Cairo University

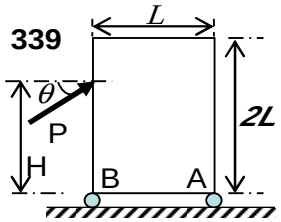
Dynamics of Rigid Body in Plane Motion

First Year Students - 2019-2020

MEC (112) - Sheet (3) - Equations of Motion

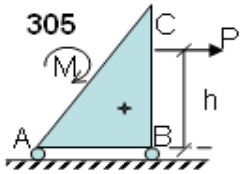
Faculty of Engineering

A force P =350N, θ =25° is applied to move the shown rectangular block (m = 80 kg, L =1.5 m) which is supported on two rollers at A and B. Case 1: H=0.75L. Case 2: H=Hmaximum so that the block not tip over. Given g=10 m/s^2, Choose the correct answers



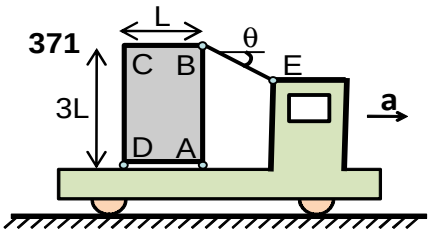
No		Required	A	B	C	D
1	case 1	The acceleration of the block	3.656	3.965	4.274	4.584
2		Reaction at roller A [N]	392.7	320.7	272.7	344.7
3		Reaction at roller B [N]	353.1	309.7	396.4	331.4
4		The block velocity after 2 sec	7.93	7.433	9.421	8.427
5	case 2	H Maximum [m]	2.523	3.198	2.692	2.186
6		Reaction at roller A [N]	550	754.2	601	652.1
7		Reaction at roller B [N]	24.19	30.23	36.28	6.05

A force P =350N, and an external moment M=45N.M, is applied to move the shown block (m = 80 kg, BC = 9 m and AB =1.5 m) on rough surface. The block is supported on two rollers at A and B. The friction coefficient is (μ=0.2). Case 1: h = 0.5*AB. Case 2: calculate hmin and hmax so that the block not tip over. Given g=10 m/s^2, Choose the correct answers



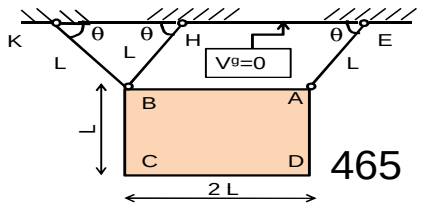
8	Case 1	The acceleration of the block	2.71	2.375	2.208	2.04
9		Reaction at roller A [N]	341.3	408.2	508.6	441.7
10		Reaction at roller B [N]	333.9	382.8	309.5	358.3
11	Case 2	H Maximum [m]	3.221	2.45	2.643	2.064
12		H Minimum [m]	-0.786	-0.63	-0.682	-0.838

In Problem 371, A uniform block ABCD (24 kg, Lx3L m, L=1.05) is loaded on two rollers on the back of the shown truck and connected in the cabinet by rod BE. Given θ=35 degrees, study the motion of the beam. Case (1): The truck starts motion with acceleration a=2.7 m/sec2 and the block not tip over. Case (2): The truck start motion with the max. accel. (a max.) so that the block not tip over. Assume g=10 m/s^2



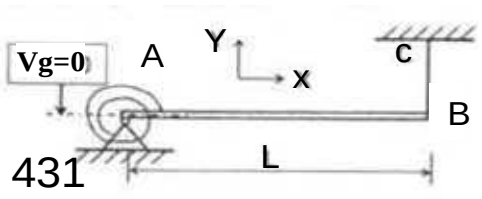
13	Case (1)	The tension in the cable BE [N]	85.1	79.11	73.12	97.07
14		The normal reaction component at A [N]	193.3	171.8	161.1	204.1
15		The normal reaction component at D[N]	21.3	19.7	24.3	25.9
16	Case (2)	The max. acceleration of the truck [m/sec2]	2.651	3.561	4.016	3.333
17		The tension in the cable BE [N]	97.66	118.8	76.54	90.62
18		The normal reaction component at A [N]	296	356.9	336.6	255.5
19		The normal reaction component at D [N]	3.7	4.93	0	6.17

