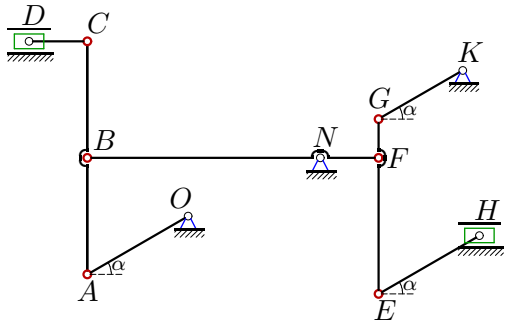
Кинематический анализ механизма (7 звеньев)

Плоский многозвенный механизм с одной степенью свободы приводится в движение кривошипом, который вращается против часовой стрелки с постоянной угловой скоростью. Найти скорости всех шарниров механизма (в см/с) и ускорения трех заданных шарниров (в м/$с^2$). Размеры даны в сантиметрах.

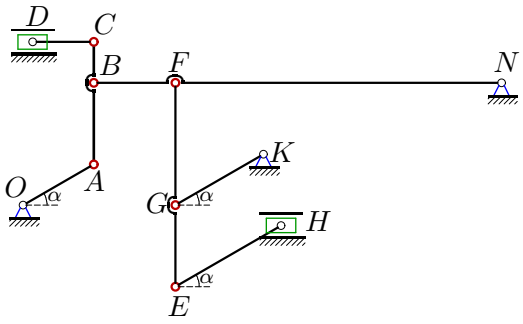
Кирсанов М.Н. **Решебник. Теоретическая механика**/Под ред. А. И. Кириллова.– М.: ФИЗМАТЛИТ, 2008. — 384 с. (с.158.)

Задача К9.1.



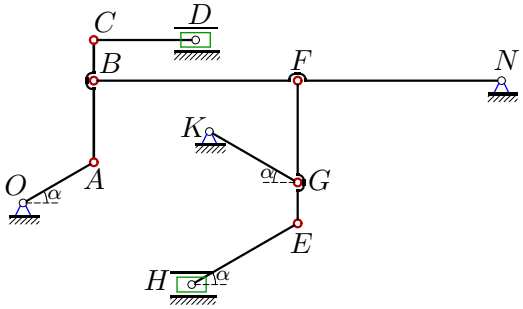
$\omega_{KG} = 3$ рад/с, $\alpha = 30°$,
$AB = 30$, $BC = 30$,
$NB = 60$, $NF = 15$,
$CD = 15$, $EH = 30$,
$FE = 35$, $FG = 10$,
$OA = 30$, $KG = 25$.
a_G, a_F, a_E– ?

Задача К9.2.



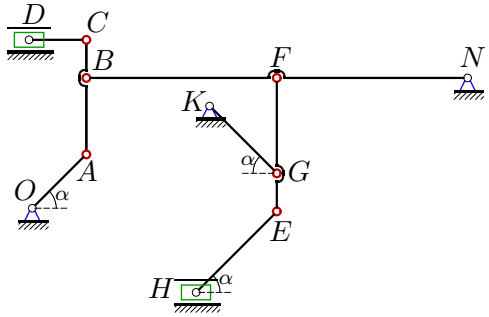
$\omega_{OA} = 3$ рад/с, $\alpha = 30°$,
$AB = 20$, $BC = 10$,
$BF = 20$, $NF = 80$,
$CD = 15$, $EH = 30$,
$FG = 30$, $GE = 20$,
$OA = 20$, $KG = 25$.
a_A, a_B, a_C– ?

Задача К9.3.



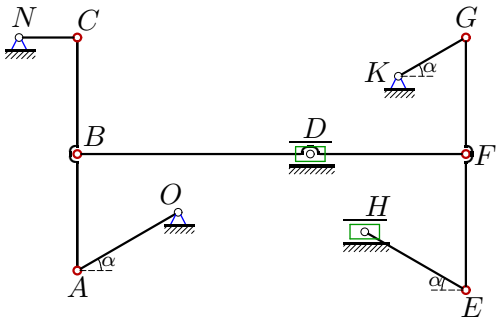
$\omega_{NB} = 1$ рад/с, $\alpha = 30°$,
$AB = 20$, $BC = 10$,
$BF = 50$, $NF = 50$,
$CD = 25$, $EH = 30$,
$FG = 25$, $GE = 10$,
$OA = 20$, $KG = 25$.
a_A, a_B, a_C– ?

