B.Sc. IPE-1st Semester

Date: 5 December, 2023
Time: 1:30 pm – 4:30 pm

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Semester Final Examination
Course Number: ME 4151
Course Title: Statics & Dynamics

Winter Semester: 2022 - 2023
Full Marks: 150
Time: 3 Hours

There are **Six** questions. Answer **all the** questions. The symbols have their usual meanings. Marks of each question and the corresponding CO and PO are written on the right side. Assume a reasonable value of missing data.

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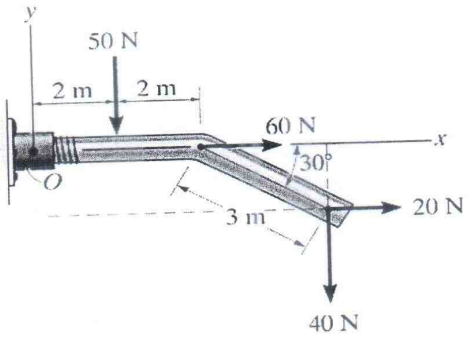
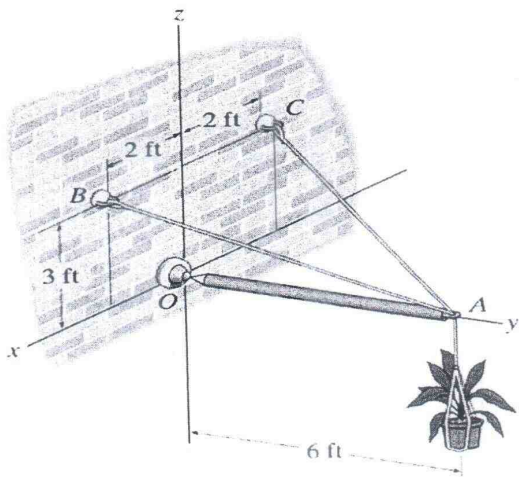
1. a. Define moment. Determine the resultant moment of the four forces acting on the rod shown in Fig A. **5 CO1 PO1**



(A)

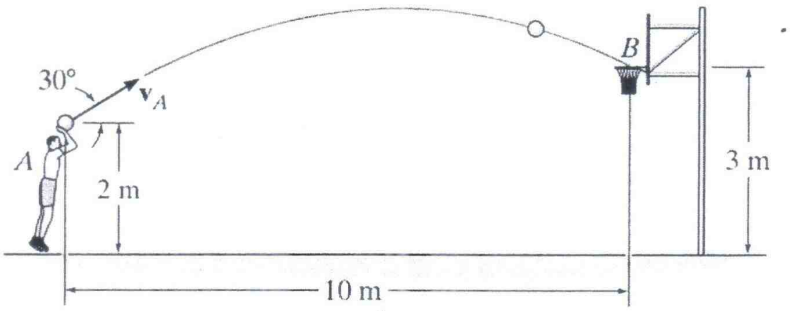
b. The boom is used to support the 75-lb flowerpot in Fig B. Determine the tension developed in wires AB and AC. **20 CO1 PO1**



(B)

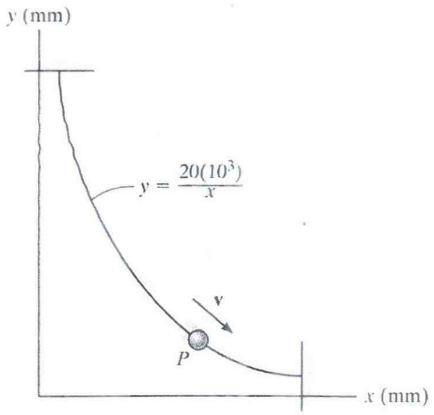
2 **a.** Write the equation of motions for a projectile with an initial velocity of U at an angle θ to the horizontal plane. Define the position of the particle as a function of time and include an equation for both horizontal and vertical motion. **5 CO3 PO2**

b. Neglecting the size of the ball, determine the magnitude v_A of the basketball's initial velocity and its velocity, and direction when it passes through the basket as shown in Fig B. **10 CO3 PO2**



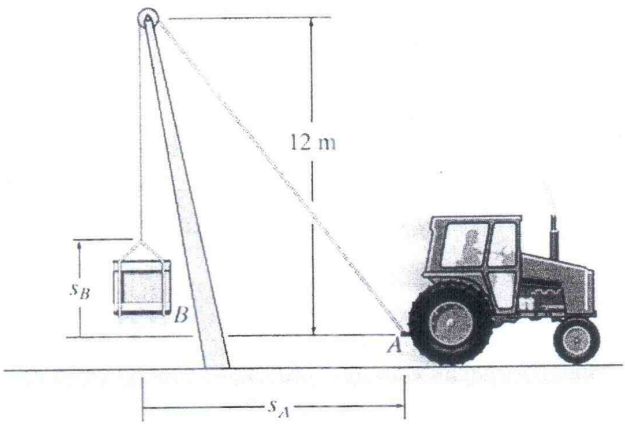
(B)

c. The particle in Fig C travels at a constant speed of 300 mm/s along the curve. Determine the particle's acceleration when it is located at point (200 mm, 100 mm) and sketch this vector on the curve. **10 CO3 PO2**



