Cairo University

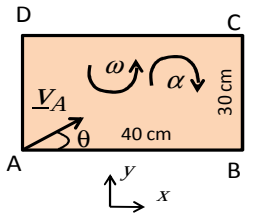
Dynamics of Rigid Body in Plane Motion

First Year Students - 2019-2020

MEC (112) - Sheet (2) - Kinematics

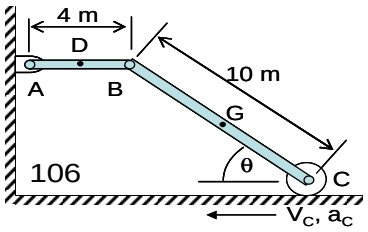
Faculty of Engineering

The shown recangular lamina moves in the xy plane. At the instant shown (when AB is horizontal) point A has a velocity $100\sqrt{2}$ cm/sec ($\theta=45^o$) and acceleration 80 cmlsec^2 to the right (→) and the lamina has ω= 2 rad/sec (c.c.w) and α= 3 rad/sec^2 (c.w). Choose the correct answers



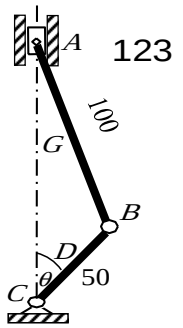
No	Required	A	B	C	D
1	$\underline{V}_B$ [m/s]	100i+180j	100i-180j	-100i+180j	-100i-180j
2	$\underline{V}_C$ [m/s]	-40i+180j	-40i-180j	40i+180j	40i-180j
3	$\underline{V}_D$ [m/s]	-40i+100j	-40i-100j	40i+100j	40i-100j
4	$\underline{a}_B$ [m/s^2]	-80i+120j	-80i-120j	80i-120j	80i+120j
5	$\underline{a}_C$ [m/s^2]	10i+240j	10i-240j	-10i+240j	-10i-240j
6	$\underline{a}_D$ [m/s^2]	170i+120j	-170i+120j	-170i-120j	170i-120j

In the position shown, end C of rod BC has a velocity of 0.8 m/s and an acceleration of 0.9 m/s^2, both directed to the left. Points D and G are mid points of rods AB and BC, respectively. At $\theta=83^o$, select the correct answer



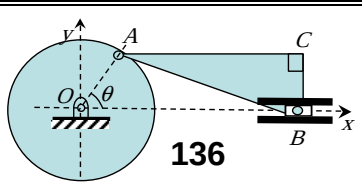
7	ω_{BC} C.C.W.	-0.086	-0.096	-0.081	-0.091
8	ω_{AB} C.C.W.	0.029	0.025	0.023	0.02
9	α_{BC} C.C.W.	-0.073	-0.1	-0.106	-0.09
10	α_{AB} C.C.W.	0.015	0.011	0.008	0.021
11	$\underline{V}_B$ [m/s]	0.106j	0.09j	0.114j	0.098j
12	V_G [m/s]	0.377	0.351	0.455	0.324
13	$\underline{a}_B$ [m/s^2]	-0.003i+0.053j	-0.002i+0.036j	-0.002i+0.045j	-0.003i+0.048j
14	a_G [m/s^2]	0.417	0.486	0.556	0.521
15	$\underline{a}_D$ [m/s^2]	-0.001i+0.022j	-0.001i+0.024j	-0.001i+0.025j	-0.001i+0.02j

In the shown slider-crank mechanism, Point A moves on the vertical slider with a velocity of 40 cm/s and an acceleration of 5 cm/s^2, both directed upward. Points D and G are mid points of rods BC and AB, respectively. At $\theta = 15^o$ find the following:



16	ωAB C.W.	1.012	0.821	1.845	1.601
17	ωBC C.W.	-0.517	-2.079	-3.286	-3.788
18	αAB C.W.	8.269	2.059	15.07	9.321
19	αBC C.W.	-4.007	-18.14	-12.23	-16.09
20	$\underline{V}_B$	-100.4i+26.9j	-136.3i+36.51j	-76.3i+20.44j	-113.2i+30.32j
21	$\underline{V}_G$	-68.13i+45.4j	-7.402i+4.933j	-38.15i+25.42j	-50.19i+33.45j
22	$\underline{a}_B$	-1518i-0.693j	-833.2i-0.38j	-122.9i-0.056j	-1131i-0.516j
23	$\underline{a}_G$	-61.44i+0.341j	-612.5i+3.396j	-759.2i+4.209j	-416.6i+2.31j
24	$\underline{V}_D$	-91.46i+24.51j	-73.8i+19.77j	-50.19i+13.45j	-109.3i+29.28j
25	$\underline{a}_D$	-281.5i-0.129j	-416.6i-0.19j	-612.5i-0.28j	-906.9i-0.414j

