

### 3A. Label the pictures with the following words from the list.

## Components to be inspected

#### Example:

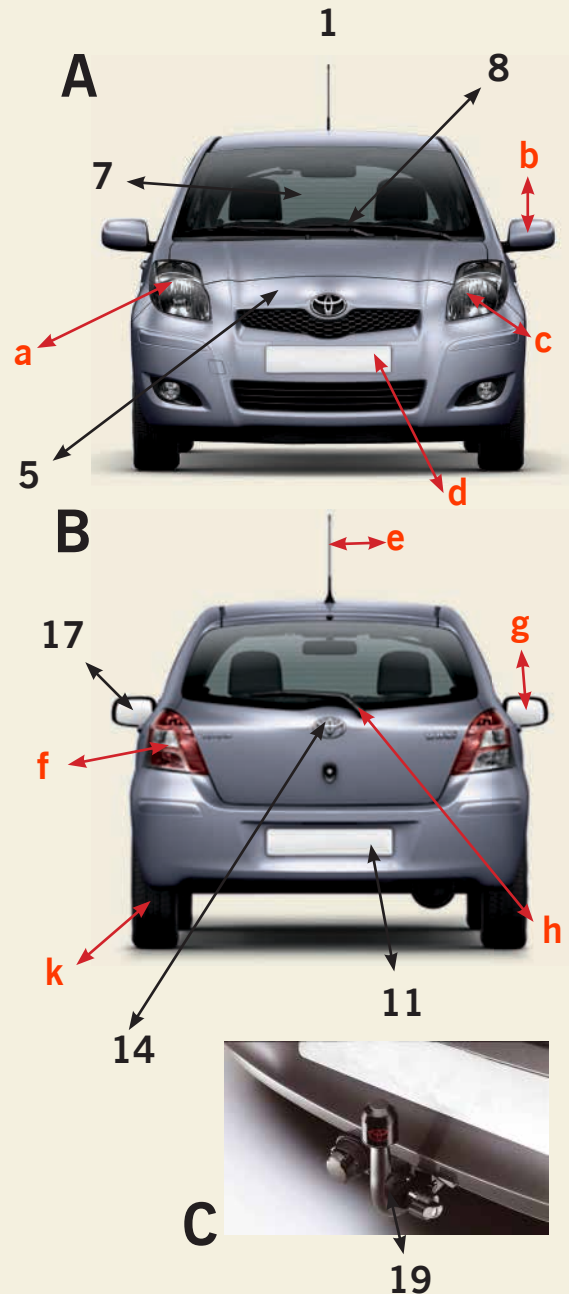
What is **Number 1** in picture A? Number 1 is an antenna.

What is **Letter 'e'** in picture B? Letter 'e' is an antenna.

- ⇒ exhaust system and exhaust emission –
- ⇒ body and vehicle structure –
- ⇒ load security –
- ⇒ hood (bonnet) –
- ⇒ horn –
- ⇒ windshield (windscreen) –
- ⇒ wipers and washers (front and rear) –
- ⇒ tires (tyres) and wheels –
- ⇒ steering and suspension –
- ⇒ registration plates –
- ⇒ brakes –
- ⇒ lights (front and rear; left and right) –
- ⇒ trunk (boot) and tailgate –
- ⇒ seats and seat belts –
- ⇒ fuel cap and fuel systems –
- ⇒ mirrors (left and right) –
- ⇒ doors (front and rear, left and right) –
- ⇒ towbar –

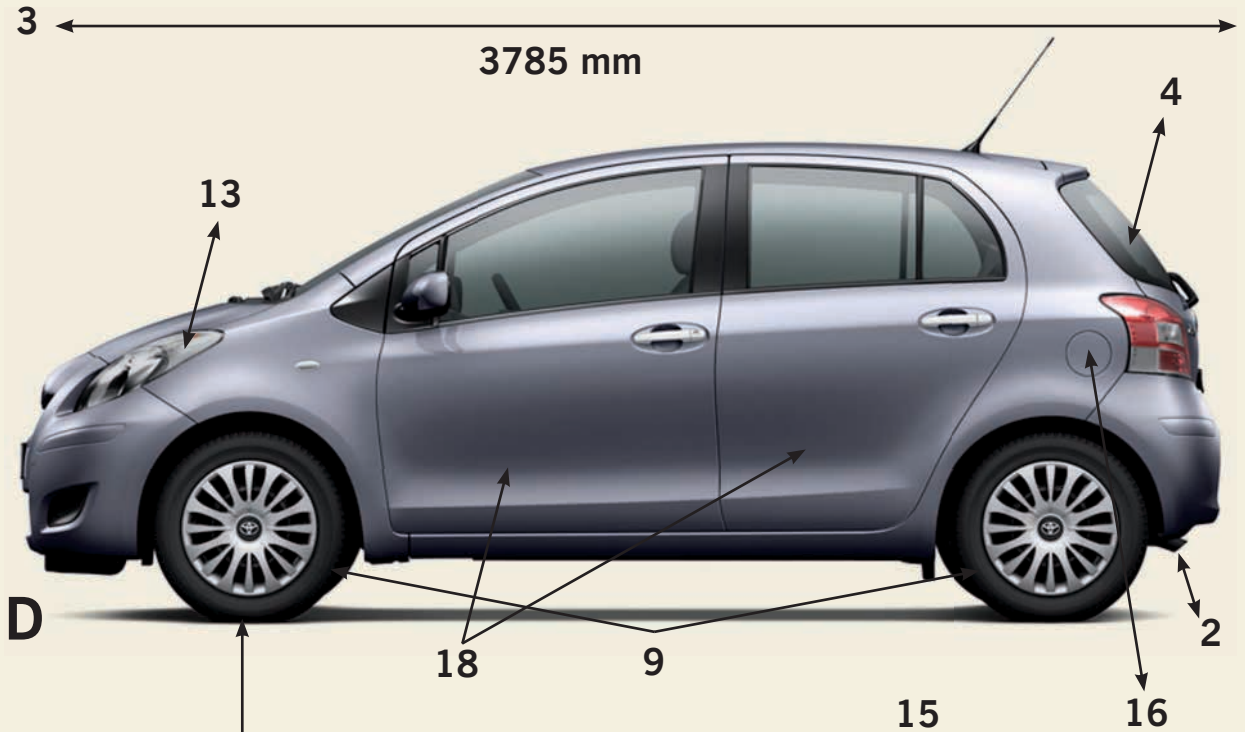
#### 3B. Which components are inspected?

