

انگلیسی

برای دانشجویان رشته

مکانیک خودرو

مرکز آموزش علمی کاربردی شهربابک

مدرس: الهام حجتی فر

۱۴۰۳-۱۴۰۴

دانشگاه جامع علمی کاربردی



The Organization for Researching and Compiling
University Textbooks in the Humanities (SAMT)



ENGLISH for the Students of *Automotive Mechanics* Hamid Askari Kermani

انگلیسی

برای دانشجویان رشته

مکانیک خودرو



حمید عسکری کرمانی

ENGLISH 2

for the Students of

Automotive Mechanics



Hamid Askari Kermani

652



9 789644 596889

شابک: ۹۶۴-۲۵۹-۶۸۸-۹

قیمت: ۱۲۵۰۰ ریال

مرکز پژوهش و نمایشگاه دائمی: تهران، خیابان انقلاب اسلامی، خیابان ابوریحان،
شماره ۲ - تلفن: ۶۶۴۰۸۱۲۰ - شماره: ۶۶۴۰۵۶۷۸

Key to Phonetic Symbols

Vowels and Diphthongs

1	i:	as in	see /si:/	12	ʌ	as in	cup /kʌp/
2	ɪ	as in	happy /hæpi/	13	ɜ:	as in	bird /bɜ:d/
3	ɪ	as in	sit /sɪt/	14	ə	as in	about /ə'baʊt/
4	e	as in	ten /ten/	15	eɪ	as in	say /seɪ/
5	æ	as in	cat /kæt/	16	əʊ	as in	go /ɡəʊ/
6	ɑ:	as in	father /fɑ:ðə(r)/	17	aɪ	as in	five /faɪv/
7	ɒ	as in	got /ɡɒt/	18	aʊ	as in	now /naʊ/
8	ɔ:	as in	saw /sɔ:/	19	ɔɪ	as in	boy /bɔɪ/
9	ʊ	as in	put /pʊt/	20	ɪə	as in	near /nɪə(r)/
10	u	as in	actual /æktʃuəl/	21	eə	as in	hair /heə(r)/
11	u:	as in	too /tu:/	22	ʊə	as in	pure /pjʊə(r)/

Consonants

1	p	as in	pen /pen/	13	s	as in	so /səʊ/
2	b	as in	bad /bæd/	14	z	as in	zoo /zu:/
3	t	as in	tea /ti:/	15	ʃ	as in	shoe /ʃu:/
4	d	as in	did /dɪd/	16	ʒ	as in	vision /vɪʒn/
5	k	as in	cat /kæt/	17	h	as in	hat /hæt/
6	g	as in	got /ɡɒt/	18	m	as in	man /mæn/
7	tʃ	as in	chain /tʃeɪn/	19	n	as in	no /nəʊ/
8	dʒ	as in	jam /dʒæm/	20	ŋ	as in	sing /sɪŋ/
9	f	as in	fall /fɔ:l/	21	l	as in	leg /leg/
10	v	as in	van /væn/	22	r	as in	red /red/
11	θ	as in	thin /θɪn/	23	j	as in	yes /jes/
12	ð	as in	this /ðɪs/	24	w	as in	wet /wet/

/ ' / represents primary stress as in about /ə'baʊt/

/ , / represents secondary stress as in academic /ækə'demɪk/

(r) An 'r' in parentheses is heard in British pronunciation when it is immediately followed by a word, or a suffix, beginning with a vowel. Otherwise it is omitted. In American pronunciation no 'r' of the phonetic spelling or of the ordinary spelling is omitted.

Lesson One

Part I. Pre-Reading

A. Word Study: Definitions

- articulate /ɑ:'tɪkjuleɪt/: connect by joints
articulated vehicle: one having parts joined in a flexible manner
axle /æksl/: 1. a rod upon or on which a wheel turns
2. a bar or a rod that passes through the centres of a pair of wheels
cargo /kɑ:gəʊ/: goods carried in a ship, aircraft, or other vehicle
chassis /ʃæsi/: framework of a motor-car or aircraft on which the body is fastened or built
differential /dɪfə'renʃl/: a mechanism which permits a rear axle to turn corners with one wheel rolling faster than the other
dump truck /dʌmp trʌk/: a truck bearing a cargo bin that can be mechanically tilted, allowing the load to be dumped
fender /fendə(r)/: strong bar, usually on the front of a car, used to lessen shock or damage in a collision
garbage /gɑ:bɪdʒ/: waste food put out as worthless; rubbish
gear /gɪə(r)/: 1. set of toothed wheels working together in a machine
2. apparatus, mechanism of wheels, levers, etc. for a special purpose

hardtop /hɑ:dtɒp/

car with a steel top (metal roof) and no sliding roof

magnitude /mægnɪtju:d/

size; greatness in size or extent

sedan /sɪ'dæn/

rpm: revolution per minute

saloon car for four or more persons in two- or four-door models

subdivide /sʌbdɪvaɪd/

divide into further divisions

torque /tɔ:k/

the moment of force which rotates a body and equals the product of a force by the arm it is applied to

van /væn/

a covered or roofed vehicle that has been adapted for personal use

vehicle /vi:əkl/

any device for carrying passengers and goods on land

B. Word Study: Definitions and Examples

absorb /əb'sɔ:b/

take or suck in

Dry sand **absorbs** water.

application /æplɪ'keɪʃn/

putting to practical use

The **application** of this new discovery in industry will change the life of the ordinary man.

available /ə'veɪləbl/

able to be used; at hand

The book you ordered is **available** now.

backbone /'bækbaʊn/

main support or major sustaining factor; firmest part

A foundation can be considered the **backbone** of a building.

classify /klæsɪfaɪ/

arrange in classes or groups; put into a class

In a library, books are usually **classified** by subjects.

component /kəm'pəʊnənt/

necessary or essential part

Two atoms of Hydrogen and one atom of

comprise /kəm'praɪz/

Oxygen are the **components** of a molecule of water.

be composed of; be consist of

The engine **comprises** hundreds of different parts.

convert /kən'veɜ:t/

change something into something different

An engine **converts** the chemical energy of fuel into mechanical energy.

decelerate /di'seləreɪt/

cause to diminish speed (\neq accelerate)

You should **decelerate** the speed of your car as you approach the traffic lights.

disconnect /dɪskə'nekt/

detach from; take apart

You should **disconnect** the TV before you fix it.

equip /ɪ'kwɪp/

supply with what is needed for a purpose

The ship was **equipped** for the voyage.

generic /dʒə'nerɪk/

common to a whole group or class; not special

Drugs and medicines are identified by their **generic** names in our country.

perform /pə'fɔ:m/

do; fulfil

He **performs** his task eagerly.

propel /prə'pel/

drive forward

Some boats are **propelled** by oars; some others are **self-propelled**.

rear /rɪə(r)/

in or at the back part

The **rear** lamps of his car were out of order.

repair /rɪ'peə(r)/

restore something worn or damaged to good condition; put in order; fix

They set to **repair** the bridge.

rotate /rəʊ'teɪt/

cause to move round a central point

That pulley **rotates** clockwise.

serve /sɜ:v/

be satisfactory for a need or purpose; meet a need

smoothly /smu:ðli:/

task /tɑ:sk/

transport /træn spɔ:t/

That box will serve for a seat.

in an even or gentle motion or movement:
free from shaking, bumping, etc.

The engine is running smoothly:
piece of work done; duty; function

It wasn't an easy task for a boy at his age.
carry (goods, persons) from one place to
another

The goods were transported by a lorry.

Part II. Reading

Automobiles and Their Basic Components

Automobile is a generic term for a self-propelled, public, or personal vehicle. According to their applications, automobiles are classified as passenger cars, trucks, and special-purpose vehicles. Passenger cars, such as taxis and buses are used to transport people in cities, on highways, or across country. Passenger cars are available in several body styles and they are made in various sizes. The sedan, the hardtop, the station wagon, and the van are examples of different passenger cars. The buses are subdivided into city and intercity passenger cars. Tourist buses make a separate group. According to their length, buses are classified as minibuses (up to 5 m), small (up to 7.5 m), medium (up to 9 m), large (up to 12 m), and articulated (over 16.5 m).

Cargo carriers include trucks, truck tractors, trailers, pole trailers, and semitrailers. The trucks may be provided with beds to transport different goods or with special-purpose bodies, such as dump bodies, tank bodies, etc. The special-purpose automobiles are equipped for performing particular tasks. Among them are fire and garbage trucks, ambulances, tower, water-tank, repair trucks, etc.

The three basic components of the automobile are the chassis, body, and engine.

The chassis comprises the drive line, running gear (undercarriage), and control mechanisms.

1. driver's cab
2. cargo body
3. clutch
4. transmission (gearbox)
5. propeller (cardan) shaft
6. final drive (driving axle)

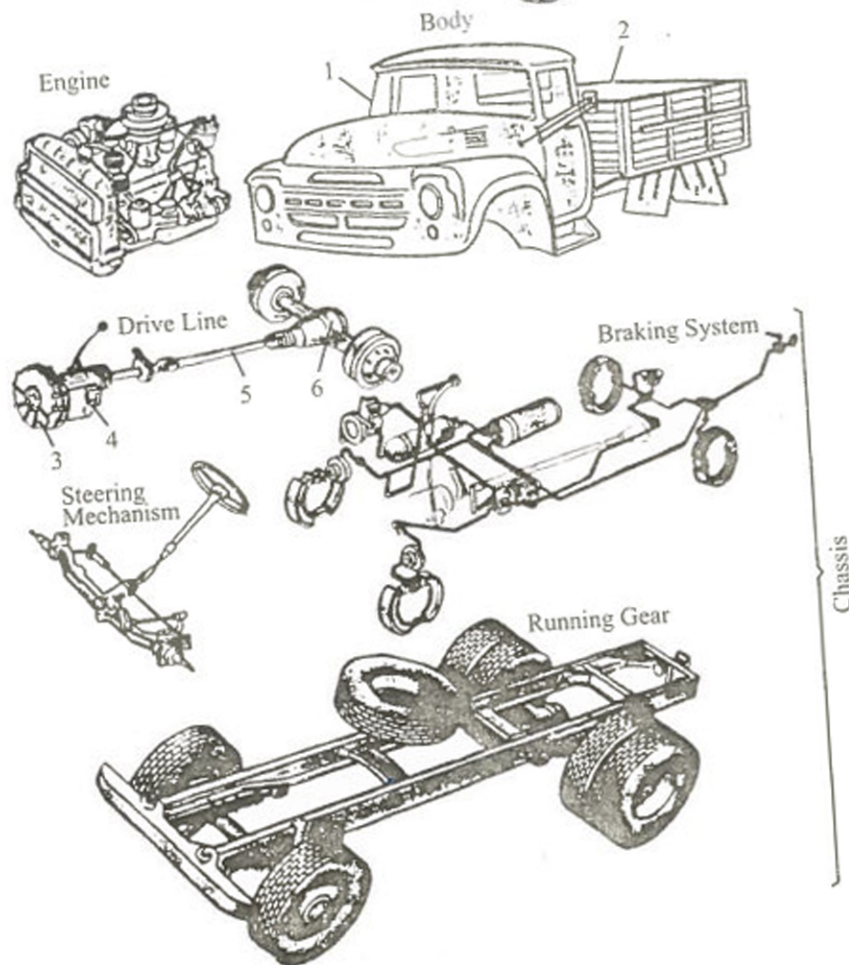


Figure 1-1. Basic Components of the Automobile.

The drive line consists of mechanisms and units which transmit torque from the engine to the drive wheels and change torque and rpm in magnitude and direction. Among these mechanisms and units are the clutch, transmission (gear box), propeller shaft, and axle shafts.

The clutch serves to disconnect the engine shaft from the transmission for a short period of time while the driver is shifting gears and to smoothly connect them again.

The transmission converts torque in magnitude and direction, making it possible to change the running speed by engaging different pairs of gears. It allows the automobile to move forth and back and the engine to be disconnected from the drive line for a longer period of time.

The propeller shaft is used to transmit torque from the transmission to the final drive at varying angles.

The differential allows the drive wheels to rotate at a different speed.

The running gear is the backbone of the automobile; it includes the frame, front and rear axles, springs, shock absorbers, wheels, and tyres.

The control mechanisms consist of the steering system for changing the direction of movement and the brakes for decelerating and stopping the automobile.

The body is an enclosure mounted on and attached to the frame of an automotive vehicle. The passenger car body is fabricated from sheet metal, glass, interior trim, and upholstery materials for the convenience and protection of the occupants from the weather and from dirt, dust, noise, smoke, etc. The body of a truck comprises of a cargo body and a driver's cab. The fenders, radiator grille, hood, and mudguards also belong to the body.

The engine converts the fuel energy into mechanical power. It usually burns or consumes a fuel. Engines are classed as external or internal combustion. In an internal combustion engine, the fuel is burnt inside the engine, and in an external combustion engine, the fuel is burnt outside the engine.

Comprehension Questions

A. Read each statement and decide whether it is true or false. Write 'T' before true statements and 'F' before false statements.

1. The term automobile covers many types of vehicles.

2. We may classify automobiles into three main groups.
3. Automobiles are usually classified based on their shapes and colour.
4. Trucks are cargo carrier vehicles.
5. Tourist buses are exactly the same as the intercity buses.
6. Ambulance is a passenger car.
7. The torque produced by the engine is directly transmitted to the rear axle.
8. The main support of the automobile is the control system.

