(3) Assume **suitable data** if **necessary** and mention them **clearly**.
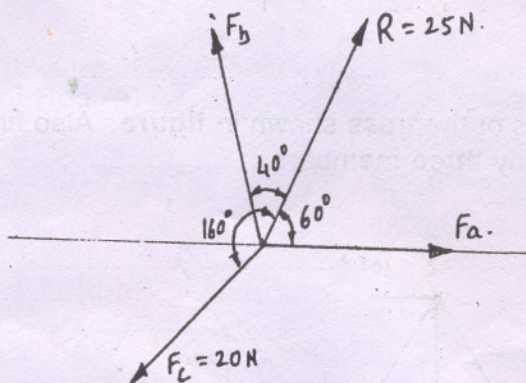
(4) Take g = 9·81 m/s².

1. Solve any **four** of following :—   **20**

(a) Resolve a system of forces shown in **figure** into a force and couple at point 'A'.
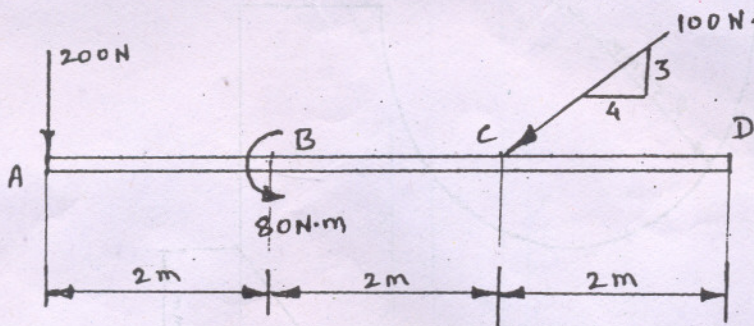
(b) A force R = 25 N has components F_a, F_b and F_c as shown in **figure**. If $F_c = 20$ N. Find F_a and F_b.


(c) Derive an expression for the Moment of Inertia of a rectangle about its centroidal Y-axis.

(d) State and prove Work-Energy principle.

(e) Water leaks from the ceiling 16 m high, at the rate of 5 drops per second. Find the distance between first and second drop when the first drop has just touched the ground.

(f) Find distance Y so that the CG of given area in **figure** has co-ordinates (25, 20).

[TURN OVER
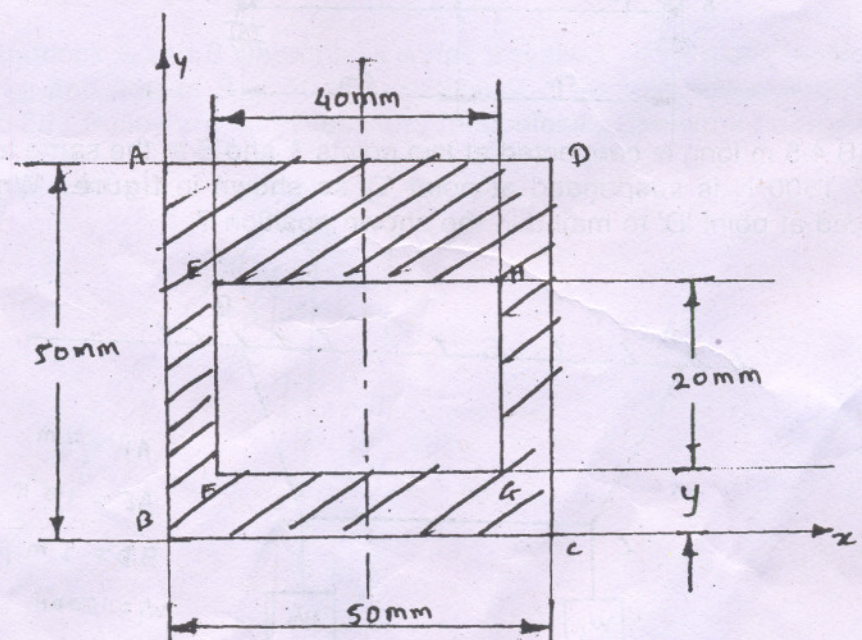
2. (a) Determine using fundamentals, the maximum height reached and the maximum distance   **10**
         travelled on horizontal surface by a projectile fired with velocity of 25 m/s at an angle of
         40°. Derive expression for maximum height and maximum distance on horizontal surface
         and verify your answers.