- ⇒ for excessive corrosion and damage –
- ⇒ for leaks –
- ⇒ if fastens and seals securely –
- ⇒ for operation and performance (efficiency test) –
- ⇒ if meets the requirements for exhaust emissions –
- ⇒ if silences effectively –
- ⇒ for condition, security, size, type and tread depth –
- ⇒ if operate to give the driver a clear view ahead –
- ⇒ for condition and the driver's view of the road –



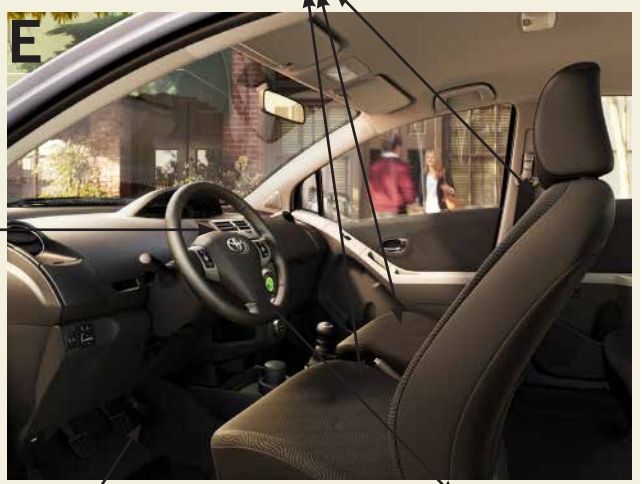


- bonnet – hood
- boot – trunk
- tyre – tire
- windscreen – windshield



D

10



E

12

3



F

# Principles of Operation and Types of Electric Motors

## 1. Match the words with its definitions.

- |                   |                 |           |
|-------------------|-----------------|-----------|
| 1. electric       | 4. electronic   | 7. motor  |
| 2. electrical     | 5. mechatronics | 8. engine |
| 3. electric motor | 6. dynamo       |           |

A. it is used in technical contexts when referring to the manufacture or use of electricity, also used with general nouns when referring to things that are powered by electricity \_\_\_\_\_

B. they are electric \_\_\_\_\_

C. they are **using** electricity for power, things that use electricity to make them, used for carrying electricity \_\_\_\_\_

D. it is an interdisciplinary area of engineering that **combines** mechanical, electrical engineering and computer sciences \_\_\_\_\_

E. it **converts** electrical energy **into** mechanical energy \_\_\_\_\_

F. they are **powered by** some sort of pressure or combustion \_\_\_\_\_

G. it **converts** mechanical energy **into** electrical energy \_\_\_\_\_

H. it is **based on** or **used in** a system of operation which involves the control of electric current by various devices, equipment and systems that use computer chips \_\_\_\_\_

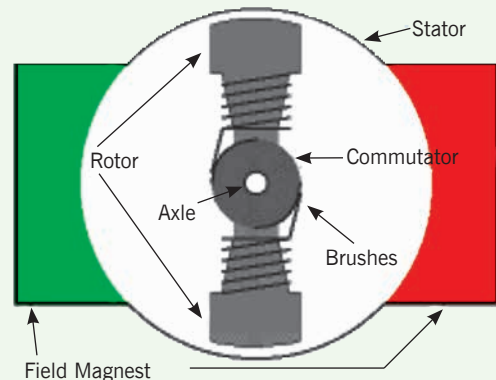
## 2. Read the words presented below. Read the text and fill in the gaps with the listed words. Discuss your answers with your partner. The picture on the right and four pictures on the next page will help you.

*continually, poles, brushes, electromagnet, shaft, pushed, permanent, pulled, field, commutator, armature, plugs, mounted*

### How DC Power Supplied Motor Works

Here is a very simple electric motor, with only one 1. \_\_\_\_\_ magnet and one 2. \_\_\_\_\_. The permanent magnet, which stands still, is called the 3. \_\_\_\_\_ magnet, while the electromagnet, which turns, is called the 4. \_\_\_\_\_. When current flows through the armature, it has north and south poles. The north pole of the armature is 5. \_\_\_\_\_ by the south pole and 6. \_\_\_\_\_ by the north pole of the field magnet, while the opposite happens to the south pole of the armature.

If the current in the armature kept flowing the same way, the armature would turn until it got to the horizontal position. Then it would stop, because the north pole of the armature would be as close as it could get to the south pole of the field magnet, while the south pole would be close to the north pole. A motor, however, has a kind of turning switch called a 7. \_\_\_\_\_. The electric current is delivered to and taken from the



Every DC motor has six basic parts: axle, armature (also known as rotor), stator, commutator, field magnet(s), and brushes.

commutator by a pair of plugs, called  
 8. \_\_\_\_\_, curved to fit against it. These  
 plug-shaped graphite contacts are called brushes  
 because, in the first electric motors, they really  
 were little brushes of copper wire. These  
 brushes, however, made many sparks, which  
 melted holes in the commutator.  
 Engineers found that graphite 9. \_\_\_\_\_ solved  
 the problem. The commutator is 10. \_\_\_\_\_ on  
 the same 11. \_\_\_\_\_ as the armature and turns  
 with it. When the armature gets to the horizontal  
 position the commutator causes the current to  
 flow through the armature wire the other way. So  
 the north pole of the armature becomes the south,  
 and the south becomes the north. Therefore, the  
 poles of the field magnet push and pull the poles  
 of the armature so that it turns 12. \_\_\_\_\_  
 . In most motors the field magnet is an  
 electromagnet, and the armature has many more  
 13. \_\_\_\_\_ than are shown here.

