# SECTION A

*Answer **ALL** questions in this section.*

1. (a) (i) Define conductance of an electrolyte.

    (ii) State Faraday's First Law of electrolysis.

    (iii) An electric current is passed through three cells in series of copper sulphate solution, silver nitrate and potassium iodide solutions. If 0.75 g of copper solid is deposited, determine the weights of iodine and silver liberated.

                    (8 marks)

  (b) (i) Differentiate between an acid and a base.

    (ii) $H_3Po_4$ acid dissociates in aqueous solution in three steps with $pK_1$, $pK_2$ and $pK_3$ with pH values 2.15, 7.20 and 12.7 respectively. If $Na_2Hpo_4$ is dissolved in water, determine the nature of the resulting solution.    (4 marks)

  (c) (i) Explain the difference between longitudinal and transverse waves.

    (ii) Describe with aid of a diagram single-slit diffraction of light waves.

    (iii) The pressure recorded by a constant volume gas thermometer at a temperature T is $5.5 \times 10^4$ N/m.
Determine the temperature T if the pressure at 273k is $3.5 \times 10^4$ N/m.

                    (8 marks)

2. (a) (i) State **three** conditions in order for a rigid body to remain in equilibrium under the action of a set of coplanar forces.

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(ii) Figure 1 shows the framework of a lifting bridge, and indicates a particular loading. The framework consists of equilateral triangles. Determine analytically:

- the force 'P';

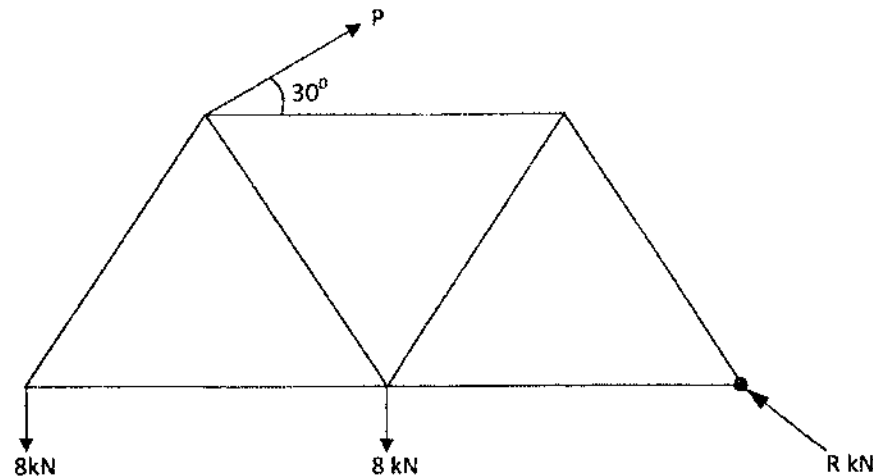- the magnitude and direction of the reaction 'R' at the pivot.

(8 marks)



**FIG 1**

(b) (i) Show that, for small oscillations the motion of a simple pendulum is simple harmonic.

(ii) Derive an expression for the period of oscillation in terms of the length of the pendulum in (b)(i).

(5 marks)

(c) (i) Explain briefly the principle of conservation of linear momentum.

(ii) A pile driver of mass 1 tonne falls freely through a distance of 5 m before striking the pile of mass 0.5 tonne. When the pile is nearly fully driven, the average resistance is 700 kN. Determine:

- the penetration per blow at that stage;

- the kinetic energy lost at impact.

(7 marks)

3. (a) State any **three** safety precautions to be observed when working with sheet metal in the workshop. (3 marks)

(b) Describe the procedure of making a wired edge. (5 marks)

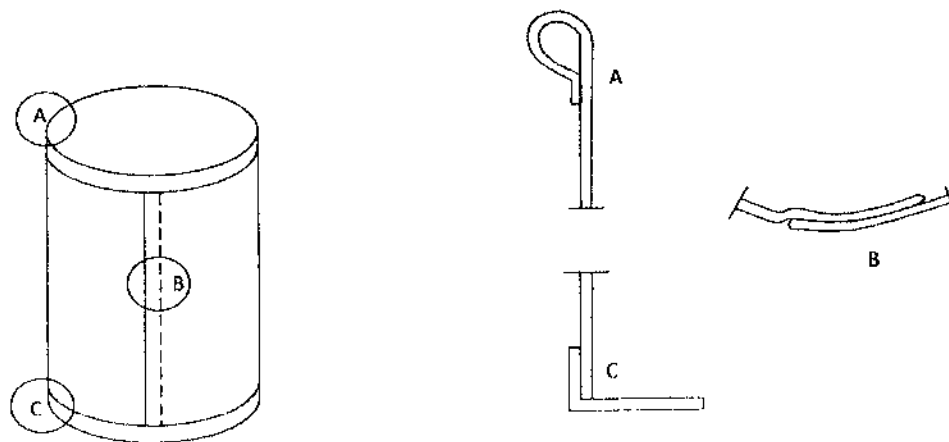(c)   Figure 2 shows a cylinder with bottom and wired edge. The lap joint at B is to be soldered.



FIG 2

(i)   Describe the procedure of making the cylinder.

(ii)   Sketch the development of the cylinder.

