Dec 1999

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 in Q.l(a). (3)

2. The clearance between a piston and the wall of a 150 mm bore cylinder liner is 0.5 mm at 10°C.

   Calculate the temperature at which the piston will just seize in the liner. (8)

   Note: Coefficient of linear expansion of the piston is 21 x 10^{-6}/°C.
   Coefficient of linear expansion of the liner is 6 x 10^{-6}/°C

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 fuel, with a chemical composition of C_2H_8, is completely bumed in 50 kg of air at stoichiometric conditions.

   Determine the mass of the fuel. (8)

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

5. The stroke to bore ratio for a six cylinder single-acting two stroke diesel engine is 2.86:1. When the engine is running at 80 rpm the mean area of the indicator diagrams is 1 380 mm^2 with a length of 80 mm when using a spring scale of 100kN/m^2/mm. The shaft power is 15 800kW and the mechanical efficiency is 86%.

   Determine the bore and stroke of the engine. (10)

6. *(a)* Sketch and label a simple refrigeration cycle diagram. (2)

   (b) Explain the condition of the refrigerant as it passes through EACH stage of the cycle in Q.6(a). (8)

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

(a) the potential difference across the 17 Q resistor; (4)

(b) the current through each resistor. (4)

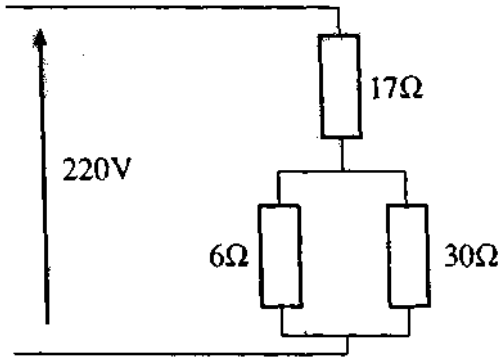

Fig. Q.8

9. An electrical appliance has a resistance of 40 Ω and is supplied with 245 V. Calculate

EACH of the following:

(a) the current; (4)

(b) the power supplied in kW. (4)

10. A 230 V electric kettle is required to heat 0.5 kg of water from 10°C to its boiling point in 5 minutes. Calculate the resistance of the heating element, given that the efficiency of the kettle is 80%. (8)

Note: Specific heat capacity of water is 4.2kJ/kgK

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

Calculate EACH of the following:

(a) the force acting on one side of the coil; (3)

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

12. A moving coil electrical test instrument has a coil resistance of 2.5 Ω and a full scale deflection with 20 mA. Sketch and label simple circuit diagrams to show how the instrument can be arranged to indicate:

(a) a maximum voltage of 20 V; (5)

(b) a maximum current of 3 A. (5)