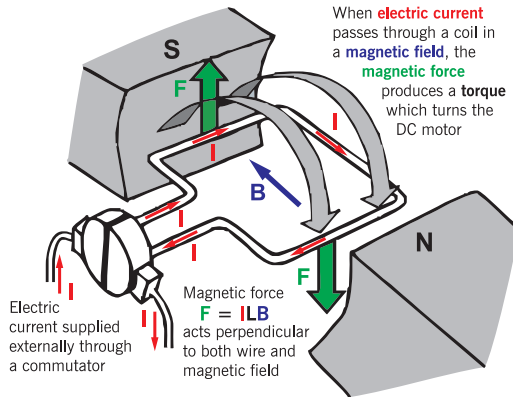


City-use electric vehicle

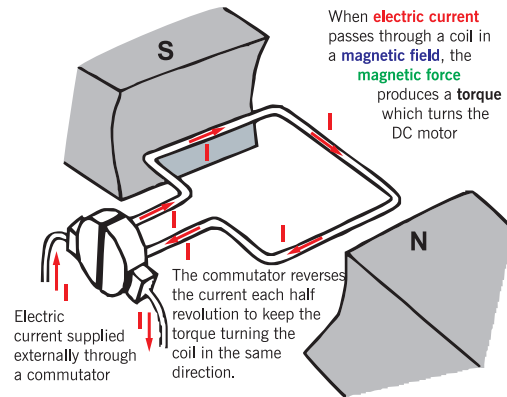


Zero-emissions vehicle

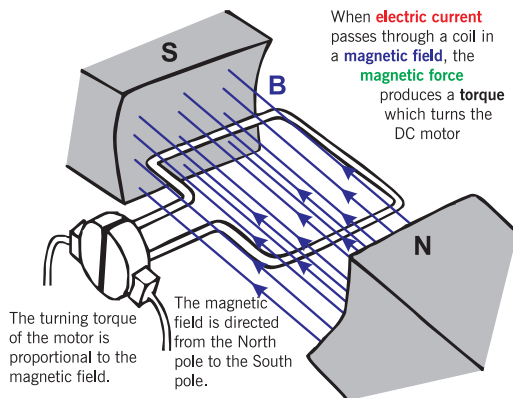
DC MOTOR OPERATION



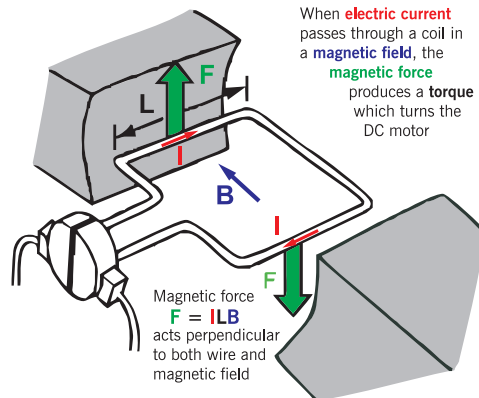
CURRENT DC IN MOTOR



MAGNETIC FIELD IN DC MOTOR



FORCE IN DC MOTOR





# Passive and Active Safety Systems in Cars

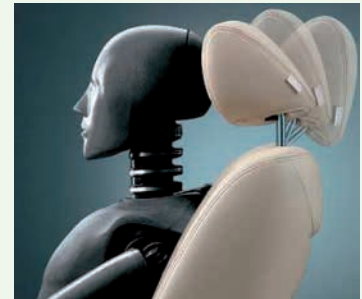
1. Read the text and match the headings to the passages.

- A. Active Head Restraint
- B. Automatic Pop-Up Hood
- C. ISOFIX Anchorage for Child Safety Seats
- D. Pre-Crash Seatbelt
- E. Seatbelt Pretensioner and Seatbelt Force Limiter
- F. SRS Side Airbag
- G. Vehicle Design

## Passive Safety Systems

### Occupant Protection Technologies

1. \_\_\_\_\_  
 This technology reduces **whiplash injury** to a front-seat occupant by moving the seat's headrest upward and forward at the time of a rear-end collision. When such a collision occurs, a hinge incorporated into the seatback yields in response to the forward motion of the occupant's torso, allowing the seatback to move rearward and a pressure plate inside it to move the headrest upward and forward based on the lever principle, cradling and protecting the occupant's head and neck.



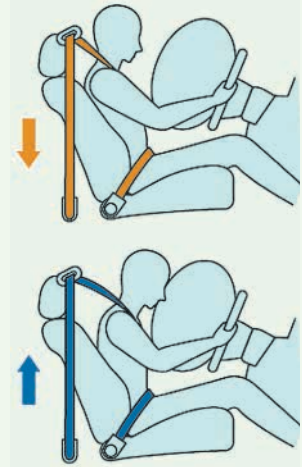
2. \_\_\_\_\_  
 Supplemental Restraint System side-impact airbag serves primarily to protect front-seat occupants from injuries to the torso – specifically, to the chest and pelvis – at the time of a side collision. Upon detection of a lateral collision by means of a sensor, the side airbag installed in the seatback deploys instantly. Side airbags designed for head protection and for rear seats have also been introduced.



### Seatbelt Technology

Seatbelts secure vehicle occupants in their seats at the time of a collision or an abrupt stop. Their purpose is to reduce injury and prevent occupants from being ejected from the vehicle. Seatbelt pretensioners and force limiters are now standard equipment. Pre-crash seatbelts have also been introduced which work in conjunction with the brake-assist function to hold vehicle occupants more securely in place when a collision is unavoidable.

3. \_\_\_\_\_  
 The pretensioner automatically tightens the seatbelt to hold the vehicle occupant firmly in place in a frontal collision. A double pretensioner retracts the seatbelt both at shoulder height and at the level of the pelvis, for even greater restraint at the moment of collision. The force limiter automatically reduces seatbelt tautness (i.e. lets out a little slack) when the vehicle occupant's seatbelt has reached a threshold level of tension as his/her torso moves forward in a frontal collision.

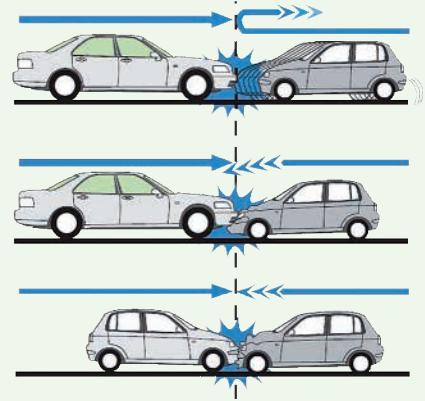


A variable force limiter helps distribute the force of the impact of a frontal collision across the occupant's body to reduce the risk of chest injury.

4. \_\_\_\_\_  
 Quickly-retracting pre-crash seatbelts work in conjunction with the brake-assist function to restrain occupants in their seats when a collision is determined (by an electronic control unit) to be unavoidable. Pre-crash seatbelts also optimize airbag deployment efficiency.

**Vehicle Compatibility**

Advancing vehicle compatibility involves improving the safety performance of a vehicle in the event of a crash with another vehicle, with a particular focus on reducing the ability of larger vehicles to cause damage to smaller vehicles in a collision. In vehicle-to-vehicle crashes, it is often the case that one vehicle sustains greater damage because of differences in mass, size and geometry – including, among other factors, body shape, ride height and bumper height. Studies in vehicle compatibility seek to minimize injury to the occupants of both vehicles involved in a crash through improvements to body structure. During vehicle development, crash tests involving a larger car and a smaller car are rigorously carried out in order to achieve structural compatibility that will enhance a vehicle’s collision impact-absorbing capacity by, for example, enabling the absorption of impact energy over surfaces rather than at specific points

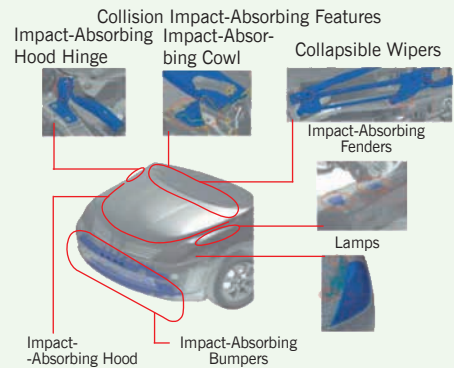


5. \_\_\_\_\_  
 Established by the International Organization for Standardization (ISO), ISOFIX is an international standard for the accommodation of child safety seats in automobiles. It specifies the built-in anchor points to be provided in the rear seat of a vehicle so as to enable the rapid and safe installation of a child safety seat. ISOFIX also sets installation standards and categories with respect both to child seats and the provisions for their accommodation, enabling a ‘universal system’ for child-safety-seat installation.

