

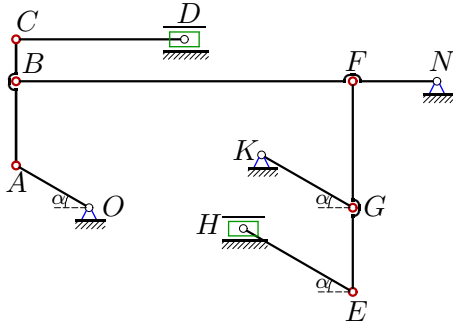
Кинематический анализ механизма (7 звеньев)

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/с²). 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.

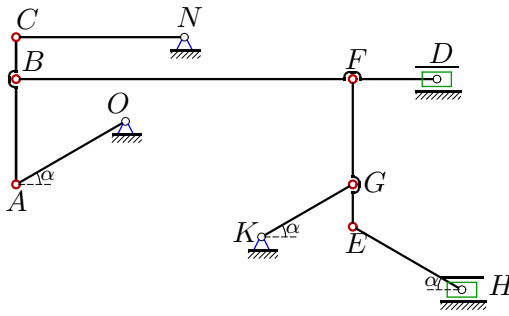
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$\omega_{OA} = 1 \text{ рад/с}, \alpha = 30^\circ,$
 $AB = 20, BC = 10,$
 $BF = 80, NF = 20,$
 $CD = 40, EH = 30,$
 $FG = 30, GE = 20,$
 $OA = 20, KG = 25.$
 $a_A, a_B, a_C - ?$

Задача К9.2.

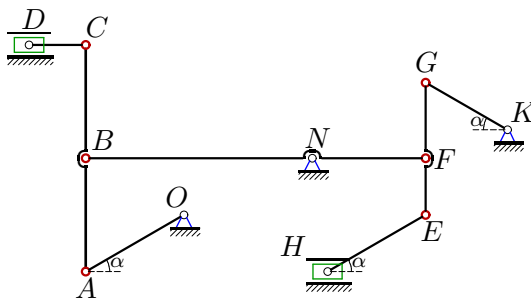
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$\omega_{NC} = 2 \text{ рад/с}, \alpha = 30^\circ,$
 $AB = 25, BC = 10,$
 $BF = 80, FD = 20,$
 $NC = 40, EH = 30,$
 $FE = 35, FG = 25,$
 $OA = 30, KG = 25.$
 $a_A, a_B, a_C - ?$

Задача К9.3.

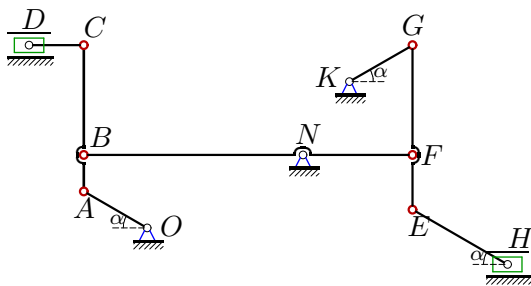
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$\omega_{KG} = 3 \text{ рад/с}, \alpha = 30^\circ,$
 $AB = 30, BC = 30,$
 $NB = 60, NF = 30,$
 $CD = 15, EH = 30,$
 $FE = 15, FG = 20,$
 $OA = 30, KG = 25.$
 $a_G, a_F, a_E - ?$

Задача К9.4.

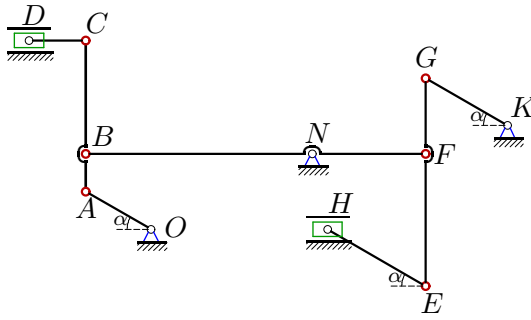
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$\omega_{KG} = 4 \text{ рад/с}, \alpha = 30^\circ,$
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 $NB = 60, NF = 30,$
 $CD = 15, EH = 30,$
 $FE = 15, FG = 30,$
 $OA = 20, KG = 20.$
 $a_G, a_F, a_E - ?$

Задача K9.5.

