GENERAL CERTIFICATE OF EDUCATION BOARD

Technical and Vocational Education Examination

JUNE 2021 **INTERMEDIATE LEVEL**

Specialty (Specialty Code)	**AUTOMOBILE REPAIRE MECHANICS (ARM)**
Subject Title	**MECHANICAL TECHNOLOGY**
Subject Code No.	**5140**
Paper No.	**2**

DURATION; Two and a Half Hours

INSTRUCTIONS

-Answer FIVE Questions; THREE from Section A and TWO from Section B.

-All Questions carry equal marks.

-Non-programmable calculators are allowed.

-You are reminded of the necessity for good English and orderly presentation in your answers.

SECTION A: TECHNOLOGY
Answer THREE questions from this section

1. FUEL SUPPLY SYSTEM

Figure 1 below represents a Diesel engine fuel supply system.

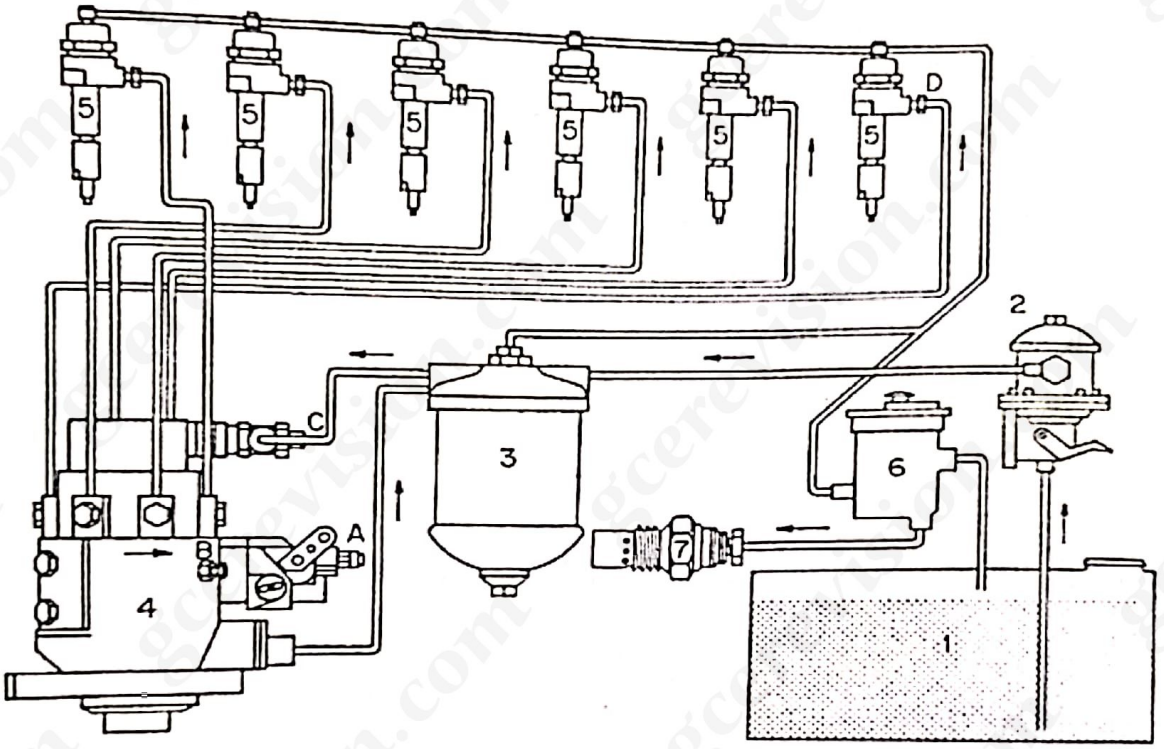


Figure 1:

(a) What type of diesel injection pump is used in figure 1 above? **(0.5 mark)**

(b) Identify the parts numbered 1, 2, 3, 4, 5, 6 and 7. **(0.25×7=1.75 marks)**

(c) Give the function of part 2, 4, 5 and 7 **(0.5×4=2 marks)**

(d) How can you bleed air from the system of this diesel engine **(1.5 marks)**

(e) Give THREE advantages of common rail diesel engine over a normal diesel engine setup **(0.75×3=2.25 marks)**

(f) State TWO faults in the injection pump that could lead to excessive carbon in the combustion chamber and exhaust. **(0.5×4=2 mark)**

2. BRAKING SYSTEM

Figure 2 below represents two types of automobile braking system.

