top of the piston stroke (= the highest point the piston reaches as it moves upward).
6. Diesel engines don't have/need a carburettor as the conventional petrol-engined cars (do), because the fuel and air enter the cylinder separately and intermix in the combustion chamber. Also, they don't need a fuel ignition system because in this type of engine, the fuel is self-ignited (as it comes in contact with the high-temperature air).
7. The petrol-engined cars have faster acceleration and higher maximum speed than the diesel-oil ones. Furthermore, petrol engines are less heavy, their operation is less noisy, and their repair is less expensive compared to the diesel-oil engines.
8. Petrol engines have crankshaft speeds of 2,500 to 5,000 revolutions per minute, while diesel-oil engines have speeds of 100 to 750 rpm.

9. Because the efficiency of a diesel engine is greater than that of a petrol one, and also because the fuel that the diesel engines operate on / use is less expensive than that used in the petrol engines.

### 1B Identifying the cylinders.

The cylinder illustrated in picture A belongs to a diesel-oil engine because it has no spark plug. The cylinder illustrated in picture B belongs to a conventional gasoline engine because it has a spark plug fitted at its top but not an injector.

### 1C Parts of the gasoline and diesel engine.

**Note** In the key to this exercise: (1) corresponds to the conventional gasoline engines (1st column of the grid), (2) corresponds to gasoline engines equipped with a fuel injection system, and (3) corresponds to diesel engines.

#### PARTS

cylinders: 1 - 2 - 3

pistons: 1 - 2 - 3

connecting rods: 1 - 2 - 3

crankshaft: 1 - 2 - 3

camshaft(s): 1 - 2 - 3

flywheel: 1 - 2 - 3

oil sump: 1 - 2 - 3

valves: 1 - 2 - 3

spark plugs: 1 - 2

injectors: 2 - 3

carburettor: 1

distributor\*: 1 - 2 (*electronic on earlier cars fitted with EFI. Modern cars with ECU have no distributor*)

ignition coil: 1 - 2 (*only in the first cars equipped with an EFI system*)

electronic ignition discharge module(s)\*: 2 (*on modern cars fitted with an ECU*)

fuel tank: 1 - 2 - 3

fuel pump: 1 - 2 - 3

fuel filter: 1 - 2 - 3

electronic control unit: 2 - 3

\* See the two notes under the first part of the table in the student's book (exercise 1C, p. 163)

**FUEL**

leaded gasoline / petrol: 1  
 unleaded gasoline / petrol: 2  
 diesel-oil: 3

**OPERATION**

Fuel and air enter the cylinder simultaneously: 1 - 2  
 Air and fuel enter the cylinder on different strokes: 3  
 Fuel and air are mixed in the carburettor: 1  
 The fuel is injected directly into the cylinder: 2 (*on modern cars*) - 3  
 The fuel is self-ignited: 3  
 The fuel is ignited by a spark: 1 - 2

**PROPERTIES**

lower compression ratio: 1 – 2  
 greater efficiency: 3  
 noisier operation: 3  
 slower acceleration: 3  
 higher maximum speed 1 - 2  
 more expensive fuel: 1 – 2  
 more heavily built: 3  
 less expensive repair: 3

**1D Similarities and differences of the three engine types.****a. Similarities of all three types of engines**

cylinders      pistons      connecting rods      crankshaf      camshaft(s)  
 flywheel      oil sump      valves      fuel tank      fuel pump      fuel filter.

The similarities of the modern petrol and diesel engines also include the: injectors and the electronic control units.

**b. Differences**

Gasoline engine		Diesel-oil engine
Conventional	With fuel injection	
spark plugs	spark plugs	—
carburettor	injectors	injectors
distributor	distributor* or electronic module	—
ignition coil	ignition coil* or electronic ignition module	—

<b>Gasoline engine</b>		<b>Diesel-oil engine</b>
<b>Conventional</b>	<b>With fuel injection</b>	
	electronic control unit	electronic control unit
leaded petrol	unleaded petrol	diesel oil
Fuel and air enter the cylinder simultaneously		Air + fuel enter the cylinder on different strokes
The fuel + air are mixed in the carburettor	The fuel is injected directly into the cylinder	
The fuel is ignited by a spark		The fuel is self-ignited

## 2. Vocabulary Practice

### 2A Replacing words in the text

#### 1st and 2nd paragraph

- |                              |                               |
|------------------------------|-------------------------------|
| 1. commonly – widely         | 4. generate: produce          |
| 2. especially – particularly | 5. for example – for instance |
| 3. trucks – lorries          | 6. similar – almost the same  |

#### 3rd paragraph

- |                            |                |                       |
|----------------------------|----------------|-----------------------|
| 1. main, basic – essential | 2. kind – type | 3. operates on – uses |
|----------------------------|----------------|-----------------------|

#### 5th paragraph

- |                                      |                                 |
|--------------------------------------|---------------------------------|
| 1. allows to enter, lets in – admits | 5. mixes together – intermixes  |
| 2. at the same time – simultaneously | 6. becomes a vapour – vaporizes |
| 3. inlet – intake                    | 7. fixed – fitted               |
| 4. straight – directly               |                                 |

#### 6th paragraph

- |                     |  |
|---------------------|--|
| 1. over – above     | 3. takes place – occurs                      |
| 2. placed – located | 4. for this reason; consequently – therefore |

#### 7th paragraph

- |  |                              |
|--|------------------------------|
| 1. because of – due to                         | 5. drawbacks – disadvantages |
| 2. furthermore; in addition to that – moreover | 6. costly – expensive        |
| 3. complete turns – revolutions                | 7. installed – fitted        |
| 4. in spite of; regardless – despite           |                              |

**2B The defined terms.**

- |                |                        |
|----------------|------------------------|
| 1. power plant | 6. acceleration        |
| 2. combustion  | 7. speed               |
| 3. stroke      | 8. self-ignition point |
| 4. vibration   | 9. compression ratio   |
| 5. ratio       |                        |

**2C Matching.**

- 1 - c      2 - g      3 - d      4 - a      5 - f      6 - b      7 - e

**2D The defined items and their Greek equivalent.**

1. combustion chamber – θάλαμος καύσης
2. induction stroke – χρόνος εισαγωγής
3. compression stroke – χρόνος συμπίεσης
4. inlet valves – βαλβίδες εισαγωγής
5. (fuel) ignition system – σύστημα ανάφλεξης (καυσίμου)
6. (fuel) injection system – σύστημα έγχυσης (καυσίμου)
7. electronic control unit – μονάδα ελέγχου, “εγκέφαλος”

**3. Listening activity****The glow plugs****The text to be read to the students.**

In diesel engines, the fuel is auto-ignited as soon as it intermixes with the high-temperature air in the combustion chamber. However, a cold engine that draws cold air in a cold winter morning will not give a high enough temperature. To help the engine start from cold and reduce smoke immediately after start up, manufacturers have fitted diesel engines with glow plugs.

Glow plugs are, in fact, electric heating elements that produce enough heat to ignite the fuel. They are called glow because they glow red hot. On most modern cars, there is one glow plug for each cylinder. They are controlled automatically by the electronic control unit. They are switched on when the ignition switch is turned by the driver. A warning light on the instrument panel shows that the glow plugs have started working. When the glow plugs have heated up enough to start the engine, the warning light goes out. So, the driver has to wait until the glow plugs warning light goes out before

he turns the ignition switch further to start the engine. If he doesn't, the engine may not start, or it will start with difficulty and make a lot of smoke.

