March 2003

GENERAL ENGINEERING SCIENCE I

Attempt ALL questions

Marks for each part question are shown in brackets

1. A tank can be filled by tap A in 3 minutes. The same tank can be filled by tap B in 5 minutes. The tank can be emptied by tap C in 7.5 minutes.

   Calculate the time to fill the tank, if all taps are fully opened when the tank is empty. (8)

2. The base of a right cone is 10 cm diameter and the slant height is 13 cm.

   Calculate EACH of the following:

   (a) the curved surface area; (4)

   (b) the volume. (4)

3. A new grinding wheel rotates at 2800 rev/min.

   Calculate EACH of the following:

   (a) the cutting speed in m/s given that the wheel diameter is 150mm; (4)

   (b) the change in cutting speed, as a percentage of the original speed, when the wheel has worn to 86.67% of its original diameter. (4)

4. A pipe 1.7 m long has an external diameter of 150 cm and a wall thickness of 2 cm.

   Calculate the mass of the pipe given that the density of the material is 7.7 times that of fresh water. (8)

5. A rope pulley tackle has FOUR pulleys in the upper sheave and THREE pulleys in the lower sheave. An effort of 260 N is required to just lift a mass of 132.5 kg.

   Calculate EACH of the following:

   (a) the velocity ratio; (3)

   (b) the mechanical advantage; (3)

   (c) the efficiency. (2)

6. The following formula relates to acceleration, distance and time.

$$a = \frac{2(s - ut)}{t^2}$$

   (a) Transpose the formula to make u the subject; (6)

   (b) Calculate the value of u when s = 78, a = 9.8 and t = 3.2. (4)

7. Calculate the thread diameter of an eyebolt to lift a maximum load of 1710 kg given that the U.T.S. of the material is 569 MN/m^2 and the factor of safety is 6. (8)

8. Calculate the remaining side and angles in a right angled triangle in which the sides that contain the right angle are 16.3 cm and 9.41cm. (8)

9. A ship has an underwater volume of 4390 m^3 when floating in water of density 1025 kg/m^3. 2000 tonne of cargo is now loaded with even distribution about the centreline, having an effective centre of gravity 5.3 m above the keel.

   Calculate the shift in the centre of gravity of the ship that this loading will cause, given that KG = 4.1m. (8)

10. A ship has a displacement of 5150 tonne.

    Calculate the distance a mass of $\frac{\Delta}{1000}$ tonne, already on board, must be moved off the centreline to cause the ship to heel by exactly 1°. (8)

    Note: $m \times d = \Delta\, GM \tan\theta$ and that KM = 6.1 m and KG = 5.3 m

11. Fig. Q.11 shows a glass inspection port fitted in a tank side.

    Calculate EACH of the following:

    (a) the pressure reading, (bars) on a gauge connected to the bottom of the tank when the tank is half full of water having a density of 1012 kg/m^3 (4)

    (b) the load on the inspection port when the tank is full. (6)

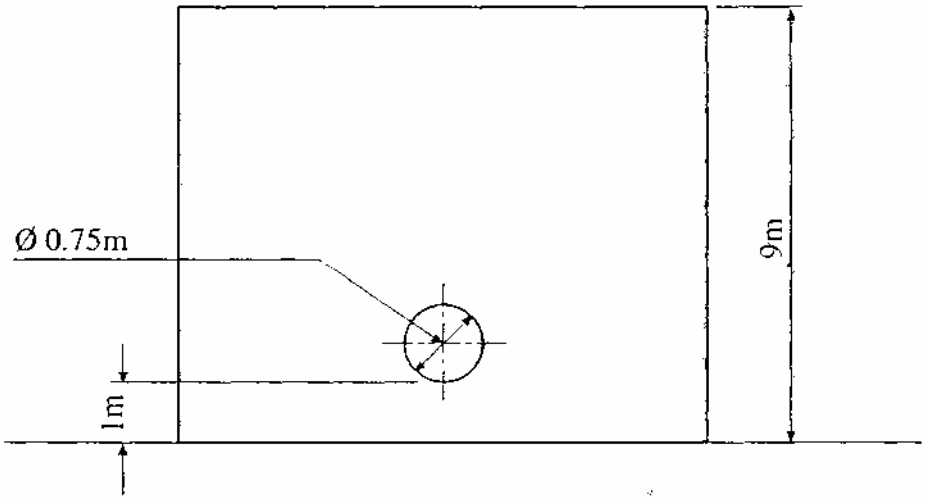

Fig. Q.11

12. Fig. Q.12 shows a beam simply supported at points A and B.

Calculate the values of the vertical reactions at points A and B. (8)

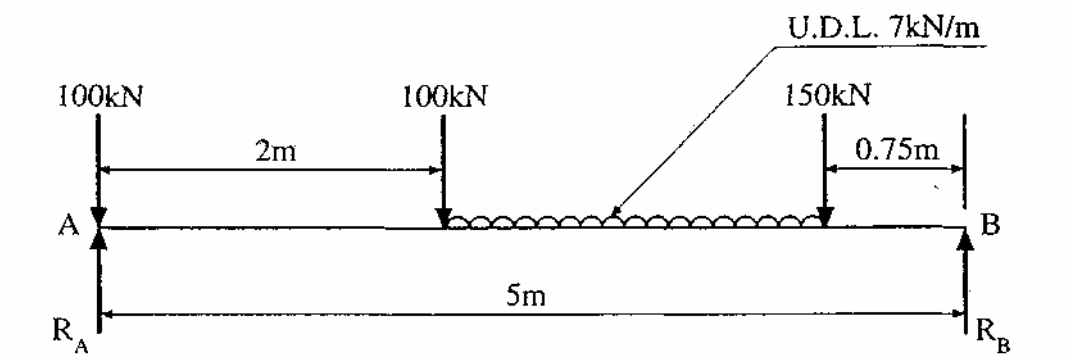

Fig. Q.12