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## Define : i) Isothermal efficiency.

**i) Isothermal efficiency** – It is defined as the ratio of isothermal power to the indicated or actual power. Isothermal efficiency = Isothermal power / Indicated power.

**ii) Volumetric efficiency –** It is the ratio of actual volume of the free air delivered at standard atmospheric condition at discharge in one delivery stroke to the swept volume by the piston during the stroke.

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## State any four types of sensors used in I.C. engine.

**Following sensors are used in ECU:** A permanent magnet inductive signal generator is mounted in close proximity to the flywheel, where it radiates a magnetic field. As the flywheel spins and the pins are rotated in the magnetic field, an alternating (AC) waveform is delivered to the ECM to indicate speed of rotation.

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## Explain with neat sketch working principle of Ice plant.

**Working of Ice plant**: The main cycle used for ice plant is vapor compression cycle with ammonia as the refrigerant in primary circuit

and brine solution in secondary circuit. Brine solution takes heat from water in secondary circuit and delivers the heat to ammonia in primary circuit. Thus, the indirect method of cooling is used in ice plant. In secondary circuit brine is cooled in evaporator and then it is circulated around the can which contains water. The heat is extracted from the water in the can and is given to the brine.

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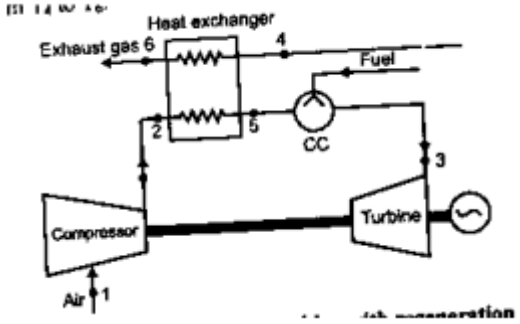
## List the methods to improve thermal efficiency of gas turbine and explain any one of them in detail

**Methods to improve thermal efficiency of gas turbine**

**1) Regeneration** – This is done by preheating the compressed air before entering to the combustion chamber with the turbine exhaust in a heat exchanger, thus saving fuel consumption.




**2) Reheating** : The whole expansion in the turbine is achieved in two or more stages & reheating is done after each stage. That increase in work done.

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## Write any four applications of compressed air.

**Following are the applications of compressed air:-**

1) To drive air motors in coal mines.

2) To inject fuel in air injection diesel engines.

3) To operate pneumatic drills, hammers, hoists, sand blasters.

4) For cleaning purposes.

5) To cool large buildings.

6) In the processing of food and farm maintenance.

7) For spray painting in paint industry.

8) In automobile & railway braking systems.

9) To operate air tools like air guns.

10) To hold & index cutting tools on machines like milling.

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## Compare reciprocating and rotary compressors (any four).

| Reciprocating compressor | Rotary compressor | | |
|---|---|---|---|
| 1. Compression of air takes place with help of piston and cylinder arrangement with reciprocating motion of piston. | 1. Compression of air takes place due to rotary motion of blades. | | |
| 2. Delivery of air intermittent. | 2. Delivery of air is continuous. | | |
| 3. Delivery pressure is high i.e. pressure ratio is high. | 3. Delivery pressure is low, i.e. pressure ratio is low. | | |
| 4. Flow rate of air is low. | 4. Flow rate of air is high. | | |
| 5. Speed of compressor is low because of unbalanced forces. | 5. Speed of compressor is high because of perfect balancing. | | |
| 6. Reciprocating air compressor has more number of moving parts. | 6. Rotary air compressor has less number of moving part. | | |
| 7. It needs proper lubrication and more maintenance. | 7. It required less lubrication and maintenance. | | |
| 8. Due to low speed of ration it can't be directly coupled to prime mover but it requires reduction of speed. | 8. Rotary air compressor can be directly coupled to prime mover. | | |
| 9. It is used when small quantity of air at high pressure is required. | 9. It is used where large quantity of air at lower pressure is required. | | |

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The following data is collected during a trial of four stroke four cylinder petrol engine.