Задача К9.4.



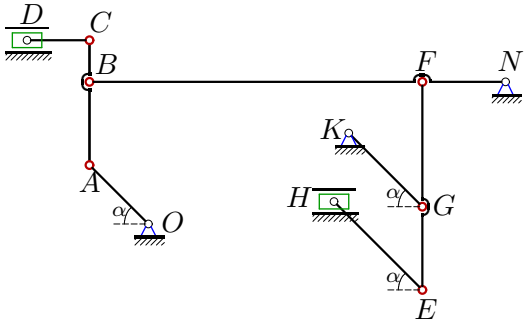
$\omega_{NB} = 1$ рад/с, $\alpha = 45°$,
$AB = 20$, $BC = 10$,
$BF = 50$, $NF = 50$,
$CD = 15$, $EH = 30$,
$FG = 25$, $GE = 10$,
$OA = 20$, $KG = 25$.
a_A, a_B, a_C– ?

Задача К9.5.



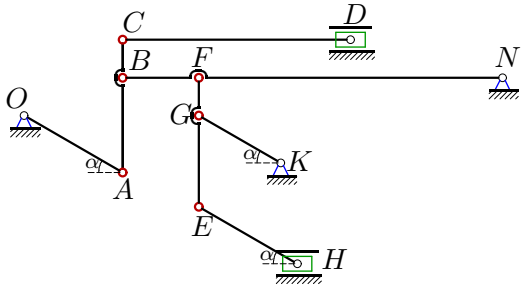
$\omega_{OA} = 2$ рад/с, $\alpha = 30°$,
$AB = 30$, $BC = 30$,
$DB = 60$, $DF = 40$,
$NC = 15$, $EH = 30$,
$FE = 35$, $FG = 30$,
$OA = 30$, $KG = 20$.
a_A, a_B, a_C – ?

Задача К9.6.



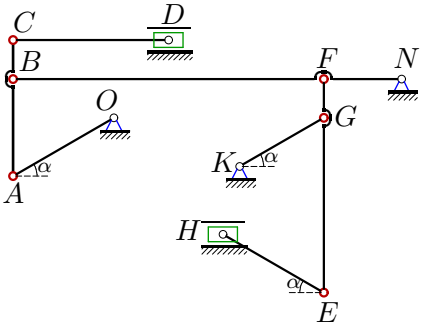
$\omega_{KG} = 3$ рад/с, $\alpha = 45°$,
$AB = 20$, $BC = 10$,
$BF = 80$, $NF = 20$,
$CD = 15$, $EH = 30$,
$FG = 30$, $GE = 20$,
$OA = 20$, $KG = 25$.
a_G, a_F, a_E – ?

Задача К9.7.



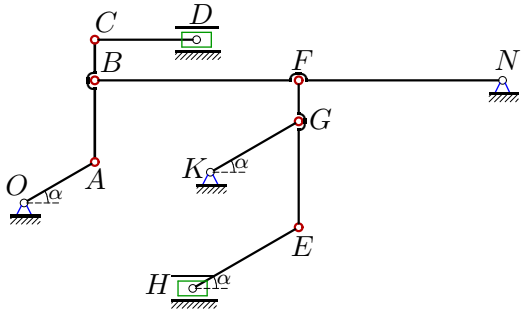
$\omega_{OA} = 3$ рад/с, $\alpha = 30°$,
$AB = 25$, $BC = 10$,
$BF = 20$, $NF = 80$,
$CD = 60$, $EH = 30$,
$FG = 10$, $GE = 24$,
$OA = 30$, $KG = 25$.
a_A, a_B, a_C – ?

Задача К9.8.



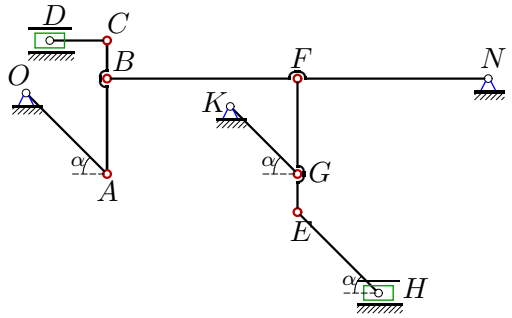
$\omega_{NB} = 1$ рад/с, $\alpha = 30°$,
$AB = 25$, $BC = 10$,
$BF = 80$, $NF = 20$,
$CD = 40$, $EH = 30$,
$FG = 10$, $GE = 45$,
$OA = 30$, $KG = 25$.
a_A, a_B, a_C – ?

