Con. 6885-13.   **LJ-10080**

(OLD COURSE)

(3 Hours)   [**Total Marks : 100**

N.B. : (1) Question No. **1** is **compulsory**.

        (2) Answer any **four** questions from the remaining **six.**

        (3) Assume suitable **data** if **necessary**.

1. Attempt all **five** questions :–   **20**

    (a) Determine the resultant of three forces originating from point (3, –3) and passing through the points as indicated. 126 N through (8, 6), 183 N through (2, –5) and 269 N through (–6, 3).

    (b) Explain the method of identifying zero force members in truss with example.

    (c) Prove $\dfrac{T_1}{T_2} = e^{\mu\theta}$ in case of belt drive.

    (d) Water flows from a horizontal pipe fixed at a height of 2 m from the ground. If water falls at a distance of 3 m horizontally, find the speed of water as it leaves the pipe.

    (e) Write short notes on coefficient of restitution.

2. (a) Five forces act on a body as shown in **figure.** Find the magnitude of forces P and Q   **8** such that the resultant of five forces is zero.
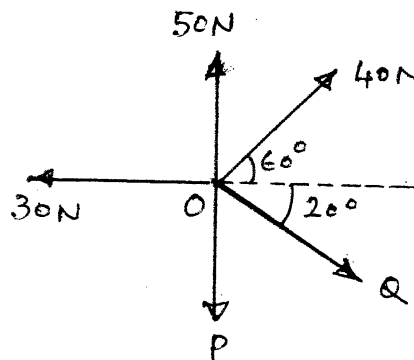
    (b) In the system shown determine the horizontal force P and tension in the rope T for   **6** pulling the lower block. Take $\mu = 0.3$ for all contact surfaces. Weight of upper and lower blocks are 500 N and 2000 N.
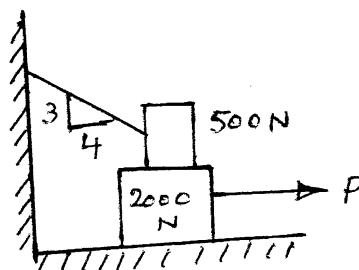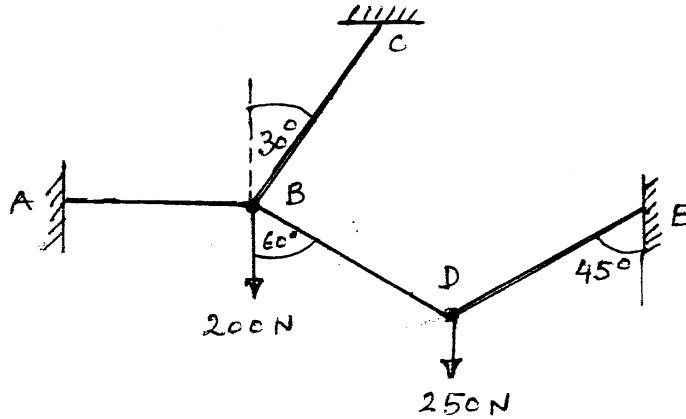

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(c) From Fundamentals obtain the maximum range of projectile. Sketch the figure neatly. **6**

3. (a) Determine the forces in various segments of the cable. Vertical forces 200 N and **8**
   250 N acts at point B and D.

(b) A car starts from rest on a curved road of radius 250 m and accelerates at a constant **6**
   tangential acceleration of $0.6\dfrac{m}{s^2}$. Determine the distance and the time for which it
   will travel before the magnitude of the total acceleration attained by it becomes
   $0.75\dfrac{m}{s^2}$.

(c) A wheel of 2 m diameter rolls without slipping on a flat surface. The centre of the **6**
   wheel is moving with a velocity of 4 m/s towards right. Determine the angular velocity
   of the wheel. Which point on the wheel will have maximum velocity and which point
   of wheel has zero velocity ? Sketch the arrangement.

