GENERAL ENGINEERING SCIENCE I **March 2007**

Attempt ALL questions

Marks for each question are shown in brackets.

1. Simplify EACH of the following, showing ALL working:

(a) $\dfrac{\left(8\frac{1}{3}\times 1\frac{1}{3}\right)}{\left(4\frac{1}{4}+4\frac{1}{2}\right)}$ (4)

(b) $\dfrac{\left(3+1\frac{3}{4}-2\frac{1}{3}\right)}{\left(\frac{2}{3}\times 1\frac{3}{4}\right)}$ (4)

2. Solve EACH of the following:

   (a) the sum of three consecutive whole numbers is 39, state the numbers; (4)

   (b) two numbers are in the ratio 1:9 and their sum is 23, state the numbers. (4)

3. A pump rod is 520mm long and has a modulus of elasticity of 200GN/m^2.

   Calculate the axial compressive stress that will cause the rod to shorten by 0.08mm when under load conditions. (8)

4. Calculate the area of a regular hexagon that measures 5cm across the corners. (8)

5. A pipe 1.85m long has an outside diameter of 75mm and an inside diameter which is 84% of the outside diameter.

   Calculate the mass of the pipe given that the relative density of the pipe material is 7.7 times that of fresh water. (10)

   Note: Density of fresh water is 1000kg/m^3

6. Calculate the height of a right cone having a volume of 2.7 litres and standing on a base of 8cm radius. (8)

7. A screwjack has a single start thread of 6mm pitch and can lift a load of 1.7 tonne with an effort of 92N. The effort is applied to a lever having an effective length of 40cm.

   Calculate EACH of the following:

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

   (b) the force ratio of the machine; (2)

   (c) the efficiency of the machine when lifting a load of 2 tonne with an effort of 97N. (3)

8. A power hoist is used to raise a mass of 312kg through a vertical height of 11m in 8.6 seconds.

   Calculate the efficiency of the system given that the power input is 9.1 kW. (8)

9. A horizontal uniform beam AB is simply supported at each end. The beam is 4.7m long and carries a uniformly distributed load of 14.7kN/m over its entire length. A mass of 235kg is applied vertically downwards at a point 1.8m from end B.

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

   (b) Calculate the value of the reactions at the supports. (7)

10. The centre of a glass viewing port that is 0.406m in diameter is situated in a vertical plane 2m above the tank bottom.

    Calculate the maximum height of water in the tank if the glass can withstand a hydrostatic load no greater than 6.5kN. (8)

    Note: Density of water 1025kg/m^3

11. A vessel has an underwater volume 2817m^3 when floating in water of density 1013kg/m^3.

    Calculate the angle of heel generated when a load of 4.8 tonne, already on board, is moved 3.8m athwartships. (8)

    Given: $m \times d = \Delta GM \tan \theta$ *with KM = 4.9m and KG = 4.05m*

12. A vessel has a displacement of 8460 tonne with KG = 5.3m. Four double bottom tanks, on the centreline, of 15m length x 4m beam x 2.08m depth are now filled with seawater.

Calculate the change in the position of G in the vessel in both magnitude and direction. (8)

Note: Density of seawater 1025kg/m^3