GENERAL ENGINEERING SCIENCE II

Attempt ALL questions

Marks for each part question are shown in brackets

1. *(a)* State the THREE modes of heat transfer. (3)

   (b) Give ONE example of EACH of the three modes stated in Q.l(a). (3)

2. A furnace uses 5.5 m^3 of gas to raise the temperature of a 250 kg mass of steel to 1023K. The calorific value of the gas is 35MJ/m^3 and the specific heat capacity of the steel is 500J/kgK.

   Determine the thermal efficiency of the furnace given that its initial temperature is 25°C. (10)

3. *(a)* Define Boyle's Law. (2)

   (b) The pressure of a gas held in a 0.05 m^3 bottle is 10 bar. Calculate the pressure of the gas when it is released into a container of volume 0.8 m^3 at constant temperature. (4)

4. One kg of a fuel with a chemical composition of CH_4 is burned completely in 20% excess air.

   Determine the amount of air which must be supplied. (10)

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

5. With respect to the refrigeration cycle state the primary function of EACH of the following:

   (a) condenser; (2)

   (b) throttle valve; (2)

   (c) evaporator. (2)

6. The following data relates to tests on a four-stroke single-acting six-cylinder IC engine:

Cylinder bore	200 mm
Piston stroke	250 mm
Diagram spring number	50kN/m^2/mm
Area of indicator diagram	650 mm^2
Length of indicator diagram	60 mm
Engine speed	300 rpm

   Calculate:

   (a) the mean effective pressure per cylinder; (4)

   (b) the indicated power of the engine. (6)

7. *(a)* Describe the structure of an atom.   (5)

   (b) Explain, with the aid of sketches, how an electric current flows through a metallic conductor.   (5)

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

   (a) the value of R;   (4)

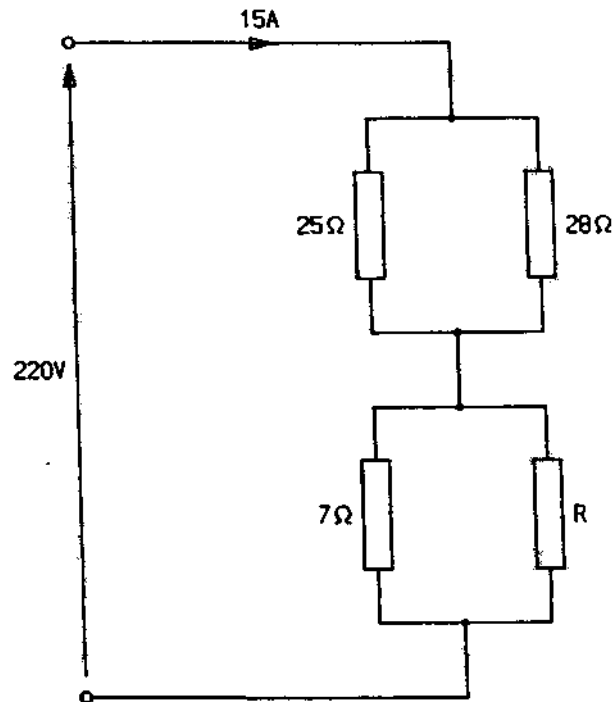   *(b)* the value of the current flowing in EACH resistor.   (6)

Fig. Q.8

9. A wire of length 40 m has a diameter of 20 mm and a resistivity of 125μΩmm.

   Determine the resistance of the wire.   (6)

10. *(a)* State Faraday's Law of electromagnetic induction.   (4)

   (b) The flux linking with a coil of 80 turns changes at a rate of 50 mWb per second.

   Calculate the average value of the induced emf.   (4)

11. *(a)* Sketch the basic construction of:

   (i) a primary cell;   (4)

   (ii) a secondary cell.   (4)

   (b) Explain the difference in operation between the two types of cell in Q.ll(a).   (2)

12. A 6kW drill is connected to a 110 V supply.

Calculate:

(a) the current required to drive the drill; (4)

(b) the internal resistance of the drill. (4)