Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.

2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.

3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and Communication Skills).

4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.

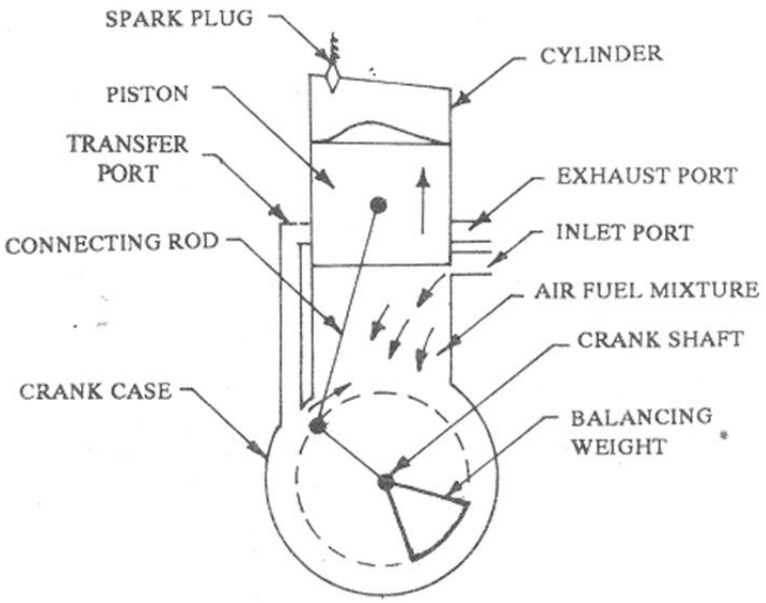
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.

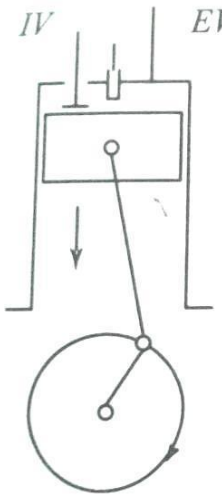
6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.

7) For programming language papers, credit may be given to any other program based on equivalent concept.

Model Answer	Marks
1. a)Attempt **any SIX** of the following:	**12**
i) State two merits of horizontal engine.	2
Answer: Merits of the Horizontal engine: *(Any two)* 1) The inertia forces of the reciprocating parts, i.e. primary and secondary forces combine together and give an impulse to the chassis frame of the vehicle. 2) The cylinder head is towards the front of the vehicle and hence driving impulse is obtained from the engine. 3) The bonnet height is reduced. 4) Engine is well balanced.	2
ii) Define swept volume.	2
Answer: Swept Volume: The nominal volume swept by the working piston when travelling from one dead center to the other is called as displacement volume or Swept volume It is expressed in terms of cubic centimeter (cm^3) and given by $V_s = A \times L = \frac{\Pi}{4} d^2 L$	2
iii) Define I.C. engine	2
Answer: I.C. engine: The I. C. engine means Internal combustion engine. The engine in which combustion take place inside the closed volume is called as I. C. engine.	2

iv) What is scavenging?	2
Answer: Scavenging: Scavenging is process of removing the exhaust gases (combustible products) from the cylinder with help of incoming fresh charge in two stroke engine. During the downward movement of the piston the mixture in the crankcase is compressed and pushed into the cylinder through the transfer port, which pushes out the exhaust gases through the exhaust port at the same time filling the cylinder with new charge, is called cross-flow scavenging.	2
v) What is need of lubrication system?	2
Answer: **Need of lubrication system** *(Any two)* 1. To provide a barrier between moving parts to reduce friction, heat buildup, and wear. 2. To disperse heat - Friction from moving parts and combustion of fuel produce heat that must be carried away. 3. Absorb and suspend dirt and other particles. Dirt and carbon particles need to be carried by the oil to the oil filter where they can be trapped. 4. Neutralize acids that can build up and destroy polished metal surfaces. 5. Coat all engine parts. Oil should have the ability to leave a protective coating on all parts when the engine is turned off to prevent rust and corrosion. 6. Resist sludge and varnish buildup.	2
vi) Define volumetric efficiency.	2
Answer: **Volumetric efficiency:** Volumetric efficiency is an indication of the breathing ability of the engine and is defined as the ratio of the air actually induced at ambient condition to the swept volume of the engine. $\eta_v = \frac{\text{Volume flow rate of air in intake system}}{\text{Rate at which volume displaced by the piston}} = \frac{V_{actual}}{V_{swept}}$	1 1
vii) What is function of oil control ring?	2
Answer: **Function of oil control ring** *(Any two)* 1. To maintain a thin film of oil on cylinder walls to avoid direct contact between piston and cylinder wall. 2. To act as a seal for the combustion chamber so that there is no leakage of gases from the combustion chamber to the crankcase. 3. To transfer heat from the piston to the cylinder wall. 4. Regulating engine oil consumption.	2
vii) List four circuits used in Solex carburetor.	2
Answer: Four circuits used in Solex carburetor: *(Any four)* 1) Starting circuit. 2) Idling or low speed circuit. 3) Normal running circuit. 4) Acceleration & Power circuit. 5) Cold starting & warming circuit.	2

b) Attempt **any Two** of the following:	8
i) Draw a neat labeled sketch of two –stroke S.I. engine (upward stroke only)	4
Answer:  Figure: two-stroke S.I. Engine	4
ii) Classify I.C. engine on the basis of 1) Cycle of operation 2) Ignition 3) Cooling 4) Cylinder arrangement.	4
Answer: Classification of I.C. Engine: The Automobiles engines classification on following basis: **1) Cycle of operation:-** a) Otto cycle engine b) Diesel cycle engine c) Duel combustion cycle engine or semi- diesel cycle engine. 2) **Method of ignition:-** a) Spark ignition (S.I.) engine b) Compression ignition (C.I.) engine **3) Types of cooling :** a)Air cooled engine b) water cooled engine c) Evaporation cooling engine. **4) Arrangement of cylinder:-** a) Vertical engine b) horizontal engine c) Radial engine d) V-engine e) Opposed cylinder engine.	4

c) Describe the working of four - stroke C. I. engine.	04
Answer: Working of 4 stroke CI engine: **1. Suction stroke:** During this stroke, inlet valve is open and exhaust valve is closed. Only air is sucked into cylinder during this stroke. The piston moves from TDC to BDC and crank shaft rotates through 180˚. **2. Compression Stroke:** The air inducted in the cylinder is compressed to the clearance volume. Both the valves are closed during this stroke. The piston moves from BDC to TDC and crank shaft rotates through 360˚. **3. Power stroke or Working stroke:** At the end of the compression stroke the fuel (diesel) is injected into the hot compressed air. The rate of injection is such a that pressure remains constant instead of change in piston position. After injection of the fuel is complete the hot gases expand. The piston moves from TDC to BDC position and crank shaft rotates through 540˚. **4. Exhaust Stroke:** The inlet valve remains closed and the exhaust valve opens. The piston move from BDC to TDC position which pushes the burnt gases outside the combustion chamber. Crankshaft rotates by two complete revolutions through 720˚.  Figure: Working of four – stroke C. I. engine	3 1
2. Attempt **any <u>FOUR</u>** of the following:	16
a) Compare 4-stroke and 2-stroke engine	4

Answer: **Comparison of 4-stroke and 2-stroke engine** *(Any four points)* — 4

Sr.	Four Stroke Engine	Two Stroke Engine
1	One **working stroke** for **every two revolutions** of the crankshaft.	One **working stroke** for **each revolutions** of the crankshaft.
2	Turning moment on the crankshaft is not even due to one working stroke for every two revolutions of the crankshaft. Hence **heavy flywheel** is required and engine runs unbalanced	Turning moment on the crankshaft is more even due to working stroke for each revolution of the crankshaft, hence **lighter flywheel** is required and engine runs balanced.
3	Engine is heavy.	Engine is light.
4	Engine design is complicated.	Engine design is simple.
5	More cost.	Less cost.