Задача К9.9.



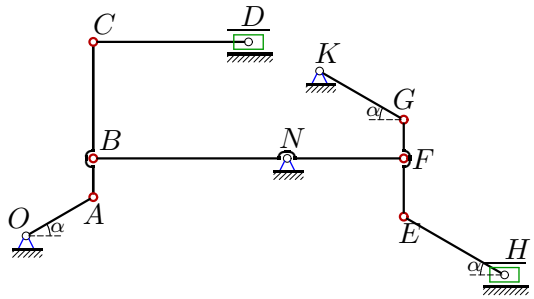
$\omega_{KG} = 2$ рад/с, $\alpha = 30°$,
$AB = 20$, $BC = 10$,
$BF = 50$, $NF = 50$,
$CD = 25$, $EH = 30$,
$FG = 10$, $GE = 26$,
$OA = 20$, $KG = 25$.
a_G, a_F, a_E – ?

Задача К9.10.



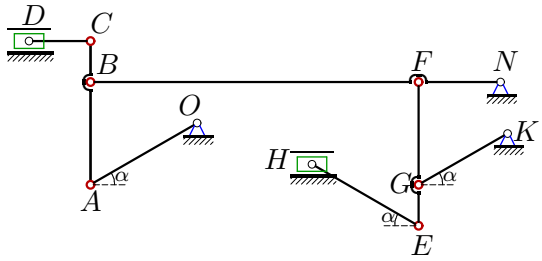
$\omega_{OA} = 1$ рад/с, $\alpha = 45°$,
$AB = 25$, $BC = 10$,
$BF = 50$, $NF = 50$,
$CD = 15$, $EH = 30$,
$FG = 25$, $GE = 10$,
$OA = 30$, $KG = 25$.
a_A, a_B, a_C – ?

Задача К9.11.



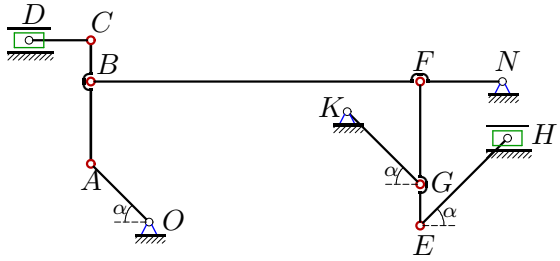
$\omega_{KG} = 2$ рад/с, $\alpha = 30°$,
$AB = 10$, $BC = 30$,
$NB = 50$, $NF = 30$,
$CD = 40$, $EH = 30$,
$FE = 15$, $FG = 10$,
$OA = 20$, $KG = 25$.
a_G, a_F, a_E – ?

Задача К9.12.



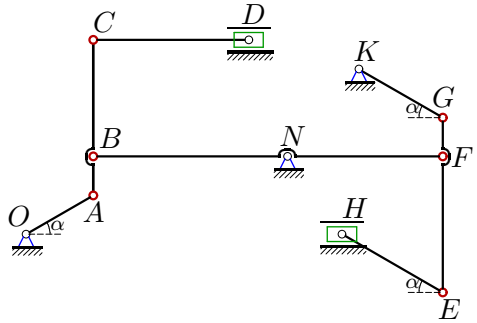
$\omega_{OA} = 2$ рад/с, $\alpha = 30°$,
$AB = 25$, $BC = 10$,
$BF = 80$, $NF = 20$,
$CD = 15$, $EH = 30$,
$FG = 25$, $GE = 10$,
$OA = 30$, $KG = 25$.
a_A, a_B, a_C – ?

Задача К9.13.



