GENERAL ENGINEERING SCIENCE II

Attempt ALL questions

Marks for each question are shown in brackets.

Section A

1. (a) Explain what is meant by the enthalpy of fusion. (2)

(b) 100 grams of ice at -5°C is heated with 40 kJ of energy.

Determine the final state and temperature. (6)

*Note:* *Specific heat capacity of ice = 2.11kJ/kgK,*
*Specific heat capacity of water = 4.18kJ/kgK,*
*Enthalpy of fusion of water = 335kJ/kg*

2. (a) State Boyles Law. (2)

(b) A perfect gas at an initial pressure, temperature and volume of 2.75 bar, 185°C and 90 litres respectively is cooled at constant pressure until its temperature is 15°C.

Determine EACH of the following:

(i) the initial mass of the gas; (3)

(ii) the final volume in $m^3$. (3)

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

3. An 8 cylinder, 4 stroke diesel has a cylinder bore of 350 mm with a stroke of 400 mm. Indicator cards were taken and each had a mean effective height of 22 mm.

The power of the engine was also tested using a dynamometer which gives a steady state torque reading of 36 kNm at 800 rpm.

Determine EACH of the following:

(a) the brake power; (3)

(b) the indicated power; (3)

(c) the mechanical efficiency. (2)

*Note: Indicator spring constant was 80 kN/m²/mm*

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. 1.5 kg of $C_3H_7$ is completely burned in air.

Determine EACH of the following:

(a) the stoichiometric mass of air.required; (4)

(b) the mass of carbon dioxide in the exhaust gases. (4)

*Note: assume air is 23% oxygen by mass*

6. At point 1 of a cyclic process 0.2 $m^3$ of air at 1.01325 bar and 20°C occupies a cylinder at bottom dead centre. Assume that losses are negligible:

(a) at top dead centre, point 2, the gas has been compressed to one tenth of its original volume at point 1. Determine the pressure assuming no temperature rise; (2)

(b) at top dead centre there is a heat addition of 60kJ which causes a pressure rise at constant volume to point 3. Determine the pressure as a result of this process; (6)

(c) the cycle continues with an expansion from point 3 back to bottom dead centre, point 4, determine the final pressure at point 4 if the temperature remains constant in this process. (2)

*Note: R = 0.287 kJ/kgK, Cv = 0.718 kJ/kgK*

## Section B

7. (a) State two sources of electricity. (2)

(b) Describe the characteristic of the atomic structure of conductors that makes them good conductors of electricity and give TWO examples. (3)

(c) Describe the characteristic of the atomic structure of insulators that makes them bad conductors of electricity and give TWO examples. (3)

8. For the circuit shown in FIG Q8 which has a battery e.m.f. of 24 V.

Determine EACH of the following:

(a) the battery terminal voltage; (4)

(b) the current at points 3, 2 and 1 in the circuit. (4)