Glow plugs have a long lifespan, so there is no need to check them regularly; nor do they need regular renewal like the spark plugs. However, if the engine has starting problems or makes a lot of smoke, then, the glow plugs should be checked and new ones fitted.

### STEP 1



The correct answer is c: The text describes how the glow plugs work.

### STEP 1



#### The correct answers.

- |                  |  |
|------------------|--|
| 1. b, cold, cold | 7. light, panel  |
| 2. c             | 8. hot, warning, out   |
| 3. a             | 9. warning light, go, start, make/produce/release                |
| 4. b             | 10. c, b   |
| 5. c             | 11. starting, makes/produces a lot of smoke, fit, new glow plugs |
| 6. b             |  |

#### Follow up

- |                     |   |
|---------------------|---|
| 1. glow             | 4. lifespan                             |
| 2. renewal          | 5. the warning light comes on/ goes out |
| 3. instrument panel | 6. the car/engine makes/produces smoke  |

## 4. Language functions

### 4A Comparing

*No key to this exercise was considered necessary.*

### 4B Presenting similarities and differences

#### Suggested answers.

- Turbine steam engines belong to the ECEs; gasoline engines belong to ICEs, instead.
- Engines without a turbocharger are not so efficient as those having / that have one.

3. Unlike ICEs, Wankels are used in automobiles.
4. The mechanical parts of a gasoline engine are similar to those of a diesel-engine one.
5. The type of fuel gasoline engines operate on differs from the type of fuel used on diesel-engine engines / diesel-engine engines use.
6. The operation of conventional cars is not so complex as that of the modern ones / cars.
7. Like gasoline engines, diesel-engine ones, have a lubrication system. / The lubrication system of (the) gasoline engines is similar to that of the diesel-engine ones / engines.
8. Unlike conventional cars, modern cars are equipped with a computer that controls the functions of the engine.
9. Wankel, like Otto engines, belong to the ICEs.
10. The f/a mixture the engine needs under steady load conditions is not so rich as the mixture it needs for a cold starting.
11. Unlike conventional gasoline engines, those equipped with fuel injection save fuel and reduce air pollution.

**Note** *Accept any other correct alternative produced by the Ss.*

## 5. Writing activity

### Suggested version.

Diesel, like gasoline engines belong to the ICEs. Both engine types are used in cars, but diesel engines are also used to move trains and ships, and to produce electric energy in power stations.

The operation of both engines is now-a-days controlled by a microprocessor / computer / control unit. Their mechanical parts are similar, as well as the way these parts operate. There are, however, some differences between the two engine types.

First of all, they differ in the type of fuel they use. Gasoline engines operate on gasoline/petrol, whereas diesel engines operate on diesel-oil, instead.

Another important difference between the two engines is the way the fuel is ignited. In gasoline engines, the fuel is ignited by means of a spark, while in diesel engines, it is self-ignited as soon as it comes in contact with the highly compressed air in the combustion chamber. Diesel engines, therefore, need no fuel-ignition system, and as a result they have a simpler electrical system.

In gasoline engines, fuel and air enter the cylinder simultaneously on the same stroke, the induction. In diesel engines, on the other hand, fuel and air enter the cylinder separated: first the air, on the induction stroke, and then the fuel, at the end of the compression stroke. In both engine types, the fuel enters the combustion chamber injected by an injector fitted at the top of the cylinder.

Gasoline engines have higher acceleration and higher maximum speed than the diesel ones. In addition, they are less heavy / lighter and less noisy, and their repair is less costly than / doesn't cost as much as the repair of diesel engines. Despite these disadvantages, diesel engines are being fitted in an increasing number of private cars, thanks to their high compression ratio which results in greater efficiency, and the less expensive fuel they operate on.



## A. The clutch

### The friction or dry clutch

#### Alternative terms.

1. dry clutch / friction clutch
2. fluid coupling / fluid drive
3. driving plate / pressure plate
4. driven plate / clutch disc / friction plate/ friction disc
5. release arm/ release fork / release lever
6. gearbox driving shaft / gearbox drive shaft / gearbox input shaft

## 1. Reading Comprehension

### 1A The sentences completed.

1. When the driver moves the car from a standstill or engages a gear, the clutch is engaged / connects the engine to the transmission system / gearbox.
2. When the driver changes gear or stops the car, the clutch is disengaged / disconnects the engine from the transmission system / gearbox.
3. The dry clutch depends on solid contact between engine and transmission / gearbox.
4. The clutch disc has a friction material / lining on both sides and is free to slide along the splines of the gearbox input / drive shaft. When the clutch is engaged, it drives / rotates the gearbox input shaft, thus transferring the engine power to the gearbox.
5. The release bearing is fitted on a guide sleeve at the front of the gearbox. It slides on / along the guide sleeve, under the action of the release arm.
6. The release arm pivots inside the end of the gearbox casing. It is either operated by a cable connected to the clutch pedal or it is actuated by a hydraulic system.

### 1B True / false sentences.

**True sentences:** 2, 5, 8

**False sentences:** 1, 3, 4, 6, 7, 9

#### The false sentences corrected.

1. When the driver engages the gear he has selected, the clutch **connects** the engine **to** the gearbox.
3. The driving plate is also called **pressure** plate.  
or The **driven** plate / clutch disc is also called friction plate.

4. The diaphragm spring is located between **the pressure plate and the clutch cover / the gearbox.**  
or The **driven / friction plate / clutch disc** is located between the flywheel and the pressure plate.
6. The pressure / driving plate is mounted to rotate with the **flywheel.**
7. The diaphragm spring is mounted **on the clutch cover.**
9. The release arm is operated by a cable connected to the **clutch pedal.**

### 1C The answers to the questions.

1. The friction clutch and the fluid coupling. The friction clutch depends on solid contact between the engine and the transmission and is operated by the clutch pedal (mechanically). The fluid coupling is automatic or semi- automatic. The transfer of power in it / the fluid coupling is done by a hydraulic medium.
2. The driven, or friction, plate is one of the clutch components. It is a disc located between the rear face of the flywheel and the driving, or pressure plate. It is free to slide along the splines of the gearbox driveshaft and has a friction material on both sides. When the clutch is engaged / the driver moves the car from a standstill and when he engages a gear, the friction plate is pushed by the pressure plate against the flywheel. Through the contacting surfaces, the power of the engine / the rotation of the flywheel is transmitted to the friction plate, which starts rotating and turning the gearbox input shaft, in this way transferring the engine power to the gearbox.
3. By means of the spring cushioning which is located between the friction material and the centre of the friction plate and absorbs the transmission shocks.
4. To push against the pressure plate, which in turn pushes the friction plate against the rear face of the flywheel (when the clutch is engaged). In this way, the friction plate comes in contact with the flywheel and rotates with it, thus transferring the power of the engine to the gearbox, by turning the gearbox input shaft.
5. To push against the friction plate (*being pushed by the diaphragm spring*) and hold it in place (*in contact with the rear face of the flywheel*) so as to achieve the transfer of the engine power from the flywheel to the clutch through the contacting surfaces.
6. The splined driveshaft of the gearbox which, when the clutch is engaged, starts rotating with the flywheel driven by the friction plate.