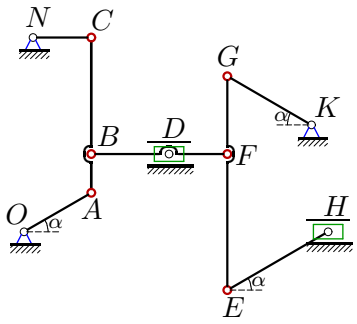
$\omega_{NB} = 3$ рад/с, $\alpha = 45°$,
$AB = 20$, $BC = 10$,
$BF = 80$, $NF = 20$,
$CD = 15$, $EH = 30$,
$FG = 25$, $GE = 10$,
$OA = 20$, $KG = 25$.
a_A, a_B, a_C – ?

Задача К9.14.



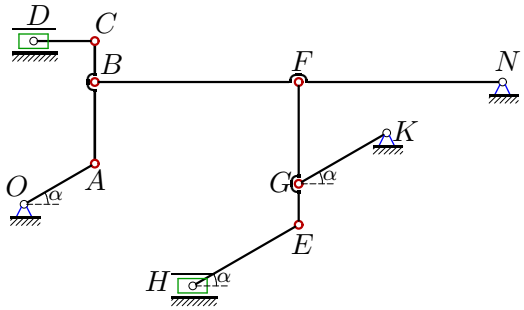
$\omega_{KG} = 4$ рад/с, $\alpha = 30°$,
$AB = 10$, $BC = 30$,
$NB = 50$, $NF = 40$,
$CD = 40$, $EH = 30$,
$FE = 35$, $FG = 10$,
$OA = 20$, $KG = 25$.
a_G, a_F, a_E – ?

Задача К9.15.



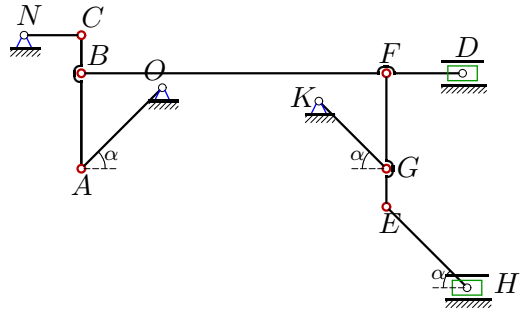
$\omega_{OA} = 1$ рад/с, $\alpha = 30°$,
$AB = 10$, $BC = 30$,
$DB = 20$, $DF = 15$,
$NC = 15$, $EH = 30$,
$FE = 35$, $FG = 20$,
$OA = 20$, $KG = 25$.
a_A, a_B, a_C – ?

Задача К9.16.



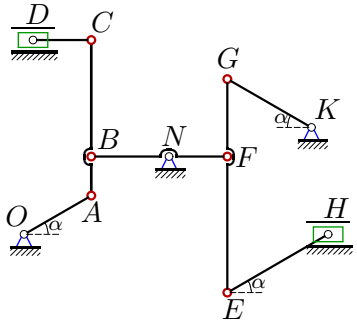
$\omega_{OA} = 4$ рад/с, $\alpha = 30°$,
$AB = 20$, $BC = 10$,
$BF = 50$, $NF = 50$,
$CD = 15$, $EH = 30$,
$FG = 25$, $GE = 10$,
$OA = 20$, $KG = 25$.
a_A, a_B, a_C – ?

Задача К9.17.



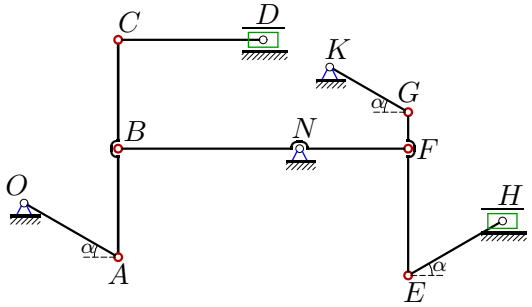
$\omega_{NC} = 2$ рад/с, $\alpha = 45°$,
$AB = 25$, $BC = 10$,
$BF = 80$, $FD = 20$,
$NC = 15$, $EH = 30$,
$FE = 35$, $FG = 25$,
$OA = 30$, $KG = 25$.
a_A, a_B, a_C – ?

Задача К9.18.



