

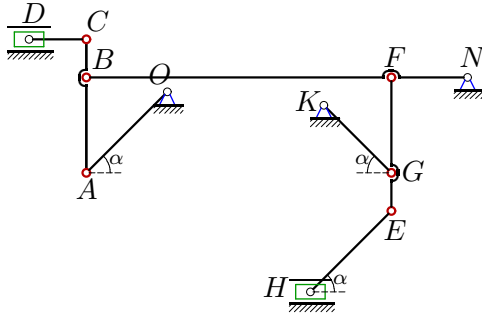
## Кинематический анализ механизма (7 звеньев)

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<sup>2</sup>). 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.

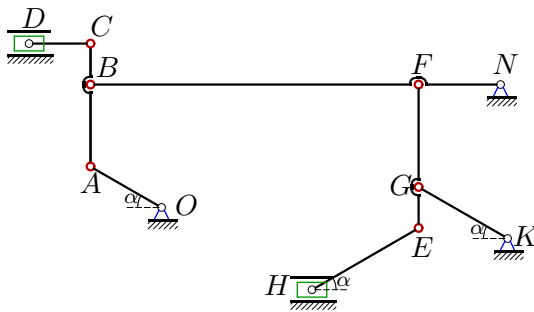
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$\omega_{OA} = 4$  рад/с,  $\alpha = 45^\circ$ ,  
 $AB = 25$ ,  $BC = 10$ ,  
 $BF = 80$ ,  $NF = 20$ ,  
 $CD = 15$ ,  $EH = 30$ ,  
 $FG = 25$ ,  $GE = 10$ ,  
 $OA = 30$ ,  $KG = 25$ .  
 $a_A$ ,  $a_B$ ,  $a_C$  - ?

### Задача К9.2.

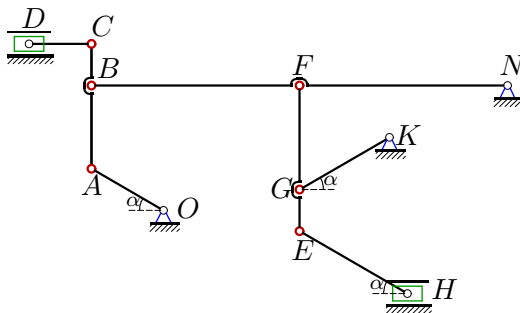
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$\omega_{OA} = 4$  рад/с,  $\alpha = 30^\circ$ ,  
 $AB = 20$ ,  $BC = 10$ ,  
 $BF = 80$ ,  $NF = 20$ ,  
 $CD = 15$ ,  $EH = 30$ ,  
 $FG = 25$ ,  $GE = 10$ ,  
 $OA = 20$ ,  $KG = 25$ .  
 $a_A$ ,  $a_B$ ,  $a_C$  - ?

### Задача К9.3.

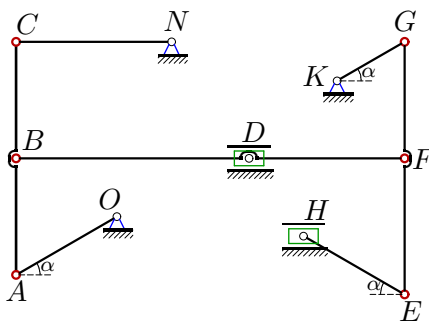
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$\omega_{KG} = 1$  рад/с,  $\alpha = 30^\circ$ ,  
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 $BF = 50$ ,  $NF = 50$ ,  
 $CD = 15$ ,  $EH = 30$ ,  
 $FG = 25$ ,  $GE = 10$ ,  
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 $a_G$ ,  $a_F$ ,  $a_E$  - ?

### Задача К9.4.

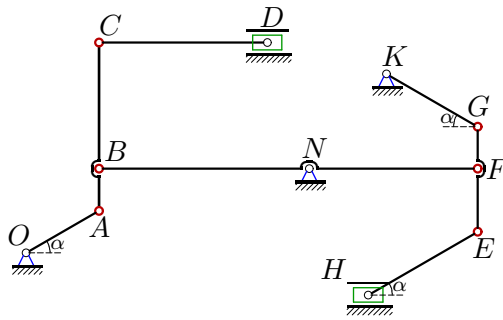
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$\omega_{NC} = 3