Q4. (B)

b) B.P. with all cylinders working = 14.7 kW

I.P. of first cylinder $I.P._1 = 14.7 - 10.14 = 4.56$ kW

— " — second — " — $I.P._2 = 14.7 - 10.3 = 4.4$ kW

— " — third — " — $I.P._3 = 14.7 - 10.36 = 4.34$ kW

— " — fourth — " — $I.P._4 = 14.7 - 10.21 = 4.49$ kW (1 mark each)

Total I.P. $= I.P._1 + I.P._2 + I.P._3 + I.P._4$

$= 4.56 + 4.4 + 4.34 + 4.49$

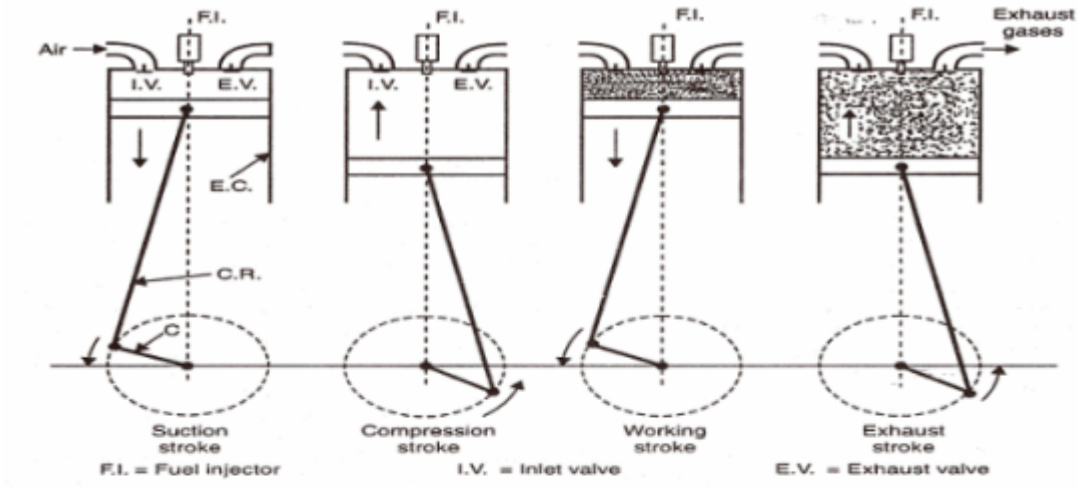
$= 17.79$ kW — (1 marks)

$\eta_{mech.} = \frac{B.P.}{I.P.} = \frac{14.7}{17.79} = 82.63\%$

— (1 marks)

# Explain with neat sketch working principle of four stroke petrol engine.

**Working of four stroke petrol engine**




1.**Intake Stroke**: As the name suggests in this stroke the intake of fuel takes place. When the engine starts, the piston descends to the cylinder's bottom from the top. Thus the pressure inside the cylinder reduces. Now the intake valve opens and the fuel and air mixture enters the cylinder. The valve then closes.

2.**Compression Stroke**: This stroke is known as compression stroke because the compression of the fuel mixture takes place at this stage. When the intake valve closes (exhaust valve is already closed), the piston forced back to the top of the cylinder and the fuel mixture gets compressed.

3.**Combustion/Power Stroke**: Now in case of petrol engine when the fuel mixture compresses to the maximum value the spark plug produces spark which ignites the fuel mixture. The combustion leads to the production of high pressure gases. Due to this tremendous force the piston is driven back to the bottom of the cylinder. As the piston moves downwards, the crankshaft rotates which rotates the wheels of the vehicle.

4.**Exhaust Stroke**: As the wheel moves to the bottom the exhaust valve opens up and due to the momentum gained by the wheel the piston is pushed back to the top of the cylinder. The gases due to combustion are hence expelled out of the cylinder into the atmosphere through the exhaust valve.
The exhaust valve closes after the exhaust stroke and again the intake valve opens and the four strokes are repeated.

## State advantages of jet propulsion over other systems.

**Advantages of jet propulsion –** 1. Higher mechanical efficiency due to absence of reciprocating parts. 2. The weight of gas turbine per kW power developed is low since the working pressures are low requiring lighter construction. 3. Can produce much more power at much higher altitudes where drag is less so higher speeds are possible and they are more efficient. 4. Reliability is one of the elements of success for jet engines. They only have a couple of moving parts and almost no vibration.

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## State advantages of closed cycle gas turbine.

Advantages of closed cycle gas turbine:

(i) It has higher thermal efficiency for the same minimum and maximum temperature limits and for the same pressure ratio.

(ii) Since the heating is external, any kind of fuel even solid fuel having low calorific value may be used.

(iii) There is no corrosion due to circulation of combustion product.

(iv) As the system is a closed one there is no loss of the working fluid.

(v) The size of the turbine will be smaller compared to an open cycle gas turbine of the same output.

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