Apr 2005

GENERAL ENGINEERING SCIENCE II

Attempt ALL questions

Marks for each question are shown in brackets.

1. A solid cast iron sphere of 250mm diameter has 2MJ of heat energy transferred to it.

Calculate the increase in the diameter in mm. (9)

Note: for cast iron:

density = 7200 kg/m^3
specific heat capacity = 0.54 kJ/kgK
coefficient of linear expansion = 1.2 x 10^{-5}/°C
volume of a sphere = $\pi d^3/6$

2. (a) Define Charles' Law for a perfect gas. (2)

(b) Air at a pressure and volume of 50kN/m^2 gauge and 3.25m^3 respectively is compressed at constant temperature to a gauge pressure of 4 bar. The atmospheric pressure is 1 bar.

Calculate the final volume. (5)

3. Methanol (CH_3OH) is completely burned in 25% excess air.

Calculate the mass of methanol burned when 50kg of air is supplied. (9)

Note: relative atomic masses: carbon = 12, hydrogen = 1, oxygen = 16
air contains 23% oxygen by mass

4. (a) Explain the term *combustion.* (2)

(b) With reference to internal combustion engines, describe the effect of supplying EACH of the following:

(i) inadequate air; (3)

(ii) excess air. (3)

5. Define EACH of the following terms and state the formula for calculating the values of such:

(a) indicated power; (3)

(b) brake power; (2)

(c) cooling water power; (2)

(d) exhaust gas power. (2)

6. (a) State the condition of the refrigerant fluid at EACH of the main points of the simple vapour compression refrigeration cycle. (4)

(b) State the essential property of a refrigeration fluid and THREE other desirable properties. (4)

7. The resistance of a 240V tungsten filament lamp at its working temperature of 2000°C is 1000 ohms.

Calculate the maximum initial current when the lamp is switched on at a room temperature of 15°C. (10)

Note: for tungsten $\alpha_o = 0.005/°C$.

8. A battery of e.m.f. 12V and internal resistance 0.2Ω is connected across the terminals XY as shown in Fig Q8.

Calculate EACH of the following:

(a) the total resistance of the circuit; (4)

(b) the current flowing in the 2.9Ω resistor; **(4)**

(c) the potential difference across the 5.1 Ω resistor. (2)

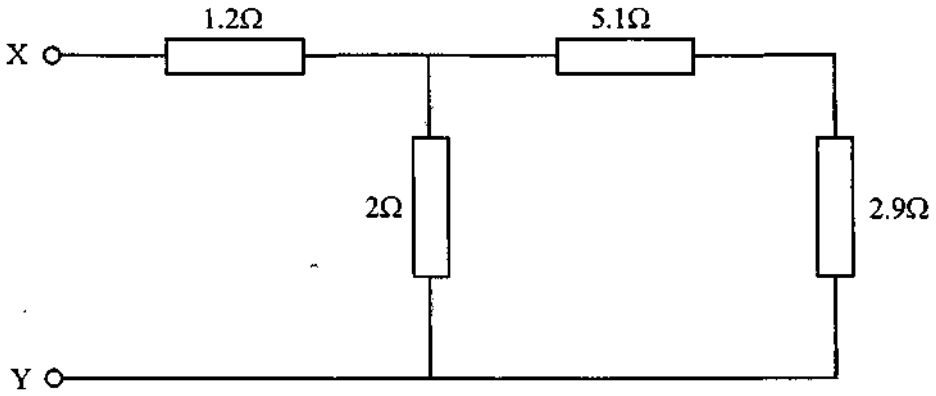

Fig Q8

9. With reference to a moving coil meter, explain EACH of the following terms, describing how the torque is produced:

(a) deflecting or driving torque; (3)

(b) restraining torque; (3)

(c) damping torque. (3)

10. (a) State the THREE main effects of an electric current. (3)

(b) State TWO practical examples of EACH effect in Q 10(a). (6)

11. Sketch and label an electrical circuit diagram that contains a battery of cells with an internal resistance, a switch, short circuit protection, two lamps in parallel and a device for dimming the lamps. (6)

12. A conductor 350mm long carries a current of 10A and is at right angles to a magnetic field lying between two circular pole faces each of 60mm radius. The total flux between the pole faces is 0.5mWb.

Calculate the force exerted on the conductor. (6)