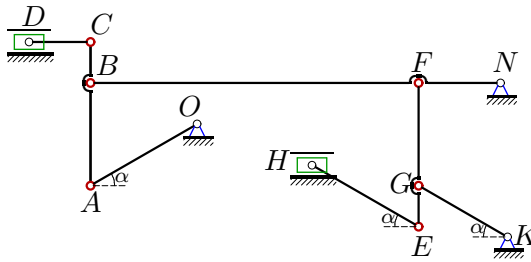
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$\omega_{OA} = 3 \text{ рад/с}, \alpha = 30^\circ,$
 $AB = 10, BC = 30,$
 $NB = 60, NF = 30,$
 $CD = 15, EH = 30,$
 $FE = 35, FG = 20,$
 $OA = 20, KG = 25.$
 $a_A, a_B, a_C - ?$

Задача K9.6.

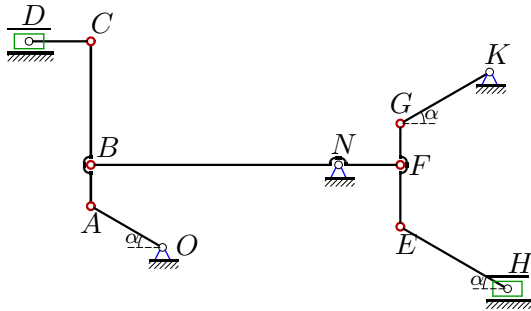
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$\omega_{NB} = 4 \text{ рад/с}, \alpha = 30^\circ,$
 $AB = 25, BC = 10,$
 $BF = 80, NF = 20,$
 $CD = 15, EH = 30,$
 $FG = 25, GE = 10,$
 $OA = 30, KG = 25.$
 $a_A, a_B, a_C - ?$

Задача K9.7.

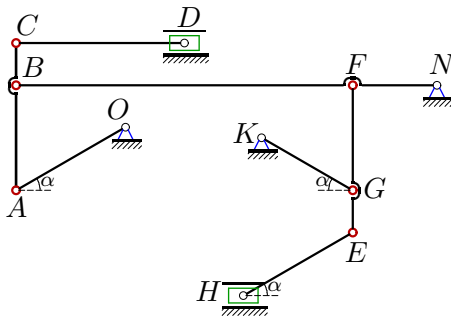
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$\omega_{KG} = 2 \text{ рад/с}, \alpha = 30^\circ,$
 $AB = 10, BC = 30,$
 $NB = 60, NF = 15,$
 $CD = 15, EH = 30,$
 $FE = 15, FG = 10,$
 $OA = 20, KG = 25.$
 $a_G, a_F, a_E - ?$

Задача K9.8.

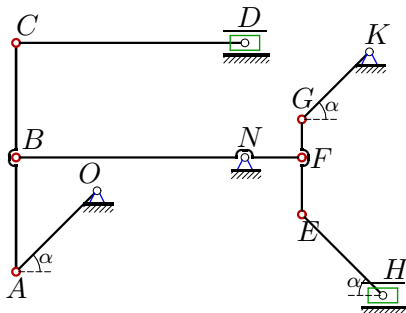
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$\omega_{KG} = 3 \text{ рад/с}, \alpha = 30^\circ,$
 $AB = 25, BC = 10,$
 $BF = 80, NF = 20,$
 $CD = 40, EH = 30,$
 $FG = 25, GE = 10,$
 $OA = 30, KG = 25.$
 $a_G, a_F, a_E - ?$

Задача K9.9.

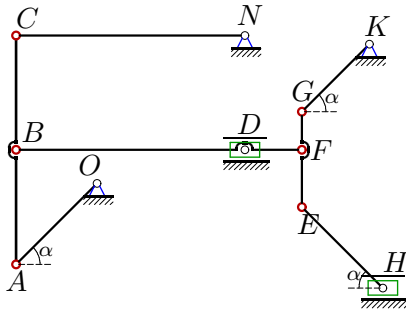
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$\omega_{KG} = 4 \text{ рад/с}, \alpha = 45^\circ,$
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 $NB = 60, NF = 15,$
 $CD = 60, EH = 30,$
 $FE = 15, FG = 10,$
 $OA = 30, KG = 25.$
 $a_G, a_F, a_E - ?$

Задача K9.10.

