Dec 1998

GENERAL ENGINEERING SCIENCE I

Attempt ALL questions

Marks for each part question are shown in brackets

1. If y varies directly as the cube of *x*, and $y = 18$ when $x = 3$, calculate the value of *y* when $x = 1.957$. (8)

2. The formula $I = \dfrac{nE}{R + nr}$ is used to determine the current when batteries are connected in series.

   (a) Transpose the formula to make *n* the subject (5)

   (b) Determine the value of *n* when $I = 1.5$, $E = 1.71428$, $r = 1.1$ and $R = 0.3$. (3)

3. Simplify the following expressions, using fractions and showing ALL working:

   (a) $\dfrac{1}{4} \div \left(\dfrac{1}{8} \times \dfrac{2}{5} \right)$ (4)

   (b) $\left(\dfrac{15}{8} \times \dfrac{12}{5} \right) - \dfrac{11}{3}$ (4)

4. Fig. Q.4 shows a triangular plate ABC.

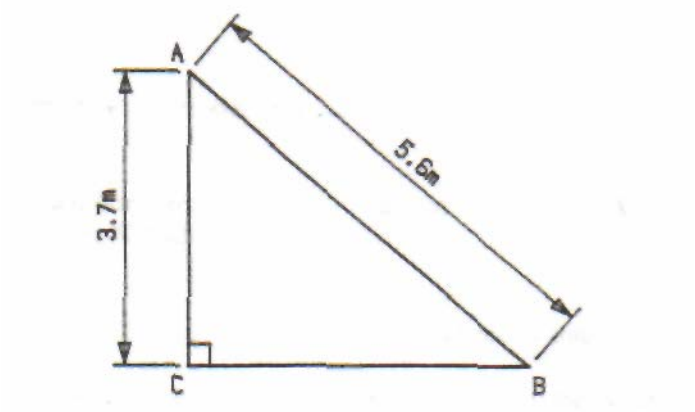

Fig. Q.4

Calculate:

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

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

5. Table Q.5 gives the mass W(kg) and the corresponding effort E(Newtons) for a lifting machine.

W(kg)	2	8	12	20
E(N)	40	69	88	127

Table Q.5

(a) Plot the graph from the tabular values. (6)

(b) Determine, using the graph in Q.5(a), the effort needed to lift a mass of 7 kg. (2)

(c) State the significance of the origin of the graph in Q.5(a). (2)

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

6. A hollow shaft has the following dimensions:

Length 3.06 m, outside diameter 40 mm and inside diameter three fifths of the outside diameter.

Determine the mass of the shaft in kilograms, given that the material has a relative density of 7.3. (10)

7. A body has a mass of 16kg and requires a force of 30 Newtons to cause accelerated motion in a horizontal plane.

Determine:

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

(b) how far the body will travel in 9 seconds from rest (5)

8. Determine the draft of a loaded box barge floating in water of density 1012kg/m^3 given that the external pressure on the bottom plating is 52.6 kN/m^2. (8)

9. A solid sphere has a diameter of 12 cm and is melted down and recast into a rectangular block.

Calculate the length of the block to the nearest centimetre given that the width is to be 90 mm and the height is to be 67 mm. (8)

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

(b) Calculate the angular velocity in radians/second for

(i) the hour hand of a clock; (2)

(ii) the minute hand of a clock. (2)

11. Indicate on a simple transverse sketch of a box barge the position of the:

(i) centre of gravity; (1)

(ii) centre of buoyancy; (1)

(iii) metacentre. (1)

(b) Determine the value of GM for a box barge floating at a draft of 4 metres, given that KG = 3.6 m and BM = 2.9 m. (3)

12. Fig. Q.12 shows a simply supported beam. The value of the uniformly distributed load is 1 kg/m.

Determine the values of reaction R_A and reaction R_B in kN. (10)

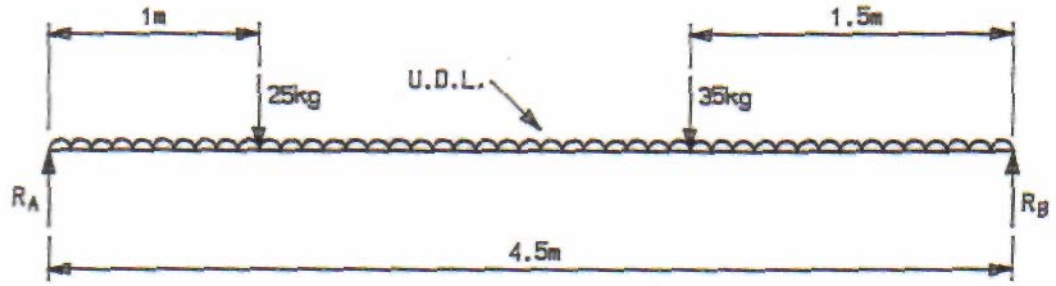

Fig. Q.12