### 1D Arranging the missing information

#### 1. How the clutch is engaged:

1 - c      2 - e      3 - f      4 - a      5 - b      6 - g      7 - d

#### 2. How the clutch is disengaged:

1 - f      2 - c      3 - a      4 - g      5 - d      6 - b      7 - e

## 2. Vocabulary practice

### 2A The main parts of the dry clutch.

- |                              |                     |
|------------------------------|---------------------|
| 1. rear face of the flywheel | 5. diaphragm spring |
| 2. friction plate            | 6. clutch cover     |
| 3. spring cushioning         | 7. release bearing  |
| 4. pressure plate            | 8. release arm      |

### 2B The equivalent English term.

- |                                 |                                 |
|---------------------------------|---------------------------------|
| 1. friction / dry clutch        | 8. release arm                  |
| 2. fluid coupling / fluid drive | 9. sleeve                       |
| 3. clutch pedal                 | 10. clutch cable                |
| 4. pressure / driving plate     | 11. clutch cover                |
| 5. friction / driven plate      | 12. gearbox casing              |
| 6. diaphragm spring             | 13. gearbox input / drive shaft |
| 7. release bearing              |                                 |

### 2C Definitions.

#### Verbs

- 1 - e      2 - c      3 - a      4 - b      5 - d

#### Nouns

- 1 - c      2 - e      3 - b      4 - f      5 - d      6 - a

### 2D Odd-one out.

- |              |             |
|--------------|-------------|
| 1. technique | 4. existing |
| 2. transport | 5. put      |
| 3. contact   | 6. often    |

## 1. Listening activity

### The text to be read to the students.

**Note** *The bold-typed words are the words missing from the text in the Student's book.*

The **fluid** coupling may be used either with or without the **friction** clutch. When it is not combined with a friction clutch, the engine power is **delivered** to the transmission system exclusively through an oil medium without any contact of **solid** parts. This type of clutch is also known as fluid drive. It consists of two **discs**. The first disc is mounted

to the rear face of the **flywheel** and, as a result, it is driven by the engine. This disc is also called the fluid flywheel. The second disc is connected to the **gear-box**. As the first disc, which is fan-bladed, rotates, it agitates the **oil** with sufficient force to **rotate** the second disc. Because the rotation of the second disc depends directly on the amount of engine **power** delivered, the prime result of fluid coupling is an automatic clutch **action**, which greatly simplifies the requirements for gear shifting.

### STEP 1

#### Giving the text a title.

The text is about the automatic and semi-automatic couplings / clutches / the fluid coupling, and most specifically about the fully automatic type / the fluid drive.

**Note** *Any of these answers is acceptable and could be the title of the text. The most suitable, however seems to be "The fluid coupling" or "The fluid drive". If, after the first reading, the students are not sure which the most appropriate title is, they could decide about it at the end of the listening activity.*

### STEP 2 – 3

#### The missing words.

They are the bold-typed words in the listening text given above.

#### Follow up

##### 1. The replaced words.

- |                |               |                |
|----------------|---------------|----------------|
| 1. delivered   | 4. agitates   | 7. simplifies  |
| 2. exclusively | 5. sufficient | 8. requirement |
| 3. mounted     | 6. prime      | 9. shifting    |

##### 2. The answers to the questions.

- The semi-automatic coupling / clutch, (*that is, a combination of friction clutch and fluid coupling*), and the fully- automatic coupling or fluid drive, (*in which the power is transmitted exclusively through an oil medium without any contact of solid parts*).
- In the semi-automatic type, the power is transmitted by contact of solid parts combined with the action of an oil medium / by a combination of friction clutch and fluid coupling. In the fully automatic type / fluid drive, the power is transmitted exclusively through an oil medium without any contact of solid parts.
- Two discs. The first disc is connected to the flywheel and the other to the gear box.
- Fluid drive.

## 4. Writing activity

### 4A The sentences translated into English.

**Note** *Actually, the students don't have but to copy phrases or sentences from the text making only some minor changes. The activity is suitable for homework.*

1. The friction / dry clutch, which depends on solid contact between engine and transmission, is more common / widely used than the fluid coupling.
2. The friction clutch is operated either with a cable connected to the clutch pedal, or, on most modern cars, by a hydraulic system.
3. The pressure / driving plate is mounted to rotate with the flywheel.
4. The clutch/friction/driven plate has a friction material (lining) on both sides.
5. The spring cushioning that is between the friction material and the centre of the clutch disc absorbs the transmission shocks and helps to give / contributes to a smooth take-up / transfer of power when the clutch is engaged.
6. When the clutch is engaged, the diaphragm spring pushes against the pressure plate, which presses the friction plate against the rear face of the flywheel holding it in place.
7. The release bearing is fitted on a sleeve located at the front of the gearbox.
8. The release fork pivots inside the end of the gearbox casing and acts on the release bearing, which slides on the / its sleeve.
9. To move the car from a standstill or to engage a gear, the driver releases the clutch pedal to engage the clutch, so that the power of the engine is transferred to the transmission system. To change a gear or to stop the car, the driver presses / steps on the clutch pedal to disconnect the engine from the road wheels.

### 4B Definition (a suggested version).

The clutch is the means of coupling the engine with the power transmission units / system. When a gear is engaged, it / the clutch transfers the power of the engine to the gearbox; when the driver changes gear or brings the car to a stop / stops the car, the clutch disconnects the engine from the transmission system. There are two basic varieties of clutches: the friction clutch and the fluid coupling.

## B. The transmission

### 1 Manual and automatic transmissions

#### TASK 1



#### The diagram completed

Transmission types

Manual → The sliding gear

Automatic + semi- automatic

→ Hydra-Matic,

→ Torque converter,

→ Continuously variable transmission (CVT)

→ serial

#### TASK 2



#### The answer to the questions.

1. The manual / conventional transmission, also known as the sliding gear.
2. The serial transmission which is used on racing and some executive cars.
3. Because they are complicated (mechanisms) and their repair is quite costly.
4. Hydraulically / By means of a special fluid, the transmission fluid.
5. The way the engine power is transferred to the final drive. In automatic transmissions it is transferred by means of hydraulic mechanisms; in manual transmission it is transferred by means of various combinations of shafts and gears. Another difference is that in automatic transmissions, the appropriate power ratio and speed is selected automatically, whereas in manual transmissions, the gears are selected by the driver and engaged by means of a lever / the gear(shift) lever.
6. In manual transmissions, by means of the lubricating oil that fills the gearbox casing, whereas in automatic transmission types by means of a special fluid, that fills the transmission casing.

#### TASK 3



#### Definition.

The transmission system is a mechanism that transfers the power of the engine from the clutch to the final drive by changing speed and power ratios between the engine and the road wheels.

## 2 Manual transmission - The sliding gear

### Alternative terms.

1. Transmission input / drive / driving / main / primary shaft
2. Transmission output / driven shaft

## 1. Reading comprehension

### 1A Suggested titles.

1. Parts and operation of the sliding gear / manual/conventional transmission.
2. The (structure of the) gear box on front-wheel drive cars.
3. The transmission on rear- and four-wheel drive cars.
4. Rotation of the transmission shafts and overdrive.