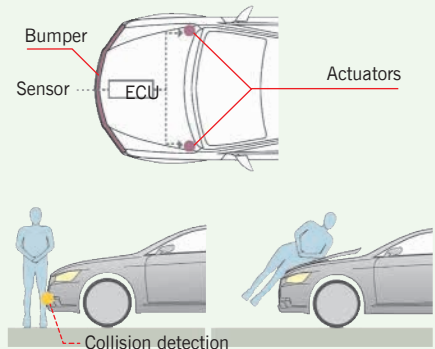


**Pedestrian Protection**

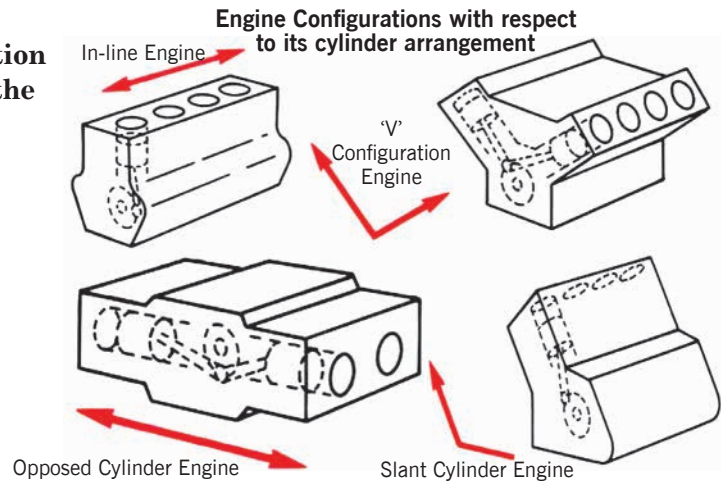
6. \_\_\_\_\_  
 This is front-end vehicle design intended specifically to reduce injuries (particularly head and lower limb injuries) to a pedestrian involved in a pedestrian-vehicle collision. To reduce the force of the collision’s impact on the pedestrian and therefore the extent of potential injury, various provisions are made in the design of the hood, fenders, wiper pivots and front bumper to allow for sufficient clearance, collapsibility, or even ejection off the vehicle. Now under development, pedestrian protection-enhancing airbags will further buffer the impact of the collision on the pedestrian by covering hard spots and components in the lower windshield area such as the cowl and wiper bases, as well as the structural pillars on each side of the windshield.



7. \_\_\_\_\_  
 A sensor and an electronic control unit built into the bumper detect a collision with a pedestrian. If necessary, actuators instantly raise the back end of the hood, leaving a space between the hood and the hard components underneath it, including the engine, to reduce the force of the impact on the pedestrian’s head.

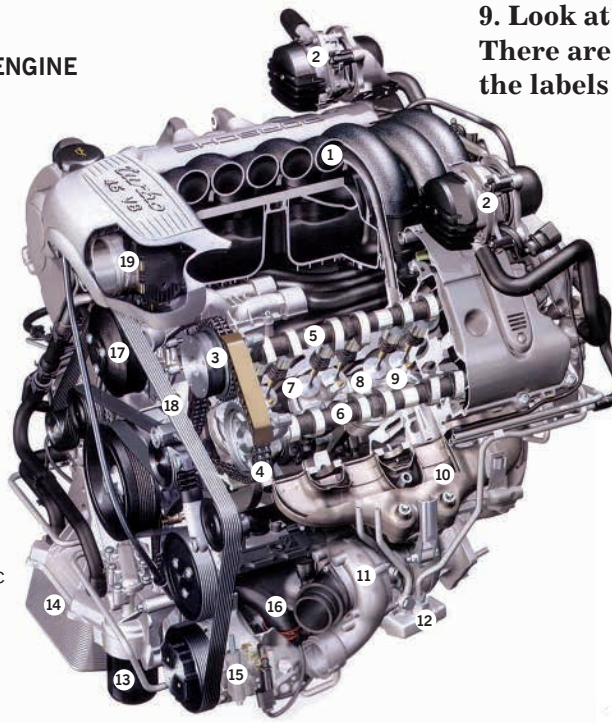


8. Look at the picture on the right. What four types of engine configuration are presented on the picture? Read the labels and explain them.



**PORSCHE CAYENNE ENGINE**

1. Intake manifold
2. Air-Injection pumps
3. VarioCam
4. Duplex timing chain
5. Intake \_\_\_\_\_
6. Exhaust \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_
9. Spark plug
10. Exhaust manifold
11. Turbocharger
12. Oil collector on turbocharger
13. Oil filter
14. Oil/collant heat exchanger
15. Air-conditioning compressor
16. Oil pump pick-up pipe
17. Water pump
18. Ancillary drive belt
19. Throttle-valve tract (electronic throttle)



9. Look at the picture on the left. There are 4 words missing. Read the labels and fill in the gaps.

**PISTON RINGS**

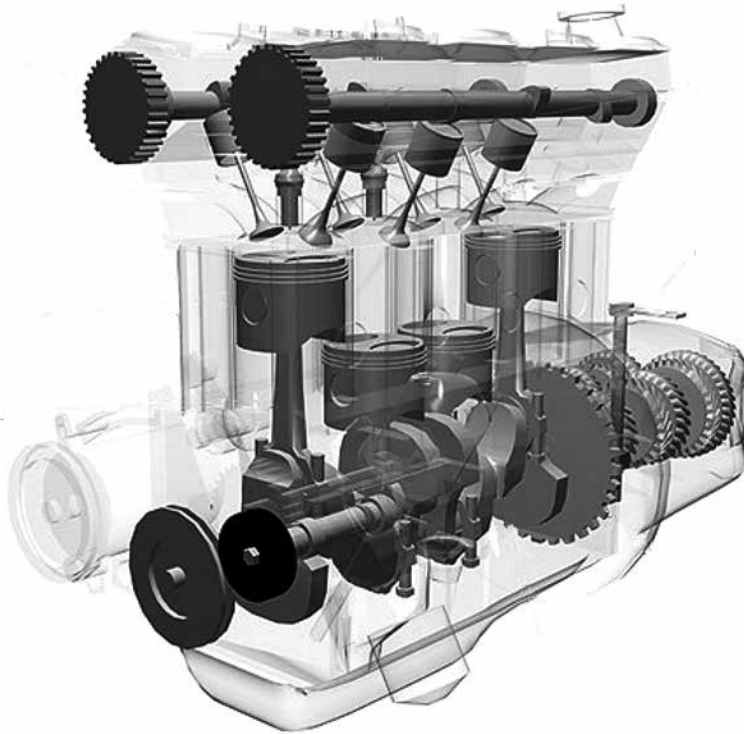


10. Look at the same picture on the previous page. Look at it for 1 min. Then label all missed elements using English words. How many elements did you label correctly?



