March 2002

GENERAL ENGINEERING SCIENCE I

Attempt ALL questions

Marks for each part question are shown in brackets

1. *(a)* Multiply $2x + 4$ by $2x - 3$ (3)

   (b) Simplify $\frac{4a}{3b} + \frac{5b}{2a}$ (5)

2. Given that y varies directly as the cube of x, and $y = 16.25$ when $x = 2.5$, calculate the value of y when $x = 0.8$. (8)

3. A radio mast is perpendicular to the ground and has a stay 138 metres long fitted between ground and mast top. The angle between the ground and the stay is 62°.

   Determine EACH of the following:

   (a) the height of the mast; (4)

   (b) the angle between the stay and the ground if the mast height is reduced by 28 metres and the same stay is used. (4)

4. A block of lead is 120 mm long by 80 mm wide and 75 mm deep. The block is melted down and recast into a solid sphere.

   Determine the diameter of the sphere if 7% of the original volume is lost in the melting process. (8)

5. The mechanical advantage of a simple machine is 76 when lifting a load of 485 kg.

   Determine EACH of the following:

   (a) the effort at this load; (4)

   (b) the velocity ratio if the efficiency is 0.47. (4)

6. Table Q.6 shows a set of results from a lifting machine.

Load kg	10	25	45	55
Effort N	35	53.5	72.5	85

Table Q.6

   (a) Construct a graph from these results. (4)

   (b) Determine the law of the machine from Q.6(a) (4)

   (c) Determine the probable effort when the load is 32 kg. (2)

7. The following formula allows pipe diameters to be determined knowing the volumetric flow rate.

$$D = \sqrt{\frac{Q}{2.038V}}$$

where D= diameter, Q = quantity flow, V = velocity.

(a) Transpose the formula to make V the subject. (4)

(b) Calculate the value of D when 6 = 0.171 and V = 3.5 using logarithms and SHOWING ALL WORKING. (6)

8. Fig. Q.8 shows the section through a support column.

Determine the direct stress in the column when supporting a vertical load of 3.6 tonne. (8)

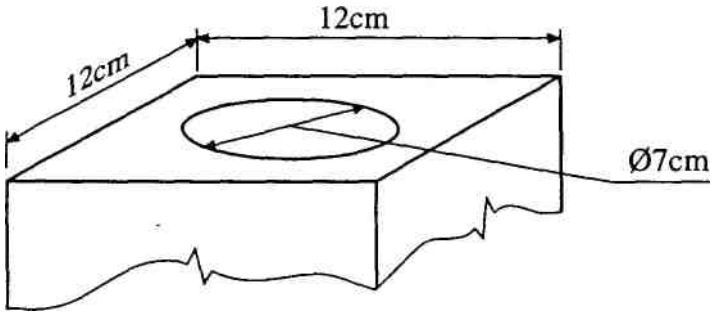

Fig. Q.8

9. Determine the width of a drydock gate if the highest water level, on one side only, is to be 17 metres and the thrust on the gate is 28 MN.

Density of river water is 1018 kg/m^3. (8)

10. A ship has a displacement of 4400 tonne.

Determine how far a mass of 8 tonne, already on board, must be moved off the centreline to cause the ship to heel by 1.3°. Given $m \times d = \Delta GM \tan \theta$ with KG = 4.3 m and KM = 5.1 m. (8)

11. A ship has an underwater volume of 6634.2m^3 in sea water of density 1025 kg/m^3.

Two double bottom tanks measuring 17.5 metres long, by 6.5 metres wide and 2.2 metres deep are positioned equally either side of the centreline. The tanks are now filled completely with fuel of density 1010 kg/m^3.

Calculate the change in the position of G in the ship in millimetres, given KG = 3.8 m. (8)