### 1B The sentences completed.

- |       |          |             |
|-------|----------|-------------|
| 1 - e | 5 - g    | 9 - k, e, i |
| 2 - i | 6 - g    | 10 - d      |
| 3 - a | 7 - b    | 11 - c      |
| 4 - j | 8 - i, h | 12 - f      |

### 1C Combined parts of sentences

- |             |   |
|-------------|---|
| 1 - d       | 7 - f                                       |
| 2 - e       | 8 - h                                       |
| 3 - e       | 9 - c                                       |
| 4 - a, b, i | 10 - g (a, b, and j could also be accepted) |
| 5 - a, b, j | 11 - b, k                                   |
| 6 - a, b, j |   |

### 1D The answers to the questions.

1. By the driver, by means of the gear(shift) lever.  
or By various combinations of the gearwheels which are fitted on the shafts of the gearbox, / By meshing the appropriate set of gearwheels, depending on the gear selected by the driver.
2. No, they differ in diameter / are of different diameters / have different diameters.
3. It carries the power of the engine from the clutch to the gearbox transferring it to the output shaft and the idler gear (on cars with two transmission shafts) or to the output and the lay-shaft(s) (in cars with three or four transmission shafts).

4. By means of the meshing gearwheels. / By meshing the appropriate set of gearwheels.
5. It is a special kind of gear fixed to the end of the output shaft and in constant mesh with the differential, which it drives. On some front-wheel drive cars (if the lay-shaft transmits power to the final drive in the 5th and reverse gears), the lay-shaft is also equipped with a pinion.
6. Almost all rear-wheel drive cars, most four-wheel drive ones and some front-wheel drive cars are equipped with a third shaft / a lay-shaft. On most of these cars, the gearwheels of the lay-shaft, by meshing with those of the input and output shaft, provide power for the reverse gear.

On some front-wheel drive cars equipped with three shafts, the lay-shaft provides power for both the reverse and the 5th forward gear. On these cars, the lay-shaft also transmits power to the final drive in these two gears (the reverse and the 5th forward).

Some rear-wheel drive cars, instead of one, have two lay-shafts. On these cars, the gearwheels of the two lay-shafts, by meshing with those on the primary (input – output shaft), provide power for all the speed gears but the fourth, which is transmitted directly from the input to the output shaft).

7. The gear wheels are permanently fixed on the input shaft of the cars with two shafts, and on the input and output shafts of the cars with three transmission shafts, that is, on all the rear-, most four- and some front-wheel drive cars.
8. So that the shaft is able to rotate, even when the gearwheels on it stay still.
9. On the front-wheel drive cars with two transmission shafts, the power of the engine is transmitted to the final drive directly by a pinion gear fitted at the end of the output shaft. On the front-wheel drive cars with three transmission shafts, the engine power is transmitted to the final drive directly, by either one pinion gear (*fitted at the end of the output shaft*) or by two final drive pinion gears (*one of which is fitted at the end of the output shaft and the other at the end of the lay-shaft, if the lay-shaft provides power for both the reverse and the 5th forward gear*). On the rear- and most four-wheel drive cars, the engine power is transmitted to the final drive by the output shaft, via /by means of the propeller shaft.

## 2. Vocabulary practice

### 2A The English equivalent term.

- |   |                         |
|---|-------------------------|
| 1. input / driving / main / primary shaft | 6. pinion gear          |
| 2. driven / output shaft                  | 7. forward gears        |
| 3. lay-shaft                              | 8. (the) reverse (gear) |
| 4. propeller shaft                        | 9. overdrive            |
| 5. idler gear                             |                         |

### 2B The defined terms.

- |               |               |                  |
|---------------|---------------|------------------|
| 1 - ratio     | 4 - permanent | 7 - conventional |
| 2 - automatic | 5 - emergency | 8 - constant     |
| 3 - manual    | 6 - level     | 9 - stationary   |

### 2C Matching

- 1 - d      2 - a      3 - e      4 - c      5 - b

### 2D Synonyms and antonyms.

Synonyms		Antonyms
different	varying	same; similar
needed; necessary	required	useless
appropriate; proper	right; correct; suitable	inappropriate; incorrect; wrong
primary; essential; basic	main; important	secondary; unimportant
conventional	common; ordinary; usual	modern; advanced; new
decrease	reduce; lessen	increase
firm; steady	permanent	temporary
still	stationary	moving
difficult; confusing	complicated	simple; easy
costly	expensive	inexpensive; cheap

**2E Word formation****The prefixes: semi-, self-, multi-, pre- and re-.****b. Forming new words**

pre-/ re-organized	re- / self-adjustable	remake	pre-/ re-/ self-taught
self- educated	pre- industrial	semi-professional	multi-national
semi-circle	semi- skilled	pre-cooked	semi-sphere
semi-automatic	multi-system	re-/ pre-arranged	self-defence
pre-/ re- heated	replace	self-centred	multi-cylinder
react	self-service	multi-media	re-construct
re-/ pre- set	pre-existing	self-ignited	pre-/ re- /self-
			re-/pre-/self-determined

**2F Prepositions.**

- |              |                |
|--------------|----------------|
| 1. with, for | 6. to          |
| 2. with      | 7. of, to / at |
| 3. for, of   | 8. in          |
| 4. from, to  | 9. in, at      |
| 5. on        | 10. of, on     |

**3. Language functions****Expressing cause/reason ↔ result/consequence****Suggestion**

The teacher should encourage and help the students to use the because of / thanks to / due to + noun structure, which they will try to avoid as it demands changes in the sentences. The most appropriate sentences to join using this structure are: 2, 5, 6 and 8.

- Because of / due to the increases in the price of oil in the 70s, which were accompanied by decreases in the demand for motor cars, manufacturers started developing energy-saving vehicles.
- Because of / due to the increasing concerns over the harmful gas emissions, all cars after the 80s use unleaded fuel and are equipped with emission controls.
- Because of / due to the drawbacks of (the) electric cars, manufacturers have started experimenting with fuel-cell hybrid cars.
- Because of / thanks to the smaller battery size of the fuel-cell hybrid cars, they have enough space for five passengers and their luggage.

No key to the rest of the sentences was considered necessary because of the great number of possible alternatives.

## C. The final drive

### 1 The differential

#### Alternative terms.

differential pinion gears / side pinion gears / side pinions / planet pinions / planet gears

differential side gears / side gears / sun gears

differential housing / differential cage

#### TASK 1



#### The parts of the differential.

1. the crown wheel - η κορώνα
2. (two) side / planet pinions - πλανήτες
3. two side / sun gears - ήλιοι
4. differential housing / cage - η φωλιά του διαφορικού

#### TASK 2



#### The sentences completed.

1. On the **front-wheel drive** cars, the power of the engine is transferred to the front road wheels. On the **rear-wheel drive cars / vehicles**, it is transmitted to the rear wheels and on **(the) four-wheel drive (cars / vehicles / ones)**, the engine power is transferred to **all four wheels**.
2. All the gears of the differential are of the **bevel** type with **straight teeth**.
3. The differential housing is **bolted / fastened / attached** to the crownwheel, and as a result it **rotates with it / is driven by it**.