B. Circle a, b, c, or d which best completes the following items.

1. "An automobile is a self-propelled vehicle." It means
 - a. we should propel the automobile ourselves
 - b. it is able to move forward by itself
 - c. it is a fast-moving vehicle
 - d. everybody should provide an automobile for himself
2. The sedan, the hardtop, and the station wagon are
 - a. passenger cars
 - b. made in various sizes and body styles
 - c. not different from each other
 - d. both a and b
3. Some automobiles are called special-purpose because they
 - a. differ in their size
 - b. can carry heavy loads
 - c. are made in certain ways to fit certain functions
 - d. are made in special models
4. Buses are subdivided by their
 - a. length
 - b. size
 - c. style
 - d. purpose
5. A farm tractor may be grouped as belonging to
 - a. trucks
 - b. passenger cars
 - c. special-purpose cars
 - d. none of the above
6. The clutch and axle shafts are subdivisions of
 - a. the transmission
 - b. the drive line
 - c. the running gear
 - d. the control mechanism

7. The rpm of the torque is increased by means of
 a. differential b. running gear
 c. propeller shaft ✓ d. gear box
8. Steering wheel can be a part of
 a. drive line ✓ b. control mechanism
 c. the body d. braking system

C. Answer the following questions orally.

- What are the three basic components of the automobile?
- How are automobiles classified based on their applications?
- What are the main components of the chassis?
- What is the function of the engine?
- What is the job of the steering system?

Part III. Homework

Section One: Vocabulary Exercises

- A. Fill in the blanks with the words from the following table. Make necessary changes if required.

Verb	Noun	Adjective	Adverb
classify	classification	classifiable classified	_____
transport	transportation transport	transportable	_____
convert	conversion	convertible	_____
vary	variation	various	variously

- The police couldn't identify him because he lived under ^{various} names.
- The ^{conversion} of water into vapour is called vaporization.
- ^{Variation} of temperature affects the crops.
- Based on their origine, substances are ^{classified} into organic and inorganic.
- His father is a driver and ^{transport} goods by his lorry.
- The tourist went to the bank to ^{convert} his dollars into rials.
- The of the animals into smaller groups helps the scientists study ^{classification}

them more easily.

- Most of our is carried out by land. ^{transportation}
- Gas is not an easily fuel. ^{convertible}
- Living things are into various subgroups. ^{classified}
- Some solid materials are into liquid. ^{converted}
- A windmill harnesses the energy of the wind and it into mechanical energy. ^{convert}
- Teaching methods may from school to school. ^{vary}

B. Fill in the blanks with the appropriate words from the list below. There are more options than required.

filled	quantity	dipper	wings
considerable	mixture	wheels	sides
figure out	source	diesel	tyres
contains	absorb	sucked	

- Before starting out for a run, be sure that the tank sufficient petrol. ^{contain}
- Locomotives have wheels, but lack ^{tyres}.
- The engine is the of power that makes the car move. ^{source}
- To check the oil, remove the rod; it shows the actual ^{quantity} present in the sump.
- Gasoline is from the gasoline tank and delivered to the carburettor. ^{sucked}
- The radiator should be ^{filled} with clean water.
- Cars, planes, and bikes have ^{wheels}.
- Squares and rectangles have four ^{sides}.
- Some cars have petrol engines and some others have engines. ^{diesel}
- Can you what makes the molecules move faster? ^{figure out}

C. Match the words in Column I with their appropriate equivalents in Column II. Insert the letters a, b, c, etc. in the parentheses provided. There are more options in Column II than required.

Column I

Column II

1. magnitude c () a. special

- | | | |
|------------------|-----|----------------------------------|
| 2. absorb e | () | b. able to be used |
| 3. cargo f | () | c. greatness in size |
| 4. particular a | () | d. waste food |
| 5. garbage d | () | e. take or suck in |
| 6. application b | () | f. goods carried in a ship, etc. |
| 7. component i | () | g. arrange in groups |
| 8. classify g | () | h. putting to use |
| 9. available h | () | i. essential part |
| 10. perform L | () | j. reduce speed |
| 11. disconnect m | () | k. drive forward |
| 12. decelerate j | () | l. do; fulfil |
| 13. propel k | () | m. detach from |
| 14. task p | () | n. main support |
| 15. serve o | () | o. meet a need |
| | | p. function; duty |
| | | q. at the back part |
| | | r. free from shaking |



Section Two: Further Reading

Read the following text carefully and then select a, b, c, or d which best completes the following items.

Included in the broad range of body types and configurations of commercial vehicles are trailers and buses. The output of commercial vehicles is drastically increased by the use of trailers. They decrease fuel and oil consumption per ton of load carried, thus cutting transportation costs.

Trailers are divided into several types depending on the method of towing, coupling type and haulage. There are single-, two-, and multi-axle trailers, semitrailers, heavy-duty trailers, and pole trailers.

A trailer consists of a cargo body, frame, axles with wheels, springs, turning gear and coupler. Trailers designed to carry extra heavy cargo usually have a plurality of wheels or rollers. The turning gear is provided on the trailers having more than one axle. The turning gear consists of a lower

turntable and a front axle with subframe. To the front axle is attached a pole with a rigid or spring-type coupler at the end.

A semitrailer has no front axle and rests with its front part on the fifth wheel of the tractor, so that it transmits a part of the weight to the fifth wheel. It may have one or more rear axles depending on its load capacity. The front part of the semitrailer is provided with retractable parking legs which support the uncoupled semitrailer. The semitrailer has no turning gear.

A pole trailer is a light frame mounted on one or two axles with wheels and springs and having a rigidly connected pole. Pole trailers are used to haul long loads. All two-axle trailers and semitrailers are equipped with air brakes operated from the tractor brake system, with marker lights, turn signal lights and stoplights.

Bus is a wheeled, self-propelled public carrier available in various capacities and sizes accommodating from 8 to more than 60 people for mass transit of passengers. As an automotive vehicle, the bus retains many passenger car and truck components. Basic bus design makes maximum utilization of space for entry, aisle, and exit areas. Heavy frames perform the same function as those in other commercial vehicles. The chassis assembly includes all the components and systems essential to operation. Body style, passenger capacity, power plant, and equipment are available in great variety.

- Trailers may be classified based on
 - the way they carry a load, the way they are pulled by the tractor, and the distance they travel
 - the distance they transport a load, and their method of coupling
 - the way they are pulled, the distance they transport a load, and the way they are joined to the tractor
 - the number of their axles and their capacity for carrying a load
- It is not true that
 - trailers increase the transportation expenses
 - by using trailers we can economize on fuel and oil
 - it is an economy to use trailers for transportation
 - trailers are made for different purposes

3. It is true that

- ✓ a. all trailers have a turning gear
- b. heavy-duty trailers usually have larger numbers of wheels
- c. a pole trailer is suitable for carrying heavy loads
- d. just semitrailers are equipped with air brakes

4. The function of the fifth wheel is

- a. not mentioned in the passage
- b. to support the uncoupled semitrailer
- c. to act as a turning gear
- ✓ d. to support part of the weight of the load

5. It is **not** true that

- a. buses share many components with trucks
- b. buses are used for mass transportation of people
- ✓ c. in designing a bus, the minimum space should be devoted to the aisle
- d. functionally, the bus frame is similar to other commercial vehicles

6. We may conclude from the passage that buses are different from other commercial vehicles mostly in their

- a. bodies
- b. chassis
- c. frames
- ✓ d. load-bearing capacity



Section Three: Translation Practice

A. Translate the following passage into Persian.

An automobile can be considered from three different points of view: the average automobile driver, the automobile engineer, and the automobile mechanic. The average automobile driver views his car as a mechanism designed for his comfort. He knows that it needs gasoline, oil, water, air and occasional repairs. Whereas the automobile engineer sees it as thousands of different parts that have assembled into a smoothly functioning unit which is a triumph of engineering and production skill. On the other hand, the automobile mechanic knows how these parts go together, knows the job of each part and the way they wear and fail. He also knows what is required to restore the car to good running condition when failure occurs.

B. Find the Persian equivalents of the following terms and write them in the spaces provided.

1. aisle
2. articulated vehicle
3. backbone
4. cargo
5. chassis
6. differential
7. disconnect
8. equip
9. fender
10. gear
11. hardtop
12. heavy-duty trailer
13. mounted on
14. multi-axle trailer
15. rear
16. repair
17. retractable
18. rotate
19. sedan
20. semitrailer
21. torque
22. transport
23. turntable
24. van
25. vehicle

1. راهرو
2. وسیله نقلیه
3. ستون اصلی
4. بار
5. شاسی
6. دیفرانسیل
7. جدا کردن
8. تجهیز کردن
9. سپر
10. دنده
11. سقف سفت
12. تریلر سنگین
13. نصب شده بر
14. تریلر چند محوری
15. عقب
16. تعمیر
17. جمع شونده
18. چرخش
19. سدان
20. سیمیترایلر
21. گشتاور
22. حمل و نقل
23. چرخش
24. ون
25. وسیله نقلیه

Lesson Two

Part I. Pre-Reading

A. Word Study: Definitions

accelerate /ək'seləreit/: increase the speed of; cause to move faster

accelerator /ək'seləreitə(r)/: a device, e.g., the pedal in a car, for controlling speed; something that makes faster and speeds up

accessory /ək'sesəri/: something extra, helpful, useful, but not an essential part of

coolant /ku:lənt/: kind of fluid used for cooling

crankcase /kræŋk'keɪs/: the metal case enclosing the crankshaft and associated parts in a reciprocating engine

ignite /ɪg'naɪt/: heat a gaseous mixture to the temperature at which combustion occurs

ignition /ɪg'niʃn/: igniting or being ignited; electrical mechanism for igniting the mixture of explosive gases in a petrol engine

instrument /ɪn'strəmənt/: implement, apparatus, used in performing an action; mechanical implement

speedometer /spi:'dɒmɪtə(r)/: instrument showing the speed of a motor-vehicle

throttle /θrɒtl/: a valve in an internal combustion engine that regulates the amount of vapourized fuel entering the cylinders

windshield /'wɪndʃi:ld/: screen of glass in front of a motor-

wipe /waɪp/:
wiper /'waɪpə(r)/:

B. Word Study: Definitions and Examples

advise /əd'vaɪz/:

approximately /ə'prɒksɪ
meɪtli/:

attain /ə'teɪn/:

attempt /ə'tempt/:

damage /'dæmɪdʒ/:

depress /dɪ'pres/:

engage /ɪn'geɪdʒ/:

excessive /ɪk'sesɪv/:

fairly /'feəli/:

gradually /'grædʒuəli/:

vehicle, etc.

clean or dry by rubbing

a device used for wiping rainwater from the windshield

recommend; give advice to

The doctor advised him a complete rest.

almost; nearly

Approximately ten million people live in Tehran.

succeed in getting or gaining

If you try hard you can attain your objectives.

try; make a start at doing something

The prisoners attempted to escape but failed.

harm; injury

The storm did great damage to the crops.

press; push or pull down

To change gears, fully depress the clutch pedal, then move the gearshift lever.

(of parts of a machine) lock together; cause to fit into

The teeth of one gear engage with those of another.

too much; too great; extreme

Excessive pressure (overinflation) ruins the tyre.

moderately; rather

He wants a fairly large car.

by degrees

Gradually depress the accelerator pedal to increase the engine speed.

immediately /ɪ'mi:diətli/

at once; without delay

I immediately recognized her.

point out; show; make known

A sign-post indicated the right road to us.

establish in a place; situate

A new school is going to be located in the

suburb.

not extreme; having reasonable limits

We need a moderate-sized house, one with

3 or 4 rooms.

check by means of an apparatus; to keep

track of by means of an electronic device

In modern war message-sending must be

monitored.

(conj) if not; or else

Do what you have been told; otherwise you

will be punished!

place or location; the right or appropriate

place

If your automobile is of automatic trans-

mission type, put the selector lever to 'p'

(park) or 'n' (neutral) position before start-

ing the engine.

provide /prə'vaɪd/

furnish; supply; prepare

Fathers usually have to provide food,

clothes, etc. for the family.

take off or away from the place occupied;

take to another place

Do not remove the wheel bolts until the

wheel has been raised off the ground.

1. (v) change position or direction; trans-

fer

2. (n) change of place or character; substi-

tution

indicate /ɪndɪkeɪt/

locate /lə'keɪt/

moderate /mə'dɪrət/

monitor /mɒnɪtə(r)/

otherwise /ə'dɔ:waɪz/

position /pə'zɪʃn/

provide /prə'vaɪd/

remove /rɪ'mu:v/

shift /ʃɪft/

shift /ʃɪft/

shift /ʃɪft/

gear-shift: mechanism for gear change

Do you prefer a manual to an automatic gear-shift?

somewhat; to a slight degree

The patient is slightly better today.

give notice of possible danger; inform in advance

warning (adj): that warns

He gave me a warning look.

slightly /slɑ:tlɪ/

warn /wɔ:n/

Part II. Reading

Control of the Automobiles

The automobile and its engine are controlled and the operation of their mechanisms is monitored by means of controls and instruments located in the cab in front of the driver's seat. The instruments provided indicate to the driver everything he wants to know.

Automobile controls include clutch pedal, brake pedal, throttle (accelerator) pedal, steering wheel, gear-shift lever, and parking brake lever (hand brake). In order to start the engine and control its operation, some other instruments are used such as radiator shutter control handle, choke button, speedometer, fuel level indicator, water temperature indicator, ignition/starter switch, and so on.

The ignition/starter switch is operated by a key which may be placed in one of the following four positions: 'OFF' position—all current consumers are switched off, and the key can be removed only at this position; 'ON' position—this is the normal driving position, the ignition is switched on; 'ACC' position—accessories such as the radio, horn, windshield wiper and heat blower operate, but the engine is off; 'START' position—starter motor is on. In some automobiles, the ignition/starter switch may include a 'LOCK' position, instead of the 'OFF' position, in which the steering wheel is locked and the key can be removed only at this position.

