GENERAL ENGINEERING SCIENCE I

Attempt ALL questions

Marks for each question are shown in brackets.
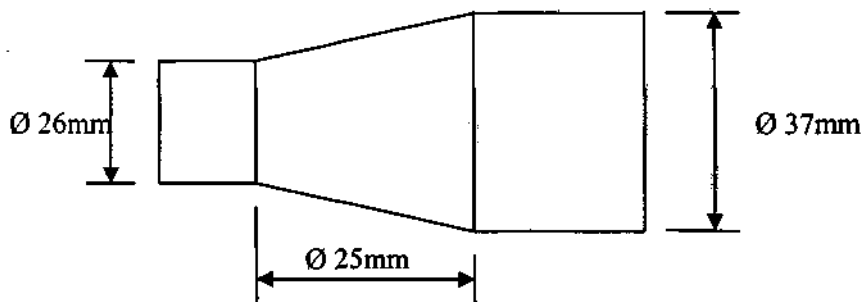
1.   A flywheel has a diameter of 0.68m and turns at 1400 rev/min.

    Calculate EACH of the following:

    (a)   the angular velocity in rad/s;   (4)

    (b)   the linear velocity in m/s of a point on the flywheel rim.   (4)

2.   Fig Q2 shows the tapered end of a pump rod.

    Calculate the angle of the taper.

FigQ2

(8)

3.   A solid sphere has a diameter of 186mm.

    Calculate EACH of the following:

    (a)   the surface area in m^2;   (4)

    (b)   the volume in m^3.   (4)

4.   A rope pulley system consists of three sheaves in one block and two sheaves in the other.
    The rope pulley system is applied horizontally to move a mass of 650kg along a horizontal plane. The
    coefficient of friction equals 0.52 between the mass and the plane.

    Calculate the effort required when the three sheave pulley is nearest the load, given that the
    efficiency of the system is 0.55.   (10)

5. One side of a triangle is 46.8mm long.
    One adjacent side is 38% longer and the angle between these sides is 59°.

    Calculate the area of the triangle. (8)

6. A pump rod is 590mm long and has a modulus of elasticity $E = 202GN/m^2$.

    Calculate the final loaded length when subjected to a direct compressive stress of $18N/mm^2$. (10)

7. A ship has a displacement of 1060 tonne. A double bottom tank on the centreline is 1.3m deep
    by 4.2m wide by 5.76m long and is completely filled with water of density $1018kg/m^3$.

    Calculate EACH of the following:

    (a) the mass of water added to the double bottom tank; (3)

    (b) the new position of the ship's centre of gravity G when the tank is filled, given that the original KG is
        3.9m. (5)

8. (a) Define EACH of the following terms as applied to a box shaped vessel:

        (i) centre of buoyancy; (2)

        (ii) metacentre. (2)

    (b) A vessel has a displacement of 1313 tonne. When a mass of 4 tonne, already on board, is moved
        5m across the deck it causes the vessel to heel by 1.3°.

        Calculate the value of GM given   m x d = A GMtan 0. (4)

9. The following formula allows torque to be determined in a shaft.

    $$T = \frac{\pi d^3 \tau}{16}$$

    Where T = Torque, τ = shear stress, d = shaft diameter.

    (a) Transpose the formula to make d the subject. (3)

    (b) Calculate the value of d when T = 575 kNm,   x = 3.14   and τ = 78 MN/m^2. (5)

10. A bulkhead is 17m high and 13m wide and is flooded on one side only with water of density 1023kg/m^3.

Calculate EACH of the following:

(a) the pressure, in bar, at the base of the bulkhead; (3)

(b) the hydrostatic force on an access door, 1.5m x 1.5m, the lower edge of which is situated 2m above the bottom of the bulkhead. (5)

11. Fig Q11 shows a simply supported beam AB.
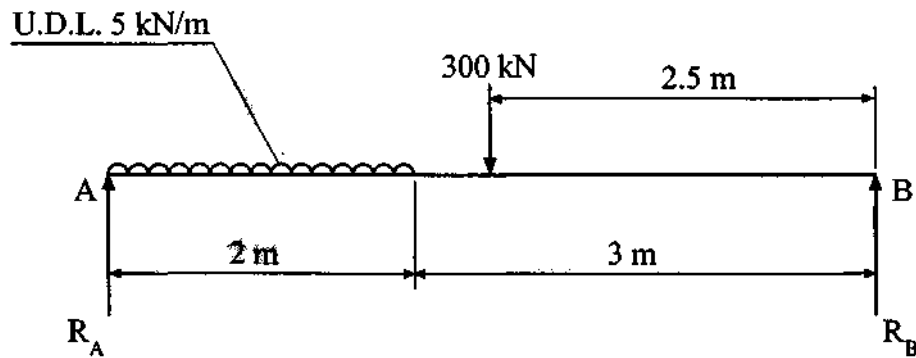
Calculate the value of reactions R_A and R_B (8)

Fig Q11

12. A pump delivers 50m^3 of sea water, having a density of 1025kg/m^3, to a height of 23m in 25 minutes.

Calculate EACH of the following:

(a) the output power of the pump in kW; (5)

(b) the input power of the pump if the efficiency of the pump is 0.73. (3)