6	Less mechanical efficiency due to more friction on many parts.	More mechanical efficiency due to less friction on few parts.	
7	More output due to full fresh charge intake and full burnt gases exhaust.	Less output due to mixing of fresh charge with burnt gases.	
8	Engine runs cooler.	Engine runs hotter.	
9	Engine is water cooled.	Engine is air cooled.	
10	Engine requires more space.	Engine requires less space.	

b) State one function and one material used for piston and oil pump. — 4

Answer:

Function of the piston: *(Any one)*

1) To transmit the force of explosion to the crankshaft. — 1
2) To form seal so that the high pressure gases in combustion chamber do not escape into crankcase.
3) To serve as guide and bearing for small end of connecting rod.

Material for Piston: *(Any one)*

1) Cast iron.
2) Silicon base Aluminum alloy. — 1

Function of oil sump: *(Any one)*

1) To store the oil for the engine lubricating system.
2) To collect the returning oil draining from the main bearing or from the cylinder walls. — 1
3) To serve as a container in which any impurities or foreign matter, e.g. liquid fuel, condensed water, blow by gasses, sludge, metal particles, can settle down.

Material for oil Sump: *(Any one)*

1) Steel (Pressed steel sheet) — 1
2) Aluminum alloy.

c) Draw a schematic diagram of a cylinder head cut section and label it. — 4

Answer:

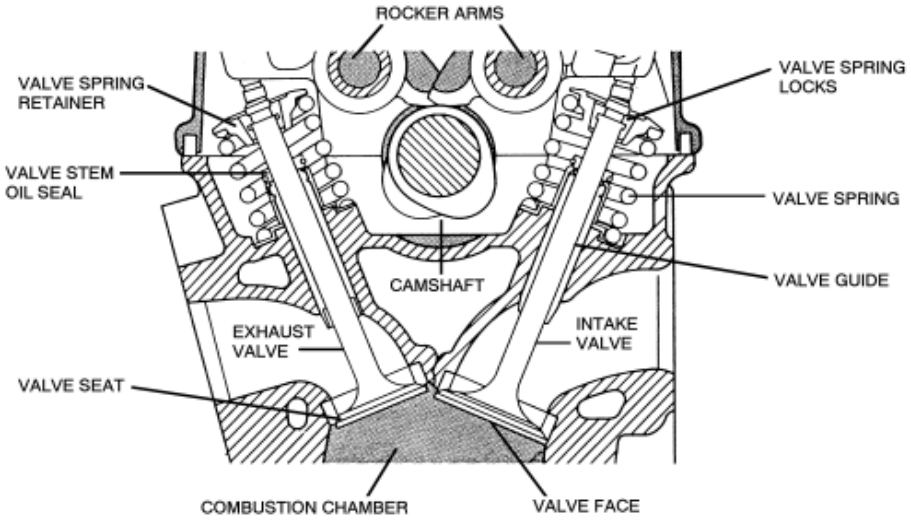
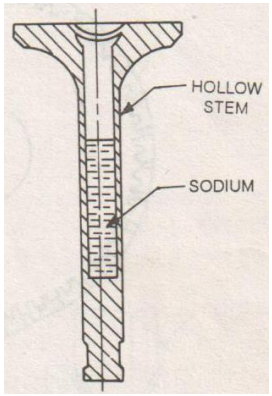
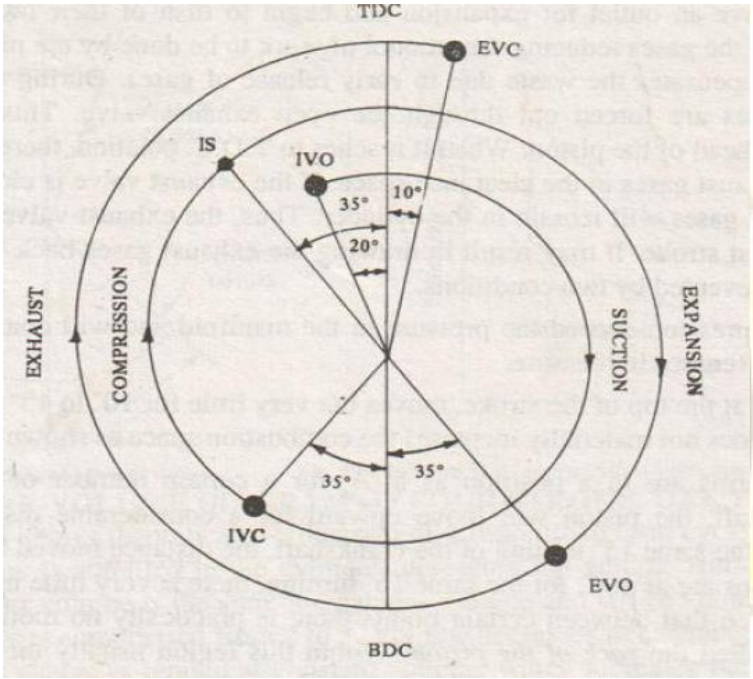


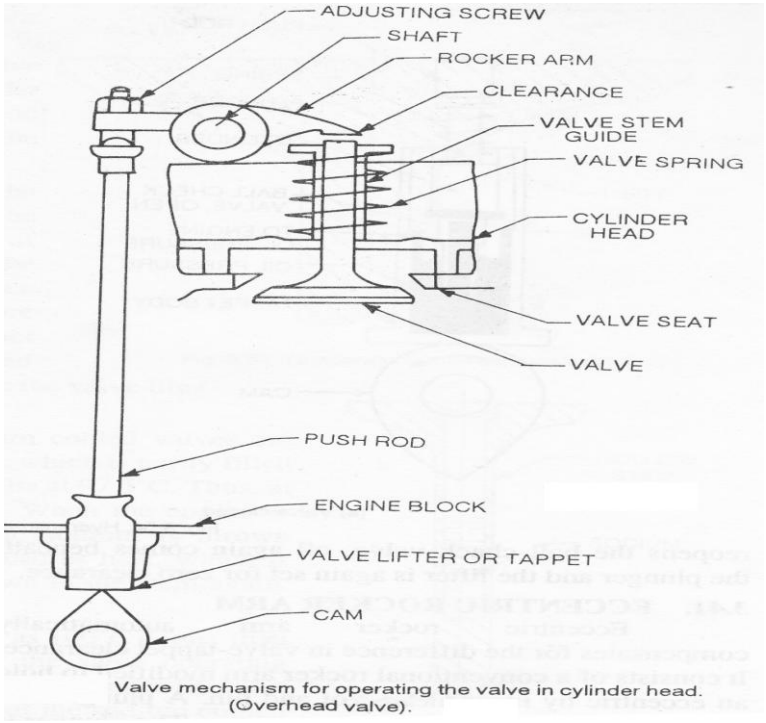
Figure: Cylinder head cut section — 4

d) Describe valve cooling with a sketch.	4
Answer: Valve Cooling: Exhaust valve temperature in modern engine is as high as 750˚C. Thus cooling of exhaust gas becomes very important. Cooling water jackets are arranged near the valves for valve cooling. In many cases nozzles are directed towards hot spot caused by the exhaust valve. In heavy duty engine, sodium cooled valves are used, the working of this valve is stated below – A sodium cooled valve has a hollow stem, which is partly filled by metallic sodium. Sodium melts at 97.5˚C. Thus at operating temperature sodium is in liquid state. When engine runs, valve moves up and down, thus sodium is thrown upward in hotter part of valve. There it absorbs heat, which is later given to cooler stem as it falls back to stem again. This keeps the valve head cool.  Figure: Sodium cooled valve	3 1
e) Draw and explain valve timing diagram of 4-stroke S.I. engine.	4
Answer: Valve timing diagram for 4- stroke S.I. engine:  Figure: Valve timing diagram of 4 stroke SI engine	2

