



[ESC101] Engineering Mechanics: NEP 2020 Practice Examination

(3 Hours)

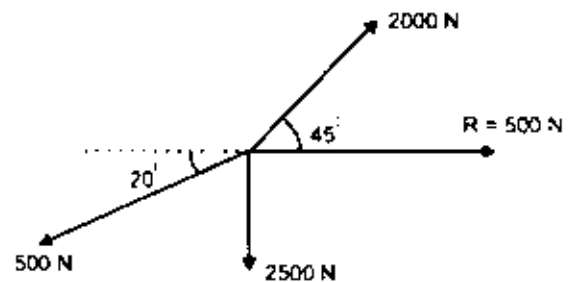
Max Marks:60

- N.B.:** (1) Question **No. 1** is compulsory.
(2) Attempt any **THREE** questions from remaining **FIVE** questions.
(3) Assume suitable data if necessary and mention the same clearly.
(3) Take $g=9.81 \text{ m/s}^2$

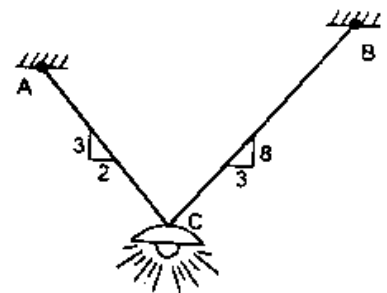
Q.1 Answer any **FIVE** questions

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- a) Figure shows a concurrent system of four forces. Three of the four forces are shown. Find the magnitude and direction of the unknown fourth force 'P' given that the resultant of the system is a horizontal force of 500 N acting to the right.

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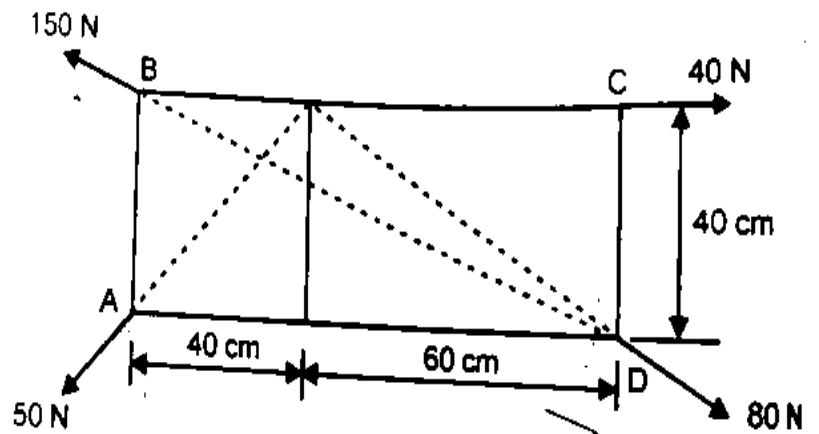
- b) A lamp weighing 150 N is supported by two cables AC and BC. Find the force developed in the cables.

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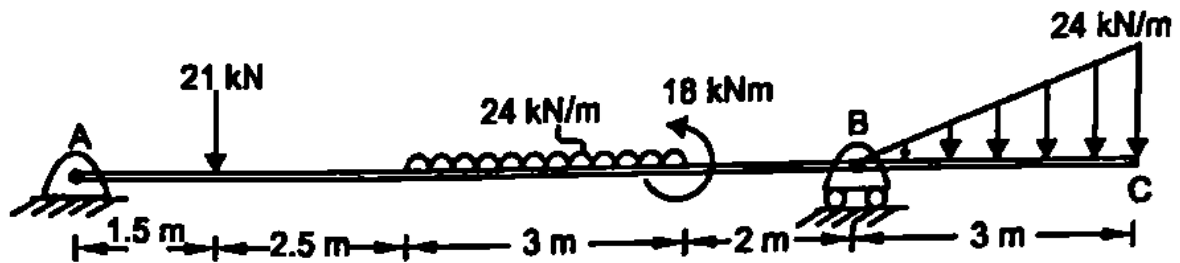
- c) A 630 gm cricket ball strikes the bat with a speed of 108 kmph and is hit back by the batsman with a speed of 144 kmph. If the ball was in contact with the bat for 72 milliseconds, determine the average impulsive force exerted on the ball. **3**
- d) The rectilinear motion of a particle has its position defined by the relation $x = t^3 - 7t^3 + 20t - 10 \text{ m}$. Determine **3**
(a) Position, velocity and acceleration at $t = 2 \text{ sec}$.
(b) Minimum velocity.
- e) Identify and briefly describe the main parts of a robot and explain their functions in the overall operation of a robotic system. **3**
- f) State and explain the laws of friction. **3**