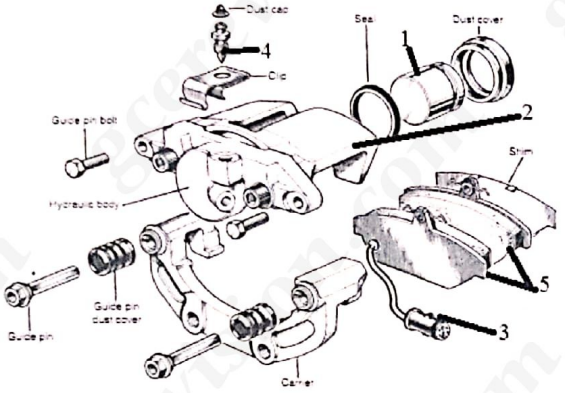
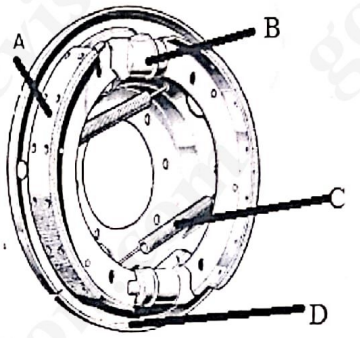


Figure 2a: Disc Brake



Figur2b: Drum Brake

Figure 2

(a) Give the function of the braking system in a vehicle. **(0.5 mark)**

(b) Give the names of the following components of the systems above: 1, 2, 3, 5,A,B,C and D **(0.25x8= 2 marks)**

(c) Give TWO differences in terms of operation between the two types of brakes above **(2 marks)**

(d) In case the two are to be employed on the vehicle, which should be at the front and why? **(1 mark)**

(e) Most vehicles are equipped with hand brakes, which of the system above do we adapt for the hand brakes and why? **(2 mark)**

(f) In the hydraulic circuit of the braking system air always affects the functioning. How do we notice there is air in the system? **(0.5 mark)**

(g) Explain in three lines how to bleed the brakes? **(2 marks)**

3. VALVES AND VALVE TIMING

Figure 3 below shows the valve timing diagram

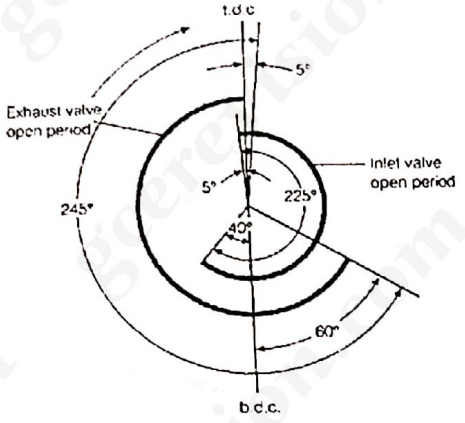


Figure 3: Valve Timing Diagram

(a) What do you understand by valve timing? **(1 mark)**

(b) Define the following terms:

(i) valve overlap **(1 mark)**

(ii) valve lead **(1 mark)**

(iii) valve lag **(1mark)**

(c) Indicate the degrees in which valve overlap has occurred on the valve timing diagram above. **(0.5 mark)**

(d) From the diagram represent the crankshaft angle at which the inlet and exhaust valves are open. **(0.5x2=1marks)**

(e) Give ONE effect if the valve clearance is

(i) too big **(1.5 marks)**

(ii) too small **(1.5 marks)**

(f) What symptom can be observed during engine operation to show that valve seals are bad. **(0.5 mark)**

(g) Explain in three lines the reason why the inlet valve is made to open some few degrees before TDC. **(1 mark)**

4. CLUTCHES

Figure 4 below shows the clutch assembly

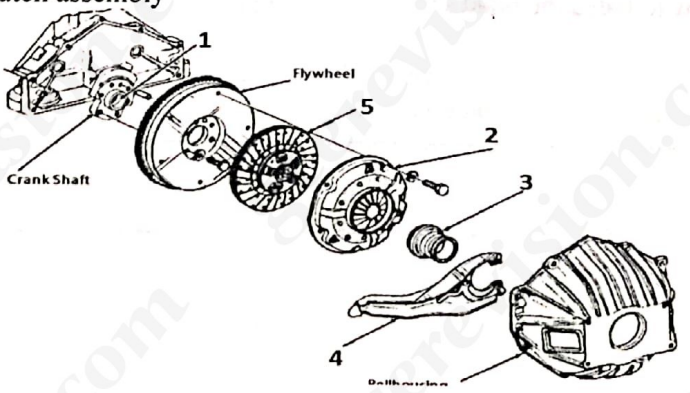


Figure 4

(a) State the function of the clutch. **(1 mark)**

(b) Give another name of the release bearing. **(0.5 mark)**

(c) Name TWO types of clutches. **(1mark)**

(d) Give one reason of adjusting the clutch. **(1mark)**

(e) State the importance of the clutch free play. **(0.5 mark)**

(f) At what operation of the clutch can we say there is clutch slip? **(1 mark)**

(g) Give the name and function of parts 1, 2, 3,4 and 5. **(5 marks)**

5. **LUBRICATION SYSTEM**

Figure 5 below shows an engine Lubrication system.

