July 2003

GENERAL ENGINEERING SCIENCE I

Attempt ALL questions

Marks for each part question are shown in brackets

1. Simplify the following:

$$\frac{3\frac{1}{4}+1\frac{1}{4}\times\frac{2}{5}}{2\frac{3}{5}-1\frac{1}{4}} \quad (6)$$

2. *(a)* Plot the graph using the ordinates given in Table Q.2. (4)

X inches	0.8	2	2.75	3.5
Y cm	2.02	5.11	7.02	8.87

Table Q.2

(b) (i) Using the graph obtained in Q.2(a) determine the equation of the line. (4)
(ii) Determine from this equation the value in centimetres of 2.16 inches. (2)

3. *(a)* Determine the length of the vertical side of a right angled triangle having a base of 6.31cm and a hypotenuse of 9.48 cm, using Pythagoras Theorem. (5)

(b) Calculate the area of the triangle to the nearest cm^2. (3)

4. A solid lead cube has sides of 9 cm length and is recast into a solid sphere.

Determine EACH of the following:

(a) the diameter of the sphere if 8% of the lead is lost in the casting process; (5)

(b) the surface area of the sphere in Q.4(a). (3)

5. A pump discharges 73 tonne of water to a height of 16 m in 38 minutes.

Determine the power supplied to the pump motor given that the system is 63% efficient. (8)

6. Fig. Q.6 shows a mass suspended by strops from points A and B.

Determine EACH of the following:

(a) the force in strops AC and BC; (8)

(b) the stress in strop BC given that it has a cross section of 75 mm by 5 mm. (2)

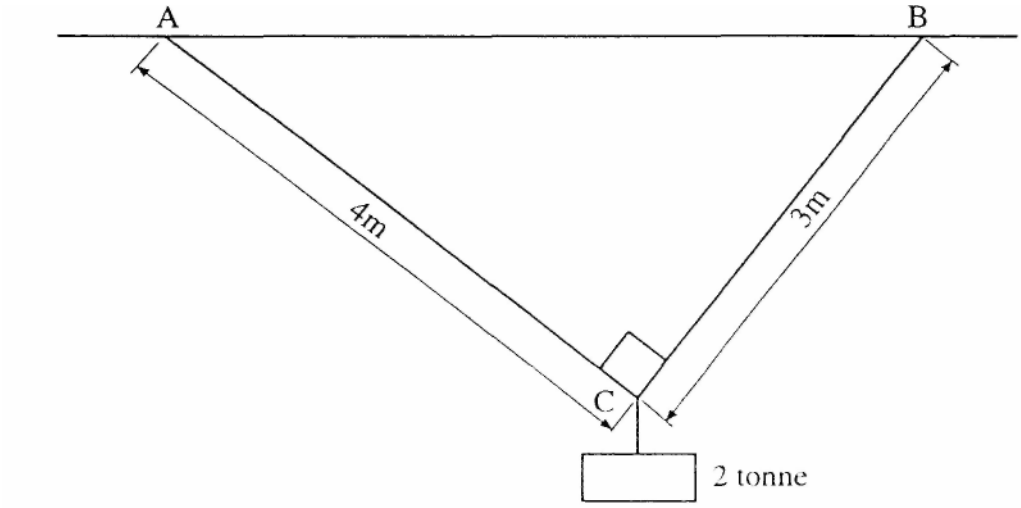

Fig. Q.6

7. A Weston Differential Pulley Block has a large pulley of 360 mm diameter and a small pulley of 345 mm diameter.

Determine the effort required to lift a 4 tonne mass given that the efficiency of the machine at this load is 56%. (10)

8. Fig. Q.8 shows a simply supported beam AB loaded as shown.

Determine the value of W kN acting at 1.8 metres from A given that the reaction force at B is 292.5 kN. (8)

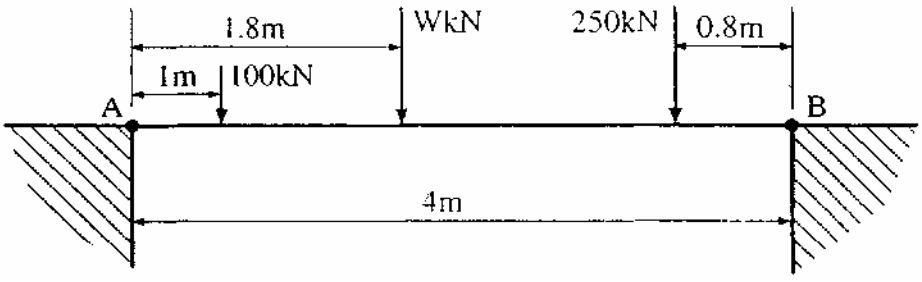

Fig. Q.8

9. A vessel steams for 5 hours at y knots, then at $3/5$ y knots for a further 11 hours.

Determine the initial speed y knots if the total distance travelled is 116 nautical miles. (8)

10. *(a)* Determine the hydrostatic force (MN) on a bulkhead 23 m wide by 28 m deep when flooded with sea water on one side only. Density of sea water 1025 kg/m^3. (5)

(b) Determine the hydrostatic pressure (bar) at the lowest point on the bulkhead. (3)

11. A crate is loaded on board a ship and when moved 8 m across the deck it causes a list of 1.8°.

Determine the mass of the crate.

Note: $m \times d = \Delta GM \tan \theta$ *KG* = 4.8 m *when KM* = 5.7 *m*
Initial displacement - 15850 tonne (8)

12. A ship of displacement 4800 tonne has the centre of gravity G positioned 4.6 m vertically above the keel.

Determine the new position of the centre of gravity above the keel when a mass of 59 tonne is loaded as deck cargo with its centre of gravity 7.3 m vertically above the keel. (8)