## 1. Listening activity

### The text to be read to the students.

#### 1st paragraph

Each of the two planet gears is **free to rotate** (1 - d) on a single shaft, which is fixed across the middle of **the differential housing** (2 - c). The two sun gears are attached to a driveshaft each driving it. The planet pinions and the sun gears are **in constant engagement** (3 - a). The power of the engine **is transmitted to the driveshafts** (4 - e)

by a rolling and sliding action between the teeth of the planet pinions and sun gears **under high pressure** (5 - b).

### 2nd paragraph

On the front-wheel drive technology, which **is the most common in family cars now-a-days** (1 - b), the crownwheel and the differential housing are located in the front of the car. They are enclosed in the same **casing as the gear box** (2 - c). The engine power is transmitted from the gearbox directly to the crownwheel by means **of the final drive pinions** (3 - d), either of only the driven shaft or of both the driven and the lay-shaft, **depending on the manufacturer** (4 - a).

### 3rd paragraph

On the rear-wheel drive cars, the **crownwheel and the differential cage** (1 - e) are enclosed in a casing which is supported in the rear axle casing between **the two driveshafts** (2 - d). The power of the engine is transferred from the transmission **to the final drive** (3 - f) by the gearbox output shaft via the propeller shaft. The propeller shaft is a steel tube with two universal joints at each end. One of the universal joints connects the **propeller shaft** (4 - a) to the gearbox output shaft. The other **universal joint** (5 - c) connects the propeller shaft to another short shaft, which ends to the final drive pinion that **drives the crownwheel** (6 - b).

### STEP 1 - 2

The information in the table numbered.

<b>1<sup>st</sup> paragraph:</b>	1 - d	2 - c	3 - a	4 - e	5 - b	
<b>2<sup>nd</sup> paragraph:</b>	1 - b	2 - c	3 - d	4 - a		
<b>3<sup>rd</sup> paragraph:</b>	1 - e	2 - d	3 - f	4 - a	5 - c	6 - b

### STEP 3

**Note - Suggestion** Give the students enough time to write the missing information in the gaps. Check that they have written the missing phrases and **not** the corresponding letters. In the exercises that follow, they will need to have the text completed. After that, one of the students, should read the text to check that they have completed the gaps correctly.

### Follow up

#### Suggested title.

The (structure of the) differential on the various car types.

## 2. Writing activity

### Suggested versions.

1. The propeller shaft is a steel tube with a universal joint at each end. It is used as an extension of the gearbox output shaft on rear-wheel drive vehicles. One of the universal joints connects the propeller shaft to the gearbox output shaft, and the other to a short shaft that has the final-drive pinion (which drives the crownwheel of the differential) attached to / at its end. As a result, the propeller shaft is used to transfer the power of the engine from the gearbox to the final drive.
2. On front-wheel drive vehicles, the differential is enclosed in the same casing as the gearbox and so the engine power is transmitted from the gearbox output (and lay-) shaft directly to the final drive, by means of the final-drive pinion(s) which is / are attached at the end of the gearbox output (and lay-) shaft(s) and drive(s) the crownwheel of the differential.

On rear-wheel drive vehicles, the differential is located far from the gearbox. The gearbox is located at the front and the differential at the rear part of the vehicle. To overcome this difficulty, the engine power is transmitted to the final drive by means of the propeller shaft, which functions as an extension of the gearbox output shaft. In fact, the job of the propeller shaft is to connect the part of the output shaft that comes from the gearbox to its other part that carries the final-drive pinion which drives the crownwheel.

### How the differential operates

#### TASK



.....

#### Inserting extra information in a text.

- a. the information is about the planet gears and it can be inserted in the 2nd sentence of the paragraph, after the phrase "...drive to the planet pinions".
- b. the information is about the sun gears and it can be inserted at the beginning of the last (4th) sentence of the paragraph.
- c. the information is related to the final-drive pinion. It can be inserted in the 1st sentence of the paragraph, before the phrase "..., turns the crownwheel".
- d. the information is about the differential cage and can be inserted at the end of the 2nd sentence of the paragraph.

## 2 The driveshafts

### 1. Reading comprehension

#### 1A The wrong sentences corrected.

1. The two **sun** gears are attached to the end of the **driveshafts** that transmit the power from **the final drive / differential to the driving wheels**, while the two **planet** gears are attached on two short shafts which are fixed in the middle of the **differential cage**.
2. The **differential cage** is bolted on the **crownwheel** and is driven by it.
3. The final drive pinion drives the **crownwheel**.
4. The planet gears are in constant mesh with the **sun gears**.  
**Or** The **teeth on the crownwheel** are in constant mesh with the final drive pinions.
5. On **front-wheel** drive vehicles, the differential is enclosed in the same casing as the gearbox, so the engine power is transmitted directly from the gearbox to the final drive.
6. The propeller shaft is an extension of the gearbox **output** shaft. It has a **universal** joint at each end and is used in **rear-wheel** drive cars to transfer the engine power to the **differential**.
7. The driveshafts of the rear-wheel drive vehicles with rigid rear-axle assembly (**are enclosed in the rear axle**), **have / need no** joints (to allow for the suspension movement) **and run straight from the differential to the wheel hubs**.  
**Or** The driveshafts of the rear-wheel drive vehicles with **independent suspension** are equipped with **universal** joints to allow for the suspension movement.

#### 1B The answer to the questions.

1. Drive or driving. For the shafts the term input is also used.
2. Driven. For the shafts the term output is also used.
3. They are of the bevel type (conical) with straight teeth.
4. a) The sun and planet gears and b) The final drive pinion(s) with the teeth of the crownwheel.
5. At the two ends of the propeller shaft, on both sides of the driveshafts on the rear-wheel drive cars with independent suspension, and at the outer sides of the driveshafts on front-wheel drive cars, universal joints are used / fixed.  
At the inner sides of the driveshafts on front-wheel drive cars, ball joints are usually fixed.

6. The joints on the front driveshafts of the front-wheel drive vehicles allow for the movements of both suspension and steering. The joints on the rear wheels driveshafts of the rear-wheel drive vehicles with independent suspension allow only for the movements of suspension.
7. They are lubricated by a special oil or grease. The gears in the differential casing are lubricated with lubricating oil, whereas the universal and ball joints are lubricated with grease.
8. To / They transfer the power of the engine from the differential to the driving wheels and, by turning them, to / they drive the car.
9. When the car moves in a straight line, the differential rotates as one unit, that is: as the differential cage rotates with the crownwheel, the planet pinions, (don't turn but) push the sun gears to rotate, thus turning the driveshafts, to which they are attached. When the car turns, the inner wheel slows down. This makes the planet pinions start rotating on their axis to speed the outer wheel. As a result, the speed of the two driving wheels differs, but the amount of power they receive is the same.