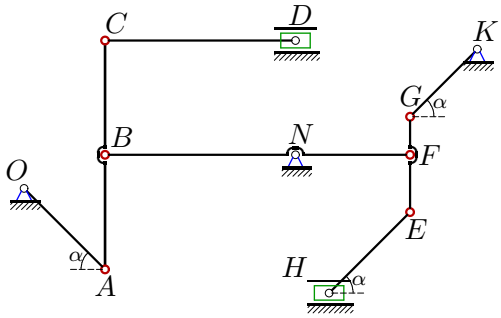
$\omega_{OA} = 4$ рад/с, $\alpha = 30°$,
$AB = 10$, $BC = 30$,
$NB = 20$, $NF = 15$,
$CD = 15$, $EH = 30$,
$FE = 35$, $FG = 20$,
$OA = 20$, $KG = 25$.
a_A, a_B, a_C – ?

Задача К9.19.



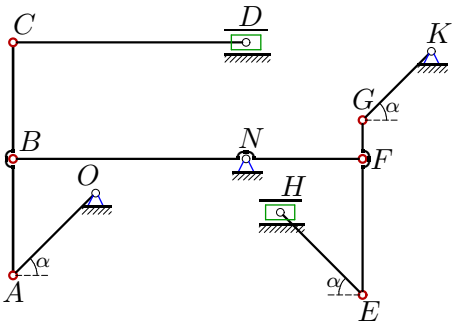
$\omega_{OA} = 1$ рад/с, $\alpha = 30°$,
$AB = 30$, $BC = 30$,
$NB = 50$, $NF = 30$,
$CD = 40$, $EH = 30$,
$FE = 35$, $FG = 10$,
$OA = 30$, $KG = 25$.
a_A, a_B, a_C – ?

Задача К9.20.



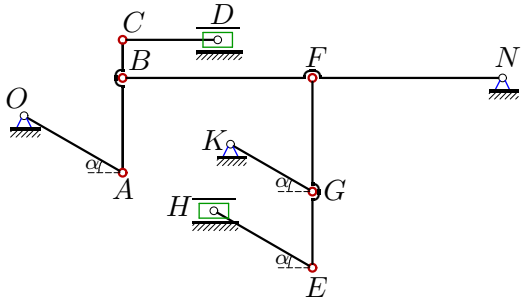
$\omega_{KG} = 4$ рад/с, $\alpha = 45°$,
$AB = 30$, $BC = 30$,
$NB = 50$, $NF = 30$,
$CD = 50$, $EH = 30$,
$FE = 15$, $FG = 10$,
$OA = 30$, $KG = 25$.
a_G, a_F, a_E – ?

Задача К9.21.



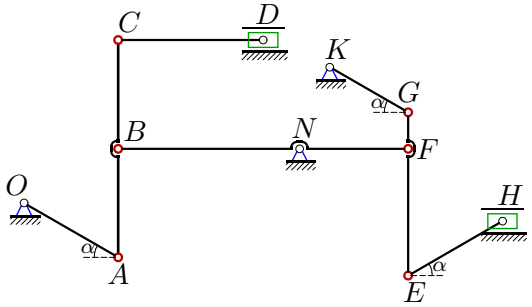
$\omega_{BF} = 1$ рад/с, $\alpha = 45°$,
$AB = 30$, $BC = 30$,
$NB = 60$, $NF = 30$,
$CD = 60$, $EH = 30$,
$FE = 35$, $FG = 10$,
$OA = 30$, $KG = 25$.
a_A, a_B, a_C – ?

Задача К9.22.



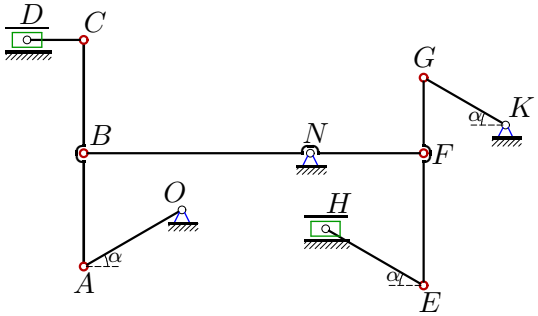
$\omega_{OA} = 2$ рад/с, $\alpha = 30°$,
$AB = 25$, $BC = 10$,
$BF = 50$, $NF = 50$,
$CD = 25$, $EH = 30$,
$FG = 30$, $GE = 20$,
$OA = 30$, $KG = 25$.
a_A, a_B, a_C – ?

Задача К9.23.



