Feb 2002

GENERAL ENGINEERING SCIENCE I

Attempt ALL questions

Marks for each part question are shown in brackets

1. Simplify EACH of the following:

(a) $\dfrac{X^2 \times X^3 \times X^5}{X^3 \times X^4}$ (4)

(b) $\dfrac{X}{2} + \dfrac{2X}{3} - \dfrac{4X}{5}$ (4)

2. A ladder 14 metres long makes an angle of 27° with a vertical wall.

Determine the distance from the wall to the foot of the ladder. (8)

3. A sphere has a diameter of 100 mm.

Determine EACH of the following:

(a) the volume of the sphere in m^3; (4)

(b) the surface area of the sphere in m^2. (4)

4. Three cylinders have diameters that are in the ratio 3:5:8. The diameter of the smallest cylinder is 380 mm.

Determine EACH of the following:

(a) the other two diameters; (4)

(b) the ratio of cylinder volumes if all the cylinders have the same length. (4)

5. Determine the inside diameter of a pipe that will deliver six times the volume of liquid as a pipe 35 mm diameter. Assume that the liquid velocity remains constant. (8)

6. *(a)* Plot the graph of the equation $y = x^2 - 2$ between the limits of $x = -1$ and $x = 3$. (6)

(b) Indicate on the graph in *Q.6(a)* the value of *y* when $x = 1.5$. (2)

Suggested scale *x axis: 4 cm = 1 unit*
y axis: 2 cm = 1 unit

7. A drydock gate is 18 metres wide and has water to a depth of 12.8 metres on one side only. Density of water 1019 kg/m^3.

Determine EACH of the following:

(a) the pressure at the bottom of the gate; (4)

(b) the load on the gate in MN. (4)

8. Fig. Q.8 shows a simple wall crane carrying a load of 1.6 tonne.

Determine, by any suitable means EACH of the following:

(a) the force in the tie; (4)

(b) the force in the jib. (4)

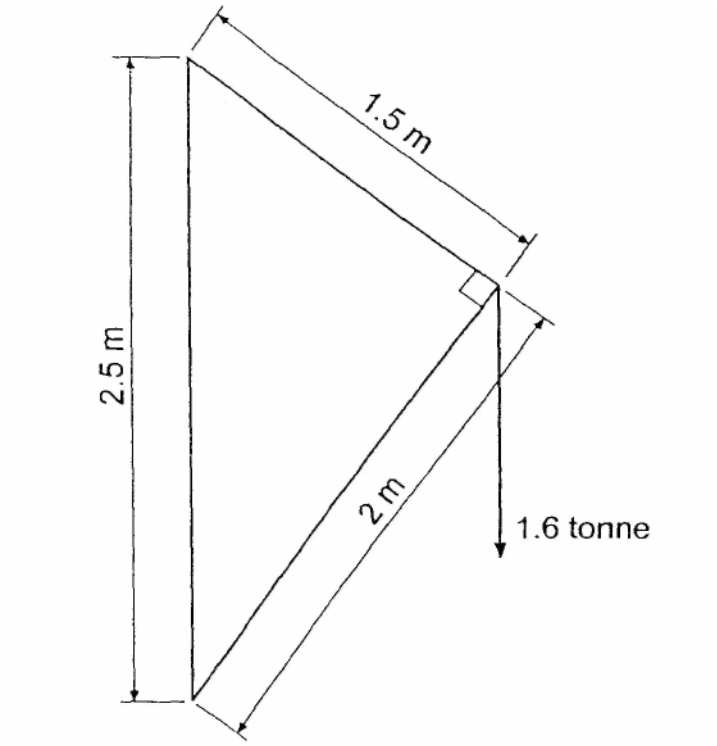

Fig. Q.8

9. The velocity of a 45kg mass is increased from 2.2 m/s to 2.9 m/s in 1.8 seconds.

(a) Calculate the accelerating force required. (5)

(b) The mass is now retarded at 0.3 m/s^2 until the mass just comes to rest.

Calculate, for the retardation period, EACH of the following:

(i) the time taken to come to rest; (3)
(ii) the distance travelled. (2)

10. A pump rod is 480mm long and has a modulus of elasticity E = 205GN/m^2.

Determine its new length when subjected to a compressive stress of 18N/mm^2. (10)

11. (*a*) A vessel has a displacement of 13450 tonne and when a mass of 28 tonne, already on board, is moved 18 metres transversely across the deck, an angle of 1.6° is produced.

Determine the position of the centre of gravity KG above the keel. (6)

Given that $m \times d = \Delta GM \tan \theta$, *and KM = 7.6 metre*

(b) State what effect the removal of this 28 tonne mass will have on the position of G and the stability of the vessel. (2)

12. A vessel has a displacement of 3000 tonne and a KG of 3.9 metre.

A centreline double bottom tank, 16 metre long, 10 metre beam, and 1.6 metre deep is now filled with fuel oil of specific gravity 0.878.

Determine the new position of the centre of gravity KG. (8)