July 2004

GENERAL ENGINEERING SCIENCE I

Attempt ALL questions

Marks for each question are shown in brackets

1. Given that y = 16 when x = 2, and that y is directly proportional to x^2.

   Calculate the value of y when x = 5 (8)

2. A sphere of diameter 9cm is recast into a solid right cone having a base radius of 4cm.

   Calculate the perpendicular height of the cone if 15% of the sphere volume is lost in the casting process. (8)

3. The following formula can be used to determine the minimum wall thickness in tubes.

   Transpose the formula to make *P* the subject:

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

   (8)

4. Calculate the area of an equilateral triangle having sides of length 11cm. (8)

5. The law of a straight line is given by Y = *a*X + *b*.

   (a) Define the term *a* in the expression. (2)

   (b) Define the term *b* in the expression. (2)

   (c) (i) Plot and join the pairs of points in Table Q.5 (4)

   (ii) Determine the values of *a* and *b* from the graph plotted in Q.5(c)(i) (2)

X	-1	0	1	2
Y	0.5	1.0	1.5	2.0

Table Q.5

6. A steel rod 2.1cm diameter is subjected to an axial load of 495kg and extends by 0.07 mm. On removal of the load the rod assumes its normal length of 94cm.

Calculate EACH of the following:

(a) the stress in the rod when loaded; (4)

(b) the strain in the rod when loaded; (3)

(c) the value of the modulus of elasticity (E) for the material. (3)

7. A tank is 7 metres deep with sides of 3.1 metres and is 96% full of water having a density of 1015 kg/m^3.

Calculate EACH of the following:

(a) the pressure on the bottom of the tank; (4)

(b) the hydrostatic force on the sides of the tank. (4)

8. Pump A can fill a tank in 12 hours.

Pump B can fill the same tank in 8 hours.

Pump C can fill an identical tank in 9 hours.

Calculate the time in hours and minutes to fill the tank if all pumps are working together. (8)

9. A vessel has a displacement of 4900 tonne. Four double bottom tanks are now filled to 73% capacity with water of density 1022 kg/m^3, each tank having the following dimensions: length 8 metres; width 4.6 metres; depth 3.15 metres.

Calculate the position of G in the vessel if the original KG was 3.9 metres. (8)

10. A simple wheel and axle lifting machine has the following dimensions:

diameter of axle 75 mm diameter
of wheel 300 mm

Calculate EACH of the following:

(a) the movement ratio (velocity ratio) of the machine; (3)

(b) the efficiency of the machine if it requires an effort of 240 N to just lift a mass of 54kg. (5)

11. A vessel has a displacement of 4860 tonne and when a mass of 5 tonne, already on board, is moved 7 metres across the deck the vessel heels by 1°.

Calculate the value of KG given that KM = 4.75 metres and

$$m \times d = \Delta \, GM \tan \theta$$ (8)

12. Fig Q. 12 shows two forces acting at a point P.

Determine the resultant force in EACH of the following:

(a) magnitude; (4)

(b) direction. (4)

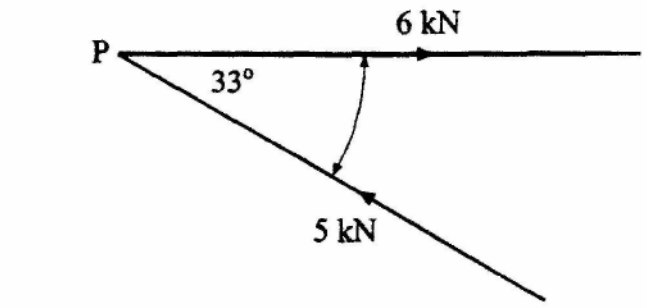

Fig Q12