GENERAL ENGINEERING SCIENCE II

Attempt ALL questions

Marks for each question are shown in brackets.

Section A

1. A steel shaft has a diameter of 48 mm.

   (a) Calculate the temperature at which a brass sleeve with a hole diameter of 47.75 mm, at a temperature of 20°C will just slide onto the shaft to provide a shrink fitting. (4)

   (b) When the combined shaft and sleeve are in use they may be subjected to a temperature rise. If the temperature rose to that determined in Q1(a), explain with reasons whether the sleeve becomes loose or not. (2)

   Note: coefficient of linear expansion of brass = 0.000018/°C

2. 5 kg of Argon gas occupied a fixed volume of 300 litres at a temperature of 20°C.

   It was accidentally heated until its temperature was 200°C.

   Calculate EACH of the following:

   (a) the amount of heat was transferred to the gas; (3)

   (b) the final pressure of the gas. (5)

   Note: R = 0.209 kJ/kgK Cv = 0.315 kJ/kgK

3. (a) Explain the form in which useful energy is stored in liquid fuels such as diesel. (2)

   (b) Describe the difference between temperature and heat transfer. State what condition is required for Heat. (3)

   (c) State the fixed points on the Celsius scale and describe how this relates to the Kelvin scale. Describe are the unit intervals determined. (3)

4. A 4 cylinder, 2 stroke diesel engine, has a bore of 120 mm and a stroke of 150 mm and runs at 800 revs per minute. Under test, the mean effective pressure was found to be 600 kN/m^2. During the test a torsion meter on the shaft gave a reading of 576 Nm.

Calculate EACH of the following:

(a) the brake power; (3)

(b) the indicated power; (3)

(c) the mechanical efficiency. (2)

5. (a) Sketch the plant diagram of a basic vapour compression refrigeration system discussing condenser sub-cooling and evaporator superheating. (4)

(b) Describe the basic functions of the FOUR key components of a vapour compression refrigeration system with reference to your diagram in Q5(a). (4)

(c) If the refrigeration system described in Q5(a) has a water cooled condenser, describe the effect of a higher cooling water inlet temperature if the flow rate remains the same. (2)

6. At point 1 of a cyclic process 0.2 m^3 of air at 1.01325 bar and 20°C occupies a cylinder at bottom dead centre. Assume that losses are negligible.

(a) At top dead centre, point 2, the gas has been compressed to one tenth of its original volume at point 1. Calculate the pressure assuming no temperature rise. (2)

(b) At top dead centre there is a heat addition of 60 kJ which causes an expansion at constant pressure to point 3. Calculate the volume as a result of this expansion. (6)

(c) The cycle continues with an expansion from point 3 back to bottom dead centre, point 4, calculate the final pressure at point 4 if the temperature remains constant in this process. (2)

Note: R=0.287kJ/kgK, C_p = 1.005kJ/kgK

Section B

7. (a) Explain the main differences in the atomic structure of materials which determines whether the material may be a good conductor or an insulator. (2)

(b) State examples of processes using electric current being used for EACH of the following:

(i) its magnetic effect; (2)

(ii) chemical effect; (2)

(iii) its heating effect. (2)

8. (a) Explain how the resistance of metals varies with temperature. Briefly explain why this occurs. (4)

(b) State an example of where this changing property is used. (2)

(c) Determine the total resistance of the circuit shown in FIG Q8. (4)

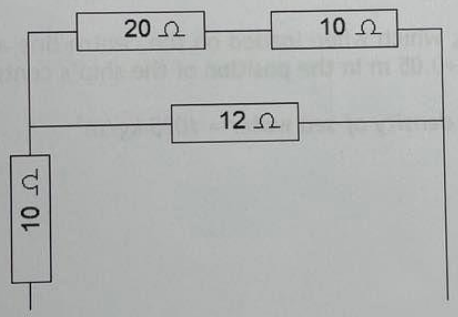

Fig Q8

9. (a) Define the resistivity of a material. (2)

(b) The resistance of 4.5 km of aluminium wire of 3 mm diameter is 420 ohms.

Calculate the resistance of 1 km of copper wire of 1.5 mm diameter. (6)

Note: the resistivity of copper = 0.65 x resistivity of Aluminium.

10. A battery consists of four cells in series each having an e.m.f. of 1.5 V and an internal resistance of 0.6 Ω.

Calculate EACH of the following:

(a) the current flowing if connected to a device of 7.6 Ω resistance; (6)

(b) the terminal voltage. (2)

11. An electrical conductor which has an effective length of 200 mm and a diameter of 9.5 mm carries a current of 35 A at right angles to a magnetic field. The force on the conductor is 22 N.

Calculate EACH of the following using appropriate S.I. units:

(a) the flux density; (3)

(b) the magnetic flux. (5)

12. A vessel has a displacement volume of 5450 m^3 in sea water.

Calculate the mass, m, which when loaded on the centre line at a Kg of 3.8 m will cause a change of +0.05 m in the position of the ship's centre of gravity. (8)

Note: KG = 3.2 m and density of sea water = 1025 kg/m^3