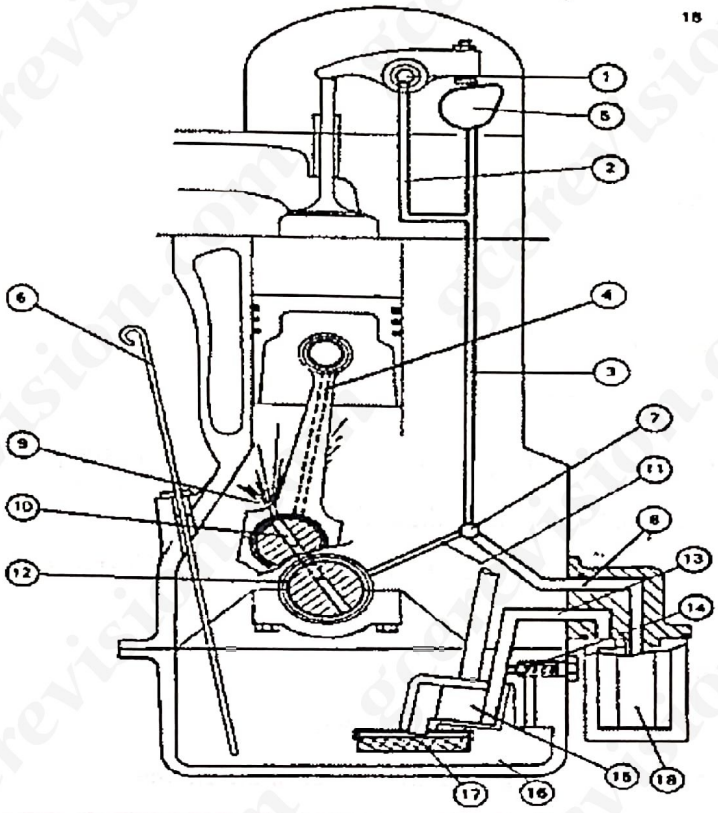


Figure 5

(a) Define the following terms related to motor oil

(i) Pour point **(1 mark)**

(ii) Viscosity **(1 mark)**

(b) Give FIVE functions of a good motor oil **(2.5 marks)**

(c) Give the name of part 3, 6, 17 and 18 **(1mark)**

(d) Give the function of the following lubrication system components

(i) Deep stick **(1mark)**

(ii) Oil light on the dashboard **(1mark)**

(iii) Baffle **(1mark)**

(iv)Engine oil additive **(1mark)**

(e) An engine oil container is labelled SAE15W50. Give the full meaning of SAE. **(0.5 mark)**

SECTION B: PROFESSIONAL CALCULATION AND SCIENCE

Answer TWO questions from this section

6. ENGINE CONSTRUCTION CHARACTERISTICS

An engine has the following characteristics

torque	190Nmm
stroke	0.0787m
compression ratio	9.8
rotational frequency	5500rev/min

(a) Calculate the swept volume of a cylinder, if the combustion chamber volume is 50949.3 **(3 marks)**

(b) If the swept volume is 448353, calculate the bore of the cylinder of the engine. **(2 marks)**

(c) Determine the total cylinder volume of one cylinder if swept volume is 448353 and combustion chamber volume. **(1mark)**

(d) Calculate the total engine capacity **(1 mark)**

(e) Determines the rate at which the piston will move up and down. **(1 mark)**

(f) If the engine has a rotational speed, calculate the effective power of the engine. **(2 mark)**

7. ENGINE WORK AND POWER.

(a) An engine that develops 120kW is tuned to raise the power output to 145kW. Calculate the percentage increase in power. **(2mark)**

(b) The force on the connecting rod is 2000N and the connecting rod is making a right angle with respect to the crank throw. The throw of the crank is 60mm.

(i) Define crank throw **(1mark)**

(ii) Calculate the torque applied to the crankshaft **(3 marks)**

(iii) Calculate the total work done when the shaft rotates 1000times **(2 marks)**

(c) Calculate the power produced if the work done is 753600J in 10seconds. **(2marks)**

8. CLUTCH AND BRAKE CHARACTERISTICS

A double plate clutch having an inner and outer radius of 250mm and 320mm respectively.

The total spring force is 4000N and coefficient of friction is 0.35.

(i) Calculate the maximum torque the clutch can transmit **(2 marks)**

(ii) Calculate the maximum power transmitted by this clutch at 60rev/sec **(2 marks)**

(b) A retarding force of 5kN acts on a vehicle of mass 1000kg moving at 72km/h.

(i) Define brake efficiency **(2 mark)**

(ii) Calculate the stopping distance **(2 marks)**

(iii) Calculate brake efficiency **(2 marks)**

9. ENGINE CHARACTERISTICS

a) Define the following terms

(i) Swept Volume **(1mark)**

(ii) Engine Capacity **(1 mark)**

(iii) Compression Ratio. **(1mark)**

b) After checking the thickness of a gauge on pin, you discovered that it is worn out by 0.7mm. the manufacturer's manual show that it supposed to have a diameter of 31mm and it is 6cm of height.

(i) Calculate the volume of the pin to be replaced. **(2 marks)**

(ii) Calculate the density of the pin if its mass is 356g. **(2 marks)**

c) The value of the bore(d) of an engine's cylinder is 74mm and its stroke (h) is 85mm. Calculate

(i) its swept volume **(S_v).** **(1 mark)**

(ii) its compression ratio **(ρ)** if the clearance volume is **Cv** = 45.077cm^3 . **(1 mark)**

(iii) the total engine **(C_T)** capacity in litres (L) knowing that the engine has 4 cylinders. **(1 mark)**