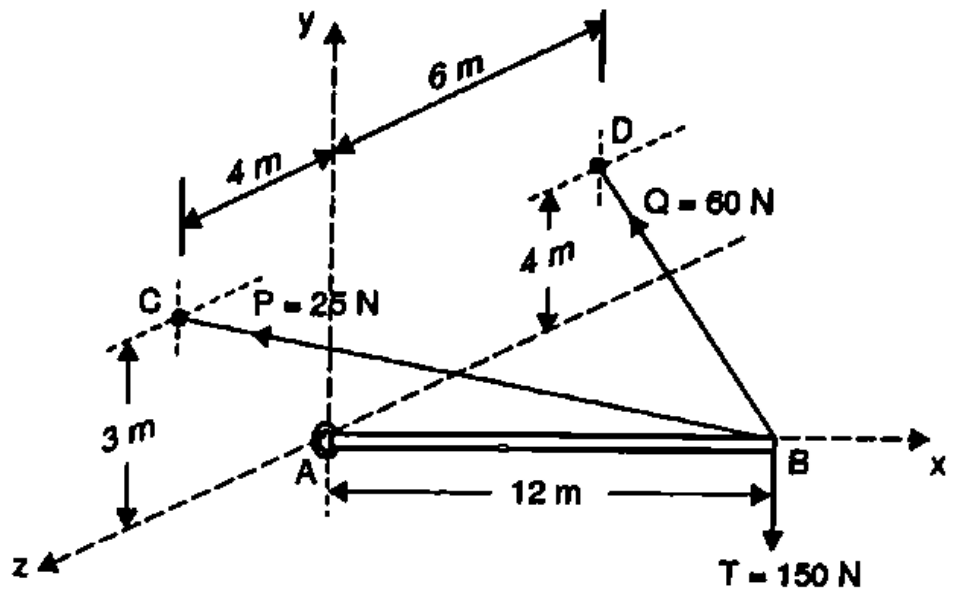
- Q.2 a)** A block ABCD of 100 cm x 40 cm dimensions is acted upon by four forces as shown. Calculate the resultant and then state its position with reference to A.



- Q.2 b)** Determine the support reactions for the beam shown in figure.

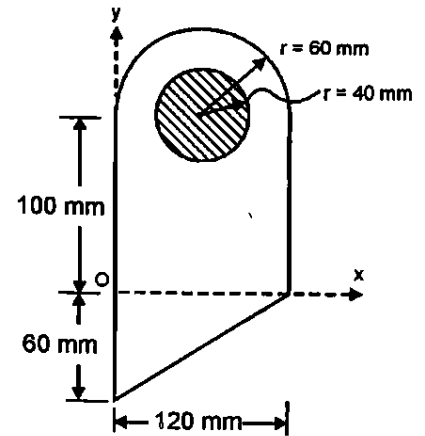


- Q.3 a)** Three Forces P, Q and T act at point B. Find the resultant of these forces.

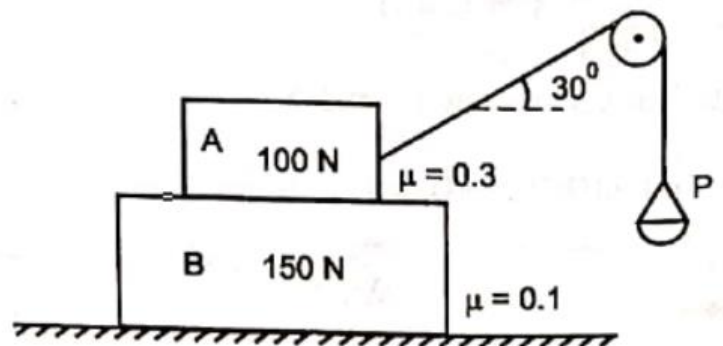




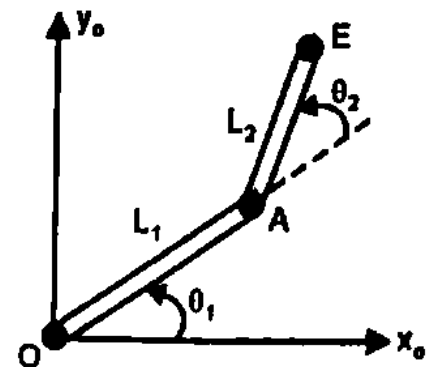
- Q.3 b)** Find the coordinates of the centroid of the area if the shaded portion is removed with respect to the axes shown in Fig.



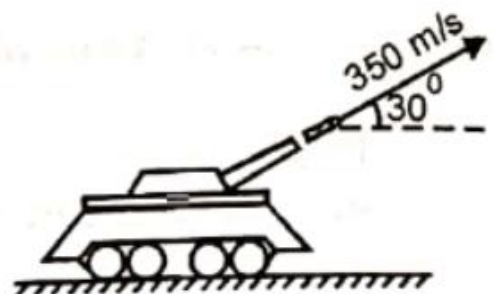
- Q.4 a)** Blocks A and B are resting on ground as shown. μ between ground and block is 0.1 and that between A and B is 0.3. Find the minimum value of P in the pan so that motion starts.



