GENERAL ENGINEERING SCIENCE II

Attempt ALL questions

Marks for each part question are shown in brackets

1. During heat treatment, a steel engine component of mass 35 kg is cooled from 640°C to 85°C by immersion in a tank of quenching oil. The oil temperature increases by 50°C during the process.

   Determine the mass of oil. (10)

   Note: Specific heat capacity of quenching oil is 1.9kJ/kg K
   Specific heat capacity of steel is 0.49kJ/kg K

2. During a constant pressure process a perfect gas is cooled from an initial condition of 1.13 bar pressure, 298 K temperature, and 0.045 m^3 volume. During the process, the temperature of the gas is reduced to 258 K.

   Determine EACH of the following:

   (a) the mass of gas; (4)

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

   Note: Characteristic Gas Constant R for the gas is 0.259kJ/kg K

3. *(a)* State the meaning of the term *combustion.* (1)

   (b) List the THREE essential conditions necessary for combustion to occur. (3)

   (c) Calculate the mass of oxygen needed to burn completely for EACH of the following:

   (i) 0.6 kg Carbon; (3)
   (ii) 0.12 kg Hydrogen. (3)

   Note: Relative atomic masses: oxygen 16: hydrogen 1; carbon 12

4. The following results were obtained during an engine-trial on a single acting, single cylinder two stroke engine:

Bore	150mm
Stroke	200 mm
Engine speed	220 RPM
Indicator diagram mean height	11.5mm
Engine indicator spring rating	50kN/m^2 per mm

   Determine EACH of the following:

   (a) the indicated mean effective pressure; (2)

   (b) the indicated power. (6)

5. With reference to a vapour compression refrigeration plant:

   (a) sketch and label a line diagram of the system; (4)

   (b) indicate on the diagram in *Q.5(a)* the state of the refrigerant at each main point in the system. (4)

6. A steel ball bearing race has a nominal diameter of 80 mm at 20°C. Its diameter must be reduced by 0.03 mm in order to assemble it in a housing.

   Determine the temperature to which it must be cooled. (6)

   Note: The coefficient of linear expansion of steel is 12 x 10^{-6}/°C

7. An 85 Ω resistor is connected to a 220 V d.c. power supply.

   Determine EACH of the following:

   (a) the circuit current; (2)

   (b) the power dissipated; (2)

   (c) the energy consumed in 4 hours. (2)

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

   (a) the current flowing in each resistor; (6)

   (b) the resistance value of R,. (4)

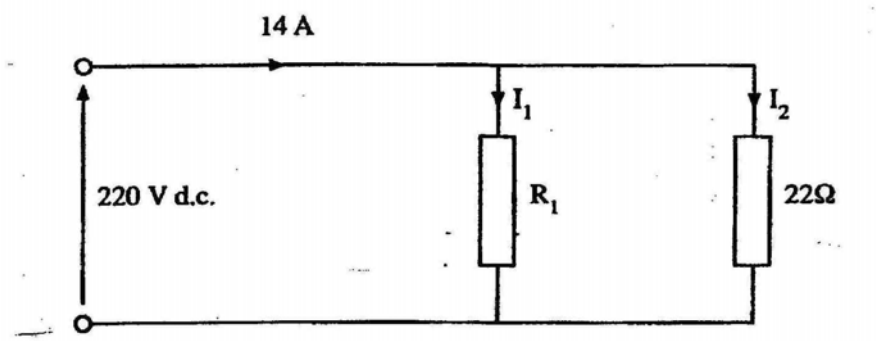

Fig. Q.8

9. A resistor is to be made by winding wire of resistivity 370 μΩmm and diameter 0.13mm around a cylindrical former.

   The total resistance of the component is to be 8 Ω.

   Determine the length of wire required. (6)

10. *(a)* State the meaning of the term *magnetic flux.* (2)

(b) An electric conductor of length 55 m moves at a velocity of $11\,m/s$ in a direction 90° to a uniform magnetic field. An e.m.f. of 0.14 V is induced in the conductor.

Determine the density of the magnetic field. (6)

11. *(a)* Describe, with the aid of a sketch, how torque is produced on the armature of a d.c. motor. (4)

(b) Explain the function of the commutator in a d.c. generator. (4)

12. The resistance of a moving coil test meter is 12Ω., and it takes 44 mA to produce full scale deflection.

(a) Explain, with the aid of circuit diagrams, how it can be adapted to measure larger currents and voltages. (6)

(b) Calculate the values of additional resistance to extend its measurement range to EACH of the following:

(i) 2 A (3)
(ii) 10V. (3)