Before starting the engine, it is necessary to check the radiator coolant

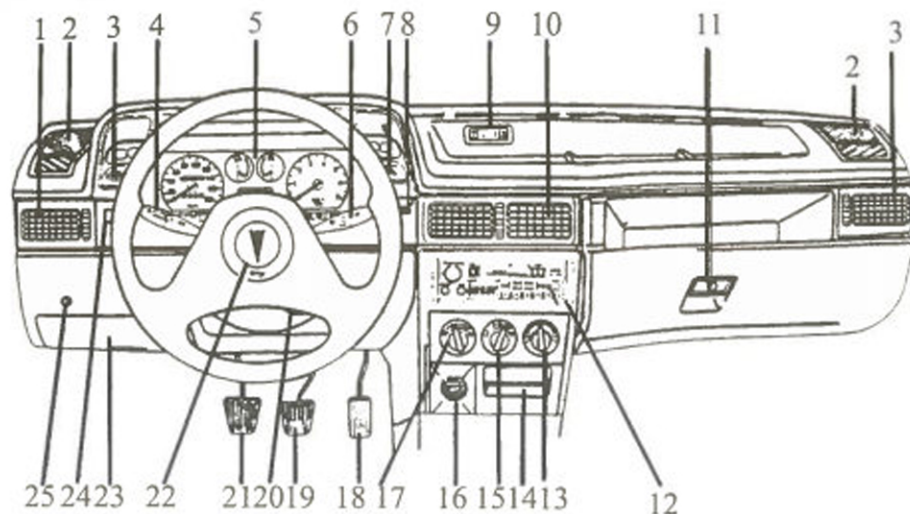


Figure 2-1. Controls and Instruments of a Passenger Car.

level, the engine crankcase oil level, and the fuel level in the fuel tank. Also, make sure that the gear lever is in the central or neutral position, i.e., free to move from side to side. Check the operation of warning lights when key is turned to the 'ON' position. It depends on the manufacturer's recommendation, but to start a cold engine the following is recommended. Close the carburettor choke by pulling choke button outward full distance. It is better to disengage the clutch by depressing clutch pedal all the way down to the cab floor. In this case the

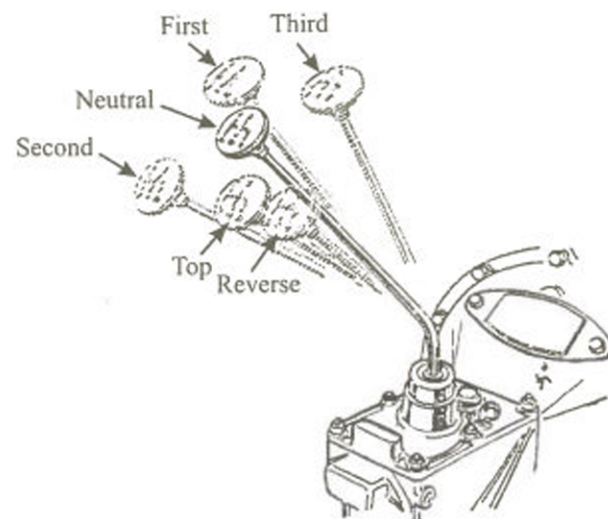


Figure 2-2. The Gear Positions.



Figure 2-3. The Ignition/Starter Switch.

transmission gears will not revolve in the thickened oil during starting, and it will ease the operation of the starter motor. Switch on ignition and the starter motor by turning the ignition key fully clockwise. Once the engine has started, release the key immediately, open the choke by pushing its button inward half-way, increase somewhat the engine speed by slightly depressing the accelerator pedal and then engage the clutch by releasing its pedal. Do not operate the starter for more than 15 seconds at a time (some motor companies advise an even 5-second limit). If the engine does not start, wait 10-30 seconds before attempting another start, otherwise the starter could be damaged.

Before starting to drive, warm up the engine at a moderate speed until the coolant temperature reaches 60°C. As the engine gets warmer, gradually open the choke fully and decrease the engine speed. Note that it is bad practice to allow the engine to warm up from cold by letting it idle slowly.

The correct way is to let the engine turn over fairly fast (approximately 1000 rpm, corresponding to a speed of 24 kph in top gears) so that it attains its correct working temperature as quickly as possible. Allowing the engine to work in a cold state, however, leads to excessive cylinder wear, and far less damage is done by driving the car on the road starting from cold than by letting it idle slowly in the garage.

Comprehension Questions

A. Read each statement and decide whether it is true or false. Write 'T' before true statements and 'F' before false statements.

- 1. The driver cannot check the work of the engine while he is sitting in the cabin.
- 2. Ignition and starting are operated by a combination ignition switch.
- 3. Choke button is an instrument which indicates the fuel level.
- 4. Water temperature is shown by means of the speedometer.
- 5. The driver can lock the steering wheel when the switch is on.
- 6. Before starting, the gear lever can be in any position.
- 7. To disengage the clutch, the accelerator pedal should be depressed.
- 8. If the engine does not start after the first attempt, immediately attempt another start.
- 9. It is advisable to warm up the engine by letting it idle slowly in the garage.

✓ B. Circle a, b, c, or d which best completes the following items.

1. If the clutch is disengaged before starting,
 a. transmission gears will revolve more easily
 b. the oil won't be thickened
 ✓ c. the transmission gears won't revolve, thus the engine starter operates more easily
 d. the engine cylinders won't be damaged
2. When starting a cold engine,
 a. the accelerator should be depressed fully
 ✓ b. the carburettor choke should be closed

c. the choke button should be pulled out

d. both b and c

3. Some devices such as horn and radio are called accessories because

a. they are essential parts of the automobile

b. they are not helpful and hence not needed in a car

✓ c. they are helpful, but their existence is not necessary for the operation of the automobile

d. the engine wouldn't work without these devices

4. In paragraph three (line eight), 'which' refers to

a. 'OFF' position

✓ b. 'LOCK' position

c. starter

d. steering wheel

5. It is not true that

a. transmission gears should not revolve in oil

✓ b. it is recommended the clutch should be disengaged before starting the cold engine

c. oil usually thickens in cold weather

d. transmission gears won't revolve freely in thickened oil

6. The best way for warming up the engine before starting to drive is

a. to close the choke fully for a longer time

b. to let the engine idle slowly until the coolant temperature reaches 60°C

c. to drive the car on the road starting from the cold

✓ d. to let the engine run over rather fast to get its correct working temperature

C. Answer the following questions orally.

1. Name different parts of the automobile controls.
2. How many positions does an ignition/starter key usually have? Name them.
3. What should you do before starting the engine?
4. What is the correct way to warm up the engine before starting to drive?
5. Why shouldn't the engine starter be used for more than 15 seconds at a time?

Section One: Vocabulary Exercises

A. Fill in the blanks with the words from the following table. Make necessary changes if required.

Verb	Noun	Adjective	Adverb
ease	ease	easy	easily
limit	limit limitation	limited	_____
thicken	thickness	thick	thickly
wear	wear	wearable weary	_____
warn	warning	warning	warningly
recommend	recommendation	commendable	_____

1. Cheap shoes soon out.
2. We must set a/an to the expense of the trip.
3. That mountain is to reach.
4. It is difficult to study the whole subject at one time. You should yourself to some of its aspects.
5. Our natural resources are, so we should be careful about them.
6. After the teacher's explanations, the students solved the problem
7. He spread the butter on the bread.
8. Lubricating oils usually in cold weather.
9. After the daily work, he usually stands at and watches TV.
10. The icecube is three inches
11. I can those shoes just for a limited period; they are showing signs of
12. That hat is no more
13. He me that there were pickpockets in the crowd.
14. They fired some shots.
15. Can you me a good novel?
16. He paid no attention to my
17. I bought that car on the of a friend.

B. Fill in the blanks with the appropriate words from the list below. There are more options than required.

foot brake	vehicles	height	belts
hand brake	ignition	manual	chain
signaling	neutral	damage	lock
declutch	pulley	length	brake

1. To slow down, take your foot off the accelerator and, if necessary, apply the gently.
2. To stop, slow down, apply the brake gently and as soon as the car speed falls below 10 k p h.
3. After the car has stopped, place the gear lever into position and apply declutch.
4. You can use the engine as a/an brake when descending steep hills.
5. Before starting, fasten seat belts and ask all the passengers to do so.
6. If you rest your foot on the clutch pedal while driving, it may cause clutch damage.
7. Keep your distance from other to avoid sudden stops.
8. Some cars have a/an gearbox and some have an automatic gearbox.
9. Bikes have a sprocket and system.
10. Turn signal switch and horn are used for signaling.

C. Match the words in Column I with their appropriate equivalents in Column II. Insert the letters a, b, c, etc. in the parentheses provided. There are more options in Column II than required.

Column I

1. instrument
2. wipe
3. advise
4. damage
5. excessive
6. locate
7. indicate

Column II

- a. too much; extreme
- b. situate; establish in a place
- c. point out; show
- d. change position
- e. implement; apparatus
- f. recommend
- g. clean or dry by rubbing

- | | | |
|--------------|-----|----------------------|
| 8. engage | (o) | h. furnish; supply |
| 9. moderate | (n) | i. harm; injury |
| 10. provide | (h) | j. take away from |
| 11. warn | (p) | k. lock together |
| 12. remove | (d) | l. place or location |
| 13. position | (L) | m. not extreme |
| 14. monitor | (q) | n. somewhat |
- o. mechanism for gear change
p. inform in advance; give notice
q. check by means of an apparatus



Section Two: Further Reading

Read the following text carefully and then select a, b, c, or d which best completes the following items.

Indicating devices serve the purpose of monitoring the operation of various engine systems. These devices include oil pressure gauges, coolant temperature gauges, fuel gauges, ammeters or charge indicators, oil pressure indicators, engine temperature indicators, and various warning lights. All these devices are arranged on the instrument panel (dashboard) in the driver's cab, while their senders are located at the strategic points about the engine and the vehicle.

Warning (indicator) lights are used to warn the driver that the engine is overheating and that the oil pressure in the engine lubricating system is too low. The lights are located on the instrument panel and are operated by their respective senders.

The oil pressure indicator is designed to indicate the pressure of oil in the engine lubricating system; it consists of sender and indicator. Similarly, the coolant temperature indicator shows the temperature of the engine cooling system; its sender is installed in the header tank of the radiator. These two indicators, and the fuel level indicator, are similar in design. The ammeter (ampermetre) serves the purpose of monitoring the charging of the battery and the operation of alternator. The ammeter is always connected in series in

the circuit where the flow of current is to be measured. Fuses and thermal cut-outs (circuit breakers) are used to protect the components of automotive electrical systems against short-circuit currents and overloads. Fuses are assembled into a panel which is usually mounted on the instrument panel. Each fuse is numbered and protects a circuit of its own. Lighting and signalling equipment are also necessary for the control of automobiles. Lights have three important functions: they provide illumination for seeing at night, for being seen, and for signalling. A complete automotive lighting system includes headlights, parking lights, side marker lights, stoplights, back up lights, taillights, hazard warning lights (turn signal) and interior lights. Interior lights include instrument panel lights, various warning and indicator lights, and dome lights. The turn signal is intended to give a warning that the vehicle is about to turn. Turn signal switch is mounted on the steering column.

- The ammeter is used to
 / a. monitor the charging of battery
 b. monitor the operation of alternator
 c. measure the flow of current
 d. all of the above
- Paragraph one mainly
 a. discusses the operation of monitoring devices
 ✓ b. introduces indicating devices
 c. talks about instrument panel
 d. discusses the location of senders and indicators
- It is **not** true that
 a. fuses protect electrical system against short-circuit conditions
 b. fuses will cut off the current if the respective circuit is subjected to extra load
 c. all fuses used in the electrical system are numbered and put together in a single panel
 ✓ d. a single fuse is used to protect different circuits
- The third paragraph mainly
 a. discusses the protection of automotive electrical systems against

Lesson Three

Part I. Pre-Reading

A. Word Study: Definitions

camshaft /kæmʃɑ:ft/:

an engine shaft fitted with a cam or cams, used to operate the valves of internal combustion engine

carburettor /kɑ:bə'retə(r)/:

that part of an internal combustion engine in which petrol and air are mixed to make an explosive mixture

carburation /kɑ:bəraɪ'zeɪʃn/:

mixing air with evaporating compounds of carbon to increase the potential heat energy

connecting rod /kə'nektɪŋ rod/:

a rod connecting the piston to the crank of a crankshaft

crankpin /kræŋkpi:n/:

the part of a crank or crankshaft to which a connecting rod is attached

crankshaft /kræŋkʃɑ:ft/:

main shaft of an engine which carries crank or cranks for the attachment of connecting rod

cylinder /sɪ'lɪndə(r)/:

tubular chamber in which the piston of an engine reciprocates

distributor /dɪ'strɪbjə:tə(r)/:

device for distributing electric current to the spark plugs of a gasoline engine so that they fire in proper order

flywheel /flaɪwi:l/:

heavy wheel revolving on a shaft to reduce the speed fluctuations or to store up kinetic energy

internal combustion engine

/ɪn'tɜ:nl kəm'bʌstʃən

'endʒɪn/:

an engine that obtains its power from heat produced by the explosion of a fuel-air mixture within the cylinder or cylinders

mount /maʊnt/:

fit into; put and fix in position

petrol /petrəl/:

refined petroleum used as a fuel in internal combustion engines (US= gasoline) cylindrical metal piece which reciprocates in a cylinder

piston /pɪstən/:

reciprocate /rɪ'sɪprəkeɪt/:

move backward and forward alternately

spark /spɑ:k/:

flash of a discharge of electric current

B. Word Study: Definitions and Examples

arrange /ə'reɪndʒ/:

put in order

She arranged the books on the shelves.

attach /ə'tætʃ/:

fasten or join

They attached labels to our luggage at the airport.

combustion /kəm'bʌstʃən/:

process of burning

Oxygen is needed for the combustion of fuel inside the cylinder.

efficiency /ɪ'fɪʃnsi/:

ratio of energy used to power produced

The efficiency of a gasoline engine is higher than the efficiency of a steam engine.

excellent /eksələnt/:

very good; of higher quality

Your ideas are excellent, but you should try hard to succeed.

flame /fleɪm/:

burning gas; blaze; visible part of a fire

He put a match to the papers and they burst into flames.

improve /ɪm'pru:v/:

make or become better

He was sick for a week but now his health is improving.

release /rɪˈliːs/

allow to go; set free

Albert Einstein was the first man to show in theory how the energy of the atom might be released.

revolve /rɪˈvɒlv/

cause to go round in a circle

The earth revolves around the sun.

row /rəʊ/

number of persons or things in a line

There are three rows of desks in the class.

solid /ˈsɒlɪd/

without holes or spaces; not hollow

Today inflated tyres are used instead of early solid tyres.

supply /səˈplaɪ/

provide; furnish

Several gas companies supply the consumers with liquid gas cylinders.

thermal /θɜːml/

of heat; having to do with heat

In a nuclear reactor, nuclear energy is converted into thermal energy.

transform /trænsˈfɔːm/

change the shape, appearance, or the quality of

A steam engine transforms heat into mechanical energy.

vast majority /vɑːst məˈdʒɔːrəti/

greatest number

The vast majority of people seem to prefer watching games to playing games.

weigh /weɪ/

have specified weight

How much do you weigh?