(12 marks)

4.   Figure 3 shows an oblique projection of a Support Bracket. Draw full size using first angle projection the following views:
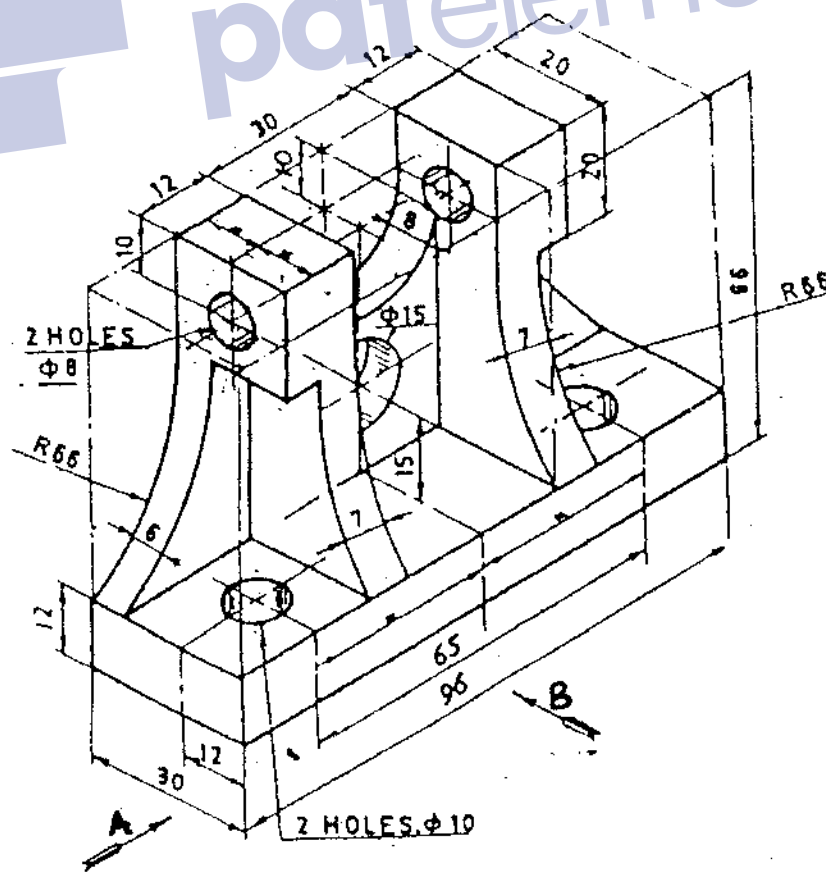


FIG. 3

(a)     a front elevation looking along arrow B;

(b)     an end elevation looking along arrow A;

(c)     plan.

Include **six** major dimensions.                                              (20 marks)

## SECTION B

*Answer any **ONE** question from this section.*

5.    (a)    (i)    State **three** types of radiations.

      (ii)   Explain how the radiations in (a)(i) above can be identified.

                                                                       (4 marks)

      (b)    (i)    Define "half-life".

      (ii)   A radioactive isotope contains $10^{15}$ atoms at certain instant. If the half-life of
             the isotope is 30 days, calculate:

             - the count rate;

             - the number of atoms disintegrated in the first second.

                                                                       (8 marks)

      (c)    (i)    State Mendeleef's Periodic Law.

      (ii)   Write down electronic configuration of an element with atomic number 24.

      (iii)  A manufacturer designs an immersion heater which has a power output of
             1500W. The heater is used to raise the temperature of 5 kg of a liquid from
             $5^0C$ to $55^0C$ in 10 minutes. Assuming that 25% of the energy is lost to the
             surrounding, determine the specific heat capacity of the liquid.

                                                                       (8 marks)

6.    (a)    (i)    With the aid of sketches, explain the following types of fluid flow:

             - laminar;

             - turbulent.

      (ii)   Define the term "centre of pressure" with reference to a surface immersed in a
             liquid.

(iii) Figure 4 shows a rectangular door, 4 m deep by 2 m wide, covering an opening in the vertical side of a tank. The top edge is 3 m below the surface of the water in the tank, and is hinged to the tank wall. The lower edge is bolted to the wall.
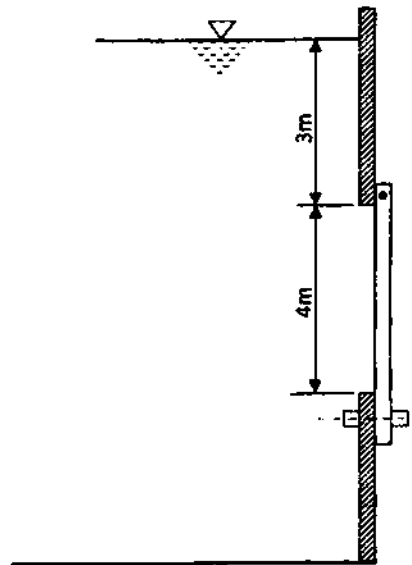


**FIG 4**

Determine:

- the resultant water thrust on the door;

- the force acting on the bolts.

(10 marks)

(b) (i) A curved plate deflects a jet of water through 180⁰ as shown in figure 5. Determine the force on the plate if the jet has a diameter of 25 mm, and a velocity of 30 ms⁻¹.
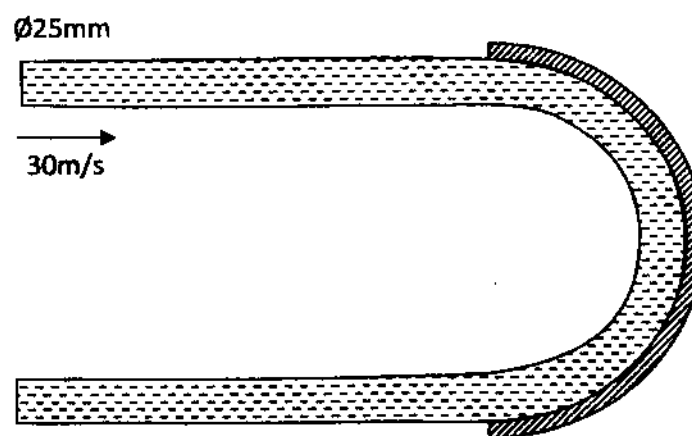Assume that there is no friction loss at the surface of the plate.



Ø25mm

30m/s

**FIG 5**