Dec 2001

GENERAL ENGINEERING SCIENCE II

Attempt ALL questions

Marks for each part question are shown in brackets

1. *(a)* State the only condition necessary for a transfer of heat energy. (2)

   (b) Outline the mechanisms by which heat is transferred by EACH of the following:

   (i) conduction; (4)

   (ii) convection. (4)

2. A copper vessel of mass 2 kg contains 0.5 kg of water. The initial temperature of the vessel and water is 20°C and the final temperature is 90°C.

   Calculate how much heat energy was added in kJ, assuming that heat losses are negligible. (6)

   Note: specific heat capacity of copper is 394 J/kgK;
   specific heat capacity of water is 4193.2 J/kgK.

3. A perfect gas undergoes a cooling process at constant pressure. The initial conditions of the gas are 1.2 bar pressure, 40°C temperature, and 0.044 m^3 volume. During the process, the temperature of the gas is reduced to 255 Kelvin.

   Determine EACH of the following:

   (a) the mass of gas; (4)

   (b) the final volume of the gas. (4)

   Note: the Characteristic Gas Constant R for the gas is 0.259kJ/kgK.

4. *(a)* Define the term *coefficient of linear expansion.* (4)

   (b) A pipe measures 5.65 m in length at a temperature of 15°C.

   Calculate the change in length when the pipe is carrying a thermal oil at a temperature of 290°C. (4)

   Note: The coefficient of linear expansion for the pipe material is 0.000012/°C.

5. State the chemical formula for EACH of the following combustion product compounds and identify the meaning of each symbol:

   (a) water; (2)

   (b) carbon dioxide; (2)

   (c) carbon monoxide; (2)

   (d) sulphur dioxide. (2)

6. *(a)* Explain what is meant by the term *combustion.* (1)

(b) State the THREE essential conditions necessary for combustion to take place. (3)

(c) Using appropriate stoichiometric combustion equations, calculate the mass of oxygen needed to burn completely EACH of the following:

(i) 0.8 kg Carbon; (4)
(ii) 0.15 kg Hydrogen. (4)

Note: the relative atomic masses of these elements are:
Hydrogen 1 Carbon 12 Oxygen 16

7. Using British Standard graphical symbols, draw an electrical circuit to show EACH of the following components connected in scries:

a battery of cells; a double pole switch; a fuse; a variable resistor; and filament lamp. (6)

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

(a) the total resistance of the circuit; (7)

(b) the circuit current. (3)

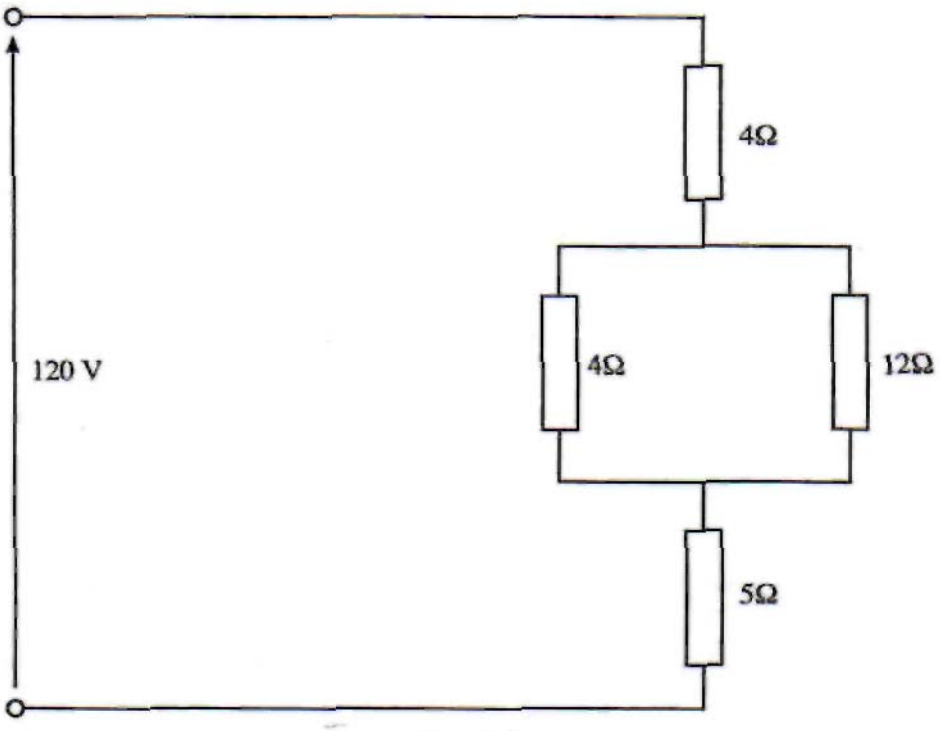

Fig. Q.8

9. A copper wire has a diameter of 0.26 mm and is used to form a resistor having a resistance of 0.48A.

Calculate the length of wire. (8)

Note: The resistivity of copper is 17 μΩmm.

10. *(a)* State *Lenz's Law*. (2)

(b) Sketch diagrams to show the distribution of magnetic flux around EACH of the following:

(i) a horseshoe magnet; (3)

(ii) two adjacent bar magnets lying a short distance apart with their north poles facing in opposite directions. (3)

11. With respect to a d.c. generator:

(a) explain with a suitable diagram how an emf is induced in the armature conductors; (7)

(b) name the component that ensures a direct current (d.c.) output. (1)

12. *(a)* Draw circuit diagrams to show how a moving coil milliammeter and a resistor are connected to measure EACH of the following:

(i) high current; (2)

(ii) high voltage. (2)

(b) Explain the operation of EACH circuit in *Q12(a).* (4)