The shown mechanism is composed of a triangle plate ABC (AB=6.8 m, BC=1.5 m) and a circular plate OA (OA=3 m). Point B moves along a slider. Point O is supported by hinge. The angular velocity for disc OA ω_1 =2.5 rad/s CCW, α_1 =4 rad/s^2 CCW. At θ =30 ^{o}, select the correct answer



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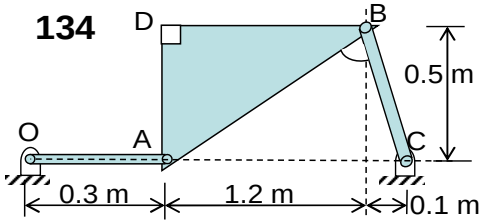
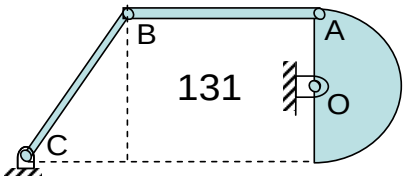
26	$\underline{V}_A$ [m/s]	-4.31i+7.465j	-2.91i+5.04j	-3.75i+6.495j	-4.03i+6.98j
27	ω_{AB} C.C.W.	-0.979	-0.749	-0.902	-1.21
28	$\underline{V}_B$ [m/s]	-4.84i	-5.598i	-5.977i	-5.219i
29	$\underline{V}_C$ [m/s]	-4.51i	-3.75i	-3.5i	-4.26i
30	$\underline{a}_A$ [m/s]	-17.38i+0.795j	-22.24i+1.017j	-27.1i+1.24j	-25.48i+1.166j
31	α_{AB} C.C.W.	-0.318	-0.344	-0.423	-0.37
32	$\underline{a}_B$ [m/s]	-29.15i	-27.28i	-23.53i	-32.9i
33	$\underline{a}_C$ [m/s]	-32.1i-1.615j	-28.6i-1.439j	-23.34i-1.174j	-33.85i-1.703j

The shown mechanism consists of 3 rigid bodies, a right angle Triangle ABD, a Rod OA and a Rod BC At the shown instant the Rod OA is horizontal. Given ωOA =2.5rad/s and αOA=3.5rad/s^2 both anti-clockwise. Points C and O are hinged supports. Assume all angular velocities and accelerations are C.C.W., Select the correct answer



34	$\underline{V}_A$ [m/s]	0.8j	0.85j	0.75j	0.65j
35	$\underline{V}_B$ [m/s]	0.288i+0.058j	0.311i+0.062j	0.266i+0.053j	0.244i+0.049j
36	ωAB	-0.577	-0.5	-0.654	-0.538
37	ωBC	-0.493	-0.451	-0.535	-0.619
38	$\underline{a}_A$ [m/s^2]	-1.504i+0.84j	-1.875i+1.05j	-2.246i+1.26j	-2.122i+1.19j
39	$\underline{a}_B$ [m/s^2]	-1.439i-0.435j	-1.313i-0.397j	-1.566i-0.473j	-1.693i-0.512j
40	αAB	-1.247	-1.163	-0.909	-0.994
41	αBC	2.746	2.982	3.453	3.688
42	$\underline{a}_D$ [m/s^2]	-1.294i+0.884j	-1.382i+0.944j	-1.205i+0.823j	-1.117i+0.763j

The shown mechanism consists of 3 rigid bodies, a semicircle (OA = 6m) where O is hinged support, Rod AB = 3.5m and Rod BC =13m. At the shown instant ωOA =2.5rad/s and αOA=3.5rad/s^2 both anti-clockwise. Assume all angular velocities and accelerations are C.C.W., Select the correct answer



43	$\underline{V}_A$ m/s	-12 i	-15 i	-14 i	-18 i
44	$\underline{V}_B$ m/s	-12i+5j	-15i+6.25j	-14i+5.83j	-16i+6.67j
45	ωAB	-1.653	-2.183	-1.786	-1.918
46	ωBC.	1.25	1.45	0.95	1.05
47	$\underline{a}_A$ m/s^2	-21i-37.5j	-20i-35.7j	-18i-32.1j	-23i-41.1j
48	$\underline{a}_B$ m/s^2	-11.83i-21.53j	-7.85i-14.28j	-9.839i-17.91j	-11.17i-20.32j
49	αAB	-6.709	-5.598	-4.858	-5.228
50	αBC	0.169	0.201	0.19	0.148