GENERAL ENGINEERING SCIENCE II

Attempt ALL questions.

Marks for each question are shown in brackets.

Section A

1. (a) Explain why materials expand as a result of heating. (2)

   (b) A sphere made of copper has a diameter of 40.19 mm at a temperature of 400°C.

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

   Note: co-efficient of linear expansion of steel = 0.000018 /°C

2. (a) Describe the difference between the specific heat capacity of steel and the enthalpy of fusion of steel. (4)

   (b) A steel casting is to be made by melting 6 kg of steel scrap which is originally at 20°C.

   If the melting point of steel is 1370°C, determine the total energy required to melt the steel. (4)

   Note: Specific heat capacity of steel = 0.48 kJ/kgK
   Enthalpy of Fusion of steel = 247 kJ/kg

3. A volume of 1.5 m^3 of a perfect gas, at a pressure of 1.01325 bar and a temperature of 20°C, is heated at constant pressure until its volume doubles. At this point the gas cannot expand further so continued heating causes the pressure to double.

   (a) Show the processes on a P-V diagram. (3)

   (b) Determine the final temperature of the gas. (5)

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4. A 6 cylinder, 4 stroke diesel engine under test has a bore of 120 mm and a stroke of 150 mm and burns 145 kg of fuel per day at 800 revs per minute. The mean effective pressure was found to 600 kN/m^2. During the test a torsion meter on the shaft gave a reading of 432.5 Nm.

Calculate EACH of the following:

(a) the indicated power; (3)

(b) the brake power; (2)

(c) the brake specific fuel consumption; (3)

(d) the mechanical efficiency. (2)

5. A fuel oil consists of 86% carbon and 14% hydrogen by mass and is completely burned with 30% excess air.

Determine EACH of the following:

(a) the mass of air required burn the fuel; (6)

(b) the mass of oxygen in the exhaust. (2)

6. Describe how the vapour compression refrigeration cycle achieves cooling. (8)

Section B

7. The circuit in Fig Q7 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) Explain the reason for the change in the voltmeter readings. (4)

(b) Determine the resistance of the cell. (4)

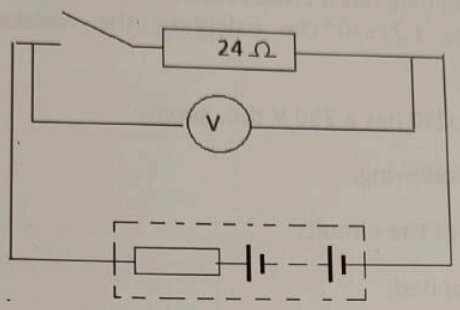

Fig Q7

8. Determine the current at points 1, 2 & 3 in the circuit shown in Fig Q8 if the cell e.m.f. is 32 V. (8)

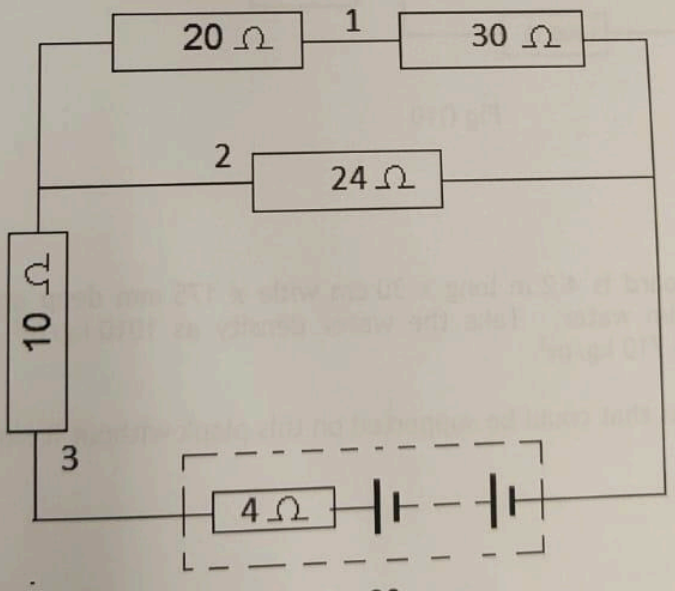

Fig Q8

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9. (a) State Lenz's Law. (2)

(b) A conductor with an effective length of 250 mm creates a magnetic flux 480 μWb when carrying a current of 45 A at right angles to a magnetic field. The force on the conductor is 48 N.

Determine the diameter of the conductor. (6)

10. (a) A copper conductor 80 m long has a cross sectional area of 2.5 mm^2. If the resistivity of copper is 1.77×10^{-8} Ωm calculate the resistance of the conductor. (2)

(b) The circuit shown in Fig Q10 has a 250 V d.c. supply.

Determine EACH of the following:

(i) the total resistance of the circuit; (2)

(ii) the total current supplied; (1)

(iii) the volt drop across the 800 Ω resister. (3)

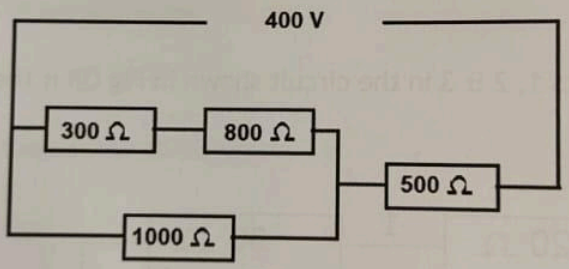

Fig Q10

11. A solid wooden board is 4.2 m long x 30 cm wide x 175 mm deep and floats horizontally in calm water. Take the water density as 1010 kg/m^3 and the density of wood as 710 kg/m^3.

Determine the mass that could be supported on this plank without it sinking. (8)

12. A ship has a displacement volume of 6430 m^3 in sea water of density 1025 kg/m^3.

Two double bottom tanks each measuring 12.5 m long x 5.5 m wide x 2.1 m deep are positioned equally, one either side of the centre line.

These tanks are now completely filled with heavy fuel oil of density 968 kg/m^3.

Determine the change in position of G, in both magnitude and direction, given that the initial KG = 3.8 m. (10)