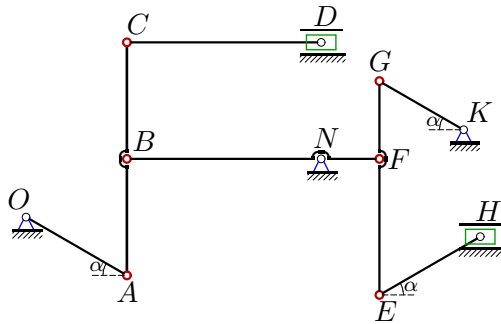
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$\omega_{NC} = 3 \text{ рад/с}, \alpha = 45^\circ,$
 $AB = 30, BC = 30,$
 $DB = 60, DF = 15,$
 $NC = 60, EH = 30,$
 $FE = 15, FG = 10,$
 $OA = 30, KG = 25.$
 $a_A, a_B, a_C - ?$

Задача K9.11.

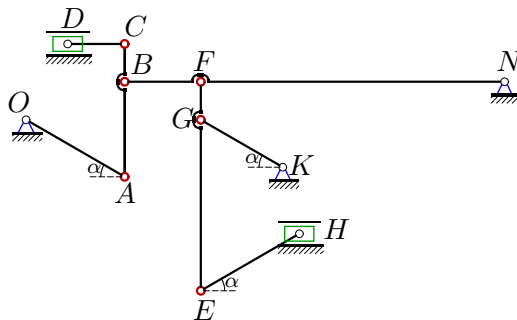
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$\omega_{OA} = 4 \text{ рад/с}, \alpha = 30^\circ,$
 $AB = 30, BC = 30,$
 $NB = 50, NF = 15,$
 $CD = 50, EH = 30,$
 $FE = 35, FG = 20,$
 $OA = 30, KG = 25.$
 $a_A, a_B, a_C - ?$

Задача K9.12.

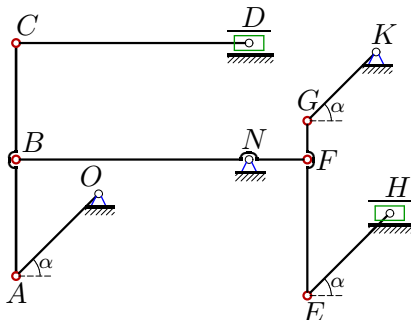
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$\omega_{OA} = 4 \text{ рад/с}, \alpha = 30^\circ,$
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 $BF = 20, NF = 80,$
 $CD = 15, EH = 30,$
 $FG = 10, GE = 45,$
 $OA = 30, KG = 25.$
 $a_A, a_B, a_C - ?$

Задача K9.13.

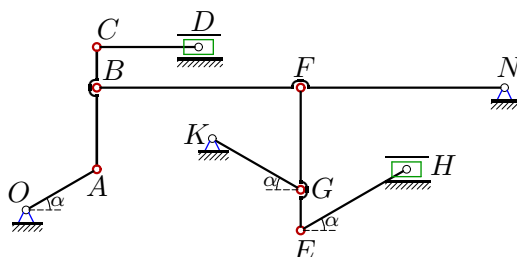
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$\omega_{KG} = 4 \text{ рад/с}, \alpha = 45^\circ,$
 $AB = 30, BC = 30,$
 $NB = 60, NF = 15,$
 $CD = 60, EH = 30,$
 $FE = 35, FG = 10,$
 $OA = 30, KG = 25.$
 $a_G, a_F, a_E - ?$

Задача K9.14.