The opening and closing operation of the inlet and exhaust valves are described as follows: 1. The inlet valve normally opens several degrees (10^0 - 30^0) of crankshaft rotation before TDC on the exhaust stroke i.e. intake valve begins to open before the exhaust stroke is finished. 2. The intake valve remains open after the piston has passed BDC (30^0 - 40^0) at the end intake stroke. 3. The exhaust valve opens well before the piston reaches BDC (30^0 to 60^0) on the power stroke. The exhaust valve remains open after some degrees (8^0 - 10^0) of crankshaft rotation after the piston has passed the TDC and intake stroke has started.	2
f) Compare dry and wet liners (four points)	4
Answer: **Comparison dry and wet liners** *(Any four)*	4

Dry liners	Wet liners
1) Dry liner is **not in direct contact** of cooling water hence it is known as dry liner.	1) Wet liners is in **direct contact** with cooling water on the outside and hence is known as wet liner.
2)It is **difficult to replaced**	2)It is **easy to replaced**
3) **No leak proof joint** is provided in the case of dry liner.	3)A leak proof joint between the cylinder casting and the liner has to be provided
4)In dry liners the **casting of cylinder block is complicated**	4)In wet liners the **casting of cylinder block is very simplified**
5) A cylinder block with dry liners is generally more **robust**.	5)A cylinder block with wet liners is **less robust** as compare to dry liner
6)For perfect contact between the liner and the block casting in case of dry liner, very **accurate machining of block and outer liner surface** is required,	6) Where as there is **no such necessity** in case of wet liner.
7) A dry liner **cannot be finished accurately** before fitting because of the shrinkage stresses produced.	7) A wet liner **can be finished accurately** before fitting.

3. Attempt **any <u>FOUR</u>** of the following:	16
a) Describe the overhead valve and overhead cam arrangement.	4
Answer: Overhead Valve Arrangement: Figure shows the valve mechanism to operate the valve when it is in the cylinder head (in I and F head design). This type of mechanism requires two additional moving parts – the push rod and rocker arm. As the cam rotates, it lifts the valve- tappet or the lifter which actuates the push rod. The push rod rotates the rocker arm about a shaft- the rocker –arm shaft, or a ball joint in some designs to cause one end to push down on the valve stem to open the valve, thus connecting the valve port with the combustion chamber.	1



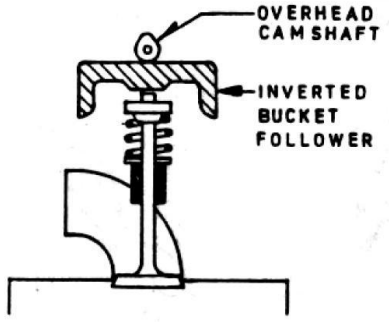
Valve mechanism for operating the valve in cylinder head. (Overhead valve).

1

Overhead Cam:

Figure shows single row valves operated by a single overhead camshaft and an inverted bucket type follower. With this type of follower, the camshaft is arranged directly over the valve stems. This type of mechanism is direct and very rigid so that valve movement follows precisely the designed cam-profile lift. Moreover, valve stems are not subjected to side-thrust which means less wear. Tappet clearances are also quite small and do not require adjustment very often.

1



1

Fig. Overhead camshaft-operated mechanism with inverted bucket type follower (Single row valves)

b) Draw and describe layout of a pump feed for patrol engine. 4

Answer: **Layout of a pump feed for petrol engine:**

The pump feed system is shown in the figure above. In this system, a steel pipe carries the fuel to the fuel pump which pumps it into the float chamber of the carburetor through a flexible pipe. If the fuel pump is mechanical, it has to be driven from the engine camshaft and hence placed on the engine itself. However electrically operated pump can be placed anywhere. It is mostly located at the rear in the fuel tank reducing the tendency of forming vapour lock. The system provides the fuel requirement at various engine speeds efficiently. 2

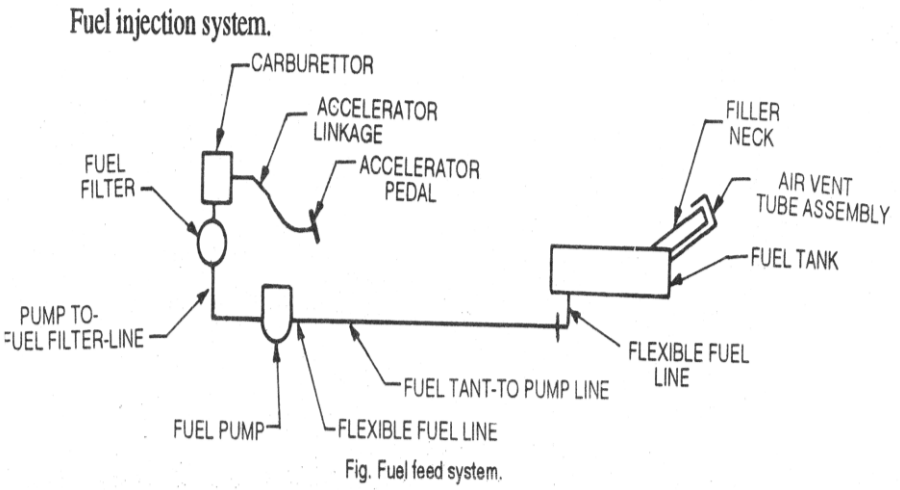
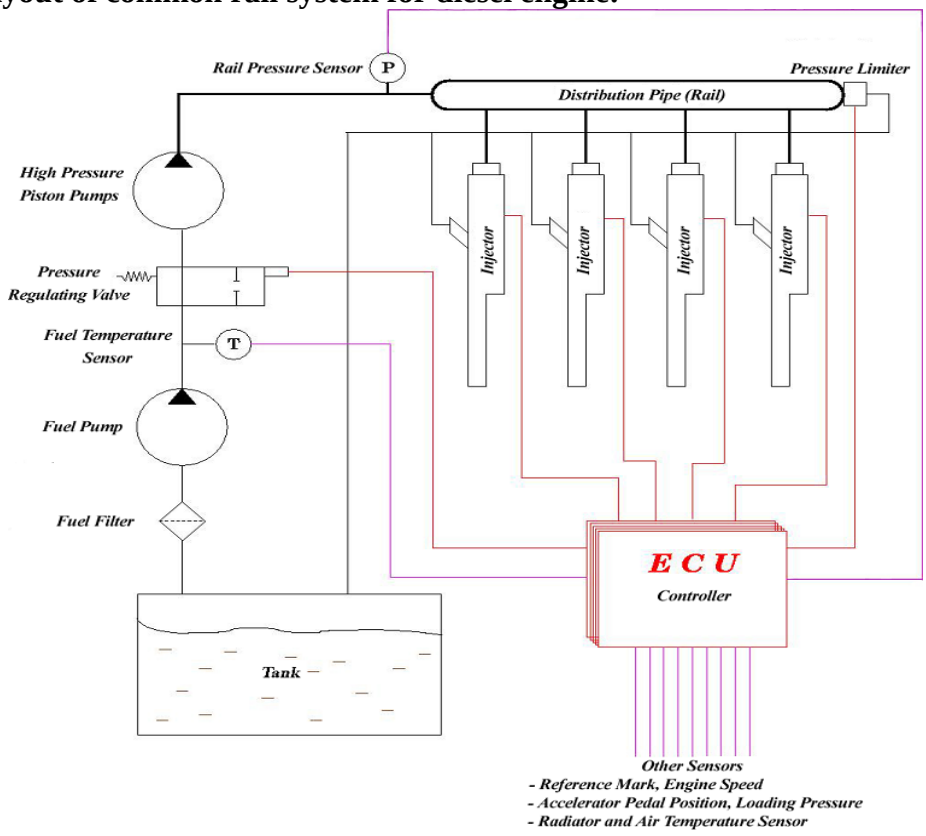


