

Indian Institute of Engineering Science and Technology, Shibpur

B. Tech (AE, CE, ME, MT, MN, CST, ETC, IT, EE) 1st Semester, End Semester Examination

April, 2021

Mechanics (AM 1101)

Full marks: 50

Time: 1 Hr 30 Min

All notations have their usual meanings

Marks for each question are shown in the right

(i) Take $g = 9.81 \text{ m/s}^2$

(ii) Assume any other data not given in the question

(iii) *The value of i in each question is the sum of last 3 digits of student's Enrollment Number*, i.e. for Enrollment No. 2020EEB049: $i = 0 + 4 + 9 = 13$

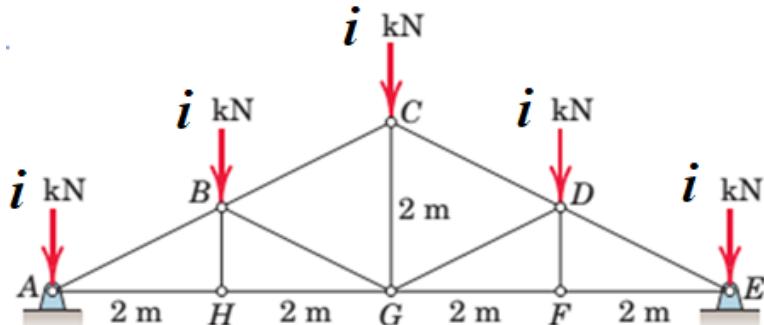
(iv) Answer any **Two (02)** questions from **Group A**, and any **Four (04)** questions from **Group B**

(v) **2 marks** are reserved for neatness and handwriting

[Group A: Statics]

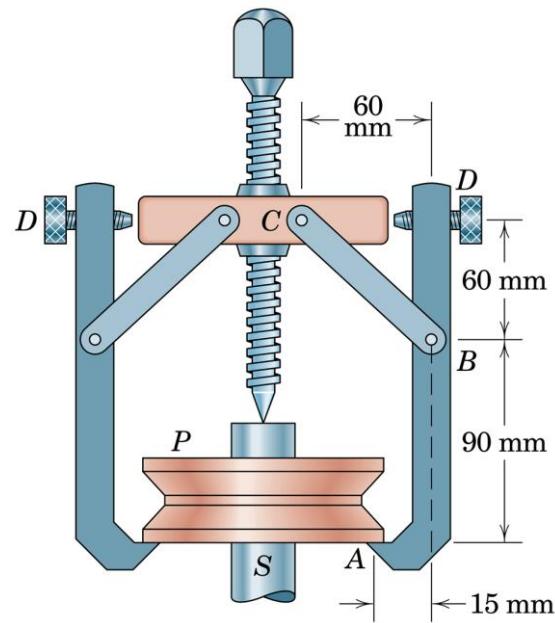
(Answer any **Two (02)** questions)

1. A snow load transfers the forces shown to upper joints of a Howe roof truss. Neglect any horizontal reaction at the supports. Determine the zero force members and then solve for the forces in all other members. **[10]**

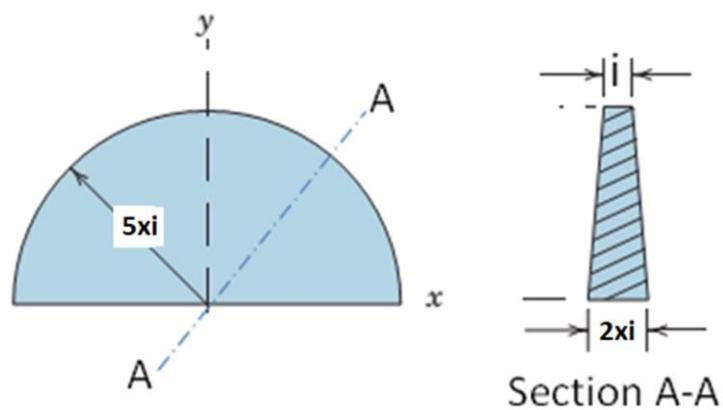


2. The figure shows a wheel puller which is removing a V-belt pulley P from its tight-fitting shaft S by tightening the central screw. If the pulley starts to slide off the shaft when the compression in the screw has reached (**1000 + i**) N, calculate the magnitude of the force supported by each jaw at A. The

adjusting screws D support horizontal force and keep the side arms parallel with the central screw. [10]

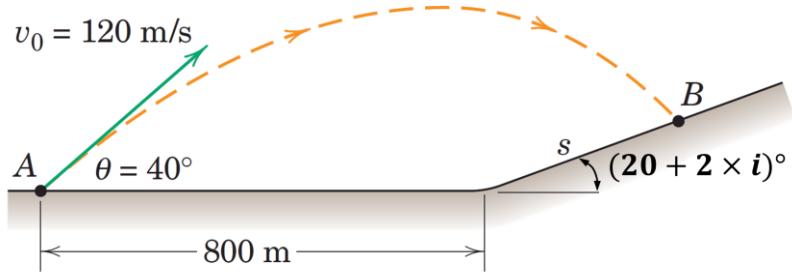


3. The thickness of the semicircular plate (radius = $5 \times i$) varies linearly from its centre to its periphery. The thickness at its centre is “ $2 \times i$ ” and thickness at its periphery is “ i ”. Determine the y-coordinate of the mass center of the plate. [10]