11. Look at the same picture on the previous page. Look at it for 1 min. Then label all compression rings, ring rails, spacers and piston elements using English words. How many elements did you label correctly?

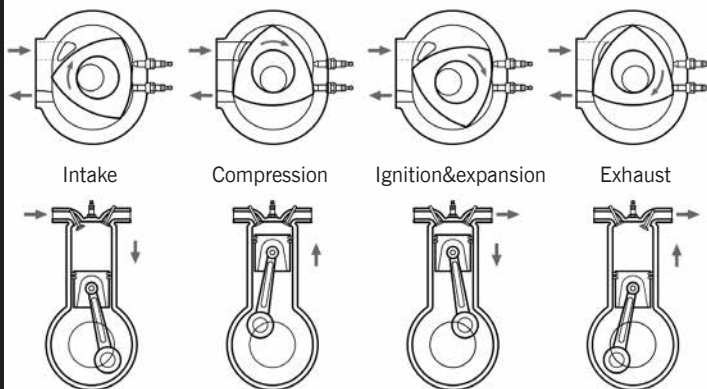
FOUR-STROKE INTERNAL COMBUSTION ENGINE



## BE TECHNICALLY CURIOUS!

### Rotary Wankel Engine from Mazda

WANKEL ROTARY PISTONLESS ENGINE  
AND FOUR STROKES OF OTTO CYCLE



Mazda-RENEISIS-16X-engine



**3. Read the text about limited slip differential and match the following three terms to the definitions:**

- A. Viscous coupling**
- B. Electronic**
- C. Mechanical**

A limited slip differential or LSD is an improvement to the open differential in that it allows a driven wheel to have a limited amount of slip before the differential attempts to correct the slippage of the wheel.

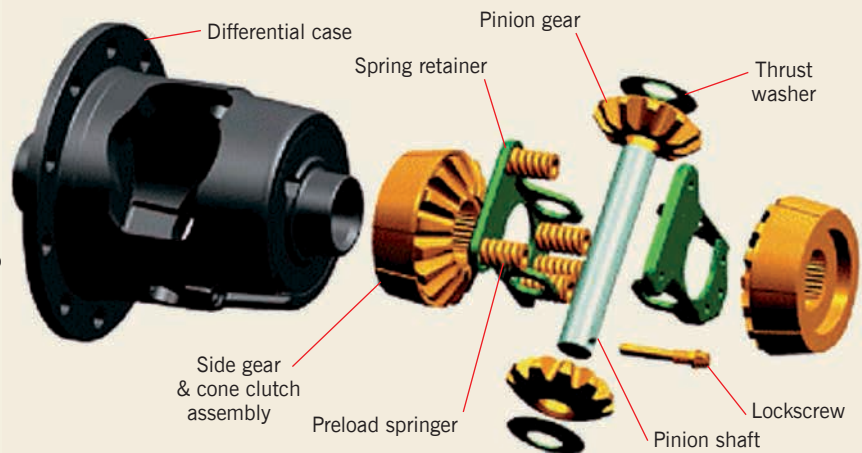
This slip is usually a very limited amount. Your tires don't have to spend five to ten seconds or more skidding before the limited slip differential attempts to correct it.

**There are basically three types of limited slip differential:**

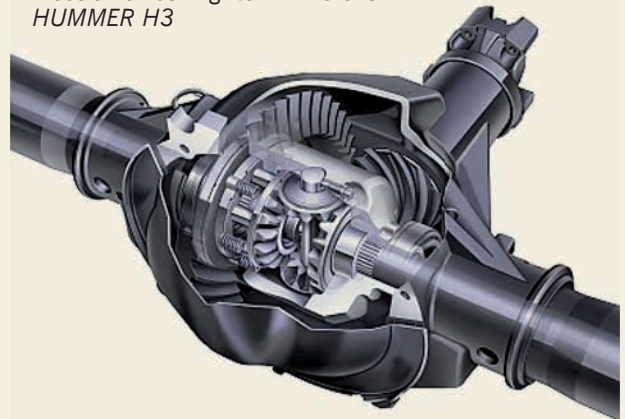
1. \_\_\_\_\_ – has two clutches inside the differential. Whenever a wheel starts to slip it activates the clutch to the shaft leading to that wheel to cut the power to that wheel thereby sending the power to the other wheel.

2. \_\_\_\_\_ – this means that there is a thick liquid inside of the LSD. The liquid spins in the direction of the wheels and if one wheel starts to spin considerably faster than the other the viscosity of the spinning liquid forces the other wheel to spin as well. This action is similar to a locking differential as power is not actually removed from the slipping wheel.

3. \_\_\_\_\_ – an electronic LSD may also have two clutches inside it and uses an ECU to determine when one of clutches should restrict the power to a wheel thereby sending the power to the other wheel. An electronic LSD may operate by itself with its own ECU or may use the systems that operate the traction control to also operate the LSD.



