

March 1990

**GENERAL ENGINEERING SCIENCE II**

**Attempt ALL questions**

**Marks for each part question are shown in brackets**

1. A mass of 410 kg of oil is cooled in one hour from a temperature of 60°C to 37°C in a cooler consisting of a bank of tubes through which hot oil passes and water circulates round the outside of the tubes. Water inlet temperature is 9°C and outlet temperature is 52°C.

Calculate the mass of cooling water required per hour. (9)

*Specific heat capacity values are, oil = 2.05 kJ/kgK  
water = 4.18 kJ/kgK*

2. During a constant temperature process gas is reduced from a pressure of 2.5 bar to 1.25 bar. The initial volume of the gas is 0.75 m<sup>3</sup> and the temperature is 27°C.

Calculate:

(a) the final volume; (4)

(b) the mass of gas. (4)

*For the gas R is 4.156 kJ/kgK.*

3. With regard to the combustion process, explain:

(a) the meaning of excess air supply; (2)

(b) the reason for always providing excess air; (4)

(c) the effects of an inadequate air supply. (2)

4. A thermometer at 12°C contains 450mm<sup>3</sup> of liquid and this volume increases to 460mm<sup>3</sup> when sensing a higher temperature.

Calculate the value of this temperature. (8)

*Coefficient of cubical expansion for the fluid is  $18 \times 10^{-5}/^{\circ}\text{C}$*

5. The indicated power of an internal combustion engine is given by

$$iP = P_m A L N.$$

Derive this expression explaining the terms and units used. (8)

6. Sketch a vapour compression type domestic refrigeration plant and briefly describe the four processes involved. (9)

7. Fig. Q.7 represents a wiring diagram for the measurement of electrical current range 0-1A or alternatively electrical voltage 0-1V.

The instrument which has a resistance of  $2\Omega$  gives a full scale deflection when a current of 2mA is passed through its coil.

(a) State the reading function of the instrument when:

(i) switches are open; (1)

(ii) switches are closed; (1)

(b) Calculate:

(i) the value of resistor  $R_1$ ; (3)

(ii) the value of resistor  $R_2$ ; (3)

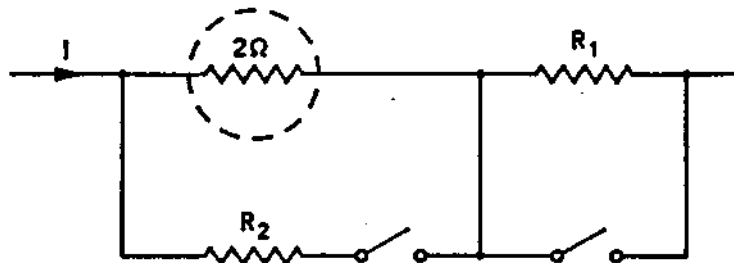


Fig. Q.7

8. (a) Sketch and label:

(i) a lead acid secondary cell; (3)

(ii) an alkaline primary cell. (3)

(b) State ONE advantage and ONE disadvantage of each cell type. (4)

9. State the main difference between electromagnets and permanent magnets and explain why electromagnets are preferred for industrial applications. (8)

10. Define and state the units for each of the following terms:

(a) magnetic flux density; (4)

(b) magnetomotive force. (4)

11. (a) Explain the term internal resistance of an electric cell stating the effect it has on the e.m.f. of the cell. (4)

(b) The terminal voltage of a cell is 1.1 V when supplying current of 0.6 A.

The e.m.f. of the cell is 1.2V.

Calculate the internal resistance of the cell. (4)

12. Resistors of  $2\ \Omega$ ,  $3\ \Omega$ . and  $5\ \Omega$  are connected in series to a 250V supply.

Calculate:

(a) the current flowing; (3)

(b) the voltage across each resistor; (3)

(c) the electrical power dissipated. (2)