Oct 2003

GENERAL ENGINEERING SCIENCE I

Attempt ALL questions

Marks for each question are shown in brackets.

1. Calculate the value of y when $x = 1.957$, given that y varies as the cube of x, and that $y = 18$ when $x = 3$. (8)

2. Fig. Q2 shows a triangular plate ABC.

   Calculate EACH of the following:

   (a) The length of side BC; (4)

   (b) The area of the plate in m^2. (4)

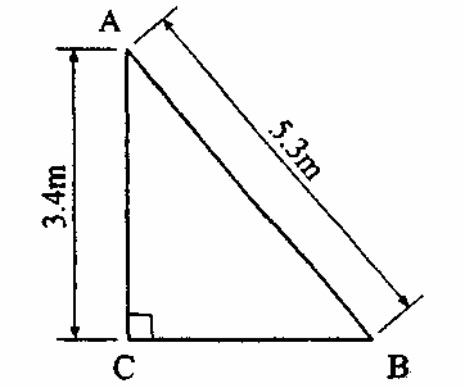

Fig. Q2

3 Table Q3 gives the mass lifted W(kg) and the corresponding effort E(Newtons) for a lifting machine.

W (kg)	3	9	15	18
E (N)	45	73	105	118

Table Q3

(a) Draw a graph for load values between 0 and 20 kg from the data given in Table Q3. (6)

(b) Determine, using the graph drawn in Q3(a) the effort needed to lift a mass of 13kg. (2)

(c) State the significance of the point where the graph in Q3(a) cuts the 0 kg load axis. (2)

Note. Suggested scale W axis 1 cm = 2kg
E axis 1 cm = 5N

4. A hollow shaft has the following dimensions:

Length 3.36m, outside diameter 45mm and inside diameter 83% of the outside diameter.

Calculate the mass of the shaft given that the material has a relative density of 7.3. (10)

5. An accelerating force of 35N is applied to a body of mass 18kg in a horizontal plane.

Calculate EACH of the following:

(a) the acceleration of the body; (3)

(b) the distance the body will travel from rest in 12 seconds. (5)

6. Calculate the draught of a loaded box barge floating in water of density 1018kg/m^3 given that the external pressure on the bottom plating is 51.7kN/m^2. (8)

7. A solid sphere has a diameter of 15cm and is melted down and recast into a rectangular block.

Calculate the length of the block to the nearest cm given that the width is to be 95mm and the height is to be 124mm. (8)

8. (a) Define the radian and express its value in degrees. (4)

(b) Calculate EACH of the following:

(i) the angular velocity in radians/second for the hour hand of a clock; (2)

(ii) the angular velocity in radians/second for the minute hand of a clock. (2)

9. (a) Indicate on a simple transverse sketch of a box barge the position of EACH of the following:

(i) centre of gravity; (1)

(ii) centre of buoyancy; (1)

(iii) metacentre. (1)

(b) Calculate the value of GM for a box barge floating at a draft of 5m, given that KG = 3.83m and BM = 2.79m. (5)

10. Calculate the distance a mass of 15 tonne, already loaded on the vessel, must be moved across the deck to cause the vessel to heel by 1.3°.

Displacement =5333 tonne KM = 4.8m KG = 3.9m.

Given that $m \times d = \Delta GM \tan \theta$. (8)

11. Fig Q11 shows a simply supported beam AB.

The value of the uniformly distributed load is 1.5 kg/m.

Calculate the values of reaction forces R_A and R_B (8)

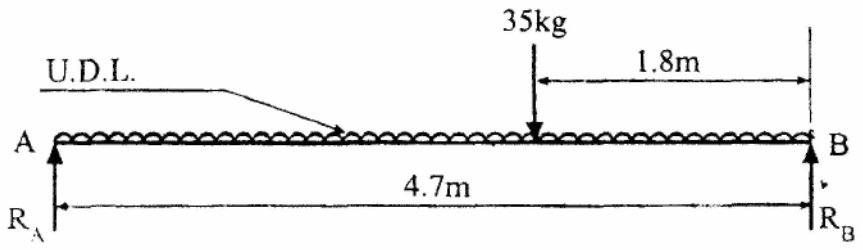

Fig. Q11

12. Fig Q12 shows a circle with two tangents at right angles. Given that the radius of the circle is *x*, prove that the shaded area is equal to $x^2\left(1 - \frac{\pi}{4}\right)$ (8)

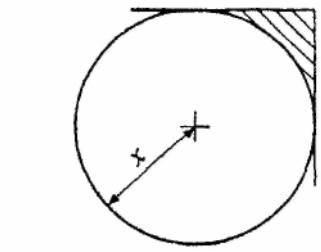

Fig. Q12