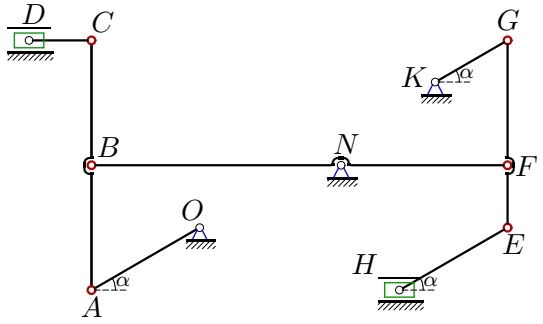
$\omega_{OA} = 1$ рад/с, $\alpha = 30°$,
$AB = 30$, $BC = 30$,
$NB = 50$, $NF = 30$,
$CD = 40$, $EH = 30$,
$FE = 35$, $FG = 10$,
$OA = 30$, $KG = 25$.
a_A, a_B, a_C – ?

Задача К9.24.



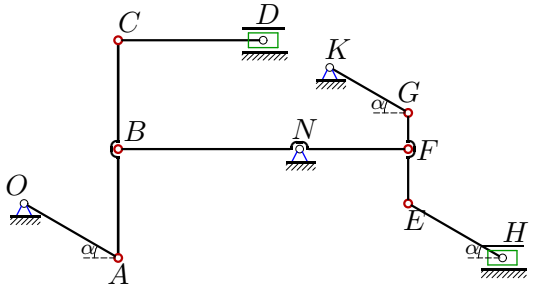
$\omega_{KG} = 4$ рад/с, $\alpha = 30°$,
$AB = 30$, $BC = 30$,
$NB = 60$, $NF = 30$,
$CD = 15$, $EH = 30$,
$FE = 35$, $FG = 20$,
$OA = 30$, $KG = 25$.
a_G, a_F, a_E – ?

Задача К9.25.



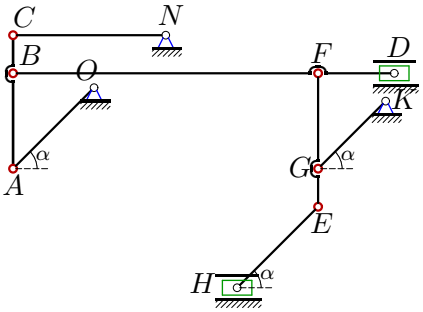
$\omega_{OA} = 1$ рад/с, $\alpha = 30°$,
$AB = 30$, $BC = 30$,
$NB = 60$, $NF = 40$,
$CD = 15$, $EH = 30$,
$FE = 15$, $FG = 30$,
$OA = 30$, $KG = 20$.
a_A, a_B, a_C – ?

Задача К9.26.



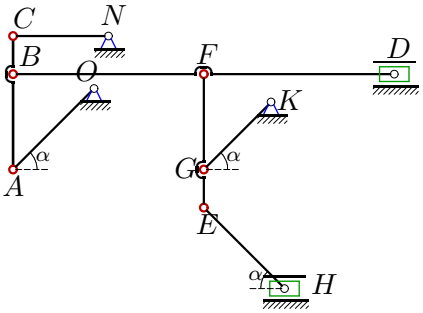
$\omega_{KG} = 3$ рад/с, $\alpha = 30°$,
$AB = 30$, $BC = 30$,
$NB = 50$, $NF = 30$,
$CD = 40$, $EH = 30$,
$FE = 15$, $FG = 10$,
$OA = 30$, $KG = 25$.
a_G, a_F, a_E – ?

Задача К9.27.



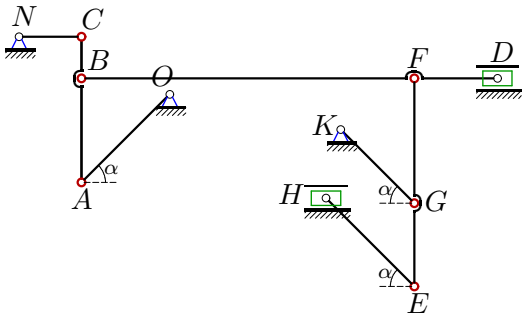
$\omega_{NC} = 4$ рад/с, $\alpha = 45°$,
$AB = 25$, $BC = 10$,
$BF = 80$, $FD = 20$,
$NC = 40$, $EH = 30$,
$FE = 35$, $FG = 25$,
$OA = 30$, $KG = 25$.
a_A, a_B, a_C – ?