Part II. Reading

Engine Design and Operation (I)

The car engine is a kind of heat engine. A heat engine converts heat energy

into mechanical work. Modern heat engines are called internal combustion engines. In an internal combustion engine, a fuel is burned inside the cylinder and the thermal energy supplied by the combustion of the fuel is directly transformed into mechanical energy which, in a controlled way, is used for driving the car. Some engines are based on carburettor engines; they run on gasoline (petrol) and liquefied petroleum-gas (LPG). A gasoline engine is excellent for an air plane because it is not heavy. Other engines are based on fuel injection and operate with diesel fuel. Engines may be liquid-cooled or air-cooled engines.

The engine of the early cars had only one cylinder and the tyres on the wheels were made of iron or of solid rubber. From that time, motor-cars have been greatly improved. Modern cars are very comfortable and travel very fast. Scientists and car-designers are trying to improve the efficiency of internal combustion engines. The efficiency of a gasoline engine is about 25%, which is not still good.

The fuel used in vast majority of car engines is petrol. To burn the fuel, oxygen is needed; therefore it is mixed with right amount of air. This air-fuel mixture forms what is known as the combustible charge. It will burn when a flame or spark is applied to it. In carburettor engines, carburettor is used to mix fuel with air. In such engines, the air-fuel mixture is ignited by a spark from the distributor. These engines are used mainly on cars and light trucks.

In diesel engines, the air-fuel mixture forms inside the cylinder and is self-ignited by the heat of compressed air. The engines powering modern tractors and heavy trucks are of the diesel type.

Based on the number of their cylinders, engines may classify into single cylinders and multi-cylinders. Motor-car engines may have four, six, or eight cylinders. These cylinders are usually mounted in a cylinder block on top of the engine. Cy-

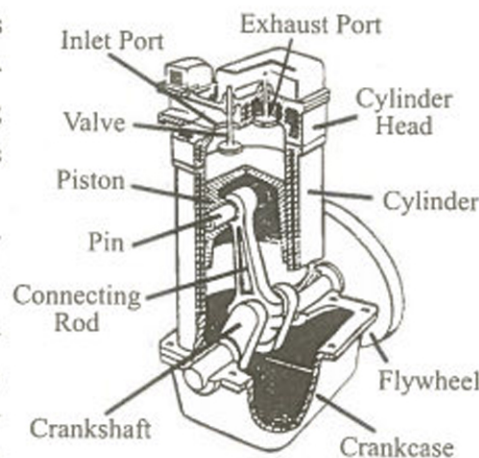


Figure 3-1. Single-Cylinder Piston Engine.

linders may arrange as single-row engines or double-row engines including V-type ones in which the two rows of cylinders are arranged at an angle to each other.

In the car engine, the air-fuel charge is taken into the cylinder and is compressed. The mixture is then ignited and it burns. In burning a great amount of heat energy is released and, because of the expansion, the pressure of the gases within the cylinder goes up. The pressure of the expanding gases acts on the piston, making it move down. The piston is attached to the small end of connecting rod and the big end of the rod is joined to the crankpin.

The motion of the piston and connecting rod rotates the crankshaft and the flywheel which is mounted at its end. Thus, the reciprocating motion of the piston is converted to the rotary motion of the flywheel. This rotary movement of the crankshaft transmits the power developed by the engine through the gearbox to the driving wheels and sets the car in motion.

Beneath the cylinder block is the crankcase, which contains two shafts, the crankshaft and the camshaft. The crankshaft, as was said, is revolved by the outward movement of the piston in the cylinder. When the crankshaft rotates it also causes the rotation of the camshaft, which lies alongside it in the crankcase. As the camshaft rotates, it pushes up rods alongside each cylinder to open and shut the valves at the top of the cylinder.

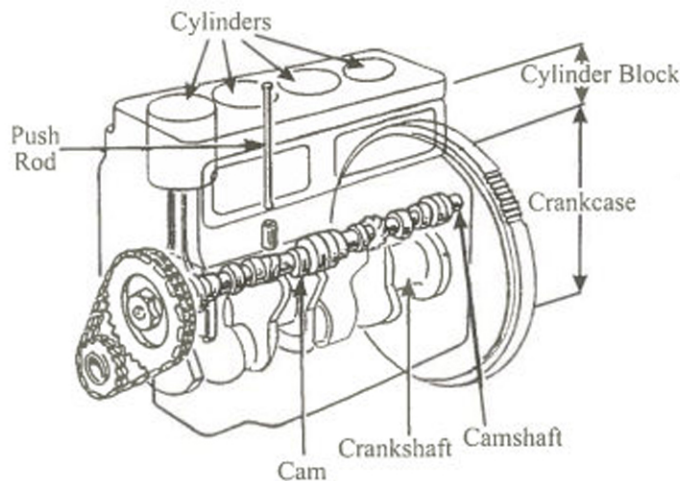


Figure 3-2. Cylinder Block.

Comprehension Questions

A. Read each statement and decide whether it is true or false. Write 'T' before true statements and 'F' before false statements.

1. The fuel used in injection engines is gasoline. **T**
2. The thermal energy produced by the combustion of the fuel is directly used for driving the car. **F**
3. Modern car engines are perfectly designed and no more improvement is possible. **F**
4. All carburettor engines run on petrol. **T**
5. In diesel engines, air is mixed with fuel by means of a carburettor inside the engine. **F**
6. Flywheel is fitted to the end of the crankshaft. **T**
7. The power supplied by the engine should be transformed to run the wheels. **T**
8. When piston goes up, it rotates the crankshaft. **T**

B. Circle a, b, c, or d which best completes the following items.

1. Camshaft is rotated
 - a. by the outward movement of the piston
 - b. by the expansion of burnt gases
 - ☒ c. by the movement of the crankshaft
 - d. by the power obtained from the gearbox
2. Connecting rods are used to
 - a. transmit the power to the gearbox
 - b. set the car in motion
 - ☒ c. transmit the motion of the piston to the rotary movement of the crankshaft
 - d. rotate the camshaft
3. The valves open and close by
 - ☒ a. the rotation of the camshaft
 - b. the movement of the flywheel
 - c. the power produced by the battery
 - d. the expanding gases on top of the cylinder

4. Heat is generated in an internal combustion engine by
- a. mixing right amount of air and fuel
 - b. the conversion of the downward movement to a rotary motion
 - ✓ c. the burning of charge present in the cylinder
 - d. the compression of the combustible mixture inside the cylinder
5. The mixture of gasoline and air is ignited because
- a. they are too inflammable
 - b. the mixture is compressed
 - ✓ c. a spark is produced by the distributor
 - d. a pressure is developed in the cylinder
6. It is **not** true that
- a. fuel is mixed with air by means of the carburettor
 - b. in a diesel engine, the mixture is ignited because of the heat of the compressed air
 - ✓ c. in a diesel engine, fuel is mixed with air before entering the cylinder
 - d. if the number of the cylinders is high, they may arrange as double-row engines
7. In paragraph three (line two), 'it' refers to
- a. oxygen
 - ✓ b. fuel
 - c. petrol
 - d. car engine
8. It is true that
- a. only one-fourth of the gasoline is changed into useful work
 - b. airplane engines should be heavy
 - ✓ c. connecting rods join the piston to the camshaft
 - d. cylinders are fitted into the crankcase
9. In paragraph four (line nine), 'ones' refers to
- a. cylinders
 - ✓ b. engines
 - c. single-row engines
 - d. double-row engines

C. Answer the following questions orally.

1. How are engines classified according to their cooling systems?
2. When does the combustible charge burn?
3. Where are cylinders fitted in?
4. What pushes the piston down?
5. What is the difference between piston movement and flywheel motion?

6. Describe the tyres of the early engines.

Part III. Homework

Section One: Vocabulary Exercises

- A. Fill in the blanks with the words from the following table. Make necessary changes if required.

Verb	Noun	Adjective	Adverb
invent	invention inventor	inventive	_____
transform	transformation	transformable	_____
improve	improvement	_____	_____
weigh	weight	weightless weighty	weightlessly
mix	mixture mix	mixed	_____

1. Success and wealth his character.
2. The was rewarded because of his
3. Mechanical energy is into electrical energy.
4. Oil and water don't
5. His character has undergone a great
6. He has a/an mind; he has designed a new type of lathe.
7. There has been a great in living conditions in recent years.
People have more facilities now.
8. Air is a/an of different gases.
9. That fat man is twice my
10. Some people enjoy having pickles with their meal.
11. Are bananas sold by or at so much a piece?
12. When a satellite escapes the gravity, it becomes

- B. Fill in the blanks with the appropriate words from the list below. There are more options than required.

the opposite of

resistance

mechanism

bottom

cylinder block
cylinder head
the same as

rear end
flywheel
disconnect

smoothly
rotary
teeth

run
top

1. The sump is at the of the engine and the rocker box is on of it.

2. In a gear system, the ratio of the number of teeth is the size ratio.

3. Do not the engine when the fuel tank is nearly empty.

4. The engine serial number is usually stamped on right side of the

5. Before performing electrical work, the cable from the negative terminal of the battery.

6. In a gear system containing two gears, the gear that has a smaller number of has a faster speed.

7. The is above the cylinder block.

8. A makes the engine run still more smoothly.

9. It is attached to the of the crankshaft.

10. Friction is the to motion between two objects in contact with each other.

C. Match the words in Column I with their appropriate equivalents in Column II. Insert the letters a, b, c, etc. in the parentheses provided.

There are more options in Column II than required.

Column I

1. release
2. supply
3. revolve
4. thermal
5. mount
6. improve
7. transform
8. solid
9. efficiency

Column II

- a. charge
- b. fit into; put and fix
- c. set free; allow to go
- d. cause to go round in a circle
- e. flame
- f. ratio of energy used to power obtained
- g. piston movement
- h. make or become better
- i. without holes or spaces

10. stroke

(k)

j. having to do with heat

k. reciprocate

l. change form or shape of

m. provide



Section Two: Further Reading

Read the following text carefully and then select a, b, c, or d which best completes the following items.

The most numerous of internal combustion engines are the gasoline piston engines used in passenger automobiles, motor boats, small units for lawn mowers and such other equipment, as well as diesel engines used in trucks, tractors, earth-moving, and similar equipment.

Characteristic features common to all commercially successful internal combustion engines include (1) the compression of air, (2) the raising of air temperature by the combustion of fuel in this air at its elevated pressure, (3) the extraction of work from the heated air by expansion to the initial pressure, and (4) exhaust. In 1862 Beau de Rochas proposed the four-stroke engine cycle as a means of accomplishing these conditions in a piston engine. The first engine to use this cycle successfully was built in 1876 by N. A. Otto. Otto cycle is the basic thermodynamic cycle for the prevalent automotive type of internal combustion engine. The Otto cycle is represented in many millions of engines utilizing either the four-stroke principle or the two-stroke principle.

Two years later Sir Dougald Clerk developed the two-stroke engine cycle by which a similar combustion cycle required only one revolution of the crankshaft. In 1891 Joseph Day simplified the two-stroke engine cycle by using a crankcase to pump the required air. Engines using this two-stroke cycle today have been further simplified by use of a third cylinder port which dispenses with the crankcase check valve used by Day.

About 20 years after Otto first ran his engine, Rudolf Diesel successfully demonstrated an entirely different method of igniting fuel. A diesel engine operates on a thermodynamic cycle in which the ratio of compression of the air charge is sufficiently high to ignite the fuel subsequently injected into the

combustion chamber. The diesel engine uses a wide variety of fuels with a higher thermal efficiency and consequent economic advantage under many service applications.

There are many characteristics of diesel engines which are in direct contrast to those of the Otto engine. For example, the larger the cylinder diameter of a diesel engine, the simpler the development of good combustion.

In contrast, the smaller the cylinder diameter of the Otto engine, the less the limitation from the detonation of the fuel.

