# June 2002

**GENERAL ENGINEERING SCIENCE I**

**Attempt ALL questions**

**Marks for each part question are shown in brackets**

1. The perimeter of a triangular field is 580 metres.

   The three sides are in the ratio 7:9:13.

   Determine the lengths of the sides of the field. (8)

2. The following formula can be used to determine the minimum wall thickness of tubes:

$$T = \frac{PD}{2f + P}$$

   Transpose the formula to make *P* the subject. (8)

3. A body of mass 24 kg is moving at 27 m/s when it is retarded uniformly to 8 m/s in 4 seconds.

   Determine EACH of the following:

   *(a)* the retardation in $m/s^2$; (3)

   *(b)* the retarding force necessary; (2)

   *(c)* the distance travelled during the retardation period. (3)

4. Two forces act at a point P as shown in Fig. Q.4.

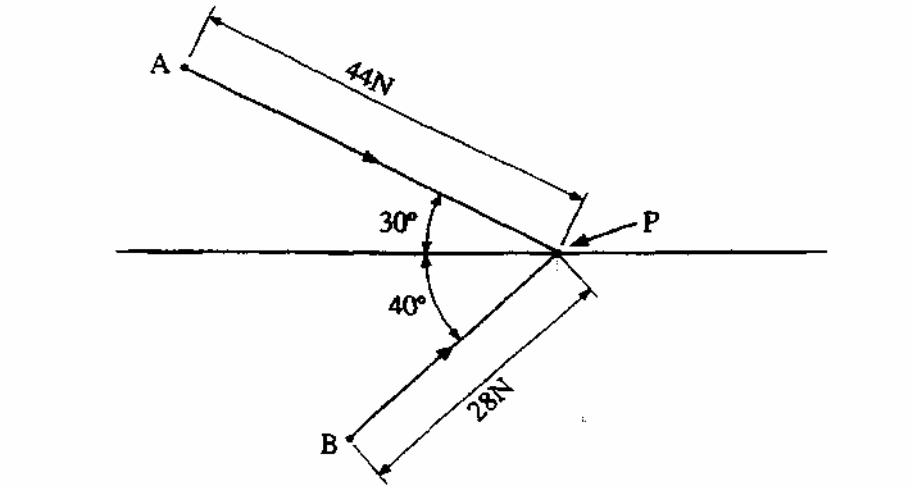


Fig. Q.4

   Determine the magnitude and direction of the resultant force. (8)

5. A block of steel has a mass of 13.7 kg.

*(a)* Determine the coefficient of friction between the steel and a horizontal surface given that it requires 123N applied parallel to the horizontal surface to just cause motion. (4)

*(b)* Rollers are now introduced under the block reducing the coefficient of friction by 87%. Determine the force applied parallel to the horizontal surface to just cause motion. (4)

6. A solid metal sphere of 12 cm diameter is totally submerged in a tank of water.

Calculate by how much the water level will rise given that the tank is 14 cm long by 14 cm wide. (8)

7. A plank of wood is 2.88 m long, 158 mm wide and 75 mm deep, and floats in water of density 1008kg/m$^3$.

Calculate the height of wood above the water surface given that the wood has a density of 730kg/m$^3$ and floats horizontally. (8)

8. Fig. Q.8 shows a horizontal beam supported at points A and B.

Determine the position of the 350kN force from support B such that $R_A = 2R_B$. (10)

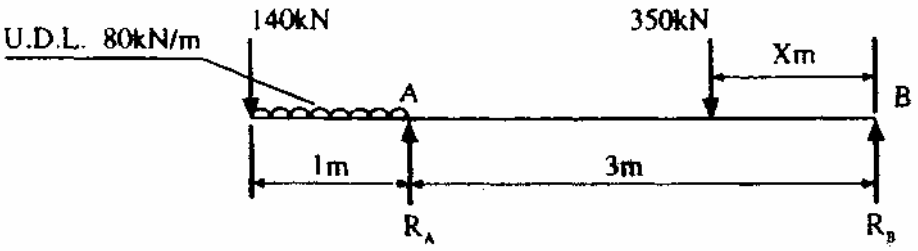


Fig. Q.8

9. A steel bar 1.6 m long has a diameter of 62.5 mm and when subjected to an axial pull of 320 kN extends by 1.83 mm.

Determine EACH of the following:

*(a)* the direct stress in the bar; (4)

*(b)* the direct strain in the bar; (3)

*(c)* the modulus of elasticity E for the steel. (3)

10. Table Q.10 gives the load carrying capacity of roller bearing journals running at constant speed.

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

*(b)* Estimate, using the graph in Q. 10(a), the safe load in kg for a roller bearing having a bore of 44.5 mm. (2)

| Bore mm | 25 | 35 | 55 | 65 |
|---|---|---|---|---|
| Load kg | 615 | 1033 | 2160 | 3140 |

Table Q.10

Suggested scales: 1cm = 2.5 mm bore
1 cm = 250 kg load

11. A container which is 20 m long, 2.5 m wide and 2.5 m high is full of cargo having a density of 2800kg/$m^3$.

The container is loaded on the centreline of a ship having a displacement of 6400 tonne at a point 3.9 m above the keel.

Determine the movement of the ship's centre of gravity when loaded given that the original KG was 6 m. (8)

12. A centre tank measuring 8m by 16m by 24m deep is full of oil having a density of 730kg/$m^3$

*(a)* Determine the hydrostatic force on the tank bottom plating. (4)

*(b)* Determine the draught of the ship in sea water of density 1025 kg/$m^3$ so that the external sea water pressure on the bottom plating is equal to the internal oil pressure. (4)