Fig. Fuel feed system.

2

c) Draw layout of a common rail system for diesel engine. State two merits of the same. 4

Answer: **Layout of common rail system for diesel engine:**

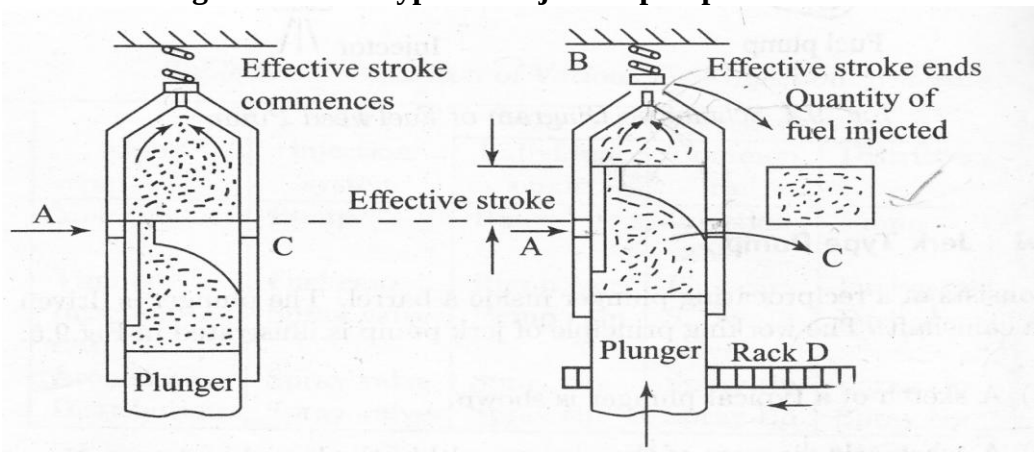
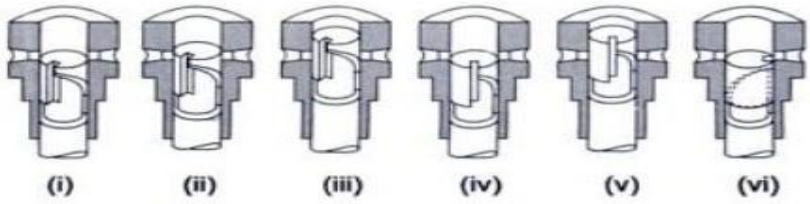


3

Merits of common rail system: *(Any two)*

1. Offers superior pick up,
2. lower levels of noise and vibration,
3. higher mileage,
4. lower emissions,
5. lower fuel consumption
6. Improved performanc

1

d) Describe fuel metering in the inline type fuel injection pump.	4
Answer: **Fuel metering in the inline type fuel injection pump**  OR  Figure: Fuel Metering in the inline type fuel injection pump The position of the plunger in the fuel injection pump can be varied by means of a control rod having a rack and pinion arrangement. By operating this rod, the position of the plunger can be changed, and by changing the position of the plunger, the supply to the injection nozzle can either be increased or stopped. When the supply to the injection nozzle is stopped, the engine is also stopped. Various positions of the plunger are shown in Figure. In Fig., (i) is the position of the plunger when it is at the bottom stroke. The position of the plunger when it is closing both the ports is shown in (ii). The maximum amount of supply is shown in (iii). Only at this position is the plunger working at full load. The position of the plunger at (iv) shows a normal load. The position at (v) shows a part load. The position at (vi) shows that no fuel is being supplied to the injector, i.e. the engine has stopped.	2 2
e) Draw a sketch of S.U. electrical pump. State 1 merit and 1 demerit of the same.	4
Answer: **S.U. electrical pump:** **Merits of S.U. electrical pump:** *(Any two)* 1. It can be situated away from the engine 2. It can be located near the fuel tank 3. It is not subjected to engine heat hence no evaporation of fuel takes place 4. It does not need to wait for the engine to start 5. It starts operating immediately as the ignition is switched on 6. It has long working life 7. It requires less maintenance	1

Demerits of S.U. electrical pump: *(Any two)* 1

1. It consumes electric supply
2. It requires battery for operation
3. It needs to be electrically insulated to avoid any sparking
4. It needs to be replaced if any problem occurs

