GENERAL ENGINEERING SCIENCE I **April 2009**

Attempt ALL questions

Marks for each question are shown in brackets.

1. Given that y varies directly as x, inversely as z, and $y = 2$ when $x = 3$ and $z = 5$.

   Determine the value of y when $x = 4$ and $z = 6$. (8)

2. A triangular field has a perimeter of 649m. The sides are in the ratio 9:13:15.

   Calculate the length of EACH side. (8)

3. A wooden pattern is in the shape of a sphere with a diameter of 15cm and is oversize by 1.67% on the linear dimension, to allow for manufacture.

   Calculate the mass of a metal sphere cast in material having a density 8.7 times that of fresh water. (8)

4. Solve for x in the following equation:

$$\frac{3x}{5} - \left(\frac{x+12}{20}\right) = 3.25$$ (8)

5. A solid right cone has a volume of 1231.5cm^3 and stands on a base of radius 7cm.

   Calculate EACH of the following:

   (a) the perpendicular height of the cone; (4)

   (b) the total surface area. (6)

6. The periodic time of a pendulum is given by the formula:

$$T = 2\pi\sqrt{\frac{L}{g}}$$

(a) Transpose the formula to make L the subject. (4)

(b) Calculate the value of g to 2 decimal places given that L = 50cm, π = 3.142 and T = 1.418 seconds. (4)

7. A body accelerates from rest for 8 seconds and attains a speed of 10m/s. The body continues at this steady speed for 8 seconds and then accelerates to 20m/s in 4 seconds. The body continues at uniform velocity for 10 seconds and then retards to rest in a further 30 seconds.

(a) Sketch the velocity time diagram. (3)

(b) Calculate EACH of the following:

(i) the second stage acceleration in m/s²; (2)

(ii) the distance travelled in metres. (5)

8. Fig Q8 shows a simple wall crane.

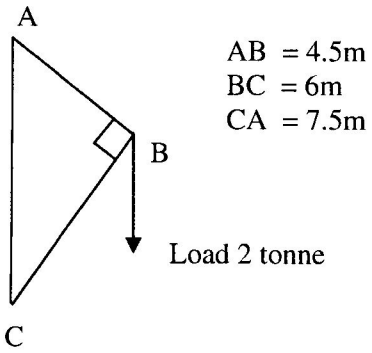

Fig Q8

Calculate EACH of the following:

(a) the direct force in the tie; (4)

(b) the direct force in the jib. (4)

9. A wire rope having an effective cross sectional area of 47.3mm² is subjected to a tensile test and fails at a load of 2475kg.

Calculate EACH of the following:

(a) the tensile stress at the moment of failure; (4)

(b) the safe working load if a Factor of Safety of 5 is given to wire ropes of this size. (4)

10. A tank measuring 8.3m long x 6.3m wide x 4.3m deep is full of oil having a relative density of 0.86.

Calculate EACH of the following:

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

(b) the mass of oil to be discharged to reduce the hydrostatic pressure calculated in Q10(a) to 25kN/m². (5)

11. When a mass of 5 tonne is moved 4m across the deck of a vessel it causes a heel of 0.9° to be generated.

Calculate the displacement of the vessel given that KM = 4.6m, KG = 3.8m and

$$GM = \frac{m \times d}{\Delta \tan \theta}$$

(8)

12. A vessel has an underwater volume of 2938m³ in water of density 1021kg/m³.

Calculate the mass to be loaded on the centreline to cause a change of 0.18m in the position of G given that KG is 3.63m and the load is to be positioned on deck 4.77m above the keel. (8)