4. (a) Determine X coordinate of centroid of lamina shown in **figure**. **4**
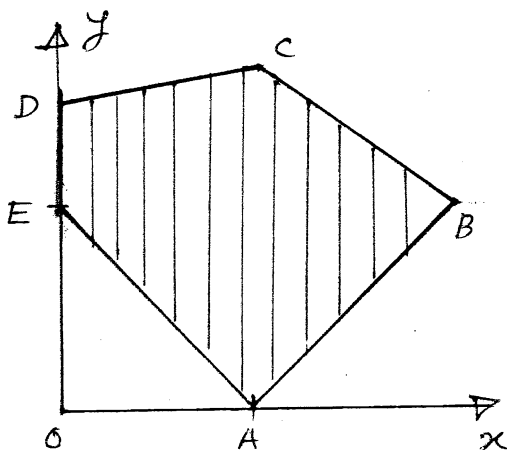
co ordinates are

$0 \rightarrow [0, 0]$
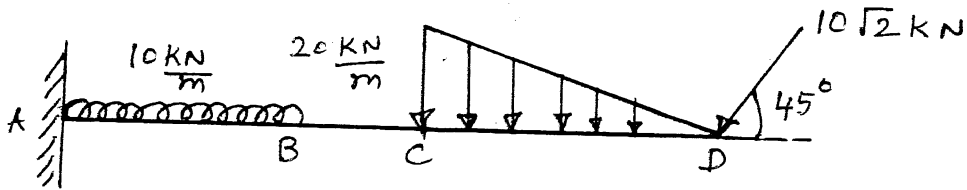
$A \rightarrow [75, 0]$

$B \rightarrow [175, 100]$

$C \rightarrow [75, 200]$

$D \rightarrow [0, 150]$

$E = [0, 100]$

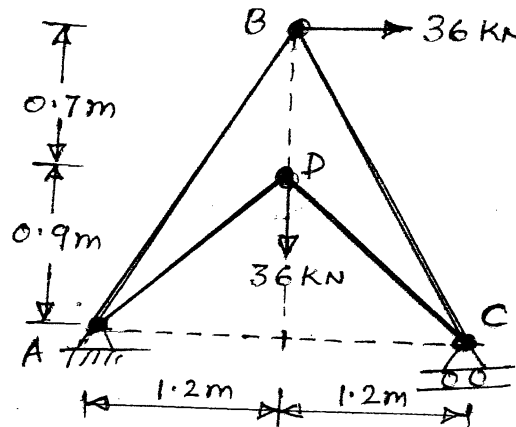(b) Determine the support reactions of the beam loaded as shown in **figure**.   **8**

Take $AB = 4m$, $BC = 2m$ and $CD = 6m$

(c) Velocity of the particle starting from rest is given by $V = (3 + 4t)\dfrac{m}{s}$. Determine the **8** distance travelled by the particle in the 6ᵗʰ second. What is its acceleration at the end of 5 seconds. At what time its velocity becomes $33\dfrac{m}{s}$?

5. (a) Analyse the following truss :—   **6**

(b) Find the power transmitted by belt having following data.   **8**
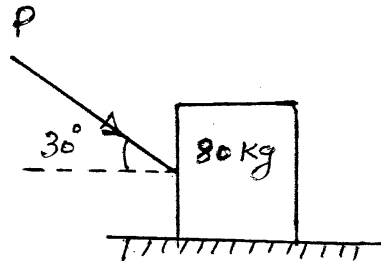Angle of contact = 180°,   Coefficient of friction = 0·2

Weight of Belt = $4\dfrac{N}{m}$,   Maximum allowable Tension = 1300 N

Belt Velocity = $20\dfrac{m}{s}$
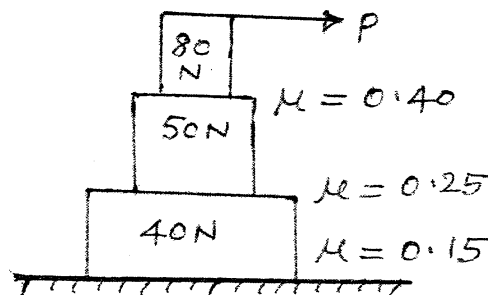
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(c) A 80kg block rests on a horizontal plane. Find the magnitude of force P required to give the block an acceleration of $2.5 \dfrac{m}{s^2}$ to the right. Take $\mu_{k=0\cdot25}$ **6**