*Electronic Locking Rear Differential  
HUMMER H3*

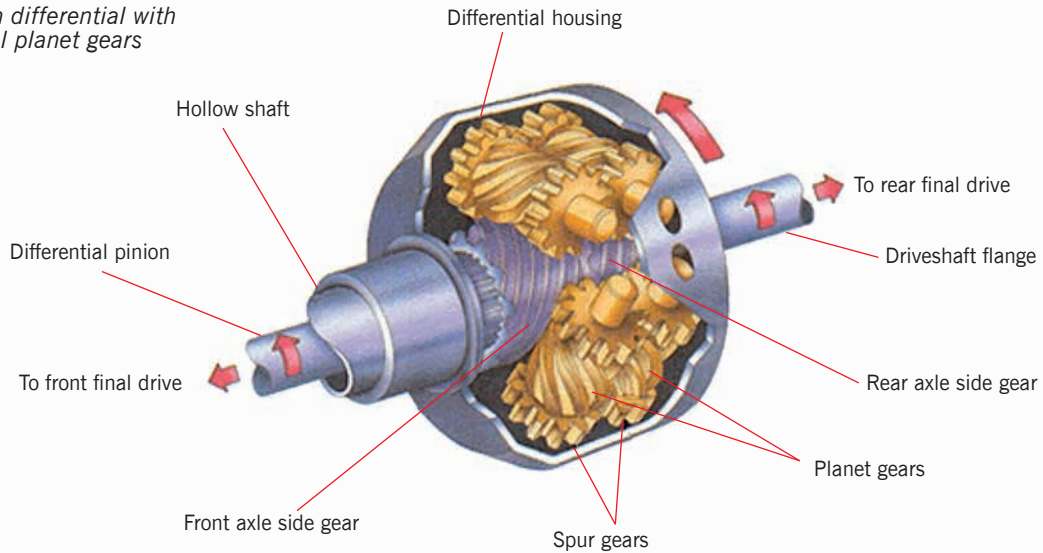


## Gearbox vs. Transmission

That answer depends on which side of the Atlantic you're on. To the Europeans, it's a gearbox. To the Americans, it's a transmission. The transmission is regarded as the entire assembly that sits behind the flywheel and clutch – the gearbox is really a subset of the transmission if you want to split hairs.

#### 4. Read the text and fill in the missing prefixes and suffixes to make the correct text.

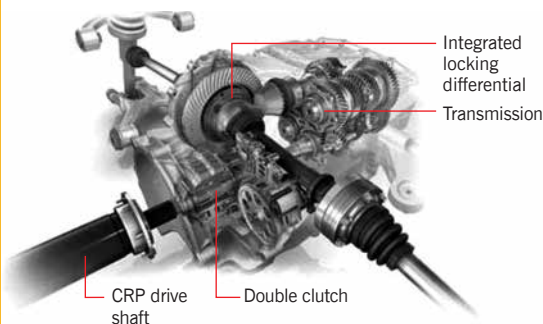
*Torsen differential with helical planet gears*



The Torsen differential is a mechanic\_\_ self-locking centre differential which regulate\_\_ the power between the front and rear axles accord\_\_ to demand. The word 'Torsen' is made up of the words 'torque' and 'sensing', indicating that the differential operate\_\_ on the basis of torque sensing. It responds to vary\_\_ rotation\_\_ forces between the input and output shafts (front and rear axle). This \_\_\_ables variable distribut\_\_\_ of the driving torque between the axles. On a Torsen differential the two output gears are \_\_\_connected by worm gears. They limit high differential rotation speeds, but still balance the speeds when cornering. The basic configuration of the Torsen differential is select\_\_\_ such that the driving forces are normal\_\_\_ distributed 50:50 across the front and rear axles. In case of slip, the Torsen differential diverts as much as 20 percent of the driving power to the axle with the better traction (max. 70:30, or 30:70). The adjust\_\_\_ is made steplessly and with no time delay. The locking effect of the Torsen differential increases automatical\_\_\_ along with the load. In contrast to a 'speed sensing' viscous lock, it operates in 'torque sensing' mode. The advantage of this method is the lack of torsion\_\_\_ stress when cornering, as the differential rotation speeds the vehicle seek\_\_ to bring about are in fact permitted.

### What is a transaxle?

*Double-clutch transmission with integrated locking differential*



**transaxle = transmission + axle**

A transaxle combines the function of a transmission with that of an axle. A transaxle incorporates all of the components of any other transmission but also includes a differential and final drive gear set.

## Revision 5

1. Answer the following questions. Your teacher will organize your work and help you with self-assessment.

- ❖ What elements of the inlet system can you name?
- ❖ What elements of the exhaust system can you name?
- ❖ What do you remember about catalytic converters?
- ❖ What elements of the fuel delivery system can you name?
- ❖ What elements of a fuel injector can you name?
- ❖ What elements of a fuel system can you name?
- ❖ What are the elements of a Common Rail System?
- ❖ How do you replace a fuel filter?
- ❖ What harmful exhaust emissions do you know?
- ❖ What are the characteristic features of the electric ignition system (EI)?
- ❖ What types of spark plug wear can you remember?
- ❖ What types of joints can you remember?
- ❖ What types of passenger car layouts can you remember?
- ❖ What do you know about a clutch operation?
- ❖ What does the differential do in a vehicle?
- ❖ What types of gears can you name?
- ❖ What are the characteristic features of a manual transmission?
- ❖ What are the characteristic features of an automatic transmission?
- ❖ What are the characteristic features of a four wheel drivetrain?
- ❖ What typical suspension systems do you know?
- ❖ What elements of the steering system can you name?
- ❖ What problems with the steering system can you name?
- ❖ What is a power steering?