Задача К9.28.



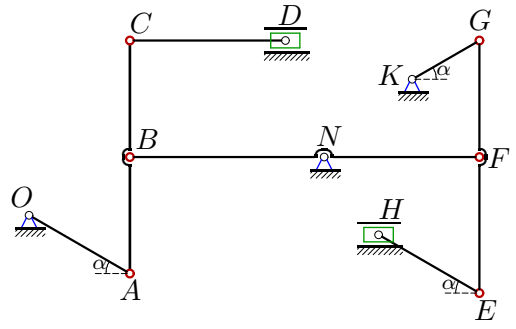
$\omega_{OA} = 4$ рад/с, $\alpha = 45°$,
$AB = 25$, $BC = 10$,
$BF = 50$, $FD = 50$,
$NC = 25$, $EH = 30$,
$FE = 35$, $FG = 25$,
$OA = 30$, $KG = 25$.
a_A, a_B, a_C – ?

Задача К9.29.



$\omega_{NC} = 2$ рад/с, $\alpha = 45°$,
$AB = 25$, $BC = 10$,
$BF = 80$, $FD = 20$,
$NC = 15$, $EH = 30$,
$FE = 50$, $FG = 30$,
$OA = 30$, $KG = 25$.
a_A, a_B, a_C – ?

Задача К9.30.



$\omega_{OA} = 4$ рад/с, $\alpha = 30°$,
$AB = 30$, $BC = 30$,
$NB = 50$, $NF = 40$,
$CD = 40$, $EH = 30$,
$FE = 35$, $FG = 30$,
$OA = 30$, $KG = 20$.
a_A, a_B, a_C – ?

К9 Ответы.
Кинематический анализ механизма (7 звеньев)

04.04.2012

№	v_A	v_B	v_C	v_D	v_E	v_F	v_G	v_H
1	300.000	259.808	300.000	150.000	146.442	64.952	75.000	168.750
2	60.000	51.962	54.083	15.000	57.689	41.569	48.000	16.000
3	115.470	100.000	104.083	28.868	64.291	50.000	57.735	69.282
4	141.421	100.000	111.803	50.000	86.023	50.000	70.711	120.000
5	60.000	54.083	51.962	15.000	65.707	37.749	40.000	35.833
6	375.000	265.165	296.464	132.583	103.078	53.033	75.000	35.355
7	90.000	77.942	79.994	18.000	137.367	62.354	72.000	86.400
8	115.470	100.000	102.632	23.094	66.583	20.000	23.094	75.056
9	100.000	86.603	90.139	25.000	99.875	43.301	50.000	65.000
10	30.000	21.213	22.847	8.485	18.248	10.607	15.000	4.243
11	83.333	72.169	144.338	125.000	57.282	43.301	50.000	62.500
12	60.000	51.962	53.329	12.000	13.363	10.392	12.000	14.400
13	424.264	300.000	335.410	150.000	103.228	60.000	84.853	144.000
14	125.000	108.253	216.506	187.500	195.256	86.603	100.000	225.000
15	20.000	18.875	17.321	7.500	15.000	15.000	15.000	15.000
16	80.000	69.282	72.111	20.000	44.542	34.641	40.000	8.000
17	42.426	31.200	30.000	8.571	13.263	10.463	8.485	5.829
18	80.000	69.282	138.564	120.000	73.866	51.962	60.000	22.500
19	30.000	25.981	30.000	15.000	35.146	15.588	18.000	22.500
20	166.667	117.851	166.667	117.851	127.475	70.711	100.000	176.777
21	84.853	60.000	84.853	60.000	109.202	30.000	42.426	75.000
22	60.000	51.962	53.329	12.000	36.056	25.981	30.000	10.000
23	30.000	25.981	30.000	15.000	35.146	15.588	18.000	22.500
24	200.000	173.205	200.000	100.000	123.111	86.603	100.000	137.500
25	30.000	25.981	30.000	15.000	18.028	17.321	20.000	15.000
26	125.000	108.253	125.000	62.500	85.923	64.952	75.000	93.750
27	226.274	166.403	160.000	45.714	41.557	55.801	45.255	5.486
28	120.000	88.248	84.853	24.244	65.346	48.865	60.000	92.126
29	42.426	31.200	30.000	8.571	16.821	10.463	8.485	9.714
30	120.000	103.923	120.000	60.000	100.240	83.138	96.000	8.000