   (b) Find Moment of inertia of given area about centroidal X and Y axis. Refer **figure**.   **10**
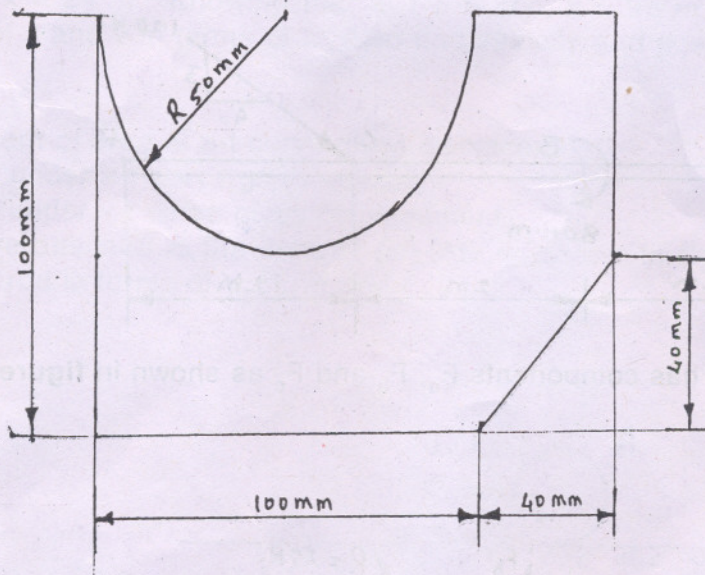
3. (a) Find forces in all the members of the truss shown in **figure**. Also find support reactions.   **10**
   Use method of sections for any three members.
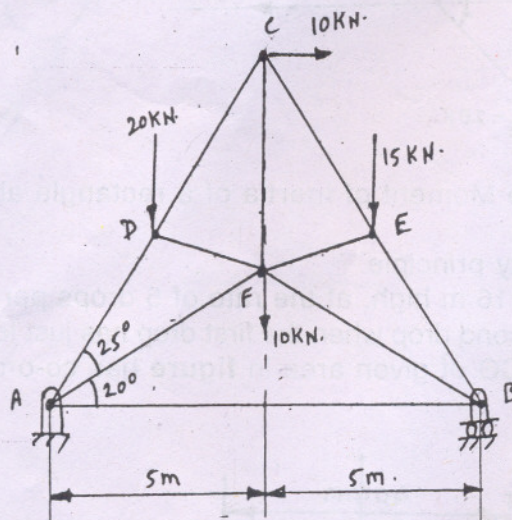
    (b) Rope AB 4·5 m long is connected at two points A and B at the same level and 4 m apart.   **10**
         Load of 1500 N is suspended at point 'C' as shown in **figure**. What load should be
         connected at point 'D' to maintain the shown position ?


