Apr 2005

GENERAL ENGINEERING SCIENCE I

Attempt ALL questions

Marks for each question are shown in brackets.

1. A pump discharges 95m^3 of sea water to an upper deck situated 14.8m vertically above the pump in 1 hour 7 minutes.

   Calculate the power supplied to the pump motor if the system efficiency is 71%.

   Note: Sea water density is 1025kg/m^3. (8)

2. The area of a circle is 1.06m^2.

   Calculate the volume of a sphere having the same radius as the circle. (8)

3. A right angled triangle is standing on its base which is 6cm long.
   The vertical height is 2.3 times the length of the base.

   Calculate EACH of the following:

   (a) the other base angle; (3)

   (b) the difference in length between the vertical height and the hypotenuse. (5)

4. A piece of steel has a mass of 23.7 kg and sits on an air lubricated horizontal surface.

   Calculate EACH of the following:

   (a) the value of the coefficient of friction if it takes a force of 4.65 N applied parallel to the surface to just cause motion; (3)

   (b) the acceleration of the mass, if the applied force is now increased to 34 N. (5)

5. An electric motor comes to rest from running speed in 1 minute 47 seconds and turns through 1193 revolutions.

   Calculate EACH of the following:

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

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

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 Q6(a) the value of y when $x = 1.5$. (2)

Suggested scale: x axis: 4cm = 1 unit

y axis: 2cm = 1 unit

7. Calculate EACH of the following:

(a) the movement ratio of the crab winch shown in Fig Q7. (6)

(b) the effort required to lift a mass of 480kg, given that the efficiency of the crab winch in Q7(a) is 0.392. (4)

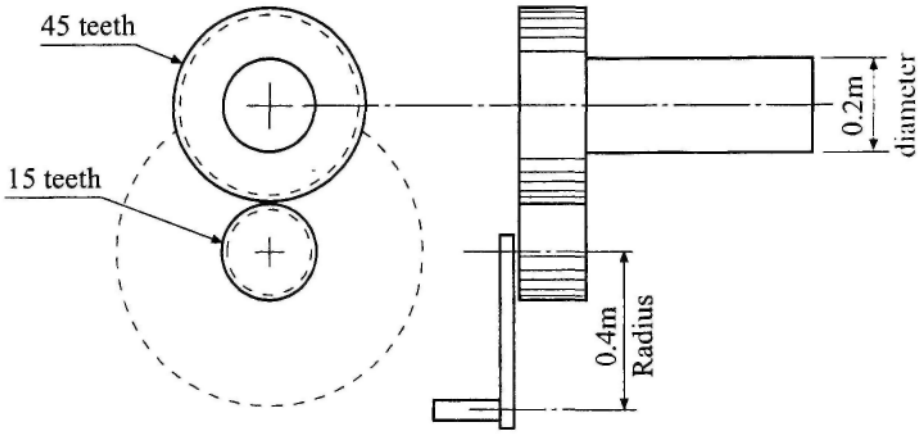

Fig Q7

8. Fig Q8 shows a simply supported beam AB.

An additional 100kN force acting vertically downwards is to be applied to the beam.

Calculate the position of the additional 100kN force, so that reaction R_A = reaction R_B . (8)

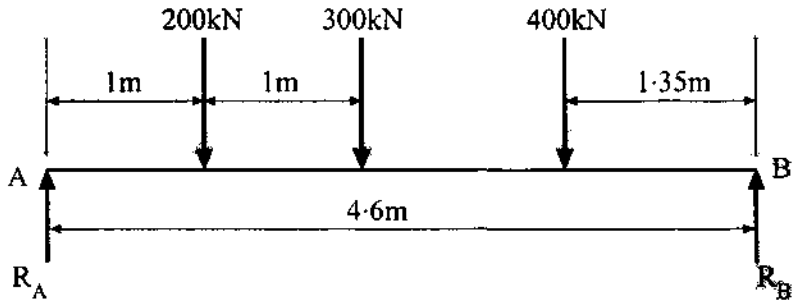

Fig Q8

9. A vessel has an underwater volume of 3918m^3 in water of density 1021kg/m^3, and when a mass of 5.5 tonne already on board is moved 9.7m across the deck it causes the vessel to heel by 1.8°.

Calculate the distance from the keel to the metacentre given that KG = 3.75m and that $m \times d = \Delta GM \tan \theta$. (8)

10. A vertical bulkhead is 7m high and 5m wide and is flooded with sea water to a height of 6.3m on one side only.

Calculate EACH of the following:

(a) the hydrostatic pressure at the base of the bulkhead; (4)

(b) the hydrostatic force on a circular access door 760mm diameter with its centre situated 5.7m down from the top of the bulkhead. (6)

Note: Density of sea water = 1025kg/m^3

11. A vessel has a displacement of 6200 tonne and a KG of 5m.
Cargo of average density 1140kg/m^3 is now loaded to fill a centreline hold
20m wide x 20m long x 8m deep and the centre of gravity of this cargo is 4.7m above the keel.

Calculate the movement of the ship's G when loaded, in both magnitude and direction. (8)

12. Calculate the thread core diameter of an eyebolt to lift a maximum load of 2000kg if the U.T.S. of the material is 490MN/m^2 and the Safety Coefficient (Factor of Safety) is 8. (8)