6. (a) Determine the mass of the pipe that can be supported as shown in **figure**. The maximum allowable tension in rope is 20kN. Neglect friction. Take. AG = BG = 1·5 m.   **8**
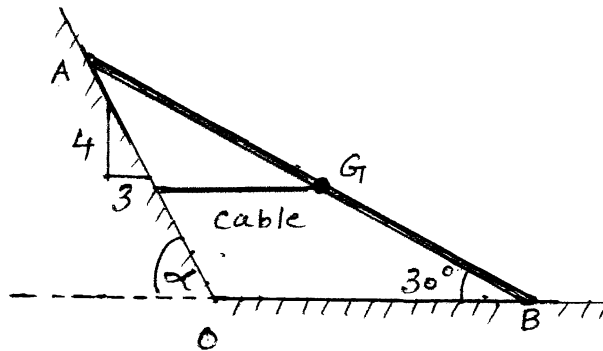
(b) Three blocks are resting as shown in **figure**. Determine maximum value of P that will destroy the equilibrium.   **6**
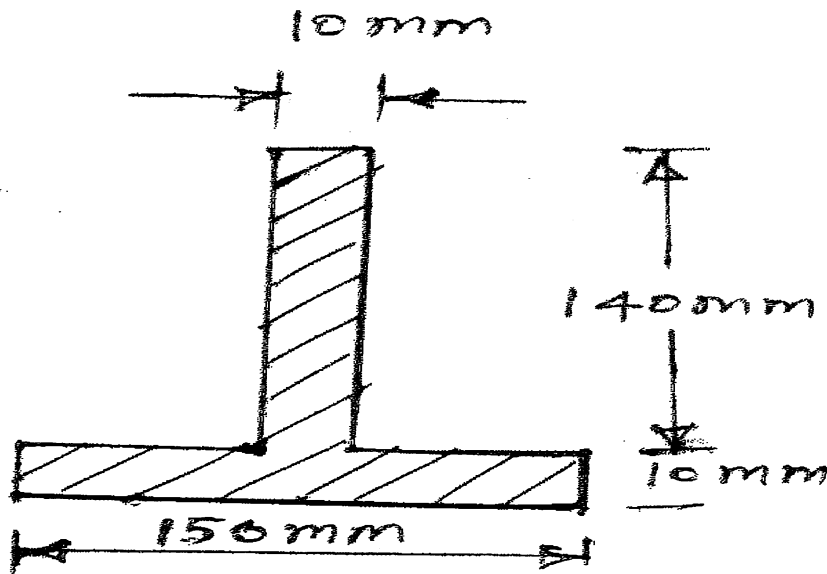

(c) At the position shown, the crank AB has an angular velocity of 3 r/s clockwise. Find the velocity of slider at C and angular velocity of rod CD. AB Horizonal.   **6**
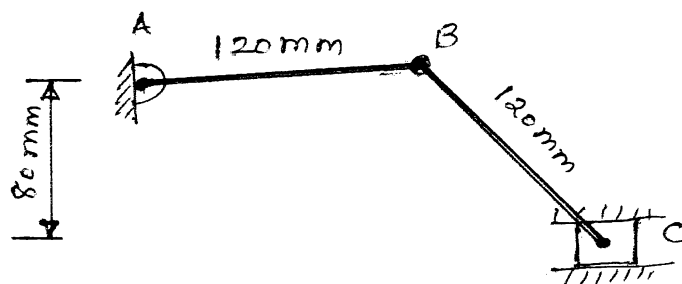
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7.   (a)   Find the moment of inertia about centroidal x-axis and y-axis.   **6**

   (b)   A collar of mass 15 kg starting from rest goes up due to applied force. The attached   **8**

   spring has $K = 3000 \dfrac{n}{m}$ and underformed length lo = 1m. Determine the velocity of

   collar when it has moved up by 0·9 m. Force is applied at an angle and magnitude of
   Force is 800 N. Neglect friction.

   (c)   A ball of mass 1 kg moving with a velocity of 3 m/s strikes a ball of mass 5 kg   **6**
   moving with a velocity of 0·6 m/s in the same direction. Show that the direction of
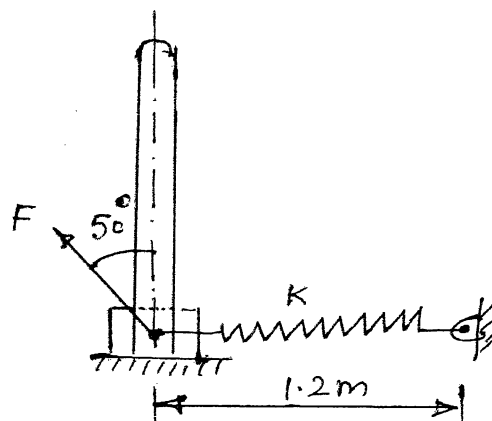   motion of the first ball is reversed. Find the loss of kinetic energy. Assume
   e = 0·75.

Fig. Q. 7 (b)