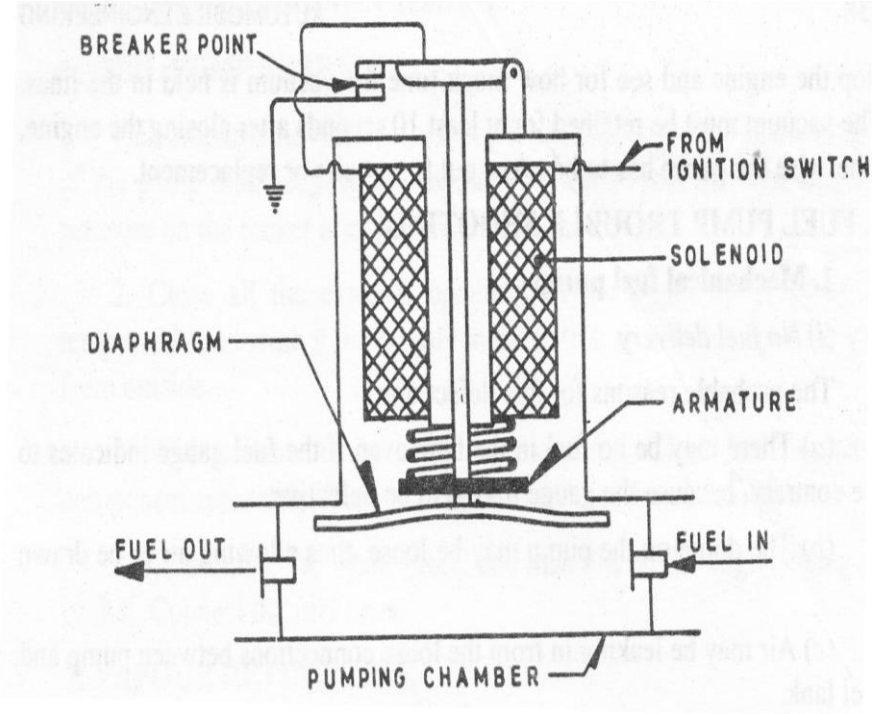


Figure: S.U. Electrical Pump 2

f) Why fuel filter and air filter are necessary for an engine? 4

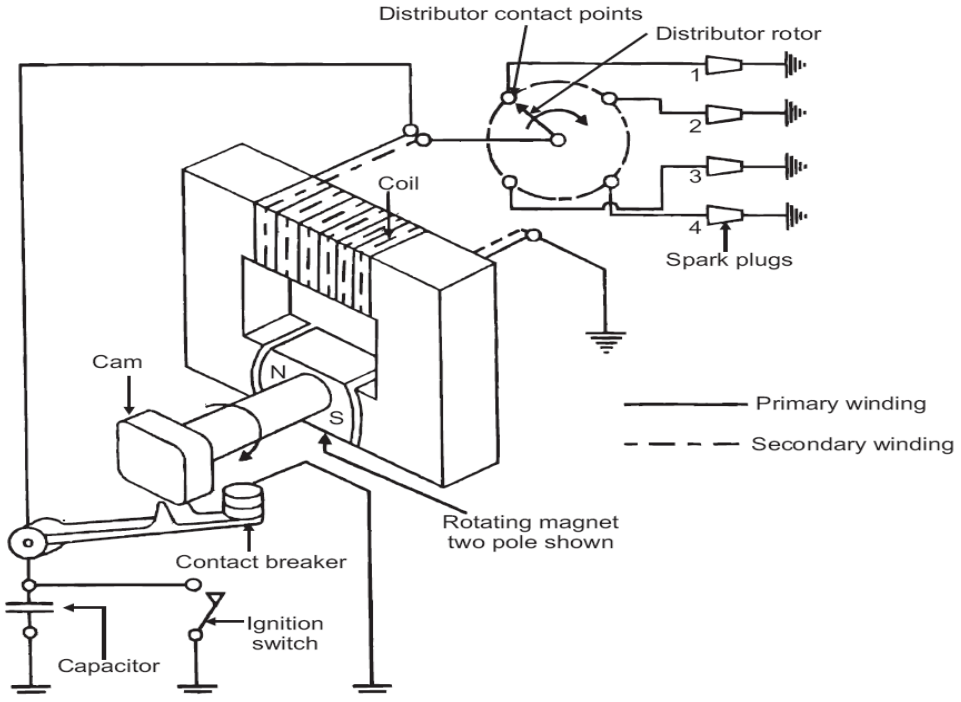
Answer:

Necessity of Fuel Filter:

The fuel entering inside the engine cylinder should be clean and dirt free. If impure fuel enters in the engine it may lead to clogging of the fuel system. Because of dirt in the charge combustion will be incomplete which will lead to incomplete combustion of the charge. This also results in deposition of combustion products on the cylinder walls which will result in pre-ignition or knocking of the engine. The dirt particle will damage the engine cylinder walls will result in loss of combustion pressure due to leakage. It is therefore customary to install fuel filter on the fuel system of automobile engines. 2

Necessity of Air filter:

As hundreds of cubic meters of air per hour is used by the engine of an automobile, it is very important that this air should be very clean. Impurities like dust in the air cause a very rapid wear if the engine, particularly of the cylinders, pistons, rings, valves and guides. Further if the dirty air enters the crankcase, it will contaminate the lubricant oil and ultimately damage the bearings and journals and decrease the service period of the lubrication system. It is therefore customary to install air filter on the intake system of automobile engines. 2

4. Attempt any FOUR of the following:	**16**
a) What are requirements of ignition system?	4
Answer: Requirements of ignition system: (*Any four)* 1. The spark should be sufficiently strong to start ignition of the charge 2. The spark duration should be sufficient to establish burning of the air-fuel mixture in all conditions 3. It should have service life almost equal to the engine 4. It should provide a good spark between the electrodes of the plugs at the correct timing 5. It should function efficiently over the entire range of engine speed. 6. It should be light, effective and reliable in service. 7. It should be compact and easy to maintain. 8. It should be cheap and convenient to handle. 9. It should not drain the battery at the time of operation.	4
b) Describe the working of magneto ignition system with a neat sketch.	4
Answer: **Magneto ignition system:** *(Note: Credit shall be given to any other suitable sketch)*  **Figure : Schematic Diagram of Magneto Ignition System** Magneto is mounted on the engine and replaces all the components of the coil ignition system except the spark plug. A magneto when rotated by the engine is capable of producing a very High voltage and does not need a battery as a source of external energy. A schematic diagram of a high tension magneto ignition system is shown Figure. The high tension magneto incorporates the windings to gen-rate the primary voltage as well as to step up the voltage and thus does not require a separate coil to boost up the voltage required to operate the spark plug. Magneto can be either rotating armature type or rotating magnet type. In this type, the armature consisting of the primary and secondary windings all rotate between the poles	2 2

of a stationary magnet. With the help of a cam, the primary circuit flux is changed and a high voltage is produced in the secondary circuit. At start the cranking speed is low the current generated by the magneto is quite small. As the engine speed increases the flow of current also increases.

c) State the need of firing order in multicylinder engine. State firing order for 4 and 6 cylinder engines. — 4

Answer: **Need of firing order in multicylinder engine**

1. It is desirable to have the power impulses equally spaced and from the point of view of balancing.
2. If all cylinders fired at once, power distribution would be very jerky, so the engine is set up to have the cylinders firing in sequence for a smoother power delivery. — 2
3. If the pistons move in a certain rhythm, then they have to receive their sparks in a certain rhythm too, due to this engine will run smoothly.

The optimum firing order of an engine ensures – (i) Reduced Engine vibrations (ii) better engine cooling and (iii) decreased back pressure.

Firing orders for 4 cylinder engine: 1-3-4-2 **OR** 1-2-4-3 **OR** 1-4-3-2 — 1

Firing orders for 6 cylinder engine: 1-5-3-6-2-4 **OR** 1-4-2-6-3-5 **OR** 1-3-2-6-4-5 **OR** 1-2-4-6-5-3 — 1

d) Compare air and water cooling system on the basis of
i) Cooling efficiency
ii) Weight
iii) Maintenance
iv) Application — 4

Answer: Compare air and water cooling system: — 4

Points	**Air cooling System**	**Water Cooling System**
Cooling Efficiency	As compared to water cooling its efficiency is less	As compared to air cooling its efficiency is more
Weight	It is light in weight	It is heavier in weight
Maintenance	No maintenance is required	Regular maintenance is required
Application	Two/Three wheeler like Motorcycles, Scooters, Auto Rickshaw etc.	Four wheelers – LMV, HMV, Heavy commercial vehicles like Cars, trucks, buses etc.

e) Describe construction and working of water pump. — 4

Answer: Construction and Working of Water pump: — 2

Impeller type water pump is mounted at the front end of the cylinder block between the block and the radiator. The pump consists of housing with inlet and outlet, and an impeller. The impeller is a flat plate mounted on the pump shaft with a series of flat or curved blades or vanes.

