June 2001

GENERAL ENGINEERING SCIENCE I

Attempt ALL questions

Marks for each part question are shown in brackets

1. Solve for *X* in the following equation:

$$2(X + 5) - 3(X - 4) = X + 12 \quad (8)$$

2. The law of a straight line is given by $Y = aX + b$

(a) Define the term *'a'* in the expression. (2)

(b) Define the term *'b'* in the expression. (2)

(c) (i) Plot and join the pairs of points in Table Q.2 (2)
(ii) Determine the values of 'a' and *'b'* from the graph. (2)

X	−1	0	2
Y	0	1	3

Suggested scale:
***X* axis: 4 cm = 1 unit**
***Y* axis: 5 cm = 1 unit**

Table Q.2

3. The curved surface area of a right cone having a slant height of 24 cm is 678 cm^2 .

Determine EACH of the following:

(a) the base diameter of the cone to the nearest cm; (4)

(b) the perpendicular height. (4)

4. A screw jack has a single start thread of 3mm pitch. An effort of 50 N is applied to the end of the operating handle, which travels 1.8 metre for each turn.

Determine, when the jack is lifting a load of 483 kg, EACH of the following:

(a) the mechanical advantage; (3)

(b) the velocity ratio; (3)

(c) the efficiency. (2)

5. Determine the draught of a box barge which is 27 metres long and 11 metres beam.

The barge has a displacement of 1507 tonne and the density of the water is 1015kg/m^3. (6)

6. A body has a mass of 23 kg.

(a) Determine the least force applied parallel to the horizontal plane to just cause motion when the coefficient of friction μ is 0.41. (4)

(b) The coefficient of friction μ is now reduced by 0.15 by the use of a suitable lubricant.

Express the reduction in effort needed to move the body as a percentage of the original force calculated in *Q.6(a).* (6)

7. Fig. Q.7 shows a vertical bulkhead fitted with a door. These are flooded with seawater of density 1025kg/m^3 on one side only.

Determine EACH of the following:

(a) the depth of flooding if the pressure at the bottom of the bulkhead is 120.67kN/m^2. (5)

(b) the load on the door. (5)

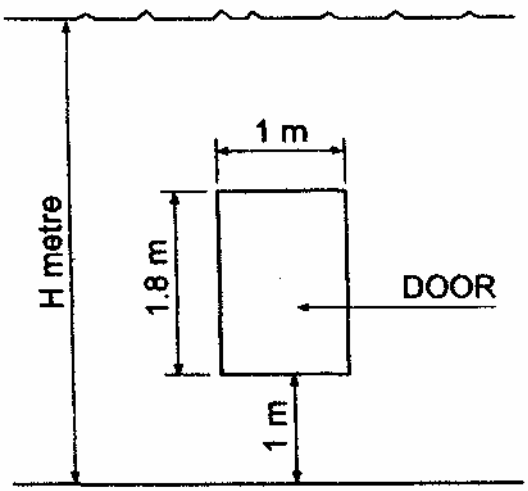

Fig. Q.7

8. A wire rope is subjected to a tensile test and fails at a load of 2325 kg. The effective cross section area is 48mm^2.

(a) Determine EACH of the following:

(i) the breaking tensile stress; (3)

(ii) the safe working load if a Factor of Safety of 5 is to be given to ropes of this size. (3)

(b) Define the term *linear strain.* (2)

9. Fig. Q.9 shows a simply supported beam.

Determine EACH of the following:

(a) the value of W so that the reaction R_B does not exceed 250 kN. (5)

(b) the value of the reaction R_A. (3)

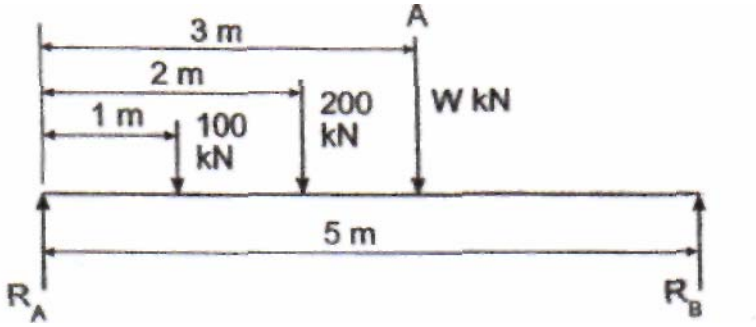

Fig. Q.9

10. An electric motor comes to rest from running speed in *2.25* minutes and turns through 1670 revolutions whilst slowing down.

Determine the running speed in rev/min. (8)

11. A vessel has an underwater volume of 7805 m^3 when floating in water of density 1025 kg/m^3.

The values of KG and KM for the vessel are 6.5 m and 7.3 m respectively.

A mass of 45 tonne is now loaded on the centreline and then moved 5 m to port.

Calculate the angle of heel adopted by the vessel. (8)

Given that $m \times d = \Delta\, GM \tan\theta$

12. A box barge has a beam of 8 metres and floats at a draught of 4.5 metres.

Determine the height of the transverse metacentre *M* above the keel. (8)

Given by $I = \dfrac{Lb^3}{12}$ and $BM = \dfrac{I}{\nabla}$

where L = length (m)

b = beam (m)

∇ = underwater volume (m^3)