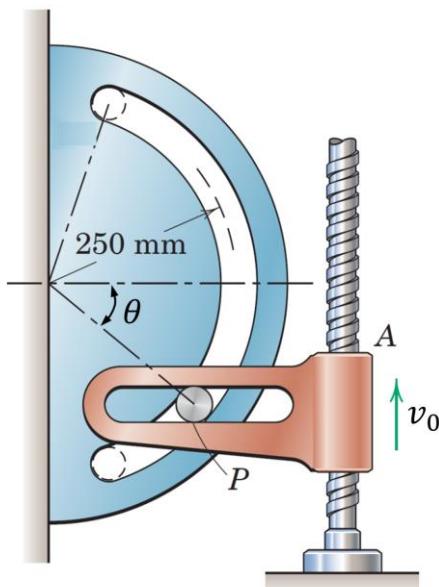


[Group B: Dynamics]
(Answer any Four (04) questions)

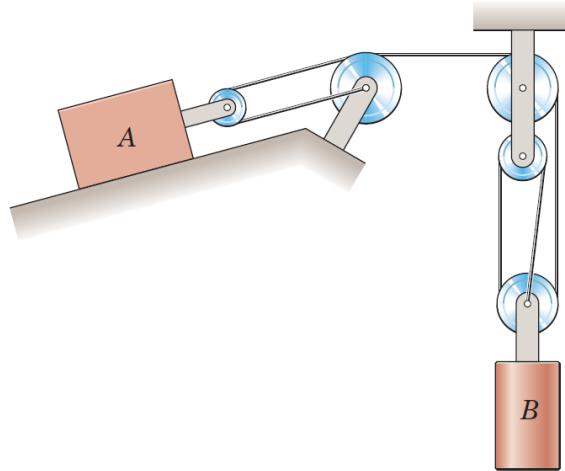
4. A projectile is launched from point A with the initial conditions shown in the figure. Determine the slant distance s which locates the point B of impact. Calculate the time of flight t . [7]



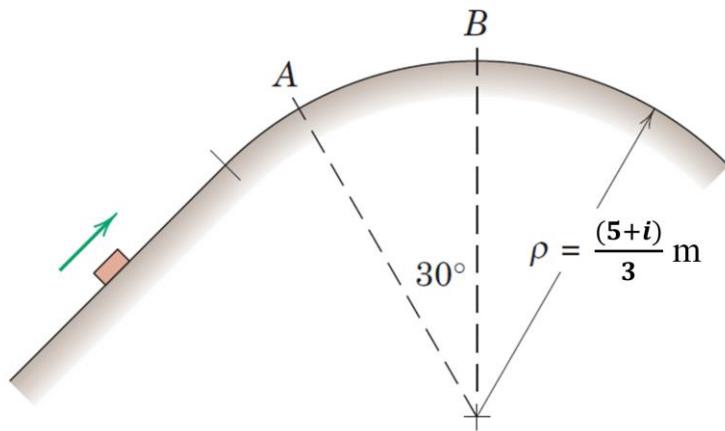
5. The motion of the pin P in the fixed circular slot is controlled by the guide A, which is being elevated by its lead screw with a constant upward velocity $v_0 = 2 \text{ m/s}$ for an interval of its motion. Calculate both the normal and tangential components of acceleration of pin P as it passes through the position for which $\theta = (20 + i)^\circ$. [7]



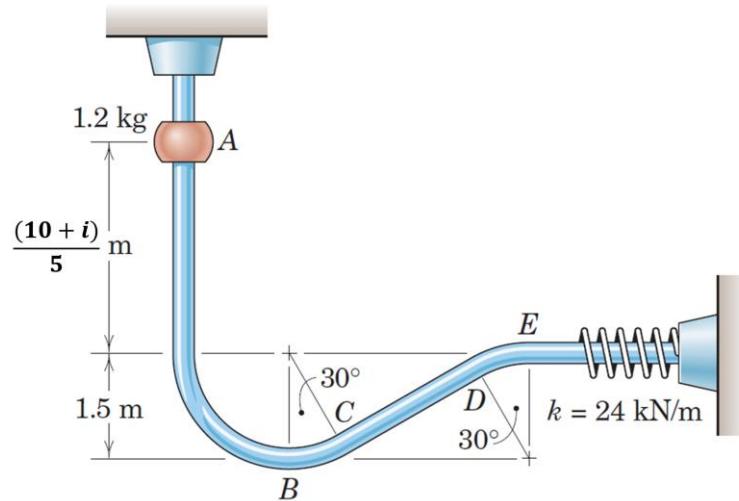
6. At a certain instant, the velocity of cylinder B is $(3 \times i)$ m/s down and its acceleration is $(5 \times i)$ m/s² up. Determine the corresponding velocity and acceleration of block A. [7]



7. If the 2 kg block passes over the top B of the circular portion of the path with a speed of 3.5 m /s, calculate the magnitude N_B of the normal force exerted by the path on the block. Determine the maximum speed v which the block can have at A without losing contact with the path. [7]



8. The 1.2 kg slider is released from rest in position A and slides without friction along the vertical-plane guide shown. Determine (a) the speed v_B of the slider as it passes position B and (b) the maximum deflection δ of the spring. [7]



9. In a pool game the cue ball A must strike the eight ball in the position shown in order to send it to the pocket P with a velocity v_2' . The cue ball has a velocity v_1 before impact and a velocity v_1' after impact. The coefficient of restitution is 0.9. Both balls have the same mass and diameter. Calculate the rebound angle θ . [7]