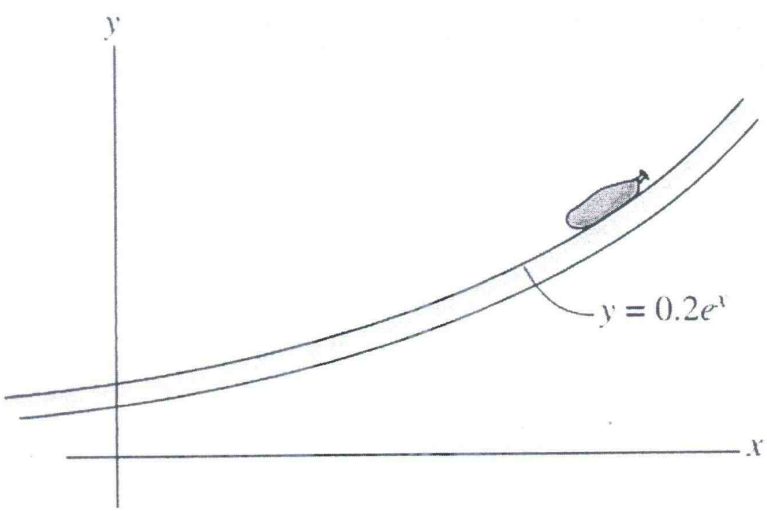
(C)

3. **a.** The tractor shown in Fig A is used to lift the 150-kg load B with the 24-m-long rope, boom, and pulley system. If the tractor travels to the right with an acceleration of 3 m/s^2 and has a velocity of 4 m/s at the instant S_A = 5m, determine the tension in the rope at this instant. When S_A = 0, S_B = 0. **10 CO3 PO3**



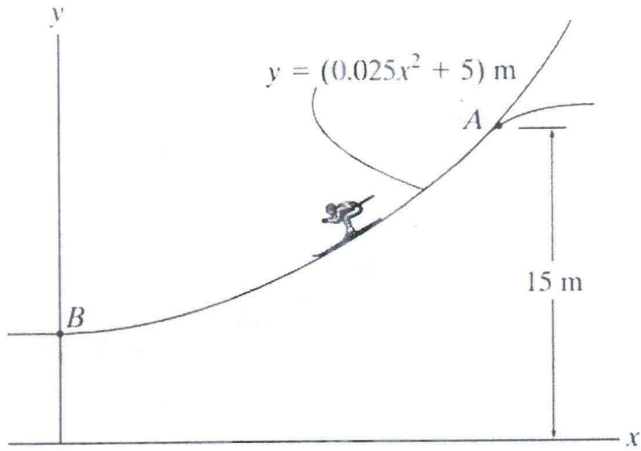
(A)

b. The 8-kg sack in Fig B slides down the smooth ramp. If it has a speed of 1.5 m/s when y = 0.2 m, determine the normal reaction the ramp exerts on the sack and the rate of increase in the speed of the sack at this instant. **15 CO3 PO3**



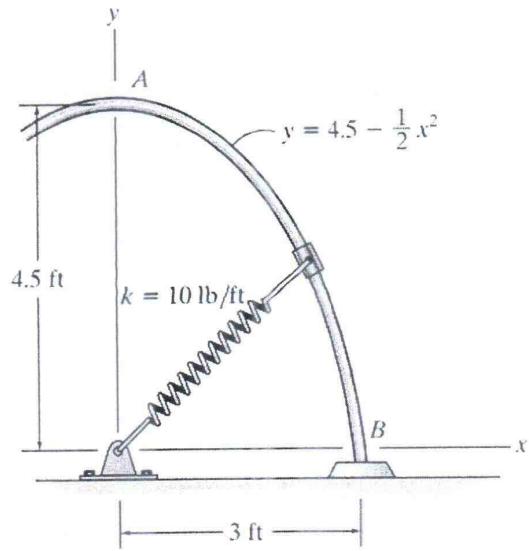
(B)

4 **a.** If the 60-kg skier passes point A with a speed of 5m/s, determine his speed when he reaches point B. Also, find the normal force exerted on him by the slope at this point as shown in Fig A. Neglect friction. **10 CO3 PO3**



(A)

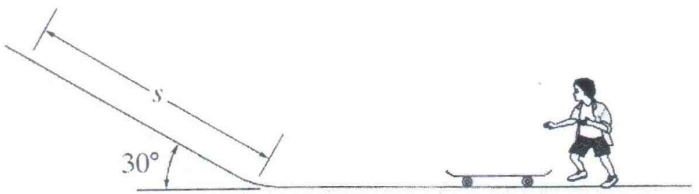
b The 2-lb collar shown in Fig B has a speed of 5ft/s at A. The attached spring has an unstretched length of 2 ft and a stiffness of k = 10 lb/ft. If the collar moves over the smooth rod, determine its speed when it reaches point B, the normal force of the rod on the collar, and the rate of decrease in its speed. **15 CO3 PO3**



(B)

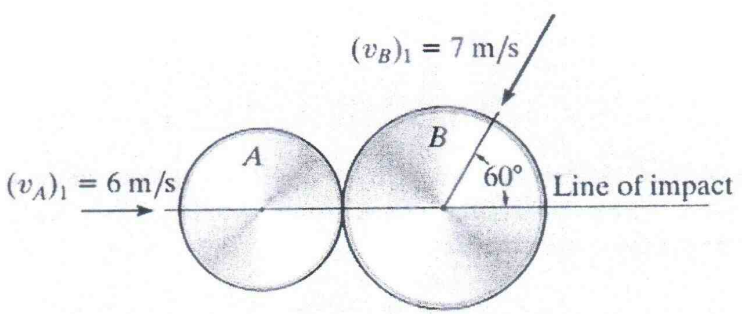
5 **a** Define the coefficient of restitution and explain elastic and plastic impacts. **5 CO4 PO2**

b The 50-kg boy in Fig A jumps on the 5-kg skateboard with a horizontal velocity of 5 m/s. Determine the distance ***s*** the boy reaches up the inclined plane before momentarily coming to rest. Neglect the skateboard's rolling resistance. **10 CO4 PO2**



(B)

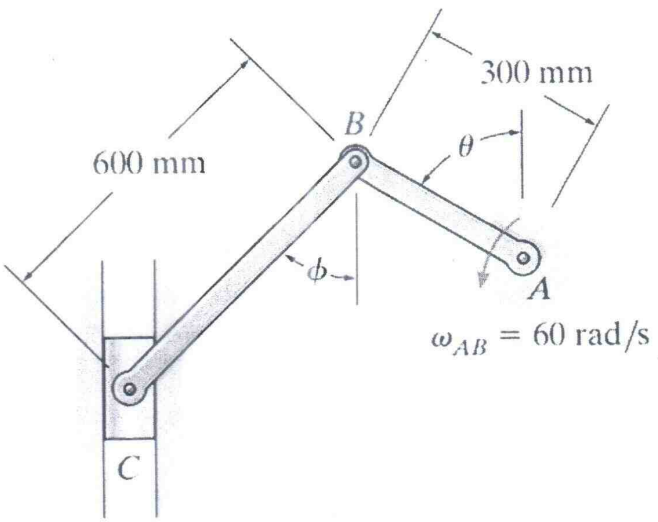
c The two disks A and B have a mass of 3 kg and 5 kg, respectively. If they collide with the initial velocities shown, determine their velocities just after impact as shown in Fig C. The coefficient of restitution is e = 0.65. **10 CO4 PO2**



(C)

6 a Rod AB in Fig A is rotating with an angular velocity of ω_{AB} = 60 rad /s. Determine the velocity of the slider C at the instant θ = 60° and Ø = 45°. Also, sketch the position of bar BC when θ = 30°, 60° and 90° to show its general plane motion.

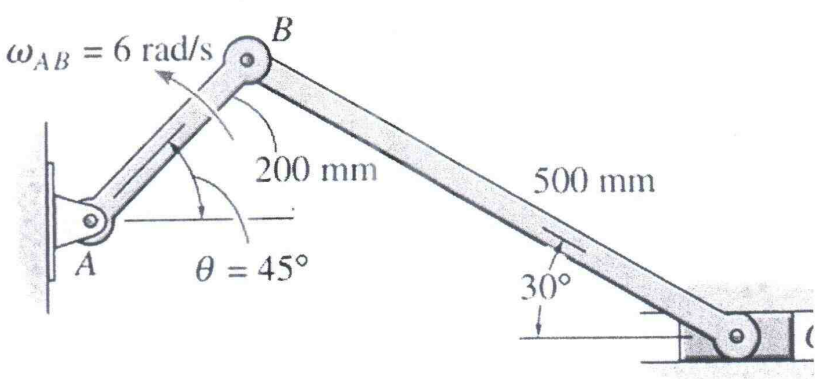
15 CO4 PO3



(A)

b If bar AB in Fig B has an angular velocity ω_{AB}= 6 rad/s, determine the velocity of the slider block C at the instant shown. Draw the position of IC showing all the angles and distance.

10 CO4 PO3



(B)