GENERAL ENGINEERING SCIENCE I

Attempt ALL questions

Marks for each question are shown in brackets.

Section A

1. (a) Evaluate x in the following expression giving your answer to TWO decimal places when a=2, b=4 and m=0.3. Show all working stages. (4)

$$x = \left(\frac{a \times b}{a}\right)^{m} \div \left(\frac{a \times b}{a^2}\right)^{\frac{m+0.5}{m}}$$

(b) Determine the value of 'n' using logarithms in the following expression when $P_2 = 3 \times P_1$ and $T_1 = 2 \times T_2$: (4)

$$P_1 T_1^n = P_2 T_2^n$$

2. (a) The ratio of carbon : hydrogen : sulphur in a fuel is given as 26:4:1. Express these proportions as percentages. (4)

(b) Simplify to the following giving the answer as the simplest mixed fraction. (4)

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

3. (a) State the law of a straight line graph explaining the terms. (2)

(b) Plot and join the pairs of points shown in Table Q3. (4)

(c) From the graph determine the equation linking X and Y. (4)

X	-2	-1	0	1	2	3
Y	-8.5	-5.5	-2.5	0.5	3.5	6.5

Table Q3

4.   (a) Define Pythagoras' Theorem.   (2)

     (b) For the triangle shown in Fig Q4 determine the length AB.   (2)
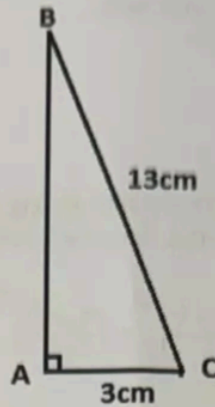

Fig Q4

     (c) An engine crankshaft has an angular velocity of 5027 rads/min. Determine
          the angle in degrees through which a crankpin rotates in 3 seconds.   (4)

5.   (a) State TWO fundamental units.   (2)

     (b) Explain what is meant by derived units using an example.   (2)

     (c) A cylinder with an internal cross sectional area of 4250 mm² contains fluid
         with a depth of 6 cm. The fluid has a mass of 300 grammes.

         Determine the density of the fluid.   (4)

6.   (a) Define the term scalene triangle.   (2)

     (b) For the shape shown in Fig Q6 determine the angle MBD describing your
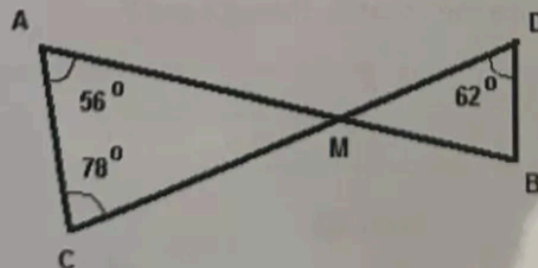   reasoning.   (6)

Fig Q6

Section B

7. A vehicle starts from rest and accelerates with constant acceleration of 1.5 m/s²
    to a speed of 7.0 m/s. It then travels at 7 m/s for 25 seconds after which it is
    retarded to a speed of 1 m/s. if the complete motion takes 44.5 seconds:

    Determine EACH of the following:

    (a) sketch the velocity/time diagram;   (2)

    (b) the time taken to reach 9 m/s;   (2)

    (c) the retardation (Deceleration);   (2)

    (d) the total distance travelled.   (2)

8. A beam of uniform cross section and density is loaded as shown in Fig Q8. The
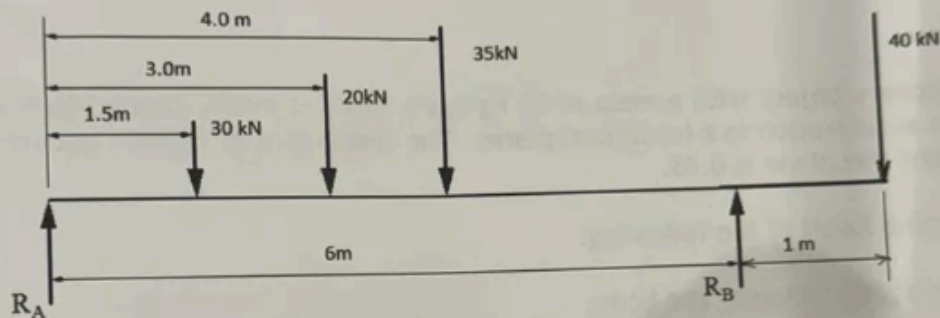   beam has a mass of 1100 kg.

Fig Q8 (not to scale)

Determine EACH of the following:

                                                                                    (6)
(a) the reaction force, R_A;

                                                                                    (2)
(b) the reaction force, R_B.

9. Fig Q9 shows a mass of 150 kg suspended from points A and B by chains.

Determine EACH of the following:

(a) the forces in chain AC;   (4)

(b) the force in chain BC.   (4)
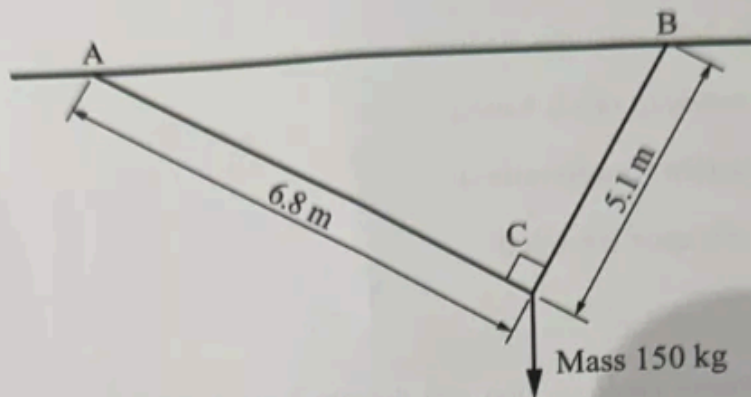

Fig Q9

10. A stationary object with a mass of 25 kg has a force of 140 N applied to it which causes acceleration in a horizontal plane. The coefficient of friction between the body and the plane is 0.35.

Determine EACH of the following:

(a) the acceleration of the body;   (4)

(b) the distance the body will travel from rest in 6 seconds.   (4)

11. A piston rod 0.8 m long has a diameter of 80 mm and when subjected to an axial
     load of 1050 kN, it is compressed by 0.65 mm.

     Determine EACH of the following:

     (a) the direct stress in the rod;   (4)

     (b) the direct strain in the rod;   (4)

     (c) the Modulus of Elasticity (E) for the rod.   (2)

12. A screw jack is used to support a load of 300 kg. The jack has a single start square
     thread with a 6 mm pitch on an effective effort radius of 120 mm. The applied
     effort is 80 Newtons.

     Determine EACH of the following:

     (a) the force ratio;   (3)

     (b) the movement ratio;   (3)

     (c) the effort required to move the load.   (2)