Dec 2006

GENERAL ENGINEERING SCIENCE I

Attempt ALL questions

Marks for each question are shown in brackets.

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

(b) Simplify $2\frac{1}{3} + 3\frac{1}{3} \times 2\frac{1}{5}$ (5)

2. Calculate EACH of the following:

(a) the length of the vertical side of a right angled triangle having a base of 7.8cm and a hypotenuse of 12.48cm, using Pythagoras Theorem; (5)

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

3. A cylindrical vessel has an internal diameter of 1.85m and a maximum internal length of 4.96m measured from inside the outwardly dished hemispherical ends.

Calculate the volume of the vessel. (10)

4. A screwjack has a screw thread of 4mm pitch operated by a lever 280mm in length.

Calculate the efficiency of the screwjack when a horizontal effort of 270N applied at the end of the lever just lifts a mass of 1.885 tonne. (8)

5. A pump delivers $68m^3$ of sea water to a height of 24m in one hour and eight minutes.

Calculate EACH of the following:

(a) the output power of the pump in kW; (5)

(b) the input power of the pump if its efficiency is 60%. (3)

Note: Density of sea water is 1025kg/m^3

6. (a) Define the radian. (2)

(b) State the number of degrees in 2.09 radians. (2)

(c) Calculate the number of revolutions made by a flywheel in 25 seconds if the flywheel has an angular velocity of 4.02 rad/s. (4)

7. A pump rod is 0.46m long and has a modulus of elasticity E = 200GN/m^2.

Calculate EACH of the following:

(a) the strain in the rod when subjected to an axial compressive stress of 16N/mm^2; (5)

(b) the new length of the rod when loaded as in Q7(a). (3)

8. A tank has the following dimensions 12m long x 8m wide x 8m deep and is filled to the top with liquid of density 1038kg/m^3.

Calculate EACH of the following:

(a) the hydrostatic pressure at a point lm from the bottom of the tank; (3)

(b) the hydrostatic force on the largest tank side. (5)

9. A vessel of displacement 4460 tonne is heeled to port by 1.8° and is required to heel to starboard by exactly 1°.

Calculate the distance a mass of 19 tonne, already on board and on the centre line, must be moved to complete the change. (8)

Note: $m \times d = \Delta GM \tan \theta$ *with KG = 5.1m and KM =5.7m*

10. A simple crane consists of a jib that is 4.5m long attached at its lower end to a wall and a tie rod 6.5m long connecting the jib head to the wall.
The angle between the jib and tie is 90° and the crane supports a load of 1.5 tonne at the jib head.

Determine EACH of the following:

(a) the force in the jib; (4)

(b) the force in the tie rod; (4)

(c) the direct stress in the tie rod which is 55mm in diameter. (2)

11. A vessel has a displacement of 4780 tonne with a KG of 4.7m.
An empty double bottom tank, 6m long x 5.8m wide x 2.8m deep is now filled with oil having a density of 960kg/m^3.

Calculate the new position of the centre of gravity KG given that the tank is symmetrical about the centre line of the vessel. (8)

12. The law of a straight line is given by the following expression:

$$Y = aX + b$$

(a) Plot and join the pairs of points shown in Table Q12 using the given scales. (4)

(b) Determine the values of *a* and *b* from your graph. (2)

(c) State the law of the plotted straight line. (2)

Scales: X axis 4cm = 1 unit

Y axis 4cm = 1 unit

X	-1.5	0	2	3
Y	0	2	4.65	6

Table Q12