Sardar Patel Institute of Technology

Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058-India
(Autonomous College Affiliated to University of Mumbai)

End Semester Examination

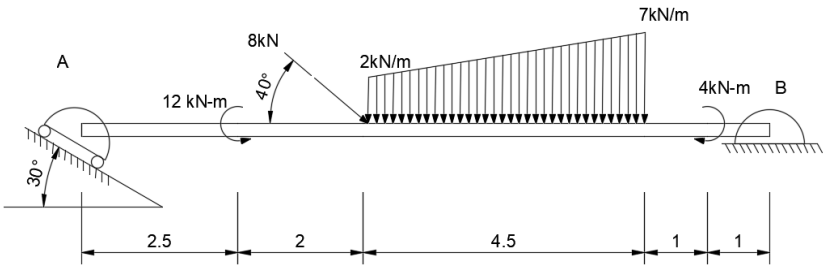
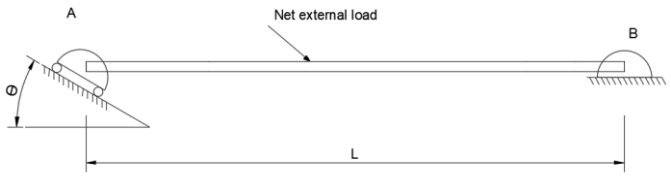
May 2021

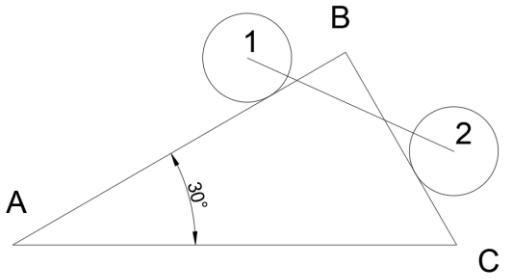
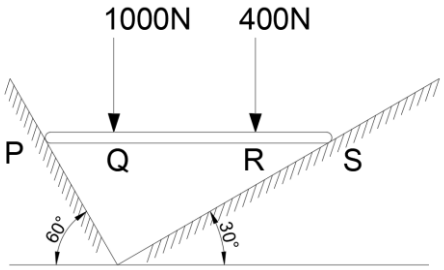
Max. Marks: 60 **Duration: 120 Minutes**
Class: F.E. **Semester: I**
Course Code: AS105 **Branch: I.T./Computer**
Name of the Course: Engineering Mechanics

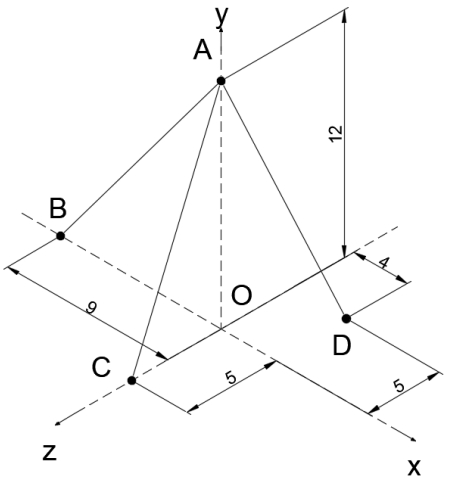
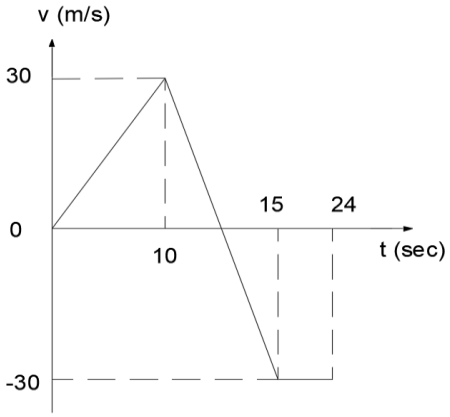
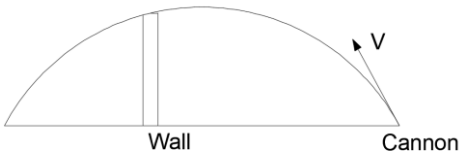
Instrucions:

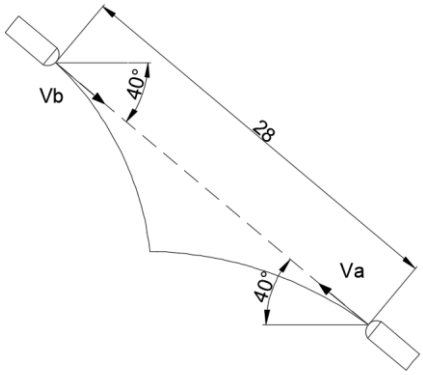
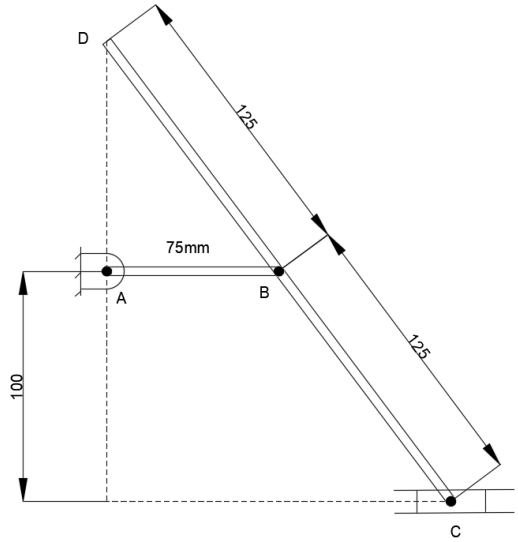
(1) All questions are compulsory.
(2) Draw neat diagrams.
(3) Assume suitable data if necessary.
(4) Solutions without a question number will not be evaluated.
(5) For Q1(a) to Q1(e), write down the correct option number in your answer sheet along with the statement for that option. Repeating the question statement is not required. You may provide additional details if required. Answers without the question number, the option number, and the statement of that option will not be evaluated.

