

GENERAL ENGINEERING SCIENCE II

Attempt ALL questions

Marks for each question are shown in brackets.

1. Define EACH of the following terms, stating ONE example of EACH:

- (a) sensible heat; (2)
- (b) enthalpy of fusion; (3)
- (c) enthalpy of evaporation. (3)

2. A mass of 0.4kg of aluminium is heated to 200°C and then immersed in 1.6kg of water contained in a copper vessel having a mass of 0.24kg. The initial temperature of the water and copper is 12°C, the final temperature is 21.8°C and there are no heat losses.

Calculate the specific heat capacity of the aluminium. (9)

*Note: the specific heat capacity of copper = 0.39kJ/kgK  
the specific heat capacity of water = 4.17kJ/kgK*

3. An oil fuel consists of 87% carbon and 13% hydrogen.

Calculate the minimum mass of air to completely burn 1kg of fuel. (8)

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

4. A perfect gas at an initial pressure, temperature and volume of 275kN/m<sup>2</sup>, 185°C and 0.09m<sup>3</sup> respectively is cooled at constant pressure until its temperature is 15°C.

Calculate EACH of the following:

- (a) the mass of the gas; (3)
- (b) the final volume; (3)
- (c) the heat rejected. (4)

*Note: R = 0.29kJ/kgK c = 1.005kJ/kgK*

5. An oil engine uses 0.225kg of oil per minute when developing a brake power of 30kW. The mechanical efficiency is 80%.

Calculate the specific fuel consumption for EACH of the following:

(a) on a brake power basis; (3)

(b) on an indicated power basis. (5)

6. (a) State a device used to counter the effect of expansion in long pipes due to temperature change. (2)

(b) A length of lead piping is 30m long when measured at a temperature of 15°C. After hot water has been flowing through it the temperature of the pipe is found to have been raised to 60°C.

Calculate the new length of the lead pipe. (5)

*Note: the coefficient of linear expansion of lead = 0.000028/°C*

7. An electric fire operated from a 240V supply has a heating element comprising of two 30 ohm coils. The coils may be connected in series to give a low setting, or in parallel to give a high setting.

Calculate EACH of the following:

(a) the power output for the low setting; (5)

(b) the power output for the high setting. (5)

8. A battery consists of 10 cells connected in series, each cell having an emf of 2V and an internal resistance of 0.05 ohm. The battery supplies a current of 5 amps to an electric motor.

Calculate EACH of the following:

(a) the potential difference of the battery; (5)

(b) the resistance of the electric motor. (3)

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

(b) List TWO practical applications of EACH effect stated in Q9(a). (3)

10. A magnetising force of  $8000\text{At/m}$  is applied to a ring of mean diameter  $300\text{mm}$  by passing a current through a coil wound on the ring. The coil is uniformly wound and has  $750$  turns.

Calculate the current in the coil. (6)

11. Describe, with the aid of a sketch, the principle of operation of a D.C. motor. (10)

12. A moving coil ammeter has a coil resistance of  $5\text{ ohms}$  and is fully deflected when a current of  $2.5\text{mA}$  flows through it.

Calculate EACH of the following:

- (a) the value of a shunt resistance required in order that the meter will be fully deflected when it is connected into a circuit carrying  $1\text{A}$ ; (5)

- (b) the value of a multiplier to be fitted to enable the meter to be used as a voltmeter with a range of  $0\text{-}50\text{V}$ . (5)