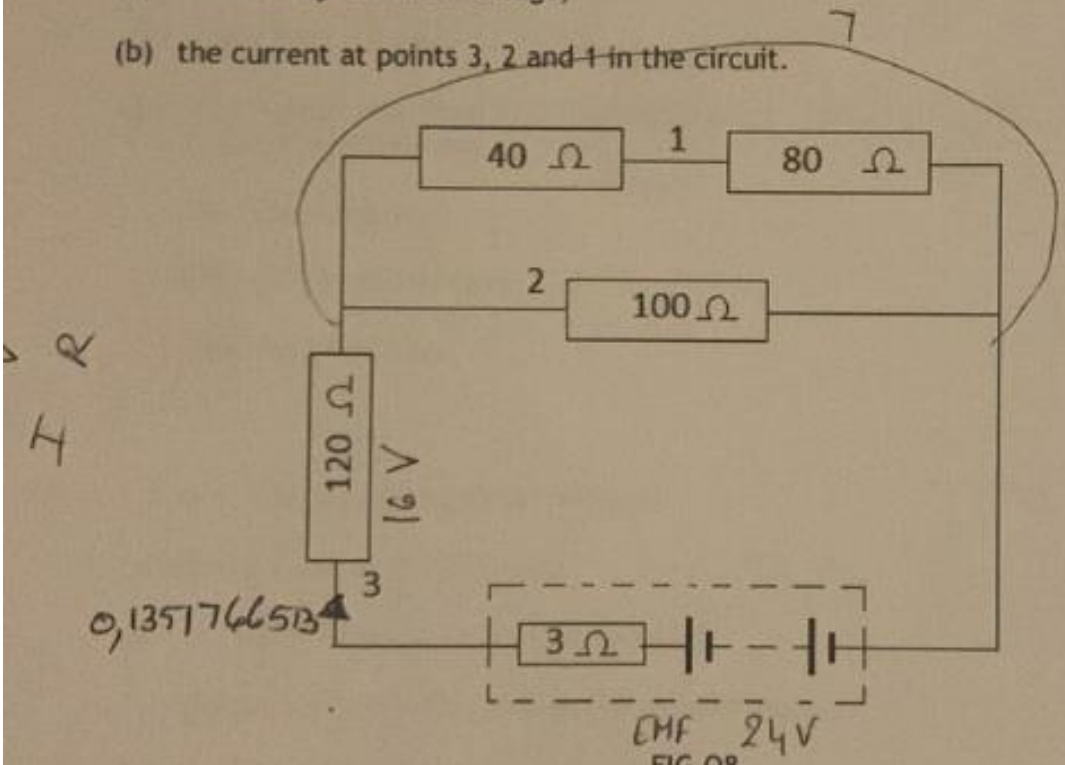


FIG Q8

9. (a) State what is the difference between a primary and a secondary cell. (2)

(b) Describe with the aid of a diagram the electro-chemical action of a lead/acid cell. (8)

10. (a) State Lenz's Law. (2)

(b) A conductor with an effective length of 500 mm creates a magnetic flux of 280 μWb when carrying a current of 45 A at right angles to a magnetic field.

The force on the conductor is 40 N.

Calculate the diameter of the conductor. (6)

11. A barge is in dry dock as shown in FIG Q11. The dry dock is rectangular with a length of 70 m and a breadth of 30 m. The dry dock is flooded and the barge, which has a beam of 20 m and a length of 62 m, just floats off the blocks when the water depth is 4.4 m. The barge displaces 6234 $m^3$ of seawater of relative density 1.025.

Determine EACH of the following:

(a) the mass of the barge; (5)

(b) the pressure on the bottom of the hull plating. Assume the barge to be a rectangular box barge. (3)

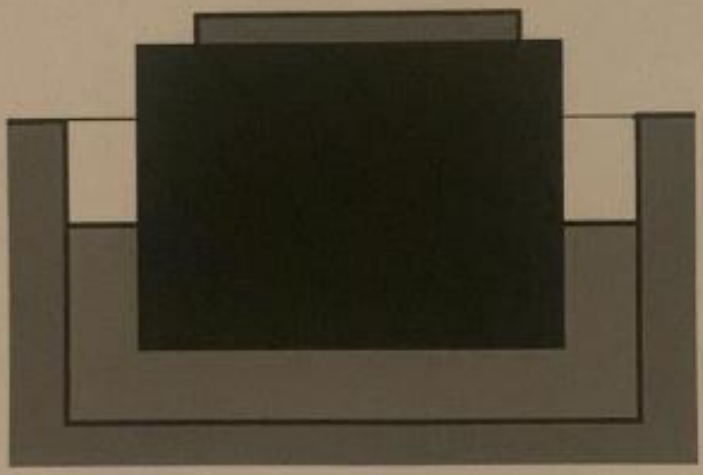

FIG Q11

12. A vessel has a displacement volume of 19000 $m^3$ in sea water. It has a rectangular fuel tank 10 m long, 8 m wide and 4 m deep. The tank is full of fuel oil with a density of 900 $kg/m^3$ and the tank bottom is 1.2 m above the keel. The KG of the vessel is 6.2 m when the tank is full.

Calculate the new KG after all of the oil has been used. (8)

*Note: the relative density of sea water is 1.025*