AB = 4m

AC = 1·5 m

BD = 1m
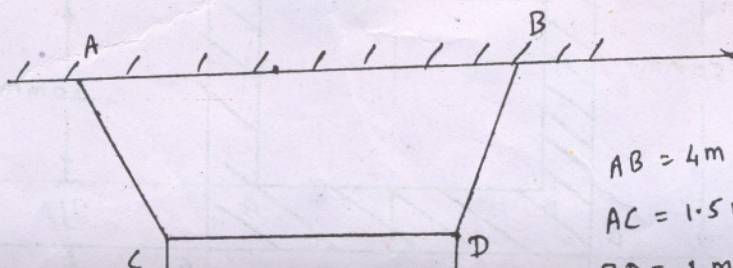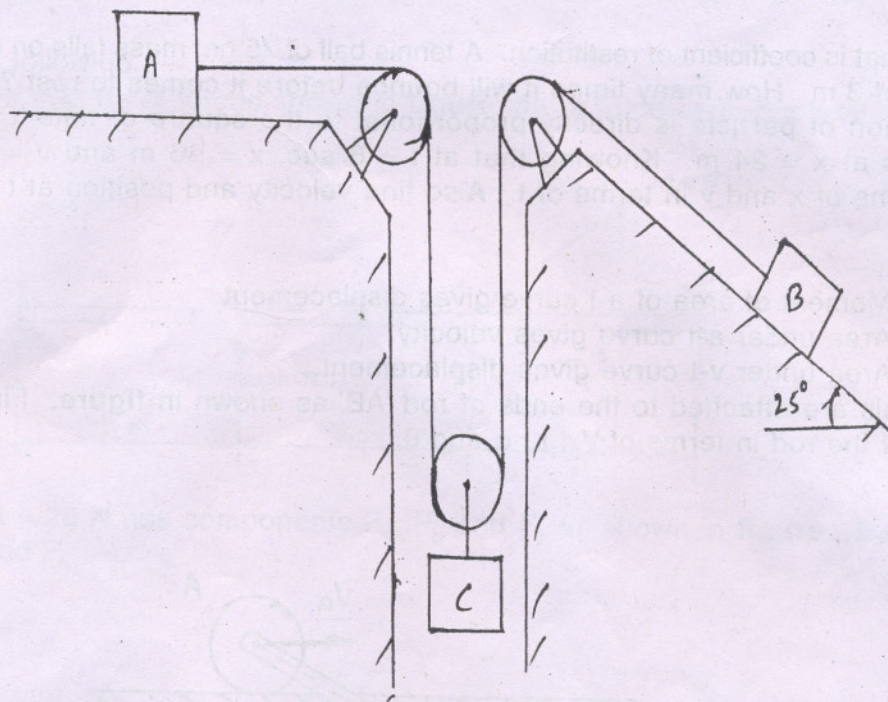
(b) Determine minimum value of co-efficient of friction so as to maintain the position shown   **10**
in **figure**. Length of Rod AB is 3·5 m and it weighs 250 N.
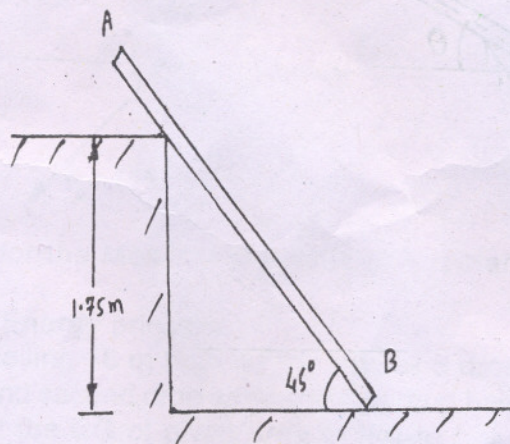
5. (a) Find the velocity of block A and B when block A has travelled 1·2 m along inclined plane.   **10**
Mass of A is 10 kg and that of B is 50 kg. coefficient of friction between block A and
inclined plane is 0·25. Pulley are mass less and frictionless. Use work energy principle.
Refer figure.

Figure - 9
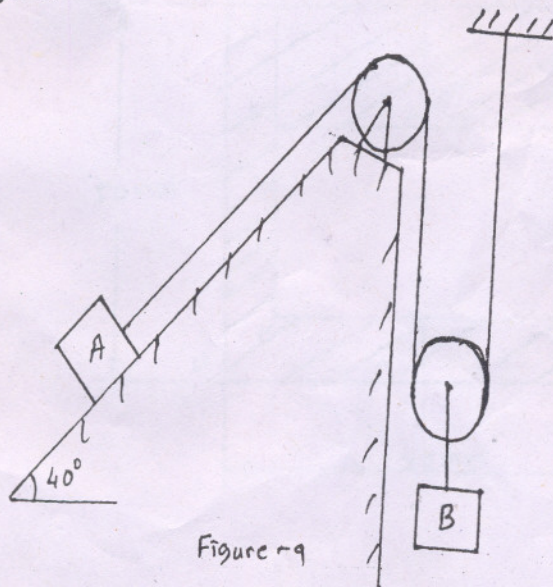
(b) Explain what is tangential and normal acceleration. A particle is moving in x-y plane and **10** its position is defined by $\bar{r} = \left[\frac{3}{2}t^2\right]i + \left[\frac{2}{3}t^3\right]j$. Find radius of curvature when t = 2 sec.

6. (a) Explain what is coefficient of restitution. A tennis ball of 75 gm mass falls on ground through **10** a height of 3 m. How many times it will bounce before it comes to rest ? Take e = 0·7.

   (b) Acceleration of particle is directly proportional to the square of time 't'. When t = 0, **10** particle is at x = 24 m. Knowing that at t = 6 sec, x = 96 m and v = 18 m/s. Find expressions of x and v in terms of t. Also find velocity and position at t = 2 sec.

7. (a) Prove that—   **10**
       (i)   Moment of area of a-t curve gives displacement.
       (ii) Area under a-t curve gives velocity
       (iii) Area under v-t curve gives displacement.

   (b) Two wheels are attached to the ends of rod 'AB' as shown in **figure**. Find the angular **10** velocity of the rod in terms of V_b, L, α and θ.