2. What parts are presented in the picture? What system do they belong to? Number the parts and then label them.

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_







**3. Underline the correct answer.**

A. What does upper right picture present?

Clutch / Dual-clutch-powershift

B. What does upper left picture present?

Clutch / Dual-clutch-powershift

**4. What is presented in pictures given below? Label the pictures A and B.**

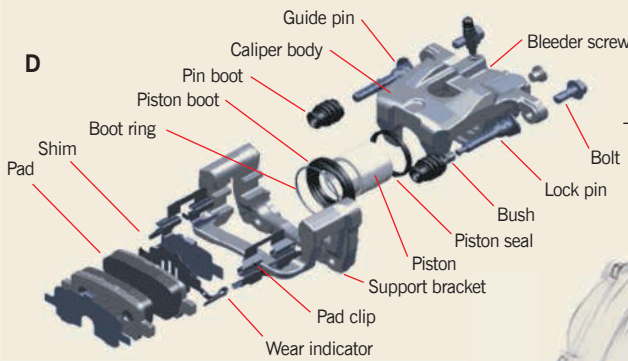
A



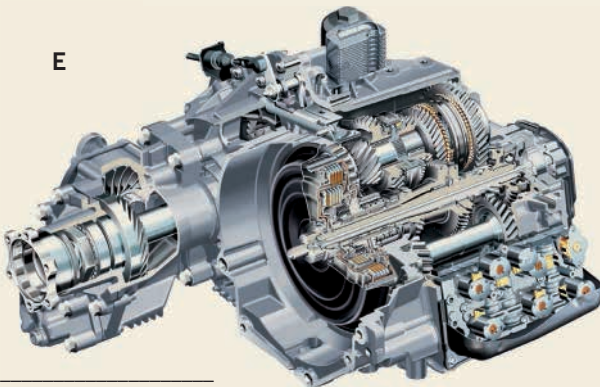
B



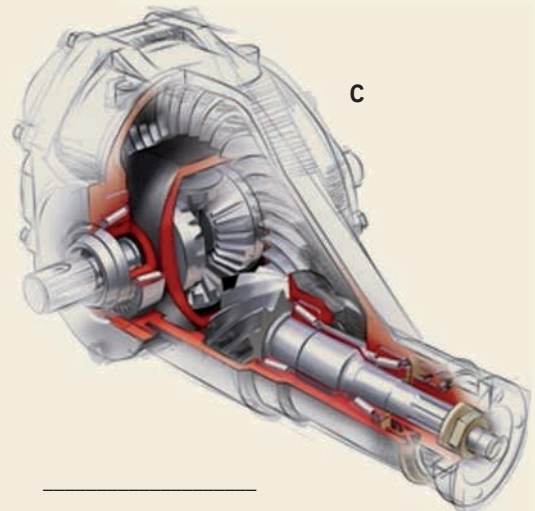
**5. What assembly do the exploded view and cutaway views present? Label the pictures C, D and E.**



**E**



**C**





## UNIT 1.5

### ETHICS IN THE WORKPLACE

- Exercise 1** – student’s own answers  
**Exercise 2** – student’s own answers  
**Exercise 3** – student’s own answers  
**Exercise 4, 5** – student’s own answers  
**Exercise 6**
- ☛ strive
  - ☛ take advantage of
  - ☛ dedicate
  - ☛ use
  - ☛ recommend, believe
  - ☛ treat
  - ☛ attempt, correct
  - ☛ conduct

- ☛ practice
- ☛ discuss, bring
- ☛ prepare
- ☛ help
- ☛ communicate
- ☛ perform
- ☛ inform

**Exercise 7** – student’s own answers

**Exercise 8** – student’s own answers

**Exercise 9** – student’s own answers

**Exercise 10** – student’s own answers

**Exercise 11** – student’s own answers

## UNIT 1.6

### WORKPLACE SAFETY AND ENVIRONMENTAL PROTECTION IN A CAR REPAIR WORKSHOP

- Exercise 1** – student’s own answers  
**Exercise 2** – student’s own answers  
**Exercise 3** – student’s own answers  
**Exercise 4** – student’s own answers  
**Exercise 5** – student’s own answers  
**Exercise 6**
1. chemical-resistant gloves
  2. rails and guards
  3. hearing and eye protection
  4. welding helmet
  5. inspection pit
  6. mechanical aid
  7. noise level
  8. non-skid soles
  9. safe lifting
  10. UV-protecting glass
  11. respond to threats of violence

**Exercise 7** – student’s own answers

**Exercise 8** – student’s own answers

**Exercise 9**

1. Hg – mercury
2. Cd – cadmium

3. Cr – chromium

4. Pb – lead

**Exercise 10**

1. parts cleaner

2. chromium-bearing paint

3. mercury containing device

**Exercise 11**

Tf = 284

Tc = 60

**Exercise 12**

220 lbs = 99.792 kg

**Exercise 13**

1. harm
2. spilled
3. damped
4. disposed
5. seep (into)
6. contaminate
7. run (off into)
8. poison
9. kill
10. pose
11. combustible
12. flammable

13. corrode
14. burn
15. unstable
16. react
17. toxic
18. contain

**Exercise 14** – student's own answers

**Exercise 15**

1. paint
2. solvent
3. rust remover
4. alkaline fluid
5. battery acid
6. oxidizer
7. sodium azide and compressed gas
8. gasoline

9. benzene
10. coolant
11. antifreezer
12. oil

**Exercise 16**  
**CHECKLIST**

- ✓ Identify
- ✓ generated
- ✓ collect
- ✓ Label
- ✓ closed
- ✓ Maintain
- ✓ Inspect
- ✓ wastes
- ✓ Designate
- ✓ emergencies
- ✓ disposal

**Exercise 17**

Word	gas <sup>1</sup>	gasoline	liquefied petroleum gas	petrol	tire / tyre	tin/can <sup>2</sup>	drum <sup>3</sup>	pound <sup>4</sup>
Dictionary meaning	gaz	gazolina	LPG	benzyna	opona	puszka, cyna, blacha, forma	bęben kocioł pojemnik	waluta jednostka
American or British?	Br.E	Am.E	Br.E Am.E	Br.E	tire – Am.E tyre – Br.E	Br.E Am.E	Br.E Am.E	Br.E Am.E

**Exercise 18** – student's own answers

**Exercise 19**

It is a scale used to measure the acidity or alkalinity of a solution. The pH scale uses a range from 0 to 14, with 7.0 indicating neutrality. Numbers beginning at 7.0 and

moving toward 0 indicate **acidity** while the numbers beginning at 7.0 and moving toward 14 indicate **alkalinity**, so the scale divides acids from bases.

**Exercise 20** – student's own answers

**Exercise 21** – student's own answers

<sup>1</sup> Może być także skrócona forma słowa 'gasoline' w American English.

<sup>2</sup> W British English słowo 'tin' znaczy: cyna, puszka, forma np. do pieczenia w piekarniku. W American English puszka to 'can', forma – 'pan'.

