Section A

1. (a) Explain what is meant by the enthalpy of fusion. (2)

   (b) 500 grammes of ice at -5°C is heated with 250 kJ of energy. What is the final state and temperature. (6)

   Note: Specific heat capacity of ice = 2.11kJ/kgK
   Specific heat capacity of water = 4.18kJ/kgK
   Enthalpy of fusion of liquid = 335kJ/kg

2. (a) Explain the meaning of the abbreviations 'STP' and 'NTP'. (2)

   (b) 1.2 kg of a perfect gas has a volume of 0.8 m^3 at a temperature of 28°C. The gas is compressed to a quarter of the original volume where its pressure is 11 bar.

   Determine the final temperature. (6)

   Note: R = 290 J/kgK

3. (a) Explain the cause of thermal expansion in materials. (2)

   (b) A copper sphere has a diameter of 40.25 mm at a temperature of 550°C.

   Calculate the temperature at which the sphere will just drop through a hole of 40 mm diameter. (6)

   Note: Co-efficient of linear expansion of copper = 0.000017/°C

4. 0.75 kg of Heptane (C_7H_{16}) is completely burned with 25% excess air.

   Calculate EACH of the following:

   (a) the stoichiometric mass of air required; (4)

   (b) the mass of carbon dioxide in the exhaust gases. (4)

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5. A 4 cylinder 2 stroke diesel engine under test has a bore of 120 mm and a stroke of 150 mm and runs at 800 revs per minute.

The average height of the engine indicator diagram was 10 mm. During the test a torsion meter on the shaft gave reading of 579 Nm. The spring constant of the test indicator was 60 kPa/mm.

Calculate EACH of the following:

(a) the brake power; (4)

(b) the indicated power; (4)

(c) the mechanical efficiency. (2)

6. (a) With the aid of a pressure enthalpy diagram describe the condition of the refrigerant fluid as it flows around the basic vapour compression plant. (4)

(b) List the energy changes that occur across EACH item of plant in the basic refrigeration system of Q6(a). (4)

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(14)

7. (a) State what happens to the electrical resistance of metals as the temperature rises. (2)

(b) Explain what happens to the flow of electrons in metals to cause the effect stated in Q7(a). (2)

(c) A wire with a resistance of 40 Ω is joined into a circle. Two conductors are joined at diametrically opposite points as shown in Fig Q7.

Determine the measured resistance between A and B. (2)

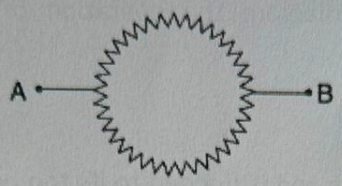

Fig Q7

(d) Explain what is meant by resistivity. (2)

8. The circuit in FIG Q8 has a voltmeter as shown. When the switch is open the reading on the voltmeter is 30 V, when the switch is closed the voltage drops to 26.67 V.

(a) What is the reason for the change in the voltmeter readings. (3)

(b) Determine the resistance of the cell. (5)

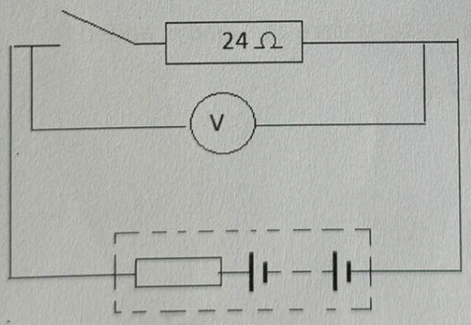

FIG Q8

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9. A conductor with an effective length of 300 mm and a diameter of 9.5 mm when carrying a current of 25 A at right angles to a magnetic field. The force on the conductor is 18 N.

Calculate EACH of the following:

(a) the flux density; (4)

(b) the magnetic flux. (4)

10. (a) In a moving coil instrument what is the purpose of a shunt resistor. (2)

(b) Describe with the aid of a diagram the operation of a moving coil instrument. (6)

11. A rectangular river dam is 30 m wide and is flooded to its top edge, on one side only, with water of density 1005 kg/m^3.

Calculate EACH of the following:

(a) the height of the dam, if the thrust under the flooded condition is 30 MN; (5)

(b) the pressure at a point 2.24 m above the base of the dam. (3)

12. (a) Describe, with the aid of a sketch, the meaning of the 'metacentre' in ship stability. (4)

(b) A mass of 50 tonnes is loaded on board ship 4 m off the centreline creating a heel angle of 1.5°.

Determine the mass of the vessel before the load is added. (6)

Note: KM = 6 m, KG = 4.9 m

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