## 2. Vocabulary practice

### 2A The Greek equivalent terms.

1. bevel type gear: κωνικός οδοντωτός τροχός με ελλειψοειδείς αύλακες
2. propeller shaft: κεντρικός άξονας
3. rolling and sliding action: δράση περιστροφής / κύλισης και ολίσθησης
4. constant velocity joint: άρθρωση / ένωση συνεχούς ταχύτητας
5. wheel hub: ακραξόνιο
6. universal joint: σπαστός, αρθρωτός σύνδεσμος, σταυρός
7. ball joint: μπιλιοφόρος (σύνδεσμος)

### 2B The English equivalent term or expression.

1. σύστημα ανάρτησης: suspension system
2. σύστημα διεύθυνσης: steering system
3. σύστημα άκαμπτου πίσω άξονα: rigid rear-axle assembly
4. ημιαξόνιο: driveshaft
5. εύκαμπτες ελαστικές επικαλύψεις / φούσκες: flexible rubber gaiters
6. υπό υψηλή πίεση: under high pressure
7. επιβραδύνω: slow down

8. ανάλογα με τον κατασκευαστή: depending on the manufacturer  
 9. επιταχύνω: speed up / accelerate

## 2C Prepositions

- |                |                |                 |
|----------------|----------------|-----------------|
| 1. in,         | 4. in, between | 7. with, with   |
| 2. to / at, to | 5. for         | 8. for, in      |
| 3. with        | 6. to          | 9. down, in, up |

## 2D Word formation

### a. The suffixes -ful and -less

Noun	Adjective		Noun	Adjective	
	+ -ful	+ -less		+ -ful	+ -less
success	successful		use	useful	useless
wonder	wonderful		speech		speechless
home		homeless	skill	skilful	
hope	hopeful	hopeless	harm	harmful	harmless
help	helpful	helpless	worth		worthless
price		priceless	respect	respectful	
care	careful	careless	rest	restful	restless

### b. The suffix -ly

- |                  |                            |               |
|------------------|----------------------------|---------------|
| 1. primarily     | 5. permanently, constantly | 9. normally   |
| 2. automatically | 6. freely                  | 10. rapidly   |
| 3. commonly      | 7. directly                | 11. specially |
| 4. continuously  | 8. regularly               | 12. manually  |

## 3. Use fo English

### S. Future, S. Present Perfect and the modals in passive voice

#### Practice

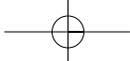
- The / A decision will not be taken until next morning.
- The spark plugs have already been replaced.
- The car market has been dominated by the Japanese since 1975.
- In the next decade, more fuel-cell cars will be constructed.
- The car I liked was sold for 5,000 ECU yesterday afternoon.
- George might be sent to England in August by his company.
- He has been offered the post of the Production Manager in Poland.

8. His professional skills are recognized by everybody.
9. The meeting should have been postponed earlier.
10. 400 workers will be fired until the end of the year.
11. The factory was built only two years ago.
12. The cable must be replaced immediately.
13. The transmission fluid level hasn't been checked (by the owner of the car) since last summer.
14. The clutch is disengaged by pressing the clutch pedal.
15. The spare part you ordered last Tuesday has just been brought.
16. The grease from the floor should have been cleaned by now.
17. Automatic transmissions are controlled by a selector lever.
18. The answer to his application letter has been sent by fax.
19. Don't worry. The new glow plugs will be fitted in a few minutes.
20. The rusty bolt cannot be removed.

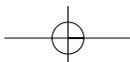
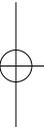
#### 4. Writing activity

##### 4A The sentences translated into English.

1. The differential cage / housing is bolted to the crownwheel.
2. The planet gears are attached to two short shafts (that are) fixed across the middle of the differential cage.
3. The planet pinions and the sun gears are in constant mesh / engagement.
4. On (the) front-wheel drive vehicles, the differential is enclosed in the same casing as the gearbox.
5. On (the) rear-wheel drive cars, the differential is enclosed / supported in the rear axle casing, between the two driveshafts.
6. The oil level in the rear axle differential casing needs regular checking / should be checked regularly, because, if it gets low, the differential may be damaged.
7. When the car drives in a straight line, the two driving (road) wheels turn / rotate at the same speed. When the car is turning, thanks to the differential, the inner wheel slows / can slow down, while the outer (wheel) speeds up.
8. To allow for the movements of the steering and suspension systems, the ends of the front driveshafts are equipped with ball and universal joints, which are covered with flexible rubber gaiters.

**4B Definition (A suggested version).**

The final drive is the car system that takes the engine power from the gearbox and transmits it to the drive (half-) shafts and, through them, to the driving road wheels, either to all four of them (on four-wheel drive cars) or only to two of them (the front on the front-wheel drive vehicles or the rear on the rear-wheel drive ones), depending on the type of the car.



# UNIT 16

## The steering system

### The function of the steering system

#### Warm up

#### The correct alternatives

- |          |             |        |
|----------|-------------|--------|
| 1 - c    | 5 - b,c     | 9 - b  |
| 2 - a    | 6 - c       | 10 - c |
| 3 - a, c | 7 - b, d, e |        |
| 4 - a,c  | 8 - a       |        |

### The main parts of the steering system

#### TASK



#### The main components of the steering system and their parts.

- The **steering** wheel that carries:
  - the **wheelspokes** which are made of sheet steel,
  - the **airbag** system, and
  - the horn
- The **steering column** that comprises:
  - the steering **wheel adjustment** mechanisms (= the steering wheel **raising**/lowering and **rake** mechanisms)
  - the steering wheel **lock** and
  - levers and **switches** for controlling the **indicator** lights and the **headlights**.
- The **steering** shaft, which is divided either into two parts: the upper or **main** and the **lower shaft**, or into three parts: the **upper** or **main**, the **intermediate**, and the **lower shaft** by **universal** joints.
- The manual **steering gear** which consists of:
  - a **casing**, known as the steering gear **housing**,
  - a **pinion** attached to the lower shaft, and

- c) the **rack** that ends in **ball** joints covered by rubber **bellow**s or gaiters.
- 5. The **tie** or **track** rods.
- 6. The steering **arms** which are connected to the road wheels by **ball** joints.

## The power-assisted steering

### TASK



### The parts of the power-steering system

**Note** Since the power-steering system functions as a booster of the manual-steering system, the students are expected to include the parts of both systems, especially those associated with the steering gear. As for the Greek terms, they are all given in the Vocabulary.

1. steering wheel
2. steering column
3. steering shaft: upper, intermediate, lower
4. universal joints
5. manual steering-gear housing
6. pinion
7. rack
8. cylinder/ power-steering gear housing
9. (double-action) piston
10. valve housing / (rotary) control valve
11. (external) steering fluid pipes / hoses (from the valve to the cylinder)
12. (steering fluid) reservoir
13. pump
14. high-pressure hose (from the pump to the valve),
15. low-pressure hose (from the pump to the valve),
16. tie/ track rod(s)
17. ball joint(s)
18. rubber bellow(s)
19. steering arm(s)

## 1. Reading comprehension

### 1A The answer to the questions.

**Note** Taking into consideration that the operation of the steering system is rather complicated, the answers given below mainly aim at helping the teacher understand how the system works, enabling him/her to check the answers of the students, who may use their knowledge of the subject when answering the questions.

