Dec 1998

GENERAL ENGINEERING SCIENCE II

Attempt ALL questions

Marks for each part question are shown in brackets

1. *(a)* State the difference between temperature and heat energy. (2)

   (b) Outline the mechanism of heat transfer by:

   (i) conduction; (3)

   (ii) convection. (3)

2. A solid cast iron sphere, 150 mm in diameter, has 2110 kJ of heat energy transferred to it

   Calculate the increase in diameter. (8)

   Note: For cast iron:
   Density $= 7.2 g/cm^3$
   Specific heat capacity $= 0.54 kJ/kgK$
   Coefficient of linear expansion $= 1.12 \times 10^{-5}/^{o}C.$

3. *(a)* Define Boyle's Law. (3)

   (b) A $3.5m^3$ volume of air at a pressure of $20kN/m^2$ gauge is compressed at constant temperature to a pressure of 4.25 bar gauge. Calculate the final volume of air given that the atmospheric pressure is $100kN/m^2$. (5)

4. A mass of methanol (CH_3OH) is completely burned in 50 kg of air to form carbon dioxide and steam. Determine the mass of the methanol given that 20% excess air is supplied. (10)

   Note: Air contains 23% oxygen by mass.
   Relative atomic masses: hydrogen 1; carbon 12; oxygen 16.

5. The area of an indicator diagram, taken from a four cylinder four-stroke diesel engine is 378 mm^2, the length is 70 mm and the spring scale is 2 bar/mm. The engine cylinder diameter is 250 mm with a 350 mm stroke. When the card was taken the engine was running at 300 rpm.

   (a) Calculate the mean effective pressure in the cylinder. (3)

   (b) Determine the indicated power of the engine assuming that all the cylinders are identically powered. (3)

   (c) Calculate the brake power of the engine for a mechanical efficiency of 86%. (2)

6. *(a)* Draw a labelled line diagram of a simple refrigeration cycle. (2)

   (b) State the function of EACH principal component in the cycle in Q.6(a). (8)

7. *(a)* With reference to electric storage batteries sketch the basic construction of:

(i) a primary cell; (4)

(ii) a secondary cell. (4)

(b) State the unit of battery capacity. (2)

8. Determine, the current in EACH resistor, for the circuit shown in Fig. Q.8. (9)

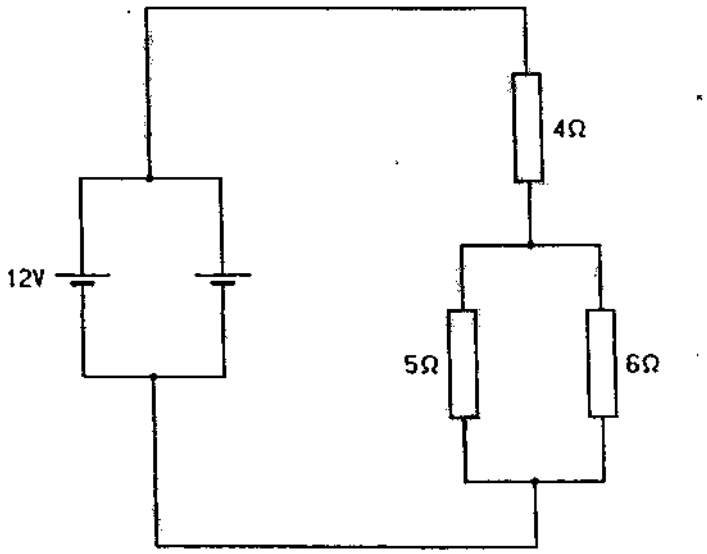

Fig. Q.8

9. An aluminium wire, 7.5 m long and 1mm diameter, is connected in parallel with a copper wire 6 m long. When a current of 5 A is passed through the combination, the current in the aluminium wire is 0.6 A. Determine the diameter of the copper wire. (8)

Note: Resistivity of copper is 0.017 μΩm
Resistivity of aluminium is 0.028 μΩm

10. *(a)* A wire, 100 m long, is moved at a constant speed of 4m/s at right angles to a uniform magnetic field.

Calculate the magnetic flux density of the field when the induced emf in the wire is 0.15 V. (4)

(b) The wire in Q. 10(a) forms part of a closed circuit having a total resistance of 0.04 Ω.

Calculate the force acting on the wire. (4)

11. *(a)* State Faraday's Law of electromagnetic induction. (3)

(b) A steady current flowing in a coil of 1 500 turns produces a magnetic flux of 2.5 mWb.

Calculate the average value of the emf induced in the coil when the current is reversed in 0.2 s. (4)

12. Explain the difference between electromotive force and potential difference in an electric circuit. (6)