- Q.4 b)** A planar elbow manipulator is shown. Write the DH parameters and hence locate the position and orientation of the end E of the manipulator. Given $L_1 = 250\text{mm}$, $L_2 = 175\text{mm}$, $\theta_1 = 30^\circ$, $\theta_2 = 40^\circ$.

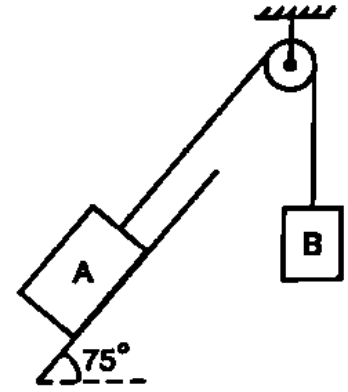


- Q.4 c)** A shell of weight 200 N is fired from a cannon of weight 12 kN with a velocity of 350 m/s as shown. Find the recoil velocity of the cannon. Neglect friction.



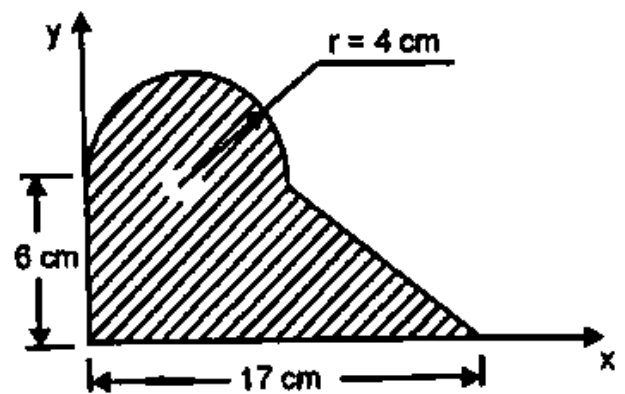


- Q.5 a)** Block A and B of mass 6 kg and 12 kg respectively are connected by a string passing over a smooth pulley. Neglect mass of pull. If coefficient of kinetic friction between the block A and the inclined surface is 0.2, determine acceleration of block A and block B. 5

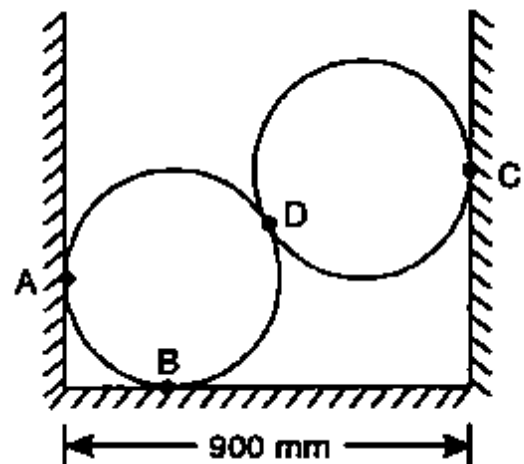


- Q.5 b)** The position vector of a particle is given by $\vec{r} = \frac{1}{4}t^3 \hat{i} + 3t^2 \hat{j}$ m. Determine at $t=2$ sec: 5
- the radius of curvature of the path
 - the N-T components of acceleration

- Q.5 c)** Find the Centroid of the shaded area shown. 5

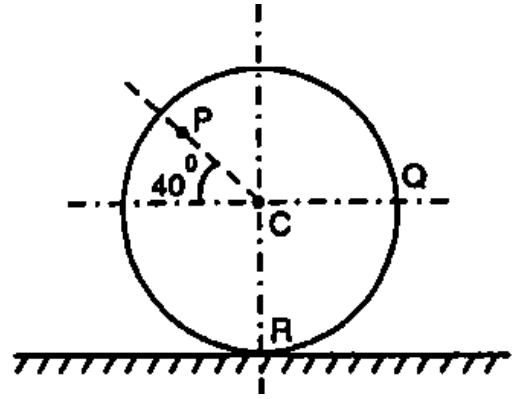


- Q.6 a)** Two smooth spheres of weight 100 N and of radius 250 mm each are in equilibrium in a horizontal channel of width 900 mm as shown. Find the reactions at the surface of contact A, B, C and D assuming all smooth surfaces. 6





- Q.6 b)** A 0.4 m diameter wheel rolls on a horizontal plane without slip, such that its centre has a velocity of 10 m/s towards right. Find the angular velocity of the wheel and also velocities of points P, Q and R shown on the wheel. Given $L(CP)=0.15\text{m}$.



- Q.6 c)** Find the force P required to accelerate the block shown in figure with 2.5 m/s^2 . Take $\mu=0.3$.

