Dec 1997

GENERAL ENGINEERING SCIENCE II

Attempt ALL questions

Marks for each part question are shown in brackets

1. *(a)* Define the *specific heat capacity* of a substance. (2)

   (b) Determine the heat required to raise a steel component of mass 500 kg to 700 K from 20°C given that the specific heat capacity is 0.5 kJ/kgK. (4)

2. A steel chisel of mass 0.5 kg is heated to 560°C and then plunged into a bath containing 0.01 m^3 of oil at 10°C. Calculate the final temperature of the oil. (10)

   Note: Density of oil: 850 kg/m^3
   Specific heat capacity of steel: 0.45 kJ/kgK
   Specific heat capacity of oil: 1.8 kJ/kgK

3. *(a)* Explain what is meant by a perfect gas. (2)

   (b) Calculate the mass of gas that will be contained in a 3 m^3 bottle at 10 bar and 20°C given that the specific gas constant is 260J/kg. (6)

4. *(a)* Explain the process of *combustion.* (2)

   (b) Explain the effect on the combustion process of:

   (i) inadequate air, (3)

   (ii) excess air. (3)

5. For the ideal refrigeration cycle state the condition of the refrigerant as it enters EACH of the following:

   (a) condenser, (2)

   (b) throttle valve; (2)

   (c) evaporator, (2)

   (d) compressor. (2)

6. A diesel engine develops 800 kW at the propeller of a vessel when using a fuel of 40 MJ/kg at the rate of 170kg/hr. The manufacturer states that the indicated output should be 950 kW.

   Calculate:

   (a) the mechanical efficiency of the engine given that the transmission losses are 5% of the propeller output; (3)

   (b) the brake thermal efficiency; (4)

   (c) the indicated thermal efficiency. (3)

7- *(a)* With reference to their atomic structure, explain the difference between electrical conductors and insulators. (4)

(b) Give TWO examples for EACH of the following:

(i) good electrical conductors;

(ii) good electrical insulators. (4)

8. For the circuit shown in Fig. Q.8, calculate:

(a) the current in each resistor, (6)

(b) the power dissipated in the parallel resistor section. (3)

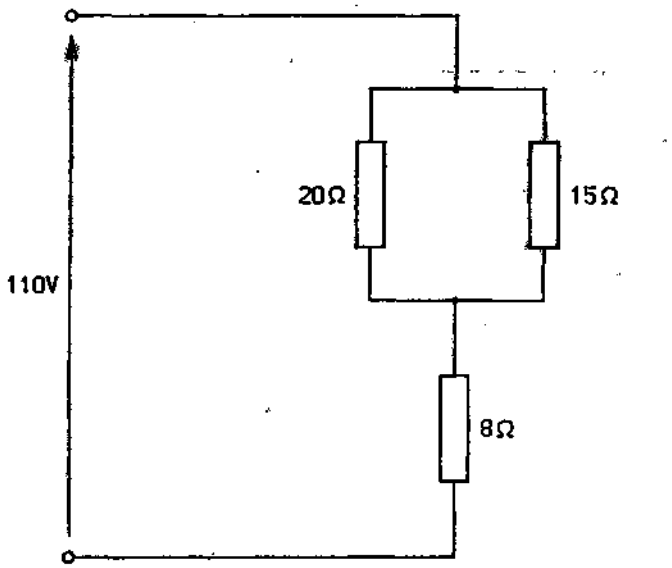

Fig. Q.8

9. A two-core cable with each conductor 8 mm^2 in cross-sectional area carries a current of 35 A. Calculate the power loss in a metre length of cable at a temperature of 20°C given that the resistivity of copper at 0°C is 17 μΩmm. (10)

Note: Temperature coefficient of resistance of copper at 0°C is 0.0043 per degree C

10. *(a)* Explain what is meant by *magnetic flux.* (2)

(b) Sketch diagrams to show how the magnetic flux would be distributed around:

(i) a horseshoe magnet; (3)

(ii) two bar magnets lying parallel to each other a short distance apart with their north poles facing different directions. (3)

11. *(a)* Draw circuit diagrams to show how a moving coil meter and a resistor are connected to measure:

(i) current; (2)

(ii) voltage. (2)

(b) Explain the operation of EACH circuit in Q.ll(a). (4)

12. A rectangular coil wound with 80 turns of wire has a mean width of 40mm and an effective length of 100 mm. The coil, carrying a current of 6 A, is placed in a uniform magnetic field of flux density 150 mT.

Calculate:

(a) the force acting on one side of the coil; (4)

(b) the maximum torque on the coil. (3)