July 1999

GENERAL ENGINEERING SCIENCE I

Attempt ALL questions

Marks for each part question are shown in brackets

1. Simplify EACH of the following:

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

   (b) $\frac{1}{m}-\frac{1}{r}$ (3)

2. A metal suitable for high speed bearings is made from tin and lead in the ratio 8.7:1.3 respectively, by mass.

   Determine the individual masses of tin and lead in a 15 kg ingot of the bearing metal. (6)

3. The formula shown gives a relationship used in thermodynamics:

$$H=\frac{S^{\frac{1}{3}}D^2}{3.25}$$

   (a) Transpose the formula to make S the subject. (5)

   (b) Calculate the value of S when H= 1530 and D=40. (3)

4. Fig. Q.4 shows a right angled triangle ABC.

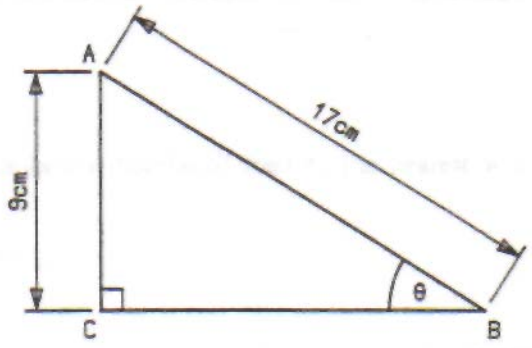

Fig. Q.4

   (a) State the values of sine, cosine and tangent of angle θ in terms of AB, BC and AC. (3)

   (b) Determine the value of θ in degrees given that AB= 17cm and AC = 9cm. (3)

5. A solid sphere has a diameter of 75mm and is to be melted down and recast into a solid cone having a base radius of 50mm.

   Determine the height of the cone. (10)

6. A flywheel is turning at 112 rev/min.

Calculate:

(a) the angular velocity of the flywheel in radian/second; (4)

(b) the linear velocity of a point on the flywheel rim at a distance of 335mm from the centre. (4)

7. A body has a mass of 3kg and is moving at 4m/s.

The body now accelerates to 10 m/s in 2.4 seconds.

Calculate:

(a) (i) the acceleration of the body; (3)

(ii) the force required to produce this acceleration. (3)

(b) the distance travelled whilst accelerating. (4)

8. Fig. Q.8 shows a simply supported beam.

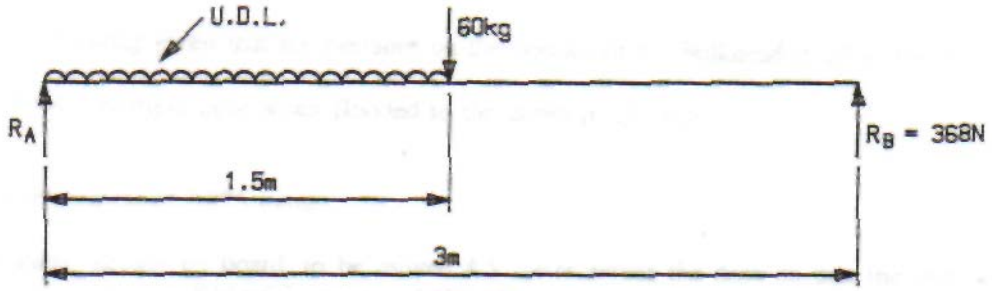

Fig. Q.8

Determine:

(a) the value of the uniformly distributed load to the nearest whole number so that the reaction R_B is not exceeded; (7)

(b) the value of reaction R_A. (3)

9. A Weston differential pulley block has a large pulley of diameter D = 360mm and a small pulley of diameter d = 300 mm.

Determine:

(a) the velocity ratio of this machine; (5)

(b) the efficiency of the machine when lifting a mass of 110 kg with an effort of 210 N. (5)

10. Q.10 shows a watertight door in a bulkhead which is flooded on one side only with seawater of density 1025kg/m^3.

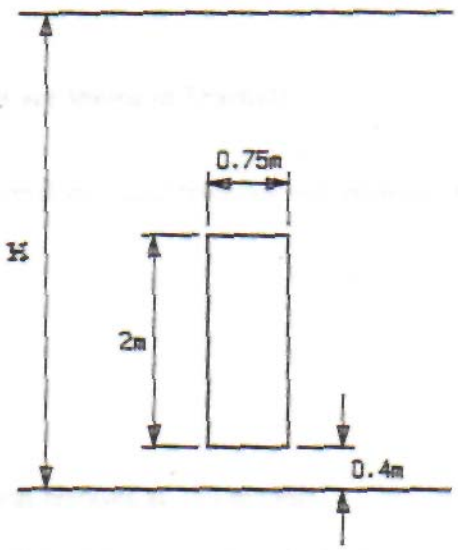

Fig. Q.10

Determine:

(a) the height of flooding given that the pressure on the bottom of the bulkhead is 84.46 kN/m^2; (4)

(b) the load on the watertight door when flooded to the depth in Q. *10(a).* (6)

11. A ship has a displacement of 3 875 tonne.

Determine the mass, already on board, to be moved 4.5 metre across the deck so that the ship will heel no more than 1.9°, given that KM = 6.3 metre and KG = 5.6 metre. (6)

Note: $m \times d = \Delta GM \tan \theta$

12. An isosceles triangle has a base 6 metre long and base angles of 70°.

Determine the area of the triangle. (8)