The pump is driven by a belt to the drive pulley mounted on the front end of the engine crankshaft. The impeller shaft is supported on one or more bearings. A seal prevents water from leaking out around the bearing. When the impeller rotates, the water between the blades is thrown outwards by centrifugal force, and is forced through the pump outlet and into the bottom of the radiator, and the water from the radiator is drawn into the pump to replace the water forced through the outlet.

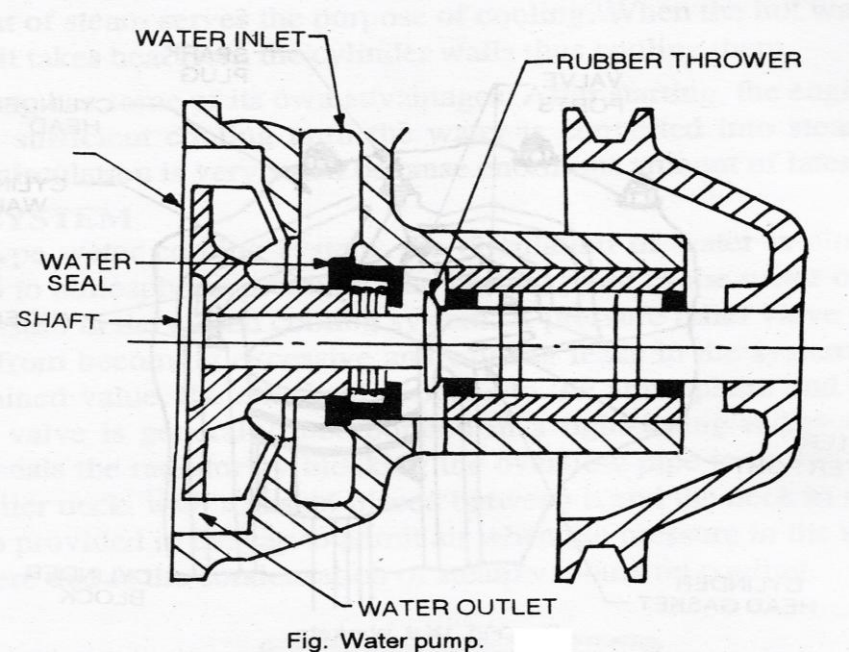


Fig. Water pump.

2

f) Why water expansion tank is needed in a liquid cooling system? State advantages of the same — 4

Answer:

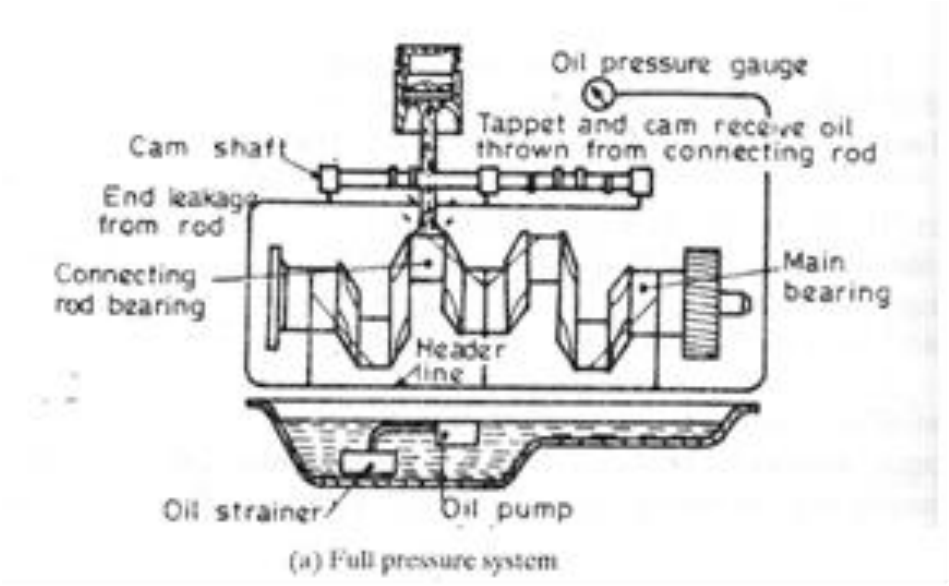
Need of water expansion tank

In modern engines, instead of overflow pipe an expansion reservoir is provided. This so connected with the radiator that it receives the excess coolant as the engine temperature increases. When the cooling water cools down, its volume decreases and the coolant in the reservoir returns to the radiator keeping the system full of coolant. — 2

Advantages: *(Any two)* — 2

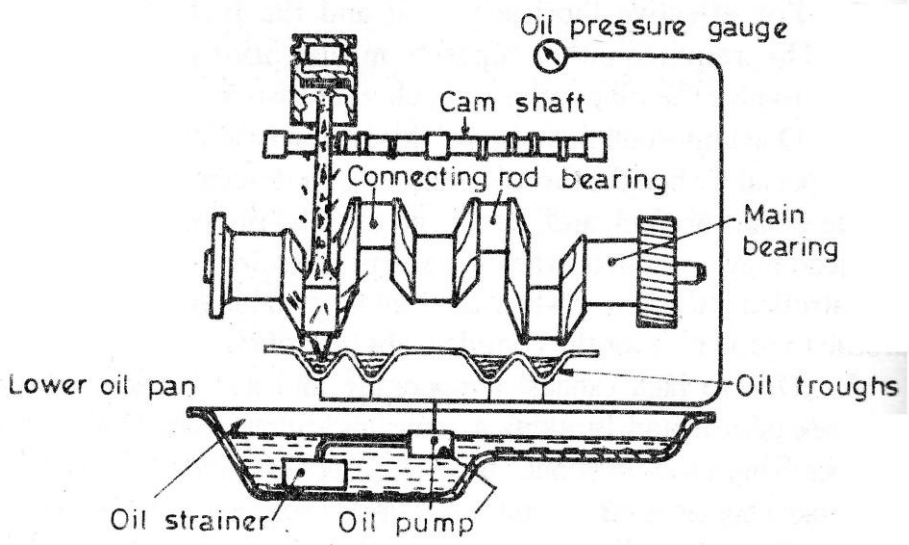
1. The reservoir is usually made of translucent plastic so that it can indicate the level of the coolant anytime.
2. There is no loss of coolant due to overflow on account of expansion.
3. As air does not enter the cooling system with this arrangement, corrosion of the cooling jackets and passages is reduced.
4. Deterioration of antifreeze is reduced.
5. Relatively smaller upper tank may be used with the radiator.