High intake-air temperature and density materially aid combustion in a diesel engine. Some engines have not performed properly on heavy fuel until provided with a supercharger. The added compression of the supercharger raised the temperature and, what is more important, the density of the combustion air. For an Otto engine, an increase in either the air temperature or density increases the tendency of the engine to knock.

1. It is true that

- ✓ a. the two-stroke engines simplified by Joseph Day are in use today
- b. Rudolf Diesel introduced his engine before Joseph Day simplified the two-stroke cycle
- c. four-stroke cycle requires the crankshaft to rotate twice as many as two-stroke one
- d. two-stroke engine was proposed by Sir Dougald Clerk in 1880

2. It is **not** true that

- a. earth-movers run by gasoline engines
- b. all internal combustion engines share some qualities
- c. in an internal combustion, engine work is obtained when the expansion of heated air is reduced to the one occurring at the beginning
- ✓ d. Beau de Rochas can be considered the founder of the two-stroke cycle

3. Which statement is **not** true about Otto cycle?

- a. It is used in the majority of car engines.
- b. It is the first engine which practically used the four-stroke cycle.
- ✓ c. This cycle is just applicable to four-stroke engines.

d. Otto proposed his cycle some 20 years before diesel engine was operational

4. In a diesel engine,

- ✓ a. first the air charge is compressed and then the fuel is injected into it
- b. a lower thermal energy is obtainable
- c. the ignition method is similar to that of a gasoline engine
- d. a super charger is used to reduce the temperature of intake air

5. According to the passage,

- a. the higher the temperature of intake air, the easier the combustion of both diesel fuel and gasoline
- b. an increase in the density of Otto engine decreases the engine knock
- ✓ c. the diesel engine is more economical than the gasoline one
- d. the larger the cylinder diameter of an Otto engine, the simpler the development of good combustion



Section Three: Translation Practice

A. Translate the following passage into Persian.

Basically, the automobile consists of four components: the engine, the framework, the power train, and the body. The engine is the source of power that makes the wheels go round and the car move. The power train is the mechanism that transmits the power from the engine to the wheels. These engines are called internal combustion engines, because the fuel (gasoline) is burned inside them. In order for an engine to operate, different systems should work together, such as fuel system, ignition system, lubricating system, cooling system and so on. The fuel system consists of a tank in which gasoline is stored, a pump which pumps gasoline from the tank, a carburettor which mixes the gasoline with air, and fuel lines which connect the three. The ignition system is part of the electric system of the automobile. Its purpose is to produce high-voltage surges and to deliver them to the combustion chambers in the engine where the high-voltage surges cause electric sparks to ignite the mixture. The lubricating system is used to lubricate the great many moving parts in the engine so that there will be no actual metal-to-metal contact.

B. Find the Persian equivalents of the following terms and write them in the spaces provided.

1. attachment
2. camshaft
3. combustion chamber
4. combustion cycle
5. connecting rod
6. crank
7. crankpin
8. crankshaft
9. cylinder block
10. distributor
11. double-row engines
12. earth moving
13. efficiency
14. expansion
15. fluctuation
16. flywheel
17. four-stroke engine
18. intake-air temperature
19. internal combustion engine
20. multi-cylinder
21. reciprocating
22. resistance
23. revolve
24. rotary movement
25. spark
26. steam engine
27. supercharger
28. surge

1. اتصالات
2. میل بادامی
3. محفظه احتراق
4. چرخه احتراق
5. میل پیوندی
6. میل
7. پین میل
8. میل بادامی
9. بلوک سیلندر
10. توزیع کننده
11. موتورهای دو ردیفی
12. جابجایی خاک
13. کارایی
14. انبساط
15. نوسان
16. چرخ فلک
17. موتور چهار stroke
18. دمای هوای ورودی
19. موتور احتراق داخلی
20. موتور چند سیلندر
21. متحرک رفت و برگشتی
22. مقاومت
23. چرخش
24. حرکت چرخشی
25. جرقه
26. موتور بخار
27. توربو شارژر
28. موج

Lesson Four

Part I. Pre-Reading

A. Word Study: Definitions

- compression** /kəm'preʃn/: stroke during which the working agent is compressed in an internal combustion engine
- displace** /dis'pleɪs/: move from its usual or proper place
- displacement** /dis'pleɪsmənt/: the volume displaced by a stroke of a piston
- exhaust port** /ɪg'zɔ:st pɔ:t/: exhaust valve; port or valve controlling the discharge of the exhaust gas in an ICE
- induction** /ɪn'dʌkʃn/: the transference of the explosive mixture of air and fuel from the carburettor to the cylinder of an ICE
- inlet port** /ɪnlet pɔ:t/: inlet valve, induction port; port or valve through which the charge is induced into the cylinder during a suction stroke
- intake** /ɪnteɪk/: the act of taking in; the place at which a fluid is taken into a pipe, channel, etc.
- port** /pɔ:t/: an opening for the passage of steam, gas, water, etc.
- scavenge** /skævɪndʒ/: remove burned gases from the cylinder of an ICE
- valve** /vælv/: any device which controls the passage of a fluid through a pipe

B. Word Study: Definitions and Examples

- alternate** /ɔ:l'tɜ:nɪt/: pass from one state, etc. to a second, then

	back to the first, etc.; exchange places regularly <i>He alternated between high spirits and low spirits.</i>
constitute /kɒnstitju:t/	make up a whole; be the components of <i>Twelve months constitute a year.</i>
correspond /kɒrə'spɒnd/	be equal to; be similar <i>His expenses do not correspond to his income.</i>
decrease /di'kri:s/	cause to become shorter, smaller, less <i>Birth rate has decreased in recent years in our country.</i>
detail /di'teɪl/	small, particular fact or item <i>The manager gave the assembly all the details about the firm.</i>
discharge /dɪ'stʃɑ:dʒ/	give or send out <i>Where do the sewers discharge their contents?</i>
economical /i:kə'nɒmɪkəl/	not wasting money, time, fuel, etc. <i>Modern car engines are more economical; they do not waste fuel.</i>
expansion /ɪk'spænzən/	becoming or making longer or bigger <i>When substances are heated, expansion takes place.</i>
extreme /ɪk'stri:m/	at the ends; farthest possible; most remote <i>The cottage was located at the extreme edge of the field.</i>
occur /ə'kɜ:(r)/	take place; happen <i>He promised not to let such incidents occur again.</i>
periodically /pɪərɪ'dɪkəlɪ/	at regular intervals; from time to time <i>Alternating current reverses its direction periodically.</i>
purpose /pɜ:pəs/	plan; intention; aim

respectively /rɪ'spektɪvli/	<i>The purpose of lubrication is to reduce friction.</i> separately and in the order mentioned <i>Training colleges for miners and fishermen are to be built in Kerman and Bandar Abbas respectively.</i>
sequence /sɪ'kwəns/	succession; connected line of events, ideas, etc. <i>Piston travels in the cylinder occur in a sequence</i>
spend /spend/	use up; consume; exhaust <i>They went on firing until all their ammunition was spent.</i>
squeeze /skwi:z/	press on from the opposite side or from all sides; compress; press hard <i>He squeezed a piece of sponge in his hand.</i>
suction /səkʃn/	(n) drawing in water, air, etc. by creating a partial vacuum <i>All vacuum-cleaners work by suction.</i>
sum /sʌm/	total obtained by adding together items, numbers or amounts; totality; the whole amount <i>The sum of 3 and 5 is 8.</i>
total /təʊtl/	complete; entire <i>What are your total debts?</i>
uppermost /ʌpə'məʊst/	highest; on the top <i>He hung the picture on the uppermost point of the wall.</i>

Part II. Reading

Engine Design and Operation (II)

To keep the engine running, the cylinder must be periodically scavenged of

burnt gases and charged with fresh mixture. For this purpose there are exhaust and inlet ports, each closed with a valve. When piston is moving down, it provides the energy stored by the flywheel; some of this energy goes to send the piston up, to open the exhaust valve and discharge the burnt gases to atmosphere.

The exhaust valve closes when the piston is at its uppermost position. The flywheel and the crankshaft keep on rotating and the piston goes down. As a result, a suction pressure is produced in the cylinder and the open inlet valve allows a fresh charge to enter it. Both inlet and exhaust valves or ports close as the piston starts to move up to squeeze the intake charge into the small space of the cylinder. Near the top of the compression the electric spark plug ignites the charge and the fuel burns. The piston is pushed down by the charge pressure and the events continually repeat.

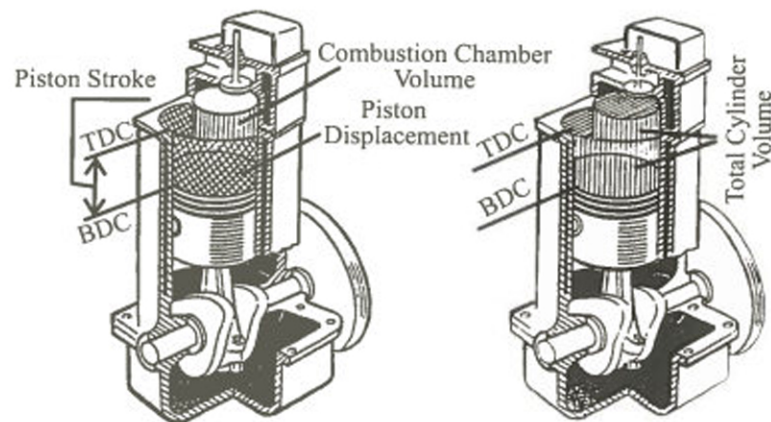


Figure 4-1. Piston Stroke and Cylinder Volumes.

Inside the cylinder the piston alternates between two extreme positions which are called top dead centre (TDC) and bottom dead centre (BDC) respectively. A one-way piston movement between TDC and BDC is called piston stroke. Each piston stroke corresponds to half a revolution (180°) of the crankshaft. A complete series of events occurring inside the cylinder during one stroke is called cycle. The space a piston travels from TDC to BDC is called piston displacement. When the piston is in TDC, the space left

above is called combustion chamber volume. The piston displacement and combustion chamber volume constitute total cylinder volume. In multi-cylinder engines the sum of piston displacements is called engine displacement, which in small engines (up to 1 litre) is given in cubic centimetres and in other engines is expressed in litres.

A single-cylinder engine which completes its working cycle in four strokes of the piston is known as the four-stroke cycle or simply four-stroke or four-cycle engine. Let us examine the sequence of events happening in one of the cylinders in more details:

Intake (or induction). The piston moves from TDC to BDC. The inlet valve is open and the exhaust valve closed. When the piston is moved down by the crankshaft and connecting rod, as a result of an increase of volume inside the cylinder, a suction pressure is produced in the cylinder and a fresh fuel and air charge is drawn into the cylinder.

Compression. The crankshaft continues to rotate and the piston moves from BDC to TDC. Both the inlet and exhaust valves are closed. The volume over the piston decreases and when the piston reaches TDC, the fuel-air mixture is compressed and its temperature goes up.

Power (also called combustion or expansion). The compressed mixture is ignited by a spark plug. The expanding gas pressure forces the piston downward from the TDC to the BDC. Both valves are closed and the temperature becomes as high as 2000°C . The piston transmits the downward push through the connecting rod to the crankshaft, making it perform mechanical work.

Exhaust. The piston moves from BDC to TDC. The exhaust valve (port) is open and the spent exhaust gases leave the cylinder through the exhaust port. At the end of this stroke the exhaust valve is closed by the action of a spring; and the camshaft, which continues to rotate, pushes up a second rod to force the inlet valve open. Now the cylinder will receive another charge of petrol-air mixture and the sequence of four strokes will start again.

Another type of carburettor engine is two-stroke cycle engine. The two-stroke engine has no valves. The intake of the air-fuel mixture and the exhaust of the burnt gases are done through ports cut in the cylinder wall, which are timely opened and closed by the moving piston. Such engines are called

scavenging engines. They are simpler, both in design and operation, than four-stroke engines. These engines run more smoothly. They are, however, less economical—up to 30% of air-fuel mixture is lost in scavenging.

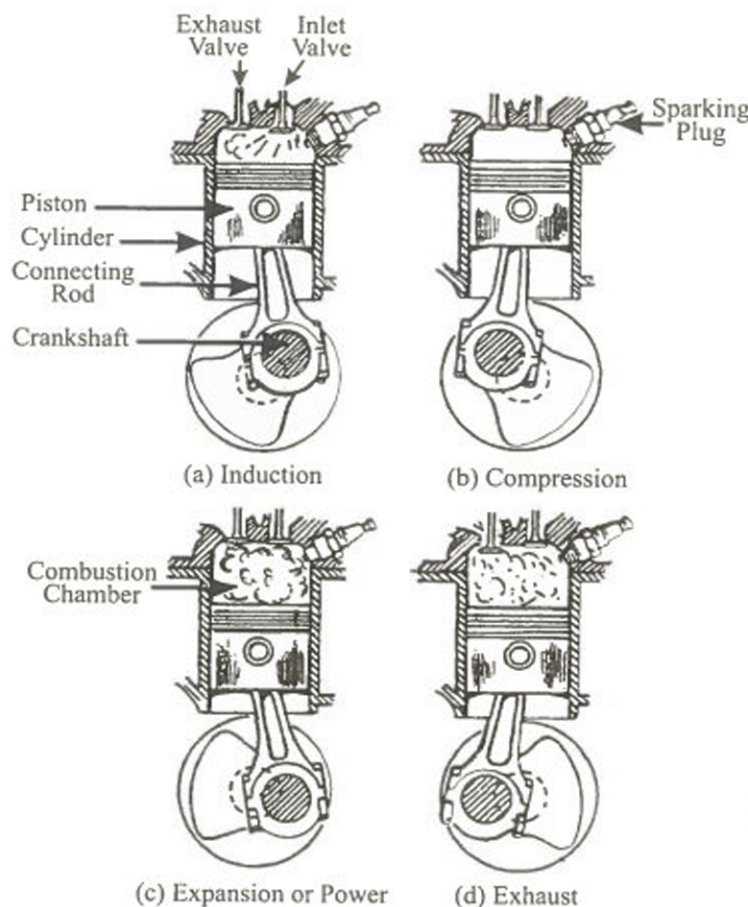


Figure 4-2. Four-Stroke Cycle.