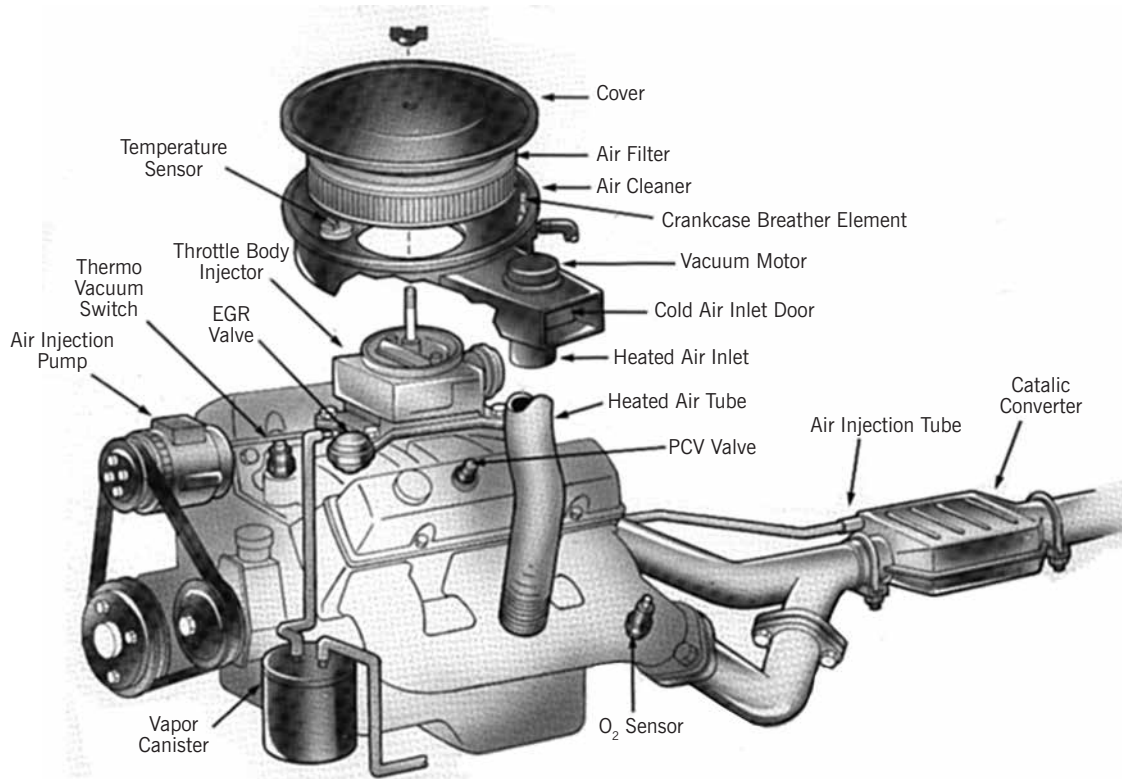
<sup>3</sup> 'Drum' w kontekście instrumentu muzycznego i w języku technicznym.

<sup>4</sup> 'Pound' w British English oznacza zarówno walutę jak również jednostkę masy. W American English – jednostkę.

## UNIT 3.22

## AUTOMOTIVE AIR INLET SYSTEM. CONSTRUCTION. OPERATION. SERVICE

## Exercise 1



## Exercise 2

1. allow
2. draws
3. mixed
4. requires
5. filter
6. goes
7. uses
8. increases
9. depressed
10. released
11. bring

12. utilise
13. idle
14. replaces
15. vary
16. filled
17. sluggishly

**Exercise 3** – student's own answers

**Exercise 4** – student's own answers

**Exercise 5** – student's own answers

**Exercise 6** – student's own answers

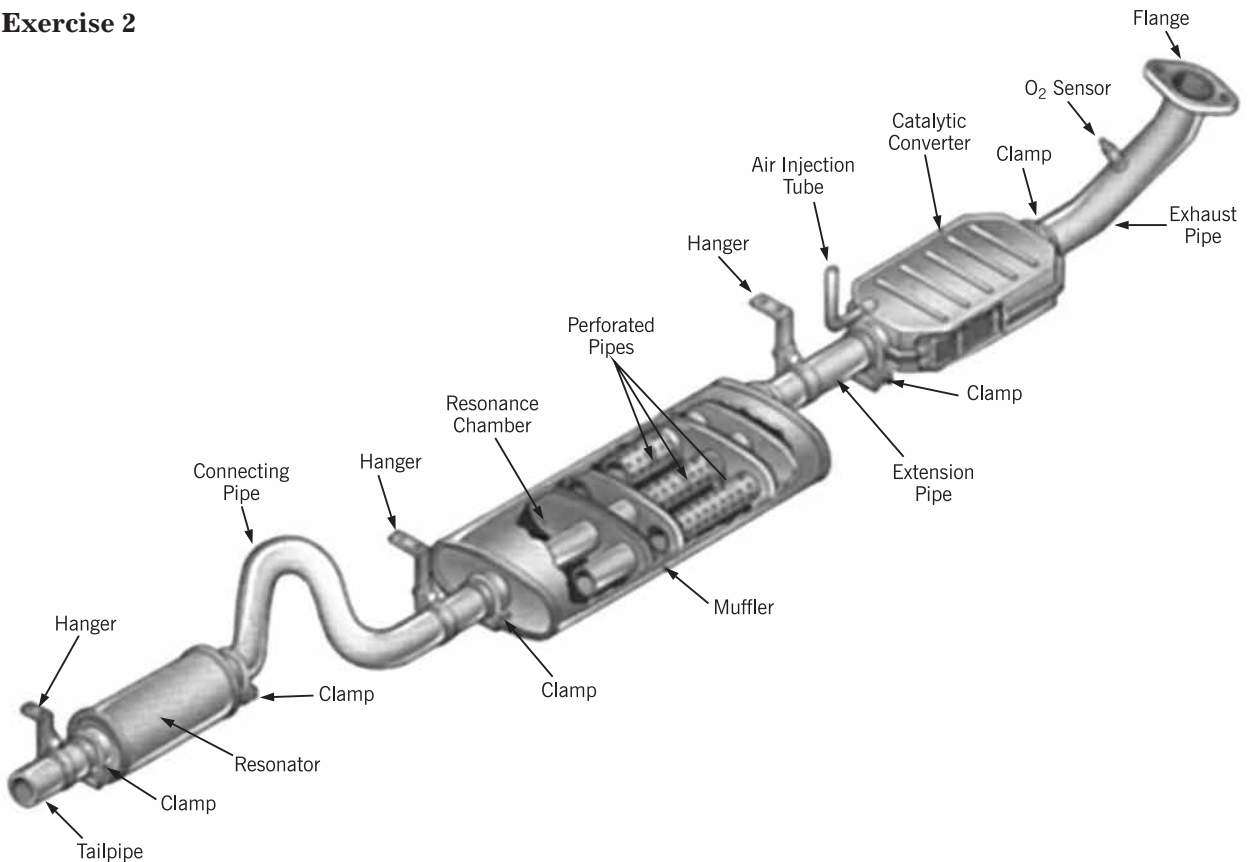
## UNIT 3.23

### AUTOMOTIVE EXHAUST SYSTEM. CONSTRUCTION. OPERATION. SERVICE

#### Exercise 1

- |              |           |
|--------------|-----------|
| 1. Fuel      | 2. engine |
| 3. gases     | 4. head   |
| 5. under     | 6. smog   |
| 7. pressures | 8. energy |

#### Exercise 2



**Exercise 3** – student's own answers

**Exercise 4** – student's own answers

#### Exercise 5

1. OBD II system **sets** diagnostic trouble codes.
2. Check Engine light turned **on**. Malfunction Indicator Lamp is **illuminated**.
3. O<sub>2</sub> sensor is slightly **sluggish**.

4. O<sub>2</sub> sensor's voltage output can be read **with** a scan tool or digital voltmeter.

5. Digital Storage Oscilloscope (DSO) is the best tool to **observe** the sensor voltage output

**Exercise 6** – student's own answers

**Exercise 7** – student's own answers