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№	ω_{OA}	ω_{CA}	ω_{CD}	ω_{BF}	ω_{FE}	ω_{KG}	ω_{EH}	ω_{NC}	a_A	a_B	a_C	a_E	a_F	a_G
1	-10.000	-5.000	17.321	-4.330	-3.750	3.000	2.500	–	–	–	–	20.854	3.784	2.250
2	3.000	-1.500	3.464	-0.520	-0.800	-1.920	-1.600	–	1.800	1.377	1.971	–	–	–
3	-5.774	2.887	4.000	1.000	-1.155	-2.309	-1.925	–	8.819	1.000	5.889	–	–	–
4	-7.071	5.000	-6.667	1.000	-2.000	-2.828	-2.357	–	19.784	1.000	11.350	–	–	–
5	2.000	0.500	–	0.866	1.167	2.000	1.333	-3.464	1.200	0.648	1.855	–	–	–
6	-18.750	13.258	17.678	-2.652	1.768	3.000	2.500	–	–	–	–	4.218	1.551	2.250
7	3.000	1.800	-1.299	-0.779	3.600	-2.880	-2.400	–	2.700	0.813	1.799	–	–	–
8	3.849	2.309	2.500	1.000	1.155	-0.924	-0.770	–	4.561	1.000	0.635	–	–	–
9	5.000	-2.500	-3.464	-0.866	-2.500	2.000	1.667	–	–	–	–	4.244	1.186	1.000
10	1.000	0.849	1.414	-0.212	0.424	0.600	-0.500	–	0.300	0.055	0.153	–	–	–
11	-4.167	4.167	1.804	1.443	-2.500	2.000	-1.667	–	–	–	–	2.079	1.287	1.000
12	2.000	1.200	-3.464	0.520	0.240	0.480	-0.400	–	1.200	0.361	0.103	–	–	–
13	21.213	-15.000	-20.000	3.000	-2.400	-3.394	2.828	–	178.059	9.000	76.044	–	–	–
14	-6.250	6.250	2.706	2.165	-5.000	4.000	3.333	–	–	–	–	13.753	4.875	4.000
15	1.000	-0.250	–	-0.866	-0.000	0.600	0.500	1.155	0.200	0.209	0.236	–	–	–
16	4.000	-2.000	4.619	-0.693	-0.800	-1.600	1.333	–	3.200	2.448	3.503	–	–	–
17	-1.414	-0.857	–	-0.300	0.583	0.339	-0.283	2.000	0.645	0.270	0.600	–	–	–
18	4.000	-4.000	4.619	-3.464	1.500	2.400	2.000	–	3.200	4.000	19.619	–	–	–
19	1.000	0.500	-0.650	-0.520	0.900	-0.720	0.600	–	0.300	0.154	0.530	–	–	–
20	5.556	3.928	-2.357	-2.357	-7.071	4.000	-3.333	–	–	–	–	17.484	8.004	4.000
21	2.828	2.000	1.000	1.000	3.000	-1.697	1.414	–	2.501	0.600	1.558	–	–	–
22	2.000	1.200	-2.078	-0.520	0.500	1.200	1.000	–	1.200	0.361	0.799	–	–	–
23	1.000	0.500	-0.650	-0.520	0.900	-0.720	0.600	–	0.300	0.154	0.530	–	–	–
24	-6.667	-3.333	11.547	-2.887	2.500	4.000	-3.333	–	–	–	–	13.017	2.610	4.000
25	1.000	0.500	-1.732	0.433	0.333	1.000	0.667	–	0.300	0.135	0.035	–	–	–
26	-4.167	-2.083	2.706	2.165	-3.750	3.000	-2.500	–	–	–	–	4.678	2.896	2.250
27	7.542	4.571	–	1.600	-0.549	1.810	-1.508	4.000	18.343	9.608	6.400	–	–	–
28	4.000	2.424	–	0.849	0.727	2.400	2.000	3.394	4.800	3.587	3.175	–	–	–
29	-1.414	-0.857	–	-0.300	0.486	0.339	0.283	2.000	0.645	0.270	0.600	–	–	–
30	4.000	2.000	-2.598	-2.078	-1.600	-4.800	-3.200	–	4.800	2.471	8.477	–	–	–