July 1997

GENERAL ENGINEERING SCIENCE I

Attempt all questions

Marks for each part question are shown in brackets

1. Evaluate EACH of the following, expressing your answer as a fraction

(a) $\left(1\frac{1}{2} \div 2\frac{1}{4}\right) \div \left(\frac{3}{4} \times 4\right)$ (5)

(b) $\left(\frac{13}{15} \div \frac{4}{3}\right) \times \left(\frac{2}{3} \div \frac{1}{2}\right)$ (5)

2. A casting of mass 52 kg consists of 10% tin, 2% zinc and the remainder copper.
Determine:

(a) how much copper is present in the alloy by mass; (4)

(b) the ratio between zinc and copper in the casting. (2)

3. A ladder is 13.5 metres long and reaches a point on a wall 10.4 metres above the ground.
Calculate:

(a) the angle the ladder makes with the horizontal at ground level; (4)

(b) the angle the ladder makes with the wall. (4)

4. A right cone has a volume of 796 cm^3 and a base radius of 8 cm.
Determine:

(a) the perpendicular height of the cone; (5)

(b) the curved surface area of the cone. (5)

5. A mass of 136.5 kg can just be moved by a horizontal force of 651 N. Lubricant is now introduced, reducing the coefficient of friction μ by 70%.
Determine the least horizontal force to just cause motion. (8)

6. A launch increases its speed uniformly from 5 knots to 19 knots in 108 seconds.

(a) Draw the velocity time diagram. (5)

(b) Determine the distance travelled. (5)

Suggested scale: 1 cm = 10 seconds
4 cm = 5 metre/second
Note: 1 nautical mile = 1852 metres

7. The following formula relates to simple harmonic motion.

$$t = 2\pi\sqrt{\frac{displacement(L)}{acceleration(g)}}$$

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

(b) Calculate L when g = 9.81, t = 0.8, and π = 3.14. (4)

8. Fig. Q.8 shows a horizontal beam, simply supported at points A and B.

Determine the position of the 400 kN force from support B such that $R_A = 2R_B$. (10)

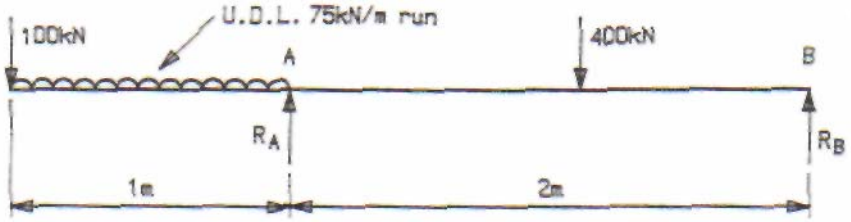

Fig. Q.8

9. Table Q.9 gives the load carrying capacity of roller bearing journals running at 1 000 revolutions per minute.

Bore mm	25	35	55	65
Safe load kg	630	1 027	2 190	3 127

Table Q.9

(a) Plot the graph from the tabular values. (6)

(b) Estimate, using the graph in Q.9(a), the safe load in kg for a roller bearing having a bore of 50 mm. (2)

Suggested scale: 1 cm = 2.5 mm bore
1cm=250kg load

10. An underwater vessel has a pressure registered on its hull of 3.75 MN/m^2 in sea water of density $1025kg/m^3$.

Determine the submerged depth of the vessel. (6)

11. A machine can lift a load of 3.5 tonne with an applied effort of 817.5N. The efficiency of the machine is 37.5%.

    Calculate the velocity ratio of this machine. (8)

12. A hollow shaft has an inside diameter of 15 mm and has the same mass as a solid shaft of 10 mm diameter, both shafts being of the same length and material.

    Determine the wall thickness of the hollow shaft. (8)