The shown plate ABCD (m=60kg, L=1.2m) is connected by three similar light rods AE, BH and BK (length=L, θ=45°). Choose the correct answers in the following cases. Case(1): If the cable KB is broken, choose at θ=90°. Case(2): the cable AE is broken, choose when BD became vertical. Assume g = 10 m/s^2



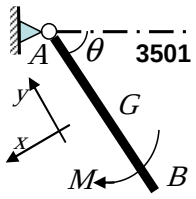
20	Case 1	The velocity of the point D	2.071	2.651	2.458	3.232
21		The angular velocity of ωAE	2.058	1.906	2.209	2.513
22		Ang. Accel. of αAE	27.24	54.49	68.11	13.62
23		The force in AE	369	511.3	475.7	546.9
24	Case 2	IB of the plate	153	117	126	144
25		Ang. velocity of the plate ω	2.855	2.486	1.932	3.04
26		The force in cable BH	618.4	670.9	776.1	933.7

In Problem 431, A uniform beam AB (24 kg, 1.05 m) is hinged at A and joined by a cable BC and connected by a rotational spring (k=18) at A, untwisted in the shown position (pos.1). The cable BC is suddenly breaks, choose the correct answers in the veridical position (pos. 2) . Given g=10 m/s^2



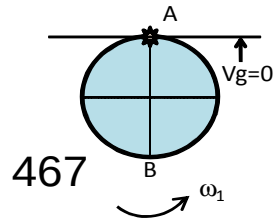
27	The ang. velocity of the rod in pos. (2) ω2	4.509	4.167	4.851	3.825
28	The ang. acc. of the rod in pos. (2) $alafa (c.c.w)	2.82	2.628	3.206	3.013
29	The reaction X at A [N]	46.27	34.52	49.21	40.39
30	The reaction Y at A [N]	412.9	495.3	619	536.6

The uniform 8kg bar AB (L=1.5m) shown is free to rotate in a vertical plane about a smooth pin at its end A. The body polar moment of Inertia Ig=1.5. The motion started when θ=30^o with ω=2 rad/sec due to couple C=7.5Nm. Case(1) at initial condition, case(2) when θ reaches70^o where g=10 m/s^2



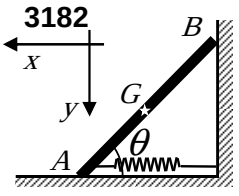
31	Case 1	The total acceleration at G	8.549	7.482	9.083	8.015
32		The total Reaction at A	64.75	69.37	60.13	73.99
33		Reaction angle with horizontal	162.4	141.3	120.2	172.9
34	Case 2	ω	4.071	3.296	3.555	3.813
35		The total acceleration at G	13.71	10.7	11.45	9.198
36		The total Reaction at A	150.9	196.9	162.4	139.5
37		Reaction angle with horizontal	94.2	118.2	134.3	110.2

In Problem 467, A uniform circular disc (m= 27 and r= 1.2) is connected to a rough hinge at A where there is a frictional moment M N.m/rad .The disc is pushed by an initial angular velocity ω1=4 rad/sec (c.c.w) form the shown position (Pos.1) and its angular velocity when AB becomes horizontal (Pos. 2) is ω1=1.4 rad/sec (c.c.w). Chose the correct answers. Given g=10 m/s^2



38	I A for the disc [kg.m2]	58.32	53.93	49.54	71.49
39	The frictional moment M at A [N.m/rad]	62.77	58.57	54.37	41.77
40	a the disc in pos. 2 (C.C.W.) [rad/sec2]	-5.667	-5.257	-6.488	-7.308
41	The horizontal reaction at A in pos. 2 [N]	50.6	59.2	63.5	76.41
42	The vertical reaction at A in pos. 2 [N]	55.06	45.59	50.32	59.79

A uniform rod AB (L=2.2 m, mass=25 kg, Ig=10.083kg m^2) moves in a vertical plane and connected to spring (Lo =0.4 m). The rod is released from rest at θ= 60^o so that a_A = 1.5 m/s^2 to the left. Assume g =10m/s^2, choose the correct answers just after starting the motion



43	aB Point B acceleration	1.053	0.742	0.866	0.99
44	α (C.W.) for Rod AB	0.787	0.911	0.726	0.973
45	NA Reaction at A	222.6	255.7	206.1	239.2
46	NB Reaction at B	56.82	62.63	91.68	68.44
47	K spring Stiffness	94.16	79.29	69.37	89.2