Question No.		Max. Marks	CO	BL
Q1 (a)	If a block placed on an inclined surface is under impending sliding motion, the surface's inclination with the horizontal is called the angle of repose. i. The above statement is completely true. ii. The above statement is completely false. iii. Exactly one other condition must be satisfied for the angle to be called angle of repose. The condition is: _____ iv. More than one other conditions must be satisfied for the angle to be called angle of repose. The conditions are: _____ _____	1	2	3
Q1 (b)	For a parallel, non-coplanar force system, Varignon's theorem is not applicable. i. The above statement is true. ii. The above statement is false.	1	3	3
Q1 (c)	The area under a v-t diagram for rectilinear motion gives the: i. Acceleration of the particle. ii. Change in displacement of the particle. iii. Jerk. iv. Potential energy of the particle.	1	4	3
Q1 (d)	For kinematic analysis of projectile motion on the surface of planet Earth, we assume that motion in the horizontal direction has uniform velocity, because: i. Gravity is assumed to act uniformly and vertically downwards, not affecting horizontal motion.	1	4	3

	ii. Air resistance is neglected. iii. Both i and ii. iv. It is a limitation of coplanar motion analysis.			
Q1 (e)	The ICR of a rigid body system is: i. Not fixed with respect to time. ii. A zero velocity point. iii. Independent of the arrangement of the members of the system in space. iv. An imaginary point. Which of the above choices is incorrect?	1	5	3
Q1 (f)	For the load system shown below find the reactions at the supports for the equilibrium of the beam. All lengths are in meters. 	7	1	3
Q1 (g)	For the beam system given in Q1 (f):  Keep the same external load system, the same span of the beam (L) and use the value of Ra (net reaction at A) that you computed from the previous solution. How will the support reaction at B change if you change the inclination of Ra with the horizontal? Choose any single value of inclination (Θ) with the horizontal between 20-40 degrees (excluding the original value of 30 degrees) for the plane on which support A rests and show whether support B's components increase or decrease with an increase or decrease in that inclination compared to the original inclination of 30 degrees. Comment on the observed behavior. (Hint: since the external load system does not change, the equations formed in the previous solution for translatory equilibrium, ΣFx and ΣFy, will not change in terms of the net external loads represented in them.) **OR**	3	1	3

	If the linearly increasing load (2kN/m to 7kN/m over 4.5m) is reversed so that it linearly decreases from left to right (i.e. 7kN/m to 2kN/m over 4.5m), does it change the system in any way? Qualify your statement by removing all other loads acting on the beam except the linearly increasing load (2kN/m to 7kN/m over 4.5m) and computing its net effect on the beam versus a linearly decreasing load's (7kN/m to 2kN/m over 4.5m) net effect in terms of equilibrium equations. (You need not compute support reactions for this comparison. Only compare the effect of the two arrangements of linearly increasing/decreasing loading in the absence of all other loads and state whether there is an increase, decrease or no change to the system's load structure.)			
Q2 (a)	Two rollers rest on two mutually perpendicular frictionless surfaces AB and BC as shown. The rollers weigh W1=200N and W2=150N respectively, and are connected by a string 1-2. Find the tension in the string and the inclination it makes with the horizontal if the system is in equilibrium.  	8	1	3
Q2 (b)	Two loads, 1000N and 400N, are placed on a horizontal, rigid bar PQRS (of length 4m) at Q and R as shown. l(RS) = 1.2m. Find the minimum length l(PQ) (i.e. the distance from point P that the 1000N load must be placed on the bar) so that the bar remains in equilibrium if the coefficient of friction for all surfaces is 0.3. Assume that the bar's self-weight is negligible.  	7	2	3
Q3 (a)	Find the forces in cables AB, AC, AD if their net resultant is R = [-1000j] kN. All lengths are in meters.	8	3	3

				
Q3 (b)	The v-t diagram for a particle's rectilinear motion is shown below. At t= 0 sec, s= -5m. Draw the displacement-time and acceleration-time diagrams for the time duration shown. 	7	4	3
Q4 (a)	A cannonball fired from the ground clears a vertical wall 1.8m high. If the cannon used for firing the cannonball is on the ground at a horizontal distance of 2.4m from the wall when the cannonball is fired, the horizontal distance between the wall and the point where cannonball lands on the ground on the other side of the wall is 1.8m. Find the least velocity with which the cannonball was fired. 	6	4	3
	OR			

Q4 (a)	Two cannons, A and B, 28m apart, are aimed at each other. Cannon A is on the ground. Cannon B is fired from an elevated position. Their cannonballs are fired simultaneously with velocities v_a = 500m/s and v_b = 300m/s. Locate the point where the cannonballs strike each other along with the time taken by both cannonballs to reach that point. 	6	4	3
Q4 (b)	Crank AB has an angular velocity of 6 rad/s clockwise in the mechanism shown. Find the velocity of point D and slider C at the instant shown. All lengths are in mm. 	6	5	3
Q4(c)	Briefly state (any two of the following four): i. The Principle of Transmissibility of a force. ii. Lami's Theorem. iii. The concept of a Couple. iv. The method for transferring a force to another point on a body using force-couple approach.	3	1	3