GENERAL ENGINEERING SCIENCE I

Attempt ALL questions

Marks for each part question are shown in brackets

1. Evaluate EACH of the following:

    (a) $\qquad 2\frac{3}{4}+1\frac{7}{8}-1\frac{3}{8}$ (4)

    (b) $\qquad 1\frac{2}{3}\times 4\frac{1}{2}\div 1\frac{1}{2}$ (4)

2. A hollow shaft has an inside diameter of 12 mm and has the same mass as a solid shaft of 32 mm diameter, both shafts being of the same length and material.

    Determine the outside diameter of the hollow shaft. (8)

3. A vessel has a displacement of 8700 tonne.

    100 tonne is now loaded on the centreline and moved a distance d metres across the deck causing the vessel to heel by 1.8°.

    KM = 5.3m
    KG in the loaded state = 4.4 m

    Determine how far the 100 tonne mass is moved, given that $m \times d = \Delta\, GM\, tan\ \theta.$ (8)

4. A ladder is 12 metre long and reaches a point on a wall 10.4 metre above the ground.

    Calculate EACH of the following:

    (a) the distance from the wall to the foot of the ladder; (4)

    (b) the angle the ladder makes with the wall. (4)

5. A sphere has a curved surface area of 4.91 m^2.

    Determine the volume of the sphere in m^3. (8)

6. A ship has a displacement of 5480 tonne, KG = 3.9 m.

    A centreline double bottom tank 15 m wide, 7 m long, and 2.3 m deep is now filled with fresh water.

    Determine the new position of the ship's centre of gravity G. (8)

7. A ship slows from 14 knots to 5 knots in 15 minutes.

    (a) Sketch the velocity-time diagram. (4)

    (b) Determine the distance travelled in nautical miles. (4)

8. A flywheel is accelerated from 575 rev/min to 925 rev/min in 28 seconds.

   Determine EACH of the following:

   (a) the acceleration in rad/s²; (4)

   (b) the number of revolutions turned during the 28 seconds. (4)

9. Fig. Q.9 shows a wall crane.

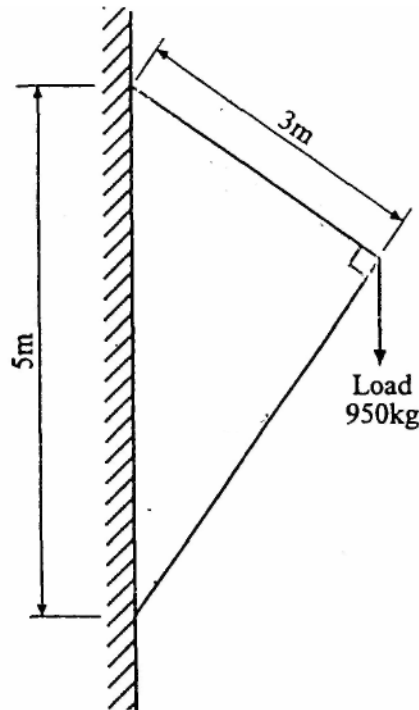   Determine the force in the jib and the tie. (8)

Fig. Q.9

10. A vertical steel bar of 20mm diameter supports a vertical load of 3.25 tonne. The bar is 0.5 metre long and has a modulus of elasticity (E) for the material of 200GN/m²

    Determine the compression of the bar, in millimetres, under these conditions. (10)

11. (a) With reference to machines, define EACH of the following terms:

         (i) mechanical advantage; (1)
         (ii) velocity ratio; (1)
         (iii) efficiency. (1)

    (b) A machine has an efficiency of 58% when lifting a load of 3.1 tonne.

        Determine the effort required to lift the 3.1 tonne given that the velocity ratio under this condition is 260. (7)

12. A tank with a base area of 3.8 m^2 is 3.3 m deep and is two thirds full of water of density 1018 kg/m^3.

Determine EACH of the following:

(a) the pressure on the bottom of the tank; (3)

(b) the thrust on the bottom of the tank when the tank is completely filled and the water

rises 2.7 m up the sounding pipe. (5)