Dec 1997

GENERAL ENGINEERING SCIENCE I

Attempt ALL questions

Marks for each part question are shown in brackets

1. A man rows a boat 3.2km downstream in 10 minutes and 3.2km upstream in 15 minutes.

   (a) Calculate the boat speed in still water in m/s. (4)

   (b) Calculate the speed of the current in m/s. (2)

2. A metal alloy consists of copper and zinc in the ratio, by volume, of 7:9.

   Calculate the mass of zinc in 1.178 m^3 of the alloy, given that 1 cm^3 of zinc has a mass of 7.3 grams. (6)

3. From the edge of a cliff, 135 metre above sea level, the angle of depression to a ship is 18°. Determine how far the ship is from the foot of the cliff. (8)

4. The total surface area of a solid cylinder is given by the following formula:

   $$S = 2\pi r^2 + 2\pi rh \quad \text{where } h = \text{height} \quad r = \text{radius.}$$

   (a) Express h in terms of the other quantities. (5)

   (b) Calculate the height of a cylinder having a diameter of 7 cm and a total surface area of 319 cm^2. Give your answer to the nearest centimetre. (5)

5. Determine the mass of liquid contained in a conical vessel which has a base diameter of 18 cm and a vertical height of 20 cm. Relative density of the liquid is 0.87. (8)

6. *(a)* Define EACH of the following:

   (i) mechanical advantage; (1)

   (ii) velocity ratio; (1)

   (iii) efficiency. (1)

   (b) A machine has an efficiency of 54%when lifting a load of 1.8 tonne.

   Determine the effort required to lift the 1.8 tonne load given that the velocity ratio at this condition is 240. (7)

7. *(a)* Plot a graph using the ordinates in Table Q.7. (4)

(b) (i) Using the graph obtained in Q.7(a) determine the equation of the line. (4)

(ii) Determine from this equation the value in centimetres of 1.75 inches. (2)

Inch	1	2	2.5	3.5
Centimetre	2.54	5.08	6.4	8.89

Table Q.7

8. A steel bar is supporting a vertical load of 3.5 tonne.

Under these conditions the bar, which is 300 mm in length, is compressed by 0.18 mm.

Calculate the diameter of the bar given that the Modulus of Elasticity for the material E=200GN/m^2.

(10)

9. A lift can carry 1.2 tonne with a maximum vertical upward velocity of 2m/s.

Determine the power of the hoist motor given that all friction and other losses equal 3.1 kW. (8)

10. A simply supported uniform beam is shown in Fig. Q.10.

The beam has a mass of 533 kg, and supports a point load of 67 kg such that R_A=3kN.

Determine:

(a) the position of the 67 kg load; (5)

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

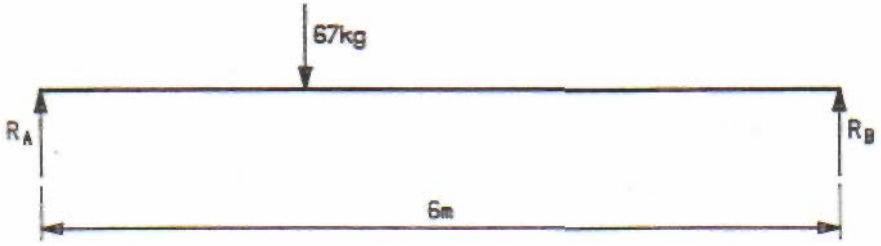

Fig Q.10

11. An electric motor comes to rest from running speed in 150 seconds and turns through 1950 revolutions whilst slowing down.

Determine:

(a) the running speed in rev/min; (4)

(b) the retardation in rad/s^2. (4)