July 1999

GENERAL ENGINEERING SCIENCE II

Attempt ALL questions

Marks for each part question are shown in brackets

1. *(a)* State the difference between latent heat and sensible heat. (2)

   (b) A block of ice of mass 1.5 kg at a temperature of -6°C is immersed in 3 litres of boiling water.

   Determine the final temperature of the mixture, assuming no heat losses. (6)

   Note: Specific heat capacity of ice is 2.1 kJ/kgK
   Specific heat capacity of water is 4.2kJ/kgK
   Specific latent heat of fusion is 335kJ/kg

2. A steam pipe is 3.85m long at a temperature of 18°C. Determine the increase in length when allowed to expand freely when carrying steam at a temperature of 260°C, given that the coefficient of linear expansion of the pipe material is 1.25×10^{-5}/°C. (6)

3. *(a)* Define Charles' Law. (3)

   (b) The air pressure in a starting air receiver is 40 bar at a temperature of 24°C. A fire in the vicinity causes the temperature to rise to 65°C. Calculate the final pressure of the air in the receiver, neglecting the increase in the size of the receiver. (6)

4. Calculate the mass of air required to burn 5 kg of propane (C_3H_8) in 30% excess air for complete combustion. (10)

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

5. The diameter of each cylinder of a six cylinder single-acting two-stroke diesel engine is 635 mm and the stroke is 1010 mm. Indicator diagrams taken off the engine when running at 2.2 rev/s gave an average area of 563 mm^2. The length of the diagrams is 80mm and the scale of the indicator spring is 1 mm = 100kN/m^2. Calculate the indicated power of the engine. (8)

6. List, giving reasons, FOUR desirable properties of a refrigerant. (8)

7. *(a)* Describe, with the aid of a sketch, the operation of a thermocouple. (8)

   (b) Give ONE example of the use of a thermocouple. (2)

8. Determine, for the circuit shown in Fig. Q.8, the current in EACH resistor. (8)

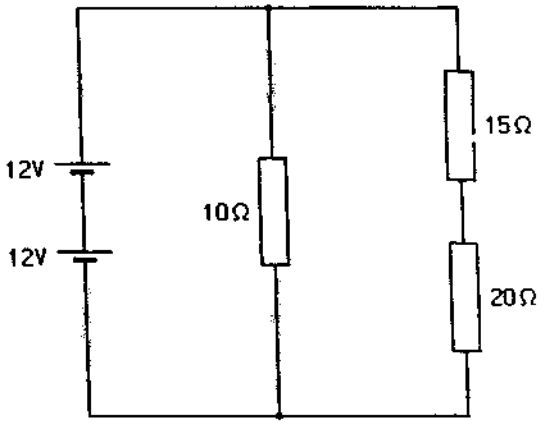

Fig. Q.8

9. A coil of copper wire has a resistance of 150 Ω at 20°C. When the coil is connected across a 240 V d.c. supply the current stabilises at 1.25 A. Calculate the average temperature of the coil. (8)

Note: The temperature coefficient of resistance of copper at 20°C is 0.0039/°C

10. A steel ring, having a mean circumference of 750 mm and a cross-sectional area of 500 mm^2, is wound with a magnetising coil of 120 turns. Determine the current required to set up a magnetic flux of 630 μWb in the ring, using the data from Table Q.10. (9)

Flux density (T)	0.9	1.1	1.2	1.3
Magnetic field strength (A/m)	260	450	600	820

Table Q.10

11. A conductor 500 mm long is moved at a constant speed at right angles to a uniform magnetic field of density 0.4 T. The conductor forms part of a closed circuit with a resistance of 0.5 Ω and the emf induced is 2 V.

Calculate:

(a) the velocity of the conductor; (3)

(b) the force acting on the conductor; (3)

(c) the work done when the conductor has moved 600 m. (2)

12. *(a)* State the essential properties of:

(i) a good electrical conductor; (1)

(ii) a good electrical insulator. (1)

(b) Give THREE examples of materials used in EACH case in Q. 12(a). (6)