Comprehension Questions

A. Read each statement and decide whether it is true or false. Write 'T' before true statements and 'F' before false statements.

- 1. The energy which is produced by the movement of piston is stored in the flywheel.

- 2. The energy stored in the flywheel is completely used to run the wheels of the car.
- 3. When the piston is at the highest point in the cylinder, the exhaust valve is closed.
- 4. The piston goes up by the energy got from the flywheel.
- 5. When the piston is at BDC, the space above it is called combustion chamber volume.
- 6. Instead of valves, two-stroke engines have ports provided in their cylinder walls.
- 7. The efficiency of a two-stroke engine is more than a four-stroke one.

B. Circle a, b, c, or d which best completes the following items.

1. In paragraph one (line two), by 'this purpose' the writer means
- scavenging the cylinder
 - charging the cylinder
 - providing the exhaust and inlet ports
 - both a and b
2. A fresh charge is entered into the cylinder because
- a suction pressure is produced in the cylinder
 - the inlet valve opens at the same time
 - the piston goes down
 - all of the above
3. The electric spark plug ignites the charge
- when the piston reaches TDC
 - when the piston begins to compress the mixture
 - at the beginning of power stroke
 - before the piston reaches the top of the compression stroke
4. During each stroke
- the crankshaft turns 180°
 - a valve opens and closes
 - the flywheel turns 360°
 - the piston moves from TDC to BDC
5. Total cylinder volume is

- the sum of piston displacements
 - the space between TDC and BDC
 - the space left above the piston when it is in TDC
 - the sum total of piston displacement and combustion chamber volume
6. In two-stroke engines, inlet and exhaust ports open and close
- by the action of a spring
 - by the movement of the camshaft
 - by the movement of inlet and exhaust valves
 - just by the movement of the piston
7. Which of the followings is **not** true?
- Scavenging engines are the same as two-stroke engines.
 - Two-stroke engines are simpler than four-stroke ones.
 - Four-stroke engines run more smoothly.
 - When the mixture ignites, its volume increases.

C. Answer the following questions orally.

- What is meant by piston displacement?
- Compared with four-stroke engines, which strokes are combined into one stroke in a two-stroke engine?
- How does the piston transmit its downward push to the crankshaft?
- How is engine displacement calculated?
- What is meant by combustion chamber volume?

Part III. Homework

Section One: Vocabulary Exercises

- A. Fill in the blanks with the words from the following table. Make necessary changes if required.

Verb	Noun	Adjective	Adverb
compress	compress compression	compressed	_____
expand	expansion	expansive	expansively

Verb	Noun	Adjective	Adverb
economize	economy economics	economical economic	economically
advance	advance advancement	advanced	_____

- Science has made great during the last fifty years.
- is the science of production, distribution, and consumption of goods.
- After passing elementary and intermediate levels, the students take part in English courses.
- Cotton is into bales to take up less space.
- Use a cold to stop bleeding.
- A tyre when you pump air into it.
- The aim of a university should be the of learning.
- The of air-fuel mixture takes place during the second stroke of the piston.
- That scholar has a/an knowledge of his subject.
- We practice when we avoid wasting our natural resources.
- We must on electricity and fuel.
- The of heated gases pushes the piston downwards.
- gas is carried in cylinders as liquefied gas.
- The government's policy hasn't been successful in recent years.

- B. Fill in the blanks with the appropriate words from the list below. There are more options than required.

anticlockwise	triangle	bolts	angle
rotary system	tighten	area	cube
at the end	slacken	divide	pull
adjustment	volume	termed	push
clockwise	handle		

- Turn the jack handle to lower the car.
- Belts, pulleys, gears, chains, and sprockets are components of a/an

-
- To find the resistance in an electrical circuit, the voltage by the current.
 - To find the of a rectangle, multiply the length by the width.
 - Turn a bolt to tighten it.
 - In a petrol engine, the movement of the pistons between the bottom and top of the cylinder is the piston stroke.
 - Wood work chisels have a smaller at the point of the tool.
 - You should turn the bolt anticlockwise to it.
 - For fan belt, follow these steps: first slacken mounting Then slacken the slide bolt. Now you can either the dynamo up to the belt or the dynamo down to slacken the belt. tighten the slide bolt and the mounting bolts.

C. Match the words in Column I with their appropriate equivalents in Column II. Insert the letters a, b, c, etc. in the parentheses provided. There are more options in Column II than required.

Column I		Column II
1. seal	()	a. make up a whole
2. detail	()	b. a long, cylindrical bar that rotates
3. extreme	()	and transmits power
4. advance	()	c. compress; press hard
5. correspond	()	d. farthest possible
6. discharge	()	e. exchange places regularly
7. decrease	()	f. economical
8. expansion	()	g. be equal to
9. alternate	()	h. fasten or close tightly
10. shaft	()	i. becoming bigger
11. squeeze	()	j. come or go forward
		k. small, particular fact
		l. give or send out
		m. not completely
		n. complete; entire
		o. cause to become shorter, smaller

Section Two: Further Reading

Read the following text carefully and then select a, b, c, or d which best completes the following items.

Look at the simplified Figure 4-3 and consider the operation of the diesel engine. Piston (7) is placed inside cylinder (6). The piston is attached to crankshaft (12) through the intermediary of connecting rod (9). If the piston is moved up and down in the cylinder, this up-and-down or reciprocating motion of the piston is changed into the rotary motion of the crankshaft by the connecting rod and the crank of the shaft. Flywheel (10) fastened to the

- cylinder head
- rocker arm
- fuel injector
- exhaust valve
- intake valve
- cylinder
- piston
- piston pin
- connecting rod
- flywheel
- crankcase
- crankshaft
- camshaft timing gear
- camshaft
- fuel injection pump
- valve lifter (tappet) and push-rod
- air cleaner

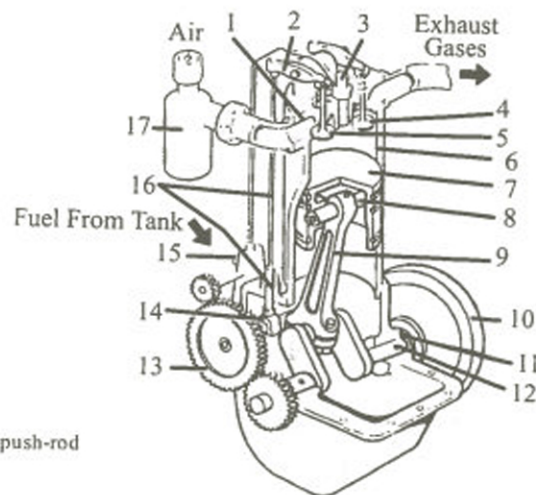


Figure 4-3. Schematic Diagram of a Single Cylinder Diesel Engine.

rear end of the crankshaft serves to make the shaft revolve uniformly when the engine is running. The cylinder is tightly closed at the top by cylinder head (1) in which two valves are fitted. Intake valve (5) admits air into the cylinder and exhaust valve (4) lets the burnt gases out. The valves are held closed by valve springs and are made to open by means of rocker arms (2) which are actuated by camshaft (14) through intermediate components (valve lifters and push-rods). The camshaft and the fuel injection pump shaft are driven by the crankshaft through gears (13). The fuel supplied by the fuel injection pump is injected into the cylinder through fuel injector (3).

- The job of the flywheel is
 - to make the shaft revolve constantly and regularly
 - to run the engine slowly
 - to support the rear end of the crankshaft
 - both a and b
- The valves are fitted in
 - the cylinder
 - the cylinder head
 - the crankcase
 - the cylinder block
- The function of the rocker arms is
 - to hold the valves closed
 - to open the valves
 - to let the air in
 - to let the burnt gases out
- Rocker arms act by means of
 - crankshaft
 - camshaft
 - valve springs
 - flywheel
- Camshaft timing gears drive
 - fuel injection pump shaft
 - camshaft
 - crankshaft
 - both a and b



Section Three: Translation Practice

A. Translate the following passage into Persian.

Where the entire cycle of events in the cylinder requires four strokes, the engine is called a four-stroke cycle or Otto cycle. If the entire cycle of events in the cylinder requires two strokes, the engine is called a two-stroke cycle engine.

A single-cylinder engine provides only one power impulse every two crankshaft rotations and delivers power flow one-fourth of the time. To provide for a more continuous flow of power, modern engines use four, six, eight or more cylinders. The power impulses are so arranged to follow one another or overlap (on six-cylinder and eight-cylinder engines). This gives a nearly even flow of power from the engine. However, additional leveling off of the power impulses is desirable. This would make the engine run still more smoothly. To achieve this, a flywheel is used.

During the power stroke, the engine tends to speed up. During other strokes it tends to slow down. When the engine tends to speed up, the flywheel resists it, because any rotating wheel resists any effort to change its speed of rotation. This is due to inertia. Inertia is a characteristic of all material objects. It causes them to resist any change of speed or direction of travel.

B. Find the Persian equivalents of the following terms and write them in the spaces provided.

- air cleaner
- bottom dead centre (BDC)
- economical
- even
- fuel injector
- induction
- inertia
- inlet port
- intake
- periodically
- piston displacement
- port
- power impulse
- rocker arm
- rotation
- scavenge
- sequence
- suction
- top dead centre (TDC)

Lesson Five

Part I. Pre-Reading

A. Word Study: Definitions

bank /bæŋk/:	row of cylinders in an engine
bearing /beərɪŋ/:	a device that supports moving parts of a machine and reduces friction; any part of machine in or on which another part revolves, slides, etc.
fastener /fɑːsnə(r)/:	any of various devices for fastening things together
radial /reɪdiəl/:	branching out all directions from a common centre; arranged like rays or radii <i>radial engine: an internal combustion engine with cylinders arranged radially like wheel spokes</i>
rectilinear /ˌrektɪˈlɪniə(r)/:	in or forming straight line; characterized by straight lines
spoke /spəʊk/:	any one of the bars or wire rods connecting the hub of a wheel with the rim
supplementary /ˌsʌplɪˈmentri/:	serving as something added to make up for a lack or deficiency; additional; extra <i>supplementary strokes: strokes during which no power or energy is produced but are necessary to complete engine cycle</i>
tappet /tæpɪt/:	a projection or lever that moves or is moved by intermittent contact, as with a

cam, in an engine or machine

B. Word Study: Definitions and Examples

admission /ədˈmɪʃn/:	admitting; allowing to enter <i>The admission of fresh charge into the cylinder takes place during the first stroke of the piston.</i>
aid /eɪd/:	help (v and n) <i>There were some problems in the ignition system and I wasn't able to start the engine; so he came to my aid.</i>
apart /əˈpɑːt/:	distinct <i>The two houses are 500 metres apart.</i>
compact /kəmˈpækt/:	closely packed together; neatly fitted <i>The machine is very compact with no large projections.</i>
consist of /kənˈsɪst əv/:	be made up of; comprise <i>The committee consists of ten members.</i>
counterpart /ˈkaʊntəpɑːt/:	person or thing exactly like, or closely corresponding to, another <i>Some domestics (i.e., native products) are even better than their foreign counterparts.</i>
distribute /dɪˈstrɪbjʊːt/:	divide and give out; put in different places <i>The firm distributed its profits among its workers.</i>
eliminate /ɪˈlɪmɪneɪt/:	remove, take or put away; get rid of <i>You should eliminate the slang words from your essay.</i>
pair /peə(r)/:	two things of the same kind to be used together <i>in pairs: in twos</i> <i>He needed a new pair of shoes.</i>

remain /rɪ'meɪn/:

be present or left after a part has gone or has been taken away

remaining: that which is remained or left
Out of twenty students who participated in the exam, seventeen students passed it; the remaining three ones had to take the course again.

require /rɪ'kwaɪə(r)/:

need; be in need of

Higher education requires intelligence and motivation.

roughly /rʌfli/:

moving by violent motion or irregularly and unevenly

Four-stroke engines run more roughly than their two-stroke counterparts.

shortcoming /ʃɔ:t'kʌmɪŋ/:

defect or deficiency; falling short of what is needed or required

The engineers are trying to eliminate the shortcomings in the design of the new machine.

straight /streɪt/:

without a bend or curve

The shortest distance between two spots is a straight line.

support /sə'pɔ:t/:

bear the weight of; hold up or keep in place

Is this bridge strong enough to support heavy lorries?

uniform /ju:nɪfɔ:m/:

always the same; not changing in form, rate, degree, manner, etc.

To have a smooth engine running, the flywheel should revolve uniformly.

vertically /vɜ:tkli/:

being at a right angle to the plane of the supporting surface

Steel support girders are erected vertically

and horizontal steel beams are joined to them.

Part II. Reading

Operation of Multi-Cylinder Engines

The cycle of operations of four-stroke engines is completed in two turns of the crankshaft. The crankshaft receives energy from the piston only during one half its turn when the piston moves on the power stroke. During the remaining three half turns, the crankshaft continues to revolve by the inertia and, aided by the flywheel, it moves the piston on all its supplementary (or auxiliary) strokes—exhaust, intake, and compression. Therefore the crankshaft of such a single-cylinder engine revolves nonuniformly and roughly: it accelerates on the power stroke and decelerates on other strokes. Furthermore, the single cylinder engine produces little power and has excessive vibration. To eliminate these shortcomings, multi-cylinder engines are built.