5. Attempt **any FOUR** of the following:	16
a) Draw a layout of lubrication system for a multicylinder engine.	4
Answer: Layout of lubrication system for a multicylinder engine *(Any one)*	4



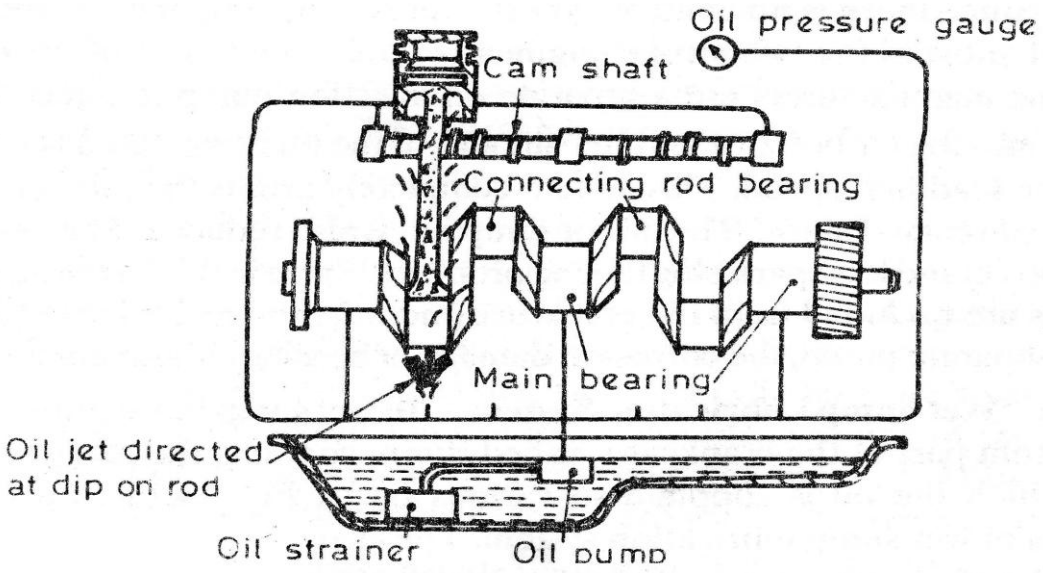
(a) Full pressure system

OR



(b) Splash system

OR



(c) Modified splash system

b) Classify lubricating oils on the basis of Viscosity and the service rating. 4

Answer: **Classification of Lubricating Oil:**

1. On the basis of Viscosity :

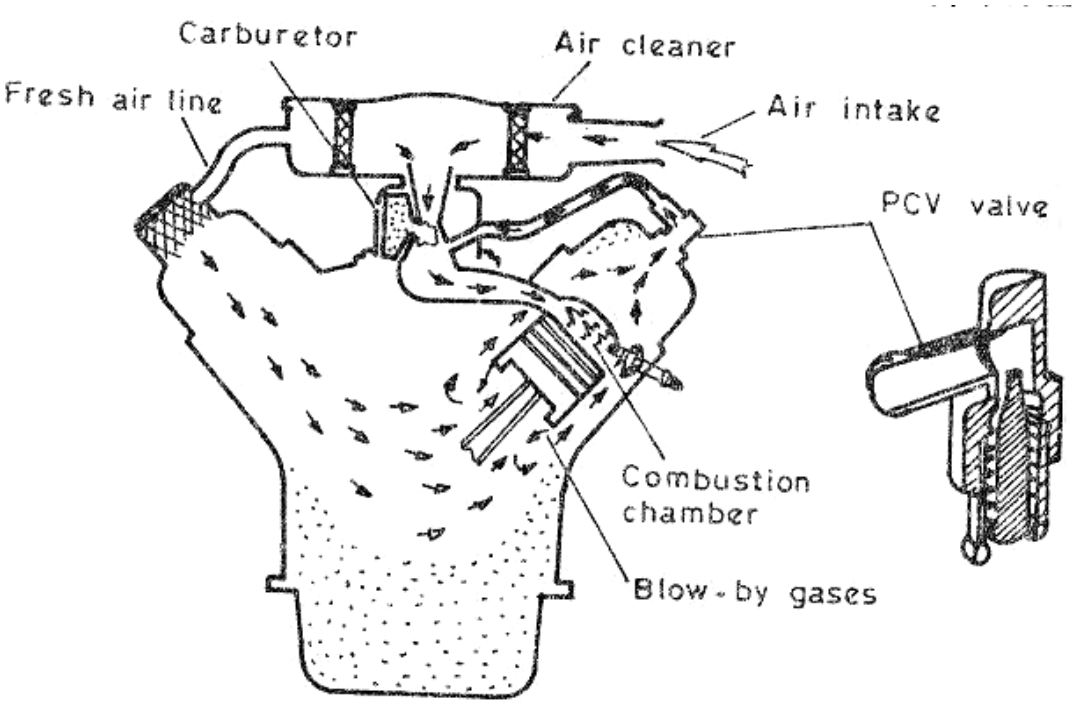
- Lubricating Oils Classify in terms of Viscosity at -18^{0}C or in cold climates.
  a) SAE 5W
  b) SAE 10W
  c) SAE 20 W
- Lubricating Oils Classify in terms of Viscosity at 99 ^{0}C or in hot climates.
  a) SAE 20
  b) SAE 30
  c) SAE 40
  d) SAE 50

2

2. On the basis of Service Rating :

- C- series
  a) CA: Use in gasoline and naturally aspirated diesel engine operated on low sulphur fuel.
  b) CB: Use in gasoline, naturally aspirated diesel engine operated on high sulphur fuel.
  c) CC: Use for lightly supercharge diesel engine.
  d) CD: Use in highly turbocharge diesel engine.
- S- series
  a) SA : Mineral oil , may contain anti-formant and poor point depresent
  b) SB : Mineral oil , containing additive impart sum oxidation stability & anti- scuff protection
  c) SC, SD & SC**:** Meets automotive manufactures specifications.

2

c) Describe the use of oil filter and oil pressure gauge in a lubrication system	4
Answer: **Use of Oil Filter :** (*any two*) 1. To block the foreign materials to entering, in the engine with lubricating oil. 2. Extremely small particle of carbon and gum suspending in oil removed from the oil. 3. Abrasive particles are removed from the oil. 4. It prevents sludge deposition to pass to the bearings. **Use of Pressure Gauge :** (*any two*) **1.** To monitor the oil pressure in the crankcase. **2.** Vapour will create due to used hot oil it will create pressure on available oil in the crankcase, it may lead to oil leakage from crankcase so this pressure should be relief with the help of pressure gauge. **3.** Use to indicate oil level in crankcase.	2 2
d) State need of a positive crankcase ventilation system. Draw a schematic diagram for the same	4
Answer: Need of Positive Crankcase Ventilation System: Since water vapour in exhaust and blow by gases enter crankcase due to various reasons, there is very chance that these contaminants will cause sludge and corrode metal parts. Therefore a mean of removing these contaminants before they can act on the oil is essential. Another reason of using crankcase ventilation is to relieve any pressure build-up in the crankcase which may cause crankshaft seal leakage.  *Closed crankcase ventilation system*	2 2

e) List four engine performance parameter. Describe two of them.	4
Answer: Engine Performance parameters: *(Any four)* 1. Power and mechanical efficiency 2. Mean effective pressure and Torque 3. Specific output 4. Fuel-air ratio 5. Volumetric efficiency 6. Specific fuel consumption 7. Thermal efficiency and heat balance. 8. Exhaust smoke and other emissions 9. Specific weight.	2
1. **Brake Power**: It is measured at the crankshaft with help of dynamometer. $B.P. = \frac{2\Pi NT}{60} = \frac{2\Pi N(W \times R)}{60}$ Watt Where , W = Net brake load on dynamometer N = Engine rpm R = Brake drum radius	1
2. **Indicated Power**: It is measure on the top of piston. $\text{I.P.} = \frac{nPLAN'}{60 \times 1000} kw$ Where, n = Number of cylinders P = Indicated mean effective pressure in N/m^2 L= Stroke in m, D = Diameter in m. A = Area of combustion chamber = $\frac{\Pi}{4} D^2$ in m^2 N = Engine rpm N' = $\frac{N}{2}$ for four stroke and N' = N for two stroke engine.	1
f) List the dynamometer types. Describe working principle of one type.	4
Answer: **Types of Dynamometer :** **1.** Prony brake dynamometer **2.** Rope Brake dynamometer **3.** Hydraulic dynamometer **4.** Eddy current dynamometer	2
Working Principle: *(Any one)* 1.**Principle of Prony brake dynamometer**: It converts power into heat by dry friction with the help of brake shoes	2

