July 2007

GENERAL ENGINEERING SCIENCE I

Attempt ALL questions

Marks for each question are shown in brackets.

1. Convert EACH of the following decimal fractions to the lowest vulgar fraction showing ALL workings:

   (a) 0.375 (3)

   (b) 0.44736 (5)

2. The following formula can be used to determine the wall thickness of tubes:

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

   Transpose the formula to make f the subject. (6)

3. (a) Plot the graph of the equation $y = x^2 - 1.5$ between the limits of $x = -1$ and $x = +2$. (7)

   (b) Indicate on the graph in Q3(a) the value of y when $x = 1.8$ (3)

   Suggested scales: *x axis 4cm = 1 unit*
   y axis 4cm = 1 unit

4. (a) State the Theorem of Pythagoras. (2)

   (b) The diagonal of a rectangle exceeds the length by 2.5cm.

   Calculate the length of the rectangle given that the width is 12cm. (6)

5. An isosceles triangle has sides of 45cm standing on a base of 35cm. The angle between a side and the base is 67.1°

   Calculate the area of the triangle in square metres. (8)

6. A rectangular lead block measuring 25cm x 18cm x 12cm is recast into a solid sphere with 2% material wastage.

Calculate the diameter of the sphere. (8)

7. A flywheel is accelerated from 980rpm to 1420rpm in 16 seconds.

Calculate EACH of the following:

(a) the angular acceleration in rad/s^2; (5)

(b) the number of revolutions turned during the acceleration period. (3)

8. The coefficient of friction between a body of mass 46kg and a horizontal plane is 0.72.

Calculate EACH of the following:

(a) the least horizontal force-to just cause motion; (2)

(b) the force applied given that the resulting acceleration is 2.1 m/s^2; (4)

(c) the distance moved in 7 seconds from rest under the action of the accelerating force. (4)

9. A horizontal uniform beam AB is simply supported at each end. The beam is 4m long and has a mass of 1250kg. A uniformly distributed load of 5kN/m is 2m long and is situated to begin at 0.75m from the left hand end, A.

(a) Sketch the beam, indicating ALL relevant information and forces acting. (3)

(b) Determine the values of the reactions at the supports. (7)

10. The gauge pressure at the bottom of a lock gate is 1.78 bar when flooded to the top with seawater of density 1025kg/m^3 on one side only. The gate is 18m wide.

Calculate EACH of the following:

(a) the depth of the gate; (3)

(b) the hydrostatic thrust on the gate. (5)

11. A ship has an underwater volume of 2927m^3 when floating in seawater of density 1025kg/m^3.

Calculate the mass to be loaded on the centreline to cause a change of 0.15m to the position of the ships G, given that KG is 3.85m and the load is to be positioned on the deck 4.9m above the keel. (8)

12. A vessel has a displacement of 4380 tonne and is listing to port by 1.1°.

Calculate the distance a container, already on board, must be moved from the centreline to cause the vessel to become upright. The container is 6m long x 1.98m wide x 2.13m high and is filled with cargo having a mass of 0.71 tonne/m^3. The empty container has a mass of 2 tonne. (8)

Given $m \times d = \Delta GM \tan \theta$ *and* $GM = 0.7m$