

GENERAL ENGINEERING SCIENCE II

Attempt ALL questions

Marks for each question are shown in brackets.

Section A

1. Explain what is meant by EACH of the following terms:

- (a) Heat energy; (2)
- (b) Higher calorific value; (2)
- (c) Convection; (2)
- (d) Enthalpy of fusion. (2)

2. (a) Define Boyles Law. (2)

- (b) A perfect gas at an initial pressure, temperature and volume of 375 kPa, 185°C and 90 litres respectively is cooled at constant pressure until its temperature is 25°C.

Determine EACH of the following:

- (i) the mass of the gas; (3)
- (ii) the final volume in m^3 . (3)

Note: $R = 0.29 \text{ kJ/kgK}$ 3. Propane (C_3H_8) is completely burned using 30% excess air.

Calculate EACH of the following:

- (a) the mass of carbon dioxide in the exhaust gases per kg of fuel; (5)
- (b) the mass of nitrogen in the exhaust gases per kg of fuel. (5)

4. (a) State TWO desirable properties of refrigerants. (2)

(b) In a vapour compression refrigeration plant, state the primary function of EACH of the following:

(i) the condenser; (2)

(ii) the expansion valve; (2)

(iii) the evaporator. (2)

5. A 6 cylinder, 2 stroke, diesel engine is tested over a 24 hour period and uses 11 tonnes of fuel. The power of the engine is tested using a dynamometer which gives a steady state torque reading of 28 kNm at 800 rpm. The mechanical efficiency was later found to be 89%.

Calculate EACH of the following:

(a) the brake power; (3)

(b) the indicated specific fuel consumption; (3)

(c) the brake thermal efficiency. (2)

Note: the calorific value of the fuel = 44 MJ/kg

6. A cast iron block has a volume of 0.217 m^3 at 450°C . Its temperature reduces to 10°C .

Determine EACH of the following:

(a) the approximate final volume; (4)

(b) the approximate percentage change in the volume. (4)

Note: the coefficient of linear expansion of cast iron = 11×10^{-6}

Section B

7. (a) Describe the structure of an atom. (2)
(b) Explain what feature of the atomic structure of some materials makes them good conductors. (2)
(c) Explain what is meant by electrical current (flow). (2)
(d) Explain what else is required to make current flow happen. (2)
8. (a) List FOUR means by which electricity may be produced. (2)
(b) State the THREE main effects of an electric current. (3)
(c) State TWO practical examples of EACH effect in Q8(b). (3)
9. An emergency lighting system is fed from a d.c supply. In part of the circuit three lights are connected in parallel and each draws a current of 4 A. The lamps have a resistance of 3.5Ω each.
- Calculate EACH of the following: (4)
- (a) the power dissipated by each lamp; (4)
(b) the total power consumed by the circuit if the total resistance of the cables was 0.4Ω ; (2)
(c) the supply voltage.

10. The circuit shown in Fig Q10 is connected across a 36 V supply. The power dissipated in the circuit is 540 W.

Calculate EACH of the following:

- (a) the value of the unknown resistor R ; (3)
- (b) the power dissipated by this resistor; (3)
- (c) the total energy consumed by the circuit in 2 hours. (2)

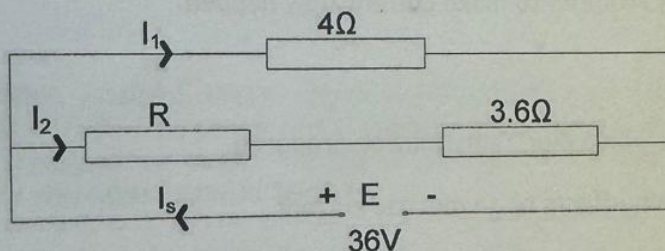


Fig Q10

11. A wooden joist is 4 m long x 30 cm wide x 75 mm deep and floats horizontally in sea water of density 1025 kg/m^3 .

Determine the height of wood above the water surface (freeboard) given that the wood has a density of 750 kg/m^3 . (8)

12. A ship with a displacement of 5050 tonne has a rectangular fuel tank 6 m long, 3 m wide and 3 m deep. The tank is full of fuel oil with a density of 950 kg/m^3 and the tank bottom is 0.8 m above the keel. The KG of the vessel is 3.9 m when the tank is full.

Determine the new KG after all of the oil from this tank has been used. (5)