1. The steering system should ensure that the passengers have a comfortable ride, so it should be designed to work in conjunction with the suspension system. It should also be designed so that the driver doesn't have to apply too much force when turning the steering wheel to take a turn or park the car. However, as the passengers' safety is more important than their comfort, the steering system should be designed so that it ensures a) that the driver feels what is happening to the front wheels and b) that he is able to keep the car pointing straight ahead, even if it hits unexpectedly on some object on the road at high speed, or if he drives on a road with bumps and irregularities.
2. They connect the parts of the steering shaft, and also make the steering-wheel adjustments possible.
3. By a lever located / placed on the left-hand side of the steering column, under the steering wheel.
4. It is one of the two main elements of the steering gear, either manual or power assisted. It is located at the front of the car, between the two tie rods, to which it is connected by ball joints, and it is like a gearwheel opened up and laid flat. It mates / is engaged with the pinion, which by turning (*towards the same direction as the steering wheel*), pushes the rack towards either the same or the opposite direction of its turning, depending on which side of the rack it (= *the pinion*) is placed.
5. When the steering wheel is turned, the steering shaft and the pinion turn with it (*towards the same direction*). As the pinion turns, it pushes the rack either to the left or to the right. (*If the pinion is placed on the upper / front side of the rack, it pushes the rack towards the opposite direction of the turning steering wheel. If it is placed on the underside / at the back side of the rack, the pinion pushes the rack towards the same direction of the turning steering wheel.*)
6. It is a hydraulically-operated servo-mechanism which assists the pinion to move the rack in order to turn the road wheels. It makes the turning of the wheels easier and so, the effort required by the driver to turn the steering wheel decreases.

7. By the control valve which, activated by the turning of the steering wheel, opens one of its sides (the left or the right) to let fluid under pressure flow to the appropriate side of the cylinder / power-steering gear, so as to push the double-action piston towards the correct direction. *(To push the rack to the left, the high-pressure fluid enters on the right side of the cylinder; to push the rack to the right, the fluid enters on the left side of the cylinder)*
8. Pushed by the high-pressure fluid *(that enters the cylinder of the power-steering gear either to its left or to its right side)*, the piston either pushes or draws the rack, *(to which it is attached)* towards the direction it should move *(pushed by the pinion)* to turn the road wheels. In this way, the rack moves easier towards this direction and, as a result, less effort is required by the driver *(when turning the steering wheel)*.
9. When the driver turns the steering wheel to change direction, the steering pump sends fluid under pressure to the control valve through the high-pressure hose. The valve, activated by the turning of the steering wheel, directs the high-pressure fluid to the appropriate side of the cylinder that includes the double-action piston *(= the opposite side of the direction towards which the piston must move to push the rack. That is, if the piston has to assist the rack in its movement to the right, the fluid must enter on the left side of the cylinder; if the piston has to assist the rack to move to the left, the fluid must enter on the right side of the cylinder and the piston. In other words, the fluid enters "behind" the piston, so as to push it to the direction required)*. The fluid pushes the piston which, in turn, either pushes or draws the moving rack towards the appropriate direction so as to turn the wheels.

## 1B The paragraphs completed.

### 1st paragraph

The driver turns the steering wheel to the right. This movement is transferred by the steering shaft to the pinion. As the pinion turns to the **right**, it pushes the steering rack to the **left**. As soon as the steering wheel is turned, the **right** side of the control valve opens allowing fluid under pressure to flow through the **right** hose and enter the **right** side of the cylinder. The high-pressure fluid pushes the piston to the **left**. Since the piston is attached to the rack, it pushes the rack to the **left** amplifying the force applied by the driver to the steering wheel. In this way, the effort required by the driver to turn the steering wheel is decreased.

2st paragraph

The driver turns the steering wheel to the left. This movement is transferred by the steering shaft to the pinion. As the pinion turns to the **left**, it pushes the steering rack to the **right**. Meanwhile, the pump sends steering fluid under pressure through the high-pressure hose to the control valve. The control valve, activated by the turning of the steering wheel, opens its **left** side and lets fluid under pressure to flow through the **left** hose to the **left** side of the cylinder which includes the piston. The high-pressure fluid pushes the piston to the **right**. The piston, acting as a booster, draws the rack to the **right** amplifying the force applied by the driver to the steering wheel. In this way, the turning of the road wheels becomes easier and thus, the effort required by the driver to turn the steering wheel is decreased.

**2. Vocabulary practice****2A Replacing words in the text.**

- |                |                |
|----------------|----------------|
| 1. permits     | 5. ride        |
| 2. work        | 6. pavement    |
| 3. conjunction | 7. applying    |
| 4. ensure      | 8. consists of |

**2B Matching.**

- Verbs:** 1 - e    2 - f    3 - d    4 - c    5 - g    6 - b    7 - a  
**Nouns:** 1 - f    2 - d    3 - a    4 - g    5 - c    6 - e    7 - b

**2C The English or Greek equivalent.**

- The car
  - a) changed direction.
  - b) is turning.
  - c) keeps pointing straight ahead.
- Ο δρόμος είναι ανώμαλος και γεμάτος σαμάρια.
- Ένας σπαστός σύνδεσμος είναι ενσωματωμένος στην κολώνα του τιμονιού.
- The main (steering) shaft is further divided to prevent intrusion into the passenger compartment, in (case of) a collision.
- Σε περίπτωση σύγκρουσης, το κατώτερο τμήμα του κυρίως άξονα διεύθυνσης μπαίνει μέσα στο άλλο και οι ακτίνες του τιμονιού παραμορφώνονται.

6. The rake and the raising or lowering of the steering wheel is / are set by a lever on the steering column.
7. On older cars, you should apply much effort to turn the wheel.

### 3. Writing activity

**Note** *Instead of the key to this exercise, it was considered more helpful to give only the directions the various components of the system move.*

- A.** When the steering wheel is turned to the **left**, the rack moves also to the left pushed by the pinion. As a result, since the piston must push the rack further towards this direction (to the left), the high-pressure fluid enters the opposite (the right) side of the cylinder, coming from the same side (the right) of the control pump, which opens as soon as the driver turns the steering wheel.
- B.** When the steering wheel is turned to the **right**, the rack moves also to the right pushed by the pinion. As a result, since the piston must push the rack further towards this direction (to the right), the high-pressure fluid enters the opposite (the left) side of the cylinder, coming from the same side (the left) of the control pump, which opens as soon as the driver turns the steering wheel.

# UNIT 17

## The suspension system; its components and their operation.

### 1. Reading comprehension

- |       |       |
|-------|-------|
| 1 - a | 5 - a |
| 2 - b | 6 - c |
| 3 - a | 7 - b |
| 4 - c | 8 - a |

### 2. Vocabulary practice

- |           |               |                  |
|-----------|---------------|------------------|
| <b>2A</b> | 1. suspension | 7. support       |
|           | 2. operate    | 8. integrate     |
|           | 3. attach     | 9. mount         |
|           | 4. screw      | 10. compensation |
|           | 5. weld       | 11. resist       |
|           | 6. locate     | 12. steer        |
| <b>2B</b> | 1. component  | 7. bearing       |
|           | 2. spring     | 8. sleeve        |
|           | 3. link       | 9. seat          |
|           | 4. wheel      | 10. bushing      |
|           | 5. frame      | 11. lateral      |
|           | 6. clamp      | 12. stable       |

### 3. Listening activity

The underlined words are missing in the students' book.

#### Rear spring

The rear springs are the coil type <sup>(1)</sup> and mounted <sup>(2)</sup> at the top to the side member

with a rubber spacer, a spring seat <sup>(3)</sup> and a screw and nut.

The bottoms of the springs are located <sup>(4)</sup> in a seat in the trailing <sup>(5)</sup> arms.

