GENERAL ENGINEERING SCIENCE I

Attempt ALL questions

Marks for each question are shown in brackets

1. Simplify EACH of the following:

    (a) $\qquad 1\dfrac{1}{3} + 2\dfrac{3}{4} - 1\dfrac{9}{16}$ (4)

    (b) $\qquad 6a - \{3a - [4a - (7 - 2a)]\}$ (4)

2 A right angled triangle has an area of 2 m^2. The sides are in the ratio of 5:12:13 and the triangle stands with the shortest side as the base.

   Calculate EACH of the following:

   (a) the perpendicular height; (6)

   (b) the length of the hypotenuse. (2)

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

    (b) Calculate the number of degrees in 1.75 radian. (2)

    (c) Calculate the angular velocity of a flywheel if a point on the rim passes a counter 16 times in 25 seconds. (4)

4. Calculate the mass of a piece of steel tube 2.85m long having an inside diameter of 25mm and a tube wall thickness of 6mm. (8)

    Note: Steel is 7.6 times heavier than an equal volume of fresh water.

5. In a test on a lifting machine the following results were obtained:

    Load = 10.193kg   Effort = 10N

    Load = 20.3 8kg   Effort = 15N

    Movement ratio (velocity ratio) = 40

Calculate EACH of the following:

(a) the linear law of the machine;   (6)

(b) the force ratio (mechanical advantage) and efficiency when the load is 81.55kg.   (4)

6. (a) Draw the graph of $y = x^2$ for values of x between -1 and +2   (4)

   (b) Using the same axes draw the graph of $y = x + 1.5$ (4)

   (c) Determine the co-ordinates of the points of intersection of the graphs drawn in Q6(a) and(b).
                                                     (2)

Suggested scale: 4cm = 1 unit X

                        4cm = 1 unit Y

7. A box barge 22 metres long and 12 metres beam, has a mass of 960 tonne and floats in water of density 1017 kg/m^3.

   Calculate the absolute pressure on the bottom plating if the atmospheric pressure is 1.013 bar.   (8)

8. A bulkhead 29 metres wide and 18 metres deep is flooded to the top, on one side only, with water of density 1025kg/m^3.

   Calculate the hydrostatic force on the bulkhead in MN.   (8)

9. When a mass of 12 tonne is moved 5.2 metres across the deck it causes a vessel to heel by 0.6°.

   Calculate the displacement of the vessel given that KM = 5.8m, KG = 4.9m and that

$$m \times d = \Delta\, GM\, \tan\, \theta \qquad\qquad (8)$$

10. A body laying on a horizontal surface has a mass of 11.8kg and requires a horizontal force of 66N to just cause motion.

Calculate EACH of the following:

(a) the value of the coefficient of friction; (3)

(b) the acceleration that would result if a horizontal force of 122N was applied. (5)

11. A uniform simply supported beam AB, having a mass of 1.07 tonne, is shown in Fig. Q. 11

Calculate EACH of the following:

(a) the value of the reaction R_A; (5)

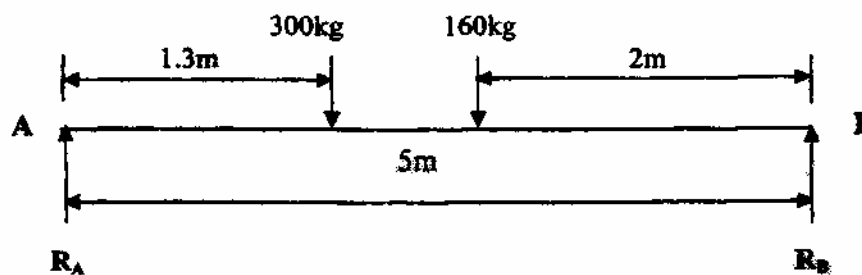(b) the value of the reaction R_B. (3)

Fig Q11

12. A pile is to be sunk 4 metres into the seabed.

Calculate the length of the pile if 33% of the pile length is to be immersed in the water and one quarter of the pile length is to be above the water surface. (8)