In multi-cylinder engines, the cylinders may have an in-line or a two-bank (V-type) arrangement. Another type of arrangement is seen in radial engines. In a four-cylinder in-line engine, the cylinders are arranged vertically in a straight line. The cylinders are numbered from front to back. In V-type engines the cylinders are arranged in two banks set at an angle to each other. V-type engines are more compact and less heavy than their in-line counterparts.

The order in which like piston strokes occur in the engine cylinder is known as the firing order. The firing order of four-cylinder engines may be 1-3-4-2 or 1-2-4-3. If the firing order of an engine is 1-3-4-2, this means that after the piston in the first cylinder has completed its power stroke, the next power stroke occurs in the third cylinder, then in the fourth cylinder, and finally in the second cylinder. Figure 5-1 shows a typical four-stroke, four-cylinder engine.

Six-cylinder in-line engines are similar to the four-cylinder ones with the exception that six-cylinder in-line engine has two more cylinders. There is a

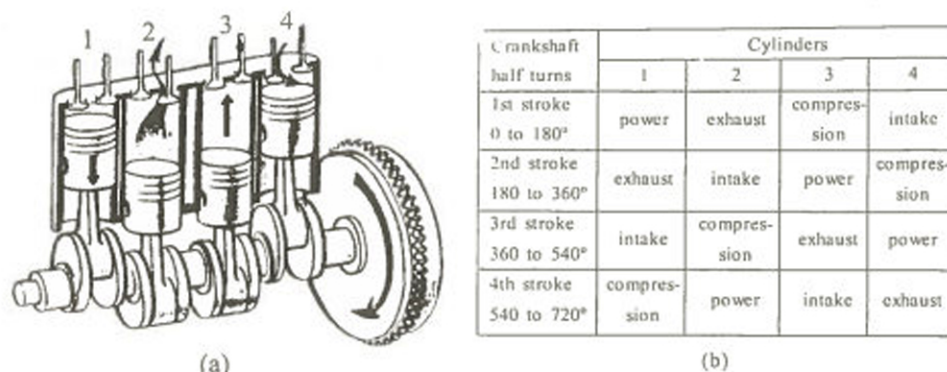


Figure 5-1. (a) Schematic Diagram and (b) Firing-Order Diagram of a Four-Cylinder, Four-Stroke Engine.

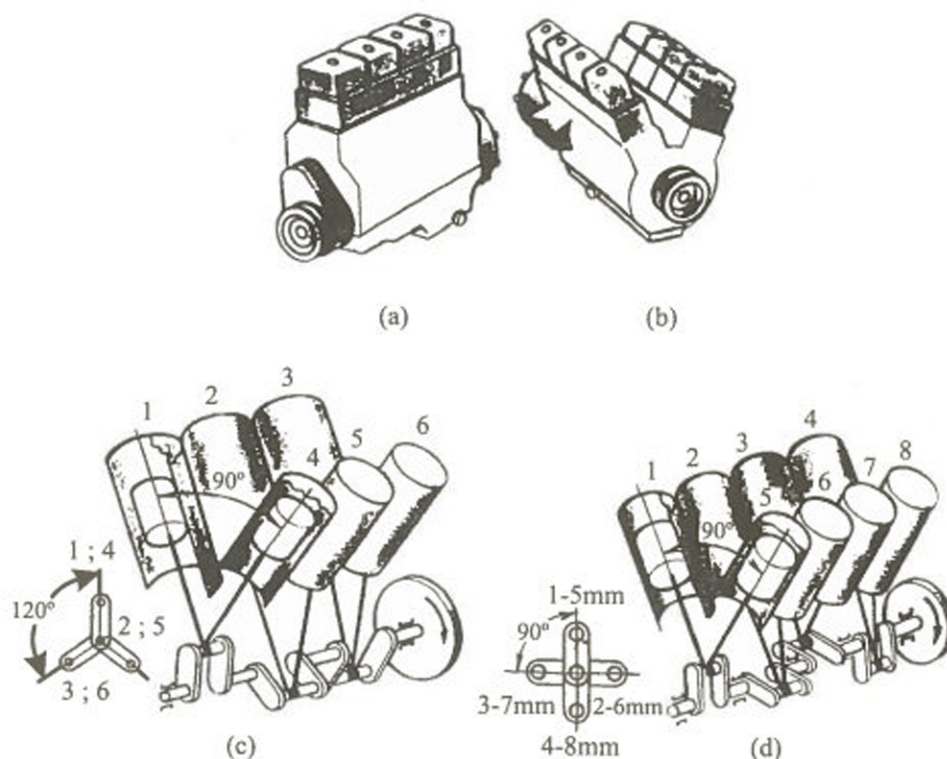


Figure 5-2. Multi-Cylinder Engines. (a) In-Line Cylinder Arrangement; (b) V-Type Cylinder Arrangement; (c) and (d) Crankthrow Arrangements in V-6 and V-8 Type Engines, Respectively; 1 Through 8—Serial Numbers of Cylinders.

difference in the way the crankshafts are supported. For example in a four-cylinder in-line engine, the crankshaft is supported by three bearings, whereas in a six-cylinder in-line engine it is supported by three or four bearings with the crankpins arranged in pairs 120 degrees apart. In eight-cylinder in-line engines the crankshaft is usually supported on five bearings.

The radial engine which is largely used in aircraft, has the cylinders radiating from a common centre, like the spokes of a wheel. In a radial engine all connecting rods work to a common crankpin. These engines are air-cooled.

To complete normal operation of the internal combustion engine, in addition to the crank gear, it consists of a valve gear and four systems: cooling, lubricating, fuel, and ignition systems. The diesel engines have no ignition system. The **crank gear** takes the pressure of expanding gases and converts the rectilinear reciprocating motion of the piston into the rotary motion of the crankshaft. It consists of a cylinder block with a crankcase, a cylinder head, pistons with rings, piston pins, connecting rods, a crankshaft, a flywheel, and an oil sump. The **valve gear** provides timely admission of the required amount of fresh charge into the cylinder and exhaust of spent gases from it. It consists of timing gears, a camshaft, tappets, push rods, rockers with fasteners, valves, springs with fasteners and valve guides.

Comprehension Questions

A. Read each statement and decide whether it is true or false. Write 'T' before true statements and 'F' before false statements.

- 1. During three movements of the piston in a four-stroke engine, the crankshaft rotates mostly by the inertia.
- 2. The sequenced strokes in multi-cylinders result in uneven engine operation.
- 3. V-type arrangement is usually used in four-cylinder engines.
- 4. In in-line engines, the cylinders are numbered from back to front.
- 5. In-line engines are heavier and take up more space.
- 6. Multi-cylinder radial engines have only one crankpin.
- 7. Crank gear mechanism changes the direction of the power produced by the engine.

B. Circle a, b, c, or d which best completes the following items.

- Intake, exhaust, and compression are called supplementary strokes because
 - they help the crankshaft rotate
 - they produce power for the crankshaft
 - during these strokes, no power is produced, but they are necessary for the completion of the operating cycle
 - they help the flywheel rotate and provide inertia for the movement of the piston
- The crankshaft of a single-cylinder four-stroke engine revolves non-uniformly because it
 - moves fast
 - goes up and down
 - produces a reciprocating movement
 - receives energy only during one stroke
- Paragraph one mainly discusses
 - the deficiencies of one-cylinder engines
 - advantages of one-cylinder engines
 - inertia and supplementary strokes
 - the four half turns of the four-stroke engine
- The second paragraph mainly talks about
 - four-cylinder engines
 - cylinder arrangement in multi-cylinder engines
 - the advantages of V-type engines
 - the way the cylinders are numbered
- It is **not** true that
 - the distribution of the load on the crankshaft is a determining factor in choosing a firing order
 - a six-cylinder engine may be supported on six bearings
 - V-type engines are more compact
 - in six-cylinder engines, crankpins are arranged in pairs

C. Answer the following questions orally.

- What are the advantages of V-type engines?

- What is meant by firing order?
- How are in-line cylinders numbered?
- What are the four systems which complete the operation of internal combustion engines?
- What is the function of valve gear mechanism?

Part III. Homework

Section One: Vocabulary Exercises

- A. Fill in the blanks with the words from the following table. Make necessary changes if required.**

Verb	Noun	Adjective	Adverb
radiate	radiation radius	radial radiant	radially radiantly
vibrate	vibration vibrator	vibratory vibrative	_____
support	support supporter	supportable	_____

- The house whenever a heavy lorry passes.
- The heat that from the fireplace increases the temperature.
- The ship's engine even at full speed causes very little
- The emitted by an X-ray apparatus penetrates solids and makes it possible to see into or through them.
- The sun is a source of energy.
- The of a circle is half the length of its diameter.
- The movements of the mobile set are the signs that somebody is calling.
- In a bicycle wheel, the spokes are arranged from the hub to the rim.
- His proposal for modifications in the design of the automobile obtained much
- That severe toothache wasn't for me.

B. Fill in the blanks with the appropriate words from the list below. There are more options than required.

micrometers	classified	external	dynamo
water pump	viscosity	adjacent	coated
oil-control	diameter	rotary	dry
fabricated	fan pulley	seat	

1. A spring on the valve stem tends to hold the valve on its
2. Friction has been into three types: dry, greasy, and viscous.
3. Dry friction is the friction between two objects.
4. The friction between two objects thinly with oil or grease is called greasy.
5. The resistance to relative motion between layers of liquid is termed viscous friction.
6. refers to the tendency of liquids, such as oil, to resist flowing.
7. The movement of the crankshaft turns the crankshaft pulley to drive the fan belt.
8. This belt drives the and the to cool the water in the engine and to generate electricity.
9. To measure dimensions of a component are used.
10. A micrometer caliper is used to measure the diameter of a small component.
11. Piston rings are classed into compression rings and rings.
12. Connecting rods are generally from a high-quality steel in the form of a bar with ring-shaped head at its ends.

C. Match the words in Column I with their appropriate equivalents in Column II. Insert the letters a, b, c, etc. in the parentheses provided. There are more options in Column II than required.

Column I		Column II
1. apart	()	a. distinct
2. compact	()	b. closely packed together
3. require	()	c. be made up of; comprise
4. shortcoming	()	d. help

5. uniform	()	e. need
6. consist of	()	f. deficiency
7. assist	()	g. remove
8. auxiliary	()	h. supplementary
9. compression ratio	()	i. always the same
		j. the total volume divided by the clearance volume when the piston is in BDC



Section Two: Further Reading

Read the following text carefully and then select a, b, c, or d which best completes the following items.

Diesel engines are more economical than their carburettor counterparts. As a result of their higher compression ratio, the diesel engines burn 25% less fuel (per unit work done). These engines operate on heavy fuels that present less fire hazard in handling. They, however, have some disadvantages: they are more bulky because the high pressure of combustion gases in the cylinder requires stronger engine components; they are more difficult to start, especially in cold weather.

The operating cycle of a four-stroke diesel engine is similar to that of carburettor engine. The four strokes are as follows.

Intake. The piston moves from TDC to BDC. The inlet valve is open. The cylinder is filled with air owing to suction.

Compression. The piston moves from BDC to TDC. The inlet and exhaust valves are closed. The air in the cylinder is compressed. The compression ratio in the diesel engine is higher (15-20); the pressure and temperature are higher too (30-40 kg/cm² and 600-700°C respectively). Such a higher temperature of the compressed air is needed to ignite the diesel fuel injected into the cylinder.

Power. Near the end of the compression stroke, the finely atomised diesel fuel is injected to the cylinder through an injector. On mixing with high-temperature air, the fuel ignites, the pressure in the cylinder rises to

70-90 kgf/cm² and the temperature reaches 1800-2000°C. The pressure forces the piston towards BDC. The inlet and exhaust valves are closed.

Exhaust. The piston moves from BDC to TDC. The exhaust valve is open. The gas temperature and the pressure drop. The spent gases are ejected from the cylinder.

- Paragraph one mainly discusses
 - higher compression ratio of diesel engines
 - the differences between diesel engines and carburettor ones
 - the advantages and disadvantages of diesel engines
 - the amount of fuel used in diesel engines
- The writer mentions disadvantages for diesel engines.
 - two
 - three
 - four
 - many
- The quality of being bulky is due to
 - the need for high pressure of combustion gases in the cylinder
 - the necessity of stronger engine components
 - the difficulty in starting the engine
 - both a and b
- When the fuel is injected into the cylinder it ignites because
 - both valves are closed
 - the pressure of air and the temperature in the cylinder are very high
 - the fuel is injected through an injector
 - the pistons in diesel engines are more powerful
- It is **not** true that
 - the injected fuel should be in the form of a very fine spray
 - diesel engines are difficult to start in cold weather
 - the ignition system sets the air-fuel mixture on fire
 - the diesel engine consumes less fuel per unit work done
- The best title for this passage would be
 - Diesel Engines
 - Advantages and Disadvantages of Diesel Engines
 - Operating Cycles in Diesel Engines
 - Running Diesel Engines

Section Three: Translation Practice

A. Translate the following passage into Persian.

The two diagrams show the push rod and valve operation in one type of petrol engine.

When the piston moves up and down in the cylinder, the connecting rods push the crankshaft round. This rotary movement also turns the crankshaft sprocket. The crankshaft sprocket drives the timing chain to turn the larger camshaft sprocket. The crankshaft to camshaft speed ratio is 2:1. The camshaft has two cams for each cylinder; there are therefore 8 cams in a 4-cylinder engine, i.e., one for each push rod.