2. **Rope Brake dynamometer**: It converts power into heat by dry friction with the help of rope.
3. **Hydraulic Brake dynamometer:** It works on the principle of dissipating the power in fluid friction created due to centrifugal action of working fluid.
4. Principle of Eddy current: Crankshaft connected to rotor when rotor rotates Eddy current are produce in stator due to magnetic flux set up by the passage of field current in electro magnets these Eddy current oppose the rotor motion thus loading the engine**.**

6. Attempt **any TWO** of the following: 16

a) Explain morse test and WIllian's line method for finding frictional power of an engine. 8

Answer: **Morse Test:** Used for multi cylinder engines

Procedure:

1. The engine is run at the required speed and the torque is measured.
2. One cylinder is cut out by shorting the plug if an S.I. engine is under test or by disconnecting an injector if a C.I. engine is under test . 4
3. The speed falls because of the lass of power with one cylinder cut out but is restored by reducing the load .
4. The torque is measured again when the speed has reached its original value.
5. If the value of I.P. measured simultaneously for each cylinder

$$I = I_1 + I_2, + I_3 + I_4$$

$$F.P. = (I.P.)_n - (B.P.)_n$$

Where n^{th} is the number of cylinders.

Willan's Line Method :

At a constant engine speed the load is reduced in increments and corresponding B.P. and gross fuel consumptions readings are taken. A graph is then drawn of fuel consumption against B.P. as in Fig. The graphs draw is called the willan's line (analogous to Willan's line for a steam engine) and extrapolated back to cut the B.P. axis at the point L. The reading OL is taken as the power loss of the engine at that speed. The fuel consumption at zero B.P. is given by OM ; and if the relationship between fuel consumption and B.P. is assumed to be liner then a fuel consumption OM is equivalent to a power loss of OL 4

Frictional power loss (F.P.) = OL

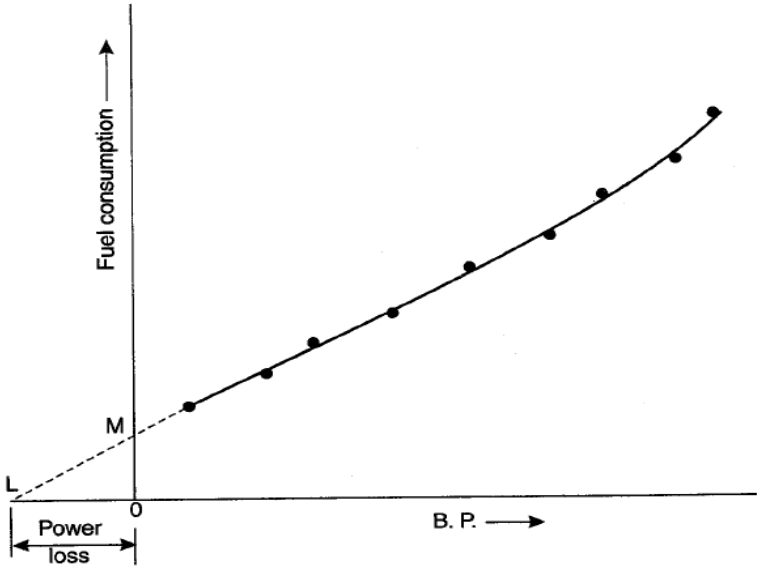


Fig. Willan's line method.

b) Following readings were noted during a test on a single cylinder 2- stroke diesel engine. Engine is motored and frictional power loss of engine is 1.5kW.Net brake load =227N, Brake drum diameter= 100cm, Engine speed = 500rpm, Fuel consumption = 22.04kg/hr . Calorific value of fuel =42000 kJ/kg. Find mechanical efficiency and brake thermal efficiency.	8
Answer: Data given F.P. = 1.5 kW Weight = 227N D = 100cm, R = 50 cm N = 500rpm m_f = 2.04kg/hr = $\frac{2.04}{60\times60} = 5.6\times10^{-4} kg/\text{sec.}$ C.V. = 42000 kJ/kg η_{mech} = ? η_{Bth} =? $B.P. = \frac{2\Pi NT}{60} = \frac{2\Pi N(W\times R)}{60}$ $= \frac{2\Pi\times500\times227\times0.5}{60}$ $= 5939.8\text{W}$ $= 5.94kw$ I.P. = B.P. + F.P. = 5.94 + 1.5 = 7.44 kW $\eta_{mech} = \frac{B.P.}{I.P}$ X 100 $\eta_{mech} = \frac{5.94}{7.44}$ X 100 η_{mech} = 79.83 % $\eta_{Bth} = \frac{B.P.}{mf\times cv}$ X 100 $\eta_{Bth} = \frac{5.94}{5.6\times10^{-4}\times42000}\times100$ $= 0.025\times100$ η_{Bth} = 25.25%	2 2 2 2

c) Following observations were taken during a test on single cylinder 4-stroke cycle engine. Duration of test =01 Hour Fuel consumption = 7Kg Speed = 200rpm I.M.E.P. = 6.1 bar Stroke = 450mm Bore =300 mm C.V. of fuel = 45MJ/kg Net brake load = 1.5 kN Brake drum diameter = 1.83 m Determine : i) I.P. ii) B.P. iii)Mechanical efficiency iv)Brake Thermal Efficiency	8
Answer: **Given Data:** Duration of test = 01 Hour Fuel consumption = 7Kg $mf = \frac{Fuelconsumption}{Duration} = \frac{7}{60\times 60}$ = 1.9 X 10^{-3} kg/sec. Speed = 200rpm for four stork, N' = $\frac{N}{2} = \frac{200}{2} = 100$ rpm I.M.E.P. P = 6.1 bar = 6.1 X 10^5 N/m Stroke, L = 450mm Bore, D = 300 mm C.V. of fuel = 45MJ/kg Net brake load = 1.5 kN = 1.5 x 10^{-3}N Brake drum diameter = 1.83 m Radius, R = 1.83/2 = 0.915 m n = Number of cylinders = 1 C.V. of fuel = 45MJ/kg = 45 X 10^3 kJ/kg. **Solution:** **1)** I.P. $= \frac{nPLAN'}{60\times 1000} kw$ I.P. $= \frac{1\times 6.1\times 10^5 \times 0.45\times \prod/4\times 0.3^2\times 100}{60\times 1000}$ **I.P.** $= 32.32kW$	2

2) $B.P. = \dfrac{2\prod NT}{60\times1000}$

$$= \frac{2\times3.14\times200\times1.5\times10^{3}\times0.915}{60\times1000}$$

$\boxed{B.P. = 28.73kw}$ 2

3) $\eta_{mech} = \dfrac{B.P.}{I.P}$ X 100

$$\eta_{mech} = \frac{28.73}{32.32}\text{ X }100$$

$\boxed{\eta_{mech} = 88.89\%}$ 2

4) $\eta_{Bth} = \dfrac{B.P.}{mf\times cv}$ X 100

$$= \frac{28.73}{7/60\times60\times45\times10^{3}}\times100$$

$\boxed{\eta_{Bth} = 32.83\%}$ 2