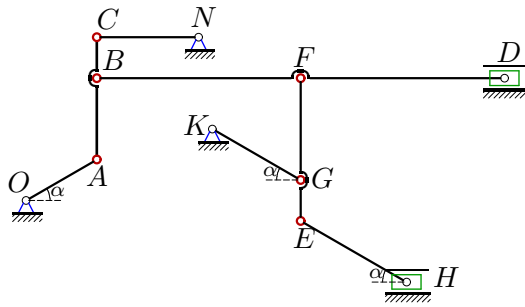
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$\omega_{OA} = 4 \text{ рад/с}, \alpha = 30^\circ,$
 $AB = 20, BC = 10,$
 $BF = 50, NF = 50,$
 $CD = 25, EH = 30,$
 $FG = 25, GE = 10,$
 $OA = 20, KG = 25.$
 $a_A, a_B, a_C - ?$

Задача K9.15.

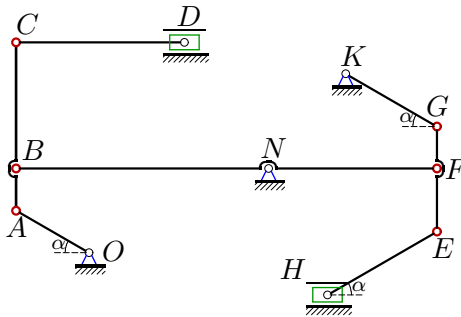
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$\omega_{NC} = 3 \text{ рад/с}, \alpha = 30^\circ,$
 $AB = 20, BC = 10,$
 $BF = 50, FD = 50,$
 $NC = 25, EH = 30,$
 $FE = 35, FG = 25,$
 $OA = 20, KG = 25.$
 $a_A, a_B, a_C - ?$

Задача K9.16.

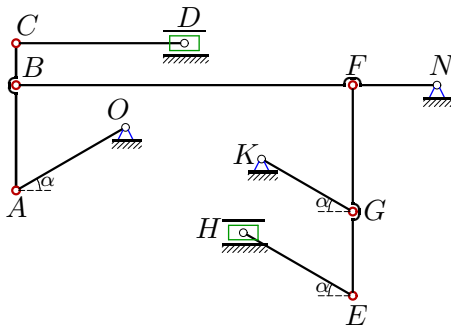
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$\omega_{OA} = 3 \text{ рад/с}, \alpha = 30^\circ,$
 $AB = 10, BC = 30,$
 $NB = 60, NF = 40,$
 $CD = 40, EH = 30,$
 $FE = 15, FG = 10,$
 $OA = 20, KG = 25.$
 $a_A, a_B, a_C - ?$

Задача K9.17.

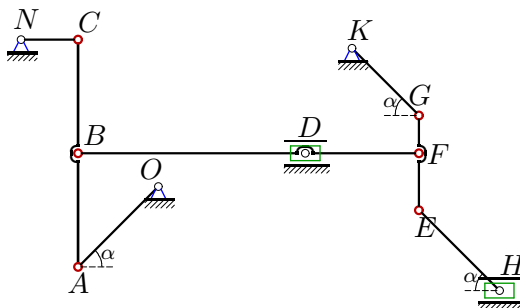
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$\omega_{KG} = 2 \text{ рад/с}, \alpha = 30^\circ,$
 $AB = 25, BC = 10,$
 $BF = 80, NF = 20,$
 $CD = 40, EH = 30,$
 $FG = 30, GE = 20,$
 $OA = 30, KG = 25.$
 $a_G, a_F, a_E - ?$

Задача K9.18.

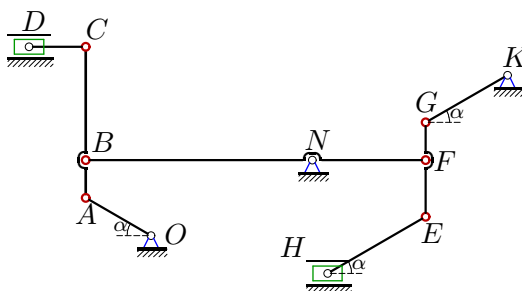
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$\omega_{NC} = 1 \text{ рад/с}, \alpha = 45^\circ,$
 $AB = 30, BC = 30,$
 $DB = 60, DF = 30,$
 $NC = 15, EH = 30,$
 $FE = 15, FG = 10,$
 $OA = 30, KG = 25.$
 $a_A, a_B, a_C - ?$

Задача K9.19.