When the camshaft rotates, the cams raise and lower the cam followers to operate the push rods. Each cam follower controls one push rod. When the latter moves up, the top end of the push rod operates the valve rocker. The rocker shaft does not move, so when the push rod raises one valve rocker arm, the other arm on the same rocker moves down to open the valve. This downward movement compresses the valve spring. When the cam moves past the highest point, the cam follower and the push rod fall; the valve spring expands to close the valve.

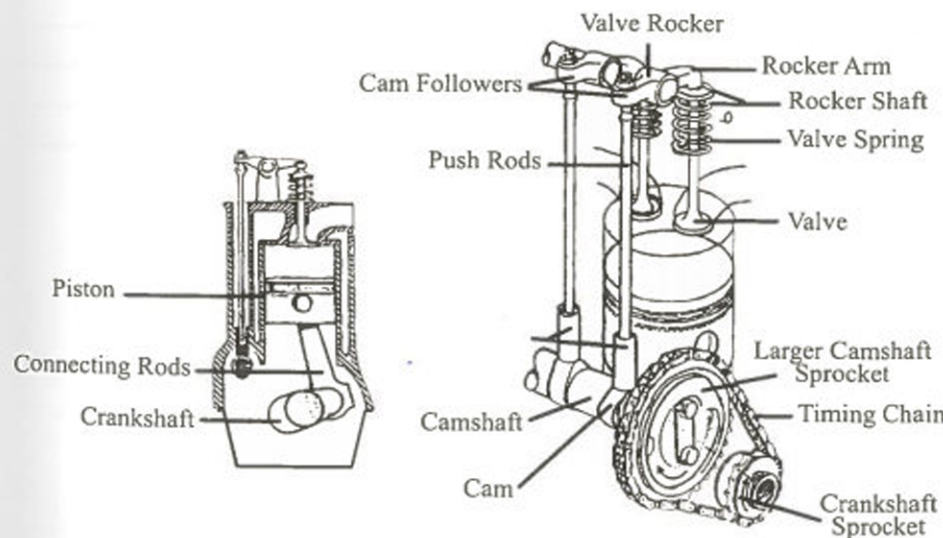


Figure 5-3. Push Rod and Valve Operation.

B. Find the Persian equivalents of the following terms and write them in the spaces provided.

1. acceleration
2. auxiliary
3. bank
4. bearing
5. compact
6. compression ratio
7. counterpart
8. crank gear
9. fabricate
10. fastener
11. handle
12. inertia
13. lubricating system
14. radial engine
15. rectilinear
16. spoke
17. tappet
18. valve gear
19. valve guide
20. vertical
21. viscous

Lesson Six

Part I. Pre-Reading

A. Word Study: Definitions

cock /kɒk/:

tap or valve for controlling the flow of a liquid or gas

duct /dʌkt/:

tube or canal through which gas or liquid passes

gauge /geɪdʒ/:

any device for measuring something

hose /hoʊz/:

1. a flexible pipe or tube used to convey fluids, especially water from a hydrant
2. such pipe equipped with a nozzle and attachment

jacket /dʒækt/:

outer covering round a boiler, tank, pipe, etc. to lessen loss of heat or, in the case of a water jacket, to cool an engine

manifold /ˈmænɪfəʊld/:

a pipe with one inlet and several outlets or with one outlet and several inlets, for connecting with other pipes, as for conducting exhausts from each cylinder into a single exhaust pipe.

rivet /rɪvɪt/:

(n) metal pin or bolt for fastening metal plates

(v) fasten with a rivet; flatten the end of a bolt to make it secure

seizure /siːʒə(r)/:

act of becoming stuck or jammed, e.g., because of too much heat or friction

shutter /ʃʌtə(r)/:

movable cover or screen used to control the amount of air flow to the radiator

B. Word Study: Definitions and Examples

adjust /ə'dʒʌst/:	regulate; set right <i>You can't see well through a telescope unless it is adjusted to your sight.</i>
circulate /sɜ:kjəleɪt/:	go round continuously <i>In many buildings hot water circulates through pipes to keep rooms warm.</i>
condense /kən'dens/:	cause to increase in density or strength; become thicker <i>Milk gradually condenses if you boil it for a long time.</i>
consumption /kən'sʌmpʃn/:	using up; consuming <i>The consumption of meats among lower class families goes down as the prices are raised.</i>
corrosion /kə'rəʊʒn/:	wearing away; destroying slowly by chemical action or disease <i>The corrosion resulting from iron rusting causes great losses for man.</i>
desirable /dɪ'zairəbl/:	to be desired; causing desire; worth having <i>It is most desirable for him that he should attend the conference.</i>
drain /dreɪn/:	(n) pipe, channel, trench, etc. for carrying away water or other unwanted liquids (v) cause to run or flow away <i>In the lower part of the cylinder block a cock is screwed to enable the engine jacket to be drained.</i>
due to /dju: tu/:	caused by; resulting from <i>His accident was due to careless driving.</i>
effect /ɪ fekt/:	(v) bring about; accomplish <i>The control of the temperature of the cooling water is effected by a thermostat, shutters or automatic cut-in and cut-out of the</i>

film /fɪlm/:

fun.

thin coating or covering

*There was a thin **film** of oil on the water.*

heat /hi:t/:

make or become hot

*When water is **heated** to a certain degree, it will boil and bubble up.*

intensify /ɪn'tensɪfaɪ/:

make or become more intense; increase; strengthen

*At a fixed pressure, the boiling and vapourization occur at a single temperature; if you **intensify** the heat, the temperature remains constant.*

liberate /lɪbəreɪt/:

set free

*A great amount of energy is locked in the atom which, if **liberated**, has a tremendous power.*

promote /prə'məʊt/:

help the progress of; help bring about; help to start

*The employment of experienced specialists **promoted** the success of the factory.*

rub /rʌb/:

move one thing backward and forward on the surface of another

*You have **rubbed** your coat against some wet paint.*

undue /ʌn'dju:/:

improper; more than is right

*He did his work with **undue** haste.*

Part II. Reading

The Cooling System

The temperature of gases in the cylinder of running engine reaches 1800-2000°C. Only part of the heat liberated in this process is converted into useful work. Another part of heat is to be carried away with cooling liquid.

During engine operation, gases heat the walls of the cylinders, pistons, and cylinder head. If the engine had not been cooled properly, the film of lubricating oil between the rubbing components of the engine would have been burnt off, resulting in undue wearing of the components, possible seizure of the pistons because of their excessive expansion, and other troubles.

Overcooling of the running engine is not desirable either. It reduces the engine power and increases the consumption of fuel. Due to thickening of the lubricant, the friction losses increase. Part of the fuel mixture condenses and washes the lubricant down from the cylinder walls thus intensifying the wear of the engine parts. In this case, because of the formation of sulphuric compounds, the corrosion wear of the cylinder walls is also promoted. For a water-cooled engine to operate normally, the temperature of the cooling water must be in the range 80-95°C.

The engine may be either water or air cooled, but the vast majority are water cooled. Internal combustion engines usually have a forced liquid cooling system and the removal of excess heat is effected through their forced cooling. The coolant is either water or special antifreeze solutions. The cooling system includes water jacket for cooling the cylinder block and head, radiator, water pump, fan, shutters, thermostat, water distributing manifold (tube), connecting

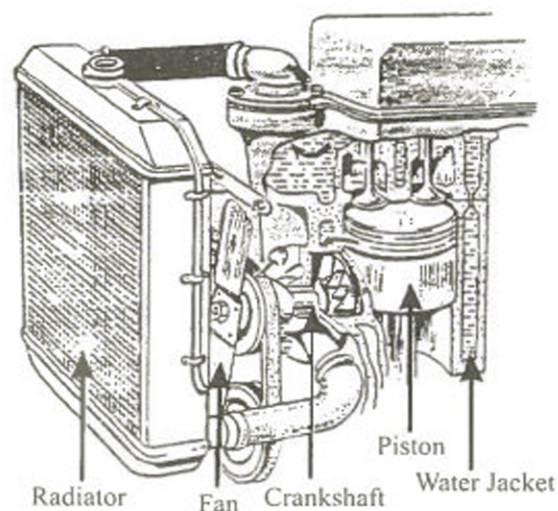


Figure 6-1. The Cooling System.

hoses, branch pipes, drain cocks and coolant temperature gauge (thermometre).

When the engine is running, the cooling water is forced to circulate through the cooling system by centrifugal water pump. The pump draws water from the radiator bottom (collector) tank and forces it under pressure into cylinder block jacket. There, it cools the walls of the cylinder. Separate parts of the cooling system are interconnected by pipes and hoses. The water then passes upwards through holes and ducts into the cylinder head jackets. The degree of cooling is adjusted by a thermostat. When the engine is warmed up, the thermostat directs the water to the top tank (or header) of the radiator. As the water flows through the numerous tubes between the header and collector tanks, it is cooled by the air blown between the tubes by cooling fan.

Comprehension Questions

A. Read each statement and decide whether it is true or false. Write 'T' before true statements and 'F' before false statements.

- 1. Pistons may jam because of improper heat.
- 2. Part of the heat set free in an internal combustion engine is unwanted.
- 3. Pistons may contract due to excessive heat and lack of oil.
- 4. If the engine is overcooled, the friction losses increase.
- 5. In an overcooled engine, the wear of the parts decreases.
- 6. Water moves through cylinder block jacket to cool the whole engine.
- 7. Water becomes cool when it passes through the tubes between top and bottom tanks of the radiator.

B. Circle a, b, c, or d which best completes the following items.

1. If the engine is not cooled properly, the result will be
 - a. possible seizure of the pistons and wear of the parts
 - b. all the troubles mentioned in paragraph one
 - c. many troubles
 - d. the troubles mentioned in paragraph one and some others
2. In paragraph two (line one), 'it' refers to
 - a. overcooling
 - b. engine

- c. running engine d. undesirability of overcooling
3. In the second paragraph, undesirable results of overcooling are mentioned.
- a. two b. three
c. four d. five
4. The first two paragraphs discuss
- a. advantages and disadvantages of overheating and overcooling
b. the disadvantages brought about by overheating and overcooling
c. undesirable results of excessive heat
d. the corrosion of the cylinder walls and undue wearing of parts
5. Water enters the engine jackets from
- a. the header tank b. the collector tank
c. the duct of the cylinder head d. the thermostat

C. Answer the following questions orally.

- What is the normal temperature of the cooling water in a water-cooled engine?
- What is the effect of overcooling on the fuel consumption in a running engine?
- How is heat removed in air-cooled engines?
- What are the results of overheating of the engine?
- How are the different parts of the cooling system interconnected?

Part III. Homework

Section One: Vocabulary Exercises

- A. Fill in the blanks with the words from the following table. Make necessary changes if required.**

Verb	Noun	Adjective	Adverb
corrode	corrosion	corrosive	corrosively
circulate	circulation	circular	_____
condense	condensation	_____	_____
press	press pressure	_____	_____

- Blood through the body.
- The central bank is going to put a new coin into
- Steam into water when it touches a cold surface.
- Distilled water is obtained through the of vapour rising from heated water.
- Most acids are extremely
- The runners ran in a path round the playground.
- Before starting the car, see that the tyre is right.
- Impure or acidic water may components of the cooling system.
- Precautions have to be taken against possible accidents when working with a hydraulic
- To release the parking brake, pull the lever up slightly and the button; then lower the lever.

- B. Fill in the blanks with the appropriate words from the list below. There are more options than required.**

antifreeze	soldered	button	hook
freeze up	pressure	screw	bolt
passages	protect	rubber	tap
ballcock	joints	jib	

- When the tank water level rises, it pushes the up, closes the inlet valve, and stops water.
- In a control panel, each has a different function.
- Two motors in a crane turn drums to control the movement of the and the
- Water flows from the radiator through a system of water and hoses.
- Many different kinds of are used to connect pipes together.
- When connecting small diameter pipes, each pipe is pushed into the connector and the connector is to the pipes.
- The cooling system can in very cold weather.
- A good solution can be left in throughout the summer.
- Besides preventing freezing in winter, a proper solution will the

- b. be loose enough to run freely
 - c. be neither too tight nor too loose
 - d. be replaced every year
5. It is **not** true that
- a. hard water could be softened rather easily
 - b. soft water is easily recognizable
 - c. the water which is drained from the system should never be used again
 - d. overheating of the engine may be due to a slack fan belt



Section Three: Translation Practice

A. Translate the following passage into Persian.

Cooling system troubles usually manifest themselves in engine overheating. The causes of overheating may be the following: lack of coolant in the cooling system, closed radiator shutter, scale and sludge accumulations in the cooling system, too loose or soiled fan belt, engine overload and faulty thermostat.

In cold weather, water may freeze in the engine cooling system, thus stopping coolant circulation. Some parts of the engine will overheat if not cooled and this could seriously damage the engine. What is worse, water expands when it freezes. Water freezing in the cylinder block could expand enough to actually crack the block. Water freezing in the radiator could burst the radiator tanks and tubes. Therefore, under such conditions, water must be drained from the cooling system whenever the engine is stopped for any prolonged period of time, or an antifreeze solution must be used to fill the system.

B. Find the Persian equivalents of the following terms and write them in the spaces provided.

- 1. circulation
- 2. components
- 3. crack

- 4. drain
- 5. duct
- 6. engine overheating
- 7. fan belt
- 8. fluid
- 9. hose
- 10. leak
- 11. manifold
- 12. rivet
- 13. seizure
- 14. sludge
- 15. water jacket
- 16. wear