There are rubber bump stops mounted in the upper part of the springs to prevent the springs bottoming. <sup>(6)</sup>

### Shock absorber

The rear shock absorbers <sup>(7)</sup> are of the gas spring type and mounted to the trailing arms at the bottom and by a bracket to the rear side member <sup>(8)</sup> at the top. The bracket is located with two screws. <sup>(9)</sup>

Many cars can also be equipped <sup>(10)</sup> with self-leveling shock absorbers in combination with other springs and anti-roll bar.

There is an anti-roll bar <sup>(11)</sup> mounted between <sup>(12)</sup> the trailing arms.

## 4. Language functions

1. Don't jack up the rear of the car unless you chock the front wheels.
2. Support the rear of the car on axle stands.
3. Don't remove the roadwheel if it is not properly supported on the axle stands.
4. Use a trolley jack for lifting the trailing arm.
5. Unscrew and remove the bracket.
6. Withdraw the shock absorber from under the vehicle.

## 5. Use of english

- |             |                 |
|-------------|-----------------|
| 1. with     | 7. of, of, with |
| 2. on       | 8. in           |
| 3. to       | 9. by           |
| 4. of, to   | 10. for, by     |
| 5. to, with | 11. to, without |
| 6. In       |                 |

# UNIT 18

## The wheel angles and their alignment

### 1. Reading comprehension

- 1A**
1. So that the car can have good steering properties and a minimum of tire wear.
  2. No. It must be empty.
  3. By encouraging the wheel to travel straight forward.
  4. No, it can't
  5. No, it also refers to its leaning outwards.
  6. When the wheel leans outwards it is considered positive and when it leans inwards it is considered negative.
  7. It ensures that the wheel turns easily and retains a self-centering effect.
  8. It points inwards.
  9. Because correct toe-in gives the correct feeling from the road through the steering wheel and assists directional stability.
  10. Vibrations that increase tire wear.

- 1B**
- |          |          |
|----------|----------|
| 1. True  | 5. True  |
| 2. False | 6. True  |
| 3. False | 7. True  |
| 4. False | 8. False |

### 2. Vocabulary practice

- 2A**
- |       |        |
|-------|--------|
| a - 3 | f - 5  |
| b - 1 | g - 8  |
| c - 4 | h - 7  |
| d - 2 | i - 10 |
| e - 6 | j - 9  |

<b>2B</b>	<b>a</b> – 5	<b>f</b> – 3
	<b>b</b> – 8	<b>g</b> – 2
	<b>c</b> – 1	<b>h</b> – 4
	<b>d</b> – 9	<b>i</b> – 7
	<b>e</b> – 6	<b>j</b> – 10

### 3. Language functions

Let the students make their own sentences choosing among the techniques provided in their books. Note that information provided in the 3<sup>rd</sup> sentence is incorrect and students must use techniques for correcting information.

### 4. Use of English

- |                |                   |
|----------------|-------------------|
| 1. incorrect   | 7. unchecked      |
| 2. ineffective | 8. disconnect     |
| 3. uncertain   | 9. unload         |
| 4. instability | 10. impatient     |
| 5. unstable    | 11. illogical     |
| 6. non-return  | 12. irreplaceable |

### 5. Useful phrases

1. good steering properties
2. caster encourages the wheel to travel straight forward
3. the greater the caster the greater the self-centering effect
4. the angle is considered positive if the wheels lean outwards
5. the inclination corresponds to the angle
6. the front part of the wheel points inwards
7. incorrect toe-in causes vibrations
8. increase tire wear

# UNIT 19

## Brakes

### A. The wheel braking system and the hydraulic system

#### 1. Reading comprehension

- 1A**
1. The ventilated brake discs, the sliding brake caliper and the special brake blocks.
  2. It is designed to prevent brake fluid escaping and to return the piston to its resting position after braking.
  3. The solid brake discs, the fixed brake calipers and the brake disc hub which acts as the brake drum.
  4. It consists of a wheel cylinder, the brake shoes, the friction lining, the brake drums, the brake adjuster and the return springs.
  5. It has two pistons. One for the primary circuit and one for the secondary circuit.
  6. For safety reasons. If there is a leak in one circuit, there will still be brake fluid in the other one.
  7. It is used for connecting the master cylinder to the clutch.
  8. Within the MIN and MAX markings.
  9. It switches on a warning light on the instrument panel to warn the driver if the brake fluid level is too low.
  10. When the brake fluid falls below the MIN level.
  11. It grounds an output on the instrument panel and the warning light / indicator comes on.
  12. Behind the pedal.

**1B Front wheel brakes:** sliding brake caliper, ventilated brake discs, brake blocks.

**Rear wheel brakes:** solid brake discs, fixed brake calipers.

**Drum brakes:** brake shoes, friction lining, brake adjuster, return springs.

**Hydraulic system:** master cylinder, brake fluid reservoir, brake circuit warning indicator, stop light control.

## 2. Vocabulary practice

- 2A**
- |                |                 |
|----------------|-----------------|
| 1. compartment | 7. comprise     |
| 2. ventilated  | 8. indicator    |
| 3. effective   | 9. safety       |
| 4. escaping    | 10. intact      |
| 5. guard       | 11. dashboard   |
| 6. assembly    | 12. switches on |
- 2B**
- |              |              |
|--------------|--------------|
| 1. guard     | 5. indicator |
| 2. adjuster  | 6. clutch    |
| 3. reservoir | 7. floater   |
| 4. sensor    | 8. switch    |
- 2C**
- |            |              |
|------------|--------------|
| anti-spin  | transmission |
| backplate  | dashboard    |
| brakeforce | left-hand    |

## B. The ABS, EBD, parking brake systems and the brake servo

### 1. Reading comprehension

- 1A**
- |       |       |
|-------|-------|
| 1 - b | 6 - a |
| 2 - a | 7 - b |
| 3 - c | 8 - a |
| 4 - a | 9 - c |
| 5 - c |       |

- 1B Anti-block braking system:** speed sensor, sensor gears, ABS warning light.  
**Parking brake system:** parking brake lever (handbrake), brake wires, brake shoes, brake lever warning lamp.  
**Brake servo:** non-return valve, pressure hose.

- 1C**
- |                             |                             |
|-----------------------------|-----------------------------|
| 1. The ABS system.          | 5. The EBD system.          |
| 2. Speed sensor.            | 6. The parking brake lever. |
| 3. The electronic computer. | 7. Brake servo.             |
| 4. The sensor gears.        | 8. The non-return valve.    |

## 2. Vocabulary practice

<b>2A</b> addition	park(ing)
pressure	enhancement
location	connection
distribution	assist (ance)
control	design

<b>2B</b> front ≠	rear	consist of ≠	divide into
earlier ≠ later		enhance ≠	reduce
similar ≠ different		connect ≠	disconnect
include ≠ exclude		inlet ≠	outlet
high ≠ low		left ≠	right

<b>2C</b> a - 2	e - 6
b - 3	f - 5
c - 4	g - 8
d - 1	h - 7

## 3. Use of English

- |            |              |
|------------|--------------|
| 1. in(to)  | 7. on, on    |
| 2. of      | 8. to        |
| 3. in      | 9. from      |
| 4. as      | 10. to, of   |
| 5. for     | 11. on       |
| 6. for, to | 12. from, in |