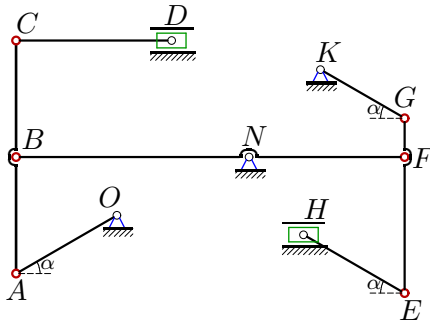
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$\omega_{BF} = 3 \text{ рад/с}, \alpha = 30^\circ,$
 $AB = 10, BC = 30,$
 $NB = 60, NF = 30,$
 $CD = 15, EH = 30,$
 $FE = 15, FG = 10,$
 $OA = 20, KG = 25.$
 $a_A, a_B, a_C - ?$

Задача K9.20.

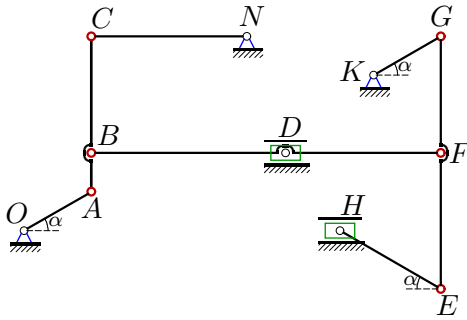
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$\omega_{OA} = 2 \text{ рад/с}, \alpha = 30^\circ,$
 $AB = 30, BC = 30,$
 $NB = 60, NF = 40,$
 $CD = 40, EH = 30,$
 $FE = 35, FG = 10,$
 $OA = 30, KG = 25.$
 $a_A, a_B, a_C - ?$

Задача K9.21.

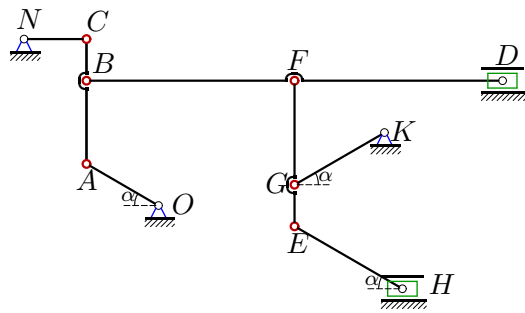
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$\omega_{OA} = 3 \text{ рад/с}, \alpha = 30^\circ,$
 $AB = 10, BC = 30,$
 $DB = 50, DF = 40,$
 $NC = 40, EH = 30,$
 $FE = 35, FG = 30,$
 $OA = 20, KG = 20.$
 $a_A, a_B, a_C - ?$

Задача K9.22.

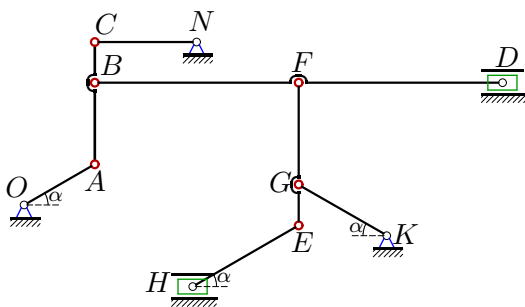
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$\omega_{NC} = 3 \text{ рад/с}, \alpha = 30^\circ,$
 $AB = 20, BC = 10,$
 $BF = 50, FD = 50,$
 $NC = 15, EH = 30,$
 $FE = 35, FG = 25,$
 $OA = 20, KG = 25.$
 $a_A, a_B, a_C - ?$

Задача K9.23.

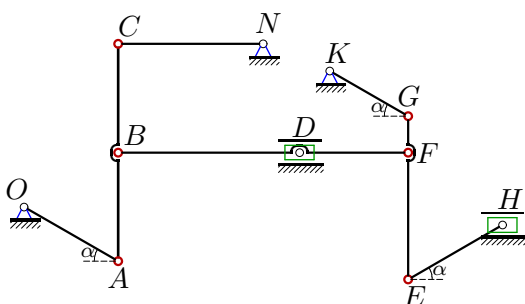
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$\omega_{NC} = 2 \text{ рад/с}, \alpha = 30^\circ,$
 $AB = 20, BC = 10,$
 $BF = 50, FD = 50,$
 $NC = 25, EH = 30,$
 $FE = 35, FG = 25,$
 $OA = 20, KG = 25.$
 $a_A, a_B, a_C - ?$

Задача K9.24.

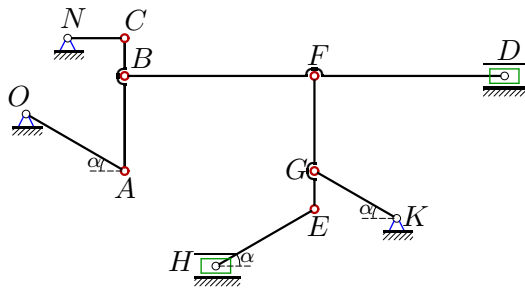
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$\omega_{OA} = 1 \text{ рад/с}, \alpha = 30^\circ,$
 $AB = 30, BC = 30,$
 $DB = 50, DF = 30,$
 $NC = 40, EH = 30,$
 $FE = 35, FG = 10,$
 $OA = 30, KG = 25.$
 $a_A, a_B, a_C - ?$

Задача K9.25.

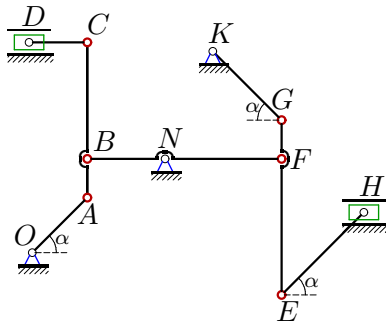
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$\omega_{NC} = 2 \text{ рад/с}, \alpha = 30^\circ,$
 $AB = 25, BC = 10,$
 $BF = 50, FD = 50,$
 $NC = 15, EH = 30,$
 $FE = 35, FG = 25,$
 $OA = 30, KG = 25.$
 $a_A, a_B, a_C - ?$

Задача K9.26.

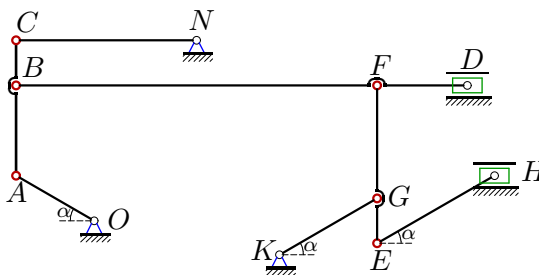
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$\omega_{KG} = 4 \text{ рад/с}, \alpha = 45^\circ,$
 $AB = 10, BC = 30,$
 $NB = 20, NF = 30,$
 $CD = 15, EH = 30,$
 $FE = 35, FG = 10,$
 $OA = 20, KG = 25.$
 $a_G, a_F, a_E - ?$

Задача K9.27.

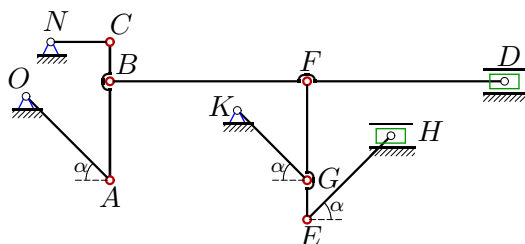
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$\omega_{NC} = 3 \text{ рад/с}, \alpha = 30^\circ,$
 $AB = 20, BC = 10,$
 $BF = 80, FD = 20,$
 $NC = 40, EH = 30,$
 $FE = 35, FG = 25,$
 $OA = 20, KG = 25.$
 $a_A, a_B, a_C - ?$

Задача K9.28.

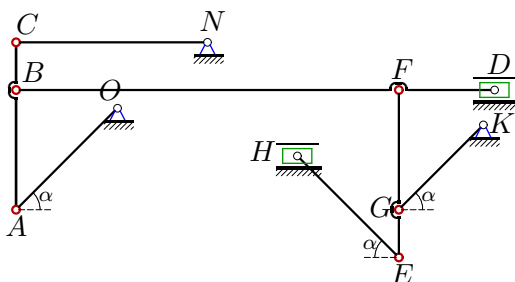
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$\omega_{OA} = 1 \text{ рад/с}, \alpha = 45^\circ,$
 $AB = 25, BC = 10,$
 $BF = 50, FD = 50,$
 $NC = 15, EH = 30,$
 $FE = 35, FG = 25,$
 $OA = 30, KG = 25.$
 $a_A, a_B, a_C - ?$

Задача K9.29.

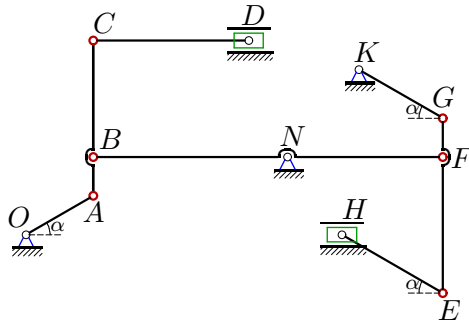
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$\omega_{OA} = 1 \text{ рад/с}, \alpha = 45^\circ,$
 $AB = 25, BC = 10,$
 $BF = 80, FD = 20,$
 $NC = 40, EH = 30,$
 $FE = 35, FG = 25,$
 $OA = 30, KG = 25.$
 $a_A, a_B, a_C - ?$

Задача К9.30.

7



$\omega_{BF} = 2 \text{ рад/с}, \alpha = 30^\circ,$
 $AB = 10, BC = 30,$
 $NB = 50, NF = 40,$
 $CD = 40, EH = 30,$
 $FE = 35, FG = 10,$
 $OA = 20, KG = 25.$
 $a_A, a_B, a_C - ?$

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	20.000	17.321	18.028	5.000	4.807	3.464	4.000	1.333
2	92.376	81.081	80.000	13.197	17.737	20.740	18.475	16.892
3	150.000	129.904	150.000	75.000	70.780	64.952	75.000	9.375
4	160.000	138.564	277.128	240.000	72.111	69.282	80.000	20.000
5	60.000	51.962	103.923	90.000	36.933	25.981	30.000	41.250
6	461.880	400.000	410.528	92.376	102.866	80.000	92.376	18.475
7	200.000	173.205	346.410	300.000	57.282	43.301	50.000	12.500
8	375.000	324.760	333.307	75.000	83.516	64.952	75.000	90.000
9	400.000	282.843	400.000	282.843	127.475	70.711	100.000	35.355
10	254.558	201.246	180.000	90.000	295.941	100.623	63.640	247.500
11	120.000	103.923	120.000	60.000	44.320	31.177	36.000	13.500
12	120.000	103.923	106.658	24.000	276.782	83.138	96.000	312.000
13	400.000	282.843	400.000	282.843	257.391	70.711	100.000	318.198
14	80.000	69.282	72.111	20.000	44.542	34.641	40.000	48.000
15	86.603	76.376	75.000	14.434	52.042	40.182	43.301	14.434
16	60.000	51.962	103.923	90.000	45.826	34.641	40.000	10.000
17	250.000	216.506	222.205	50.000	60.093	43.301	50.000	16.667
18	21.213	16.771	15.000	7.500	10.607	10.607	10.607	0.000
19	207.846	180.000	360.000	311.769	119.059	90.000	103.923	129.904
20	60.000	51.962	60.000	30.000	78.102	34.641	40.000	90.000
21	60.000	56.624	51.962	22.500	87.284	47.268	48.000	52.750
22	51.962	45.826	45.000	8.660	31.225	24.109	25.981	34.641
23	57.735	50.918	50.000	9.623	34.694	26.788	28.868	38.490
24	30.000	27.042	25.981	7.500	67.086	17.299	18.000	56.250
25	34.641	30.405	30.000	4.949	18.109	15.795	17.321	18.805
26	66.667	47.140	149.071	141.421	257.391	70.711	100.000	176.777
27	138.564	122.202	120.000	23.094	37.364	33.307	27.713	14.780
28	30.000	22.062	21.213	6.061	16.336	12.216	15.000	23.031
29	30.000	22.062	21.213	6.061	5.510	7.398	6.000	7.758
30	115.470	100.000	200.000	173.205	180.370	80.000	92.376	207.846

N_0	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	1.000	-0.500	0.433	0.173	-0.067	-0.160	-0.133	-	0.200	0.153	0.180	-	-	-
2	3.079	1.320	-	0.800	-0.158	-0.739	0.616	2.000	2.995	1.988	1.600	-	-	-
3	-5.000	-2.500	8.660	-2.165	1.875	3.000	-2.500	-	-	-	-	3.924	1.468	2.250
4	8.000	-8.000	-9.238	2.309	1.333	4.000	-2.667	-	-	-	-	1.292	1.923	3.200
5	3.000	-3.000	-3.464	0.866	-0.750	-1.200	1.000	-	1.800	1.855	5.341	-	-	-
6	15.396	9.238	-26.667	4.000	-1.848	3.695	-3.079	-	72.983	16.000	10.162	-	-	-
7	-10.000	10.000	11.547	-2.887	-2.500	2.000	1.667	-	-	-	-	4.881	1.682	1.000
8	-12.500	-7.500	-8.119	-3.248	1.500	3.000	2.500	-	-	-	-	3.818	2.183	2.250
9	-13.333	-9.428	-4.714	-4.714	-7.071	4.000	3.333	-	-	-	-	19.827	8.509	4.000
10	8.485	3.000	-	3.000	13.500	-2.546	-2.121	3.000	25.720	15.510	5.400	-	-	-
11	4.000	2.000	-2.078	-2.078	0.900	1.440	1.200	-	4.800	2.471	8.477	-	-	-
12	4.000	2.400	6.928	-1.039	4.800	-3.840	-3.200	-	4.800	1.445	3.198	-	-	-
13	-13.333	-9.428	-4.714	-4.714	-7.071	4.000	3.333	-	-	-	-	35.518	8.509	4.000
14	4.000	-2.000	-2.771	-0.693	0.800	1.600	-1.333	-	3.200	2.448	3.503	-	-	-
15	-4.330	1.443	-	0.750	-1.443	-1.732	1.443	3.000	4.732	0.218	2.250	-	-	-
16	3.000	-3.000	1.299	0.866	-2.000	1.600	1.333	-	1.800	1.855	5.341	-	-	-
17	-8.333	-5.000	-5.413	-2.165	0.833	2.000	1.667	-	-	-	-	2.165	0.982	1.000
18	-0.707	-0.250	-	-0.250	0.000	-0.424	0.354	1.000	0.179	0.022	0.150	-	-	-
19	10.392	-10.392	-12.000	3.000	5.196	-4.157	3.464	-	32.995	5.400	78.891	-	-	-
20	2.000	1.000	1.299	0.866	-2.000	1.600	1.333	-	1.200	0.541	0.139	-	-	-
21	3.000	-0.750	-	-1.039	-1.550	-2.400	-1.600	-1.299	1.800	1.384	1.312	-	-	-
22	-2.598	0.866	-	-0.450	-0.866	-1.039	-0.866	3.000	1.704	0.345	1.350	-	-	-
23	-2.887	0.962	-	0.500	-0.962	1.155	-0.962	2.000	2.103	0.097	1.000	-	-	-
24	1.000	0.250	-	-0.520	1.650	-0.720	0.600	-0.650	0.300	0.139	0.203	-	-	-
25	1.155	0.495	-	-0.300	0.148	-0.693	0.577	2.000	0.421	0.547	0.600	-	-	-
26	-3.333	4.714	-3.143	2.357	-7.071	4.000	-3.333	-	-	-	-	25.442	8.004	4.000
27	6.928	-2.309	-	1.200	1.478	-1.109	0.924	3.000	12.115	6.425	3.600	-	-	-
28	1.000	0.606	-	-0.212	0.182	0.600	-0.500	1.414	0.300	0.300	0.311	-	-	-
29	1.000	0.606	-	0.212	-0.073	0.240	-0.200	0.530	0.300	0.185	0.140	-	-	-
30	-5.774	5.774	2.500	2.000	-4.619	3.695	3.079	-	10.184	2.000	38.200	-	-	-