


Name: Enrolment No:	
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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
Supplementary Examination, December 2023

Course: Engineering Mechanics
Program: B.Tech. Aerospace
Course Code: MECH 2031

Semester: III
Time: 03 hrs.
Max. Marks: 100

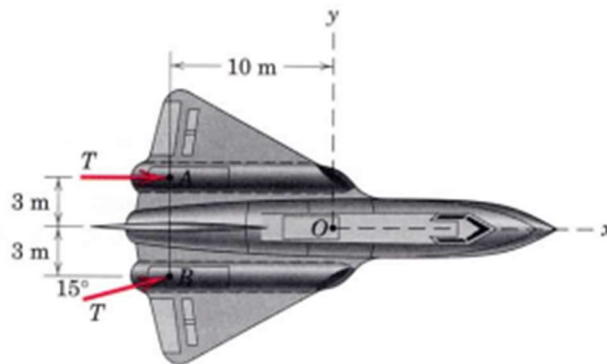
Instructions: 1. All questions of the particular section should be answered collectively at one place.
2. Assume suitable right-handed coordinate system if it is not mentioned in problem.

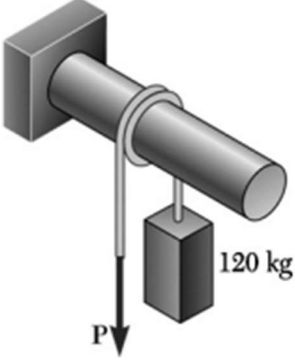
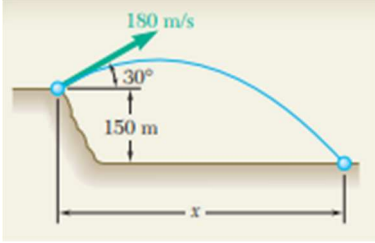
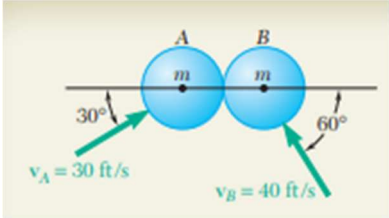
SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Explain the Varignon's theorem.	4	CO1
Q 2	State & derive the expression for parallel axis theorem.	4	CO1
Q 3	What is the condition of self-locking in wedge and screw jack friction applications.	4	CO1
Q 4	Explain instantaneous centre of rotation.	4	CO1
Q 5	What are the conditions of equilibrium for the coplanar and concurrent force systems?	4	CO1

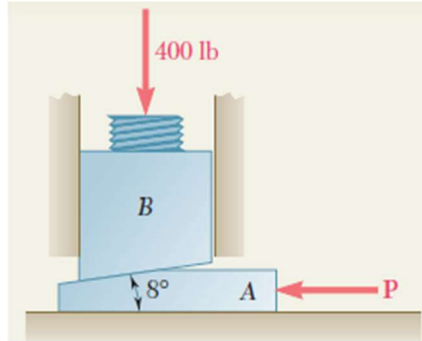
SECTION B
(4Qx10M= 40 Marks)

Q 6	<p>The direction of two thrust vectors of an experimental aircraft can be independently changed within limits. For shown configuration in figure, determine the equivalent force-couple system at point O. Then replace this by a simple resultant and determine its location on x-axis.</p>	10	CO1
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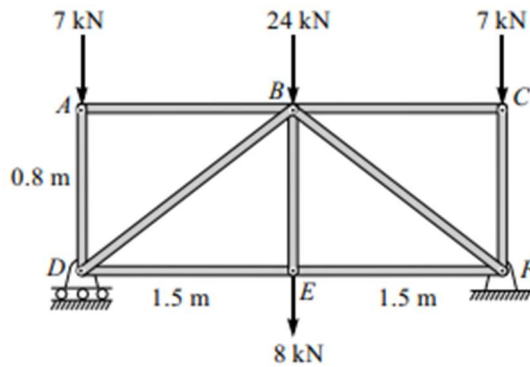
Q 7	<p>A 120-kg block is supported by a rope which is wrapped $1\frac{1}{2}$ times around a horizontal rod shown in figure. Knowing that the coefficient of static friction between the rope and the rod is 0.15, determine the range of values of P for which equilibrium is maintained.</p> 	10	CO2
Q 8	<p>A projectile is fired from the edge of a 150-m cliff with an initial velocity of 180 m/s at an angle of 30° with the horizontal. Neglecting air resistance, determine (a) the horizontal distance from the gun to the point where the projectile strikes the ground, (b) the greatest elevation above the ground reached by the projectile.</p> 	10	CO2
Q 9	<p>The magnitude and direction of the velocities of two identical frictionless balls before they strike each other are as shown. Assuming $e = 0.90$, determine the magnitude and direction of the velocity of each ball after the impact.</p> 	10	CO2
<p>SECTION-C (2Qx20M=40 Marks)</p>			
Q 10	<p>The position of machine block B is adjusted by moving wedge A as shown in figure. Knowing that the coefficient of static friction is 0.35 between all surfaces</p>	20	CO3

of contact. Determine the force P required (a) to raise block B , and (b) to lower block B .



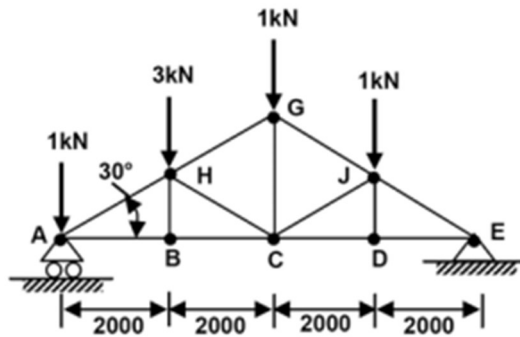
Q 11

Calculate the forces in all members of the truss as shown in figure below. Neglect the weight of the members.



Or,

Determine the forces in member in GH, GJ, and CG of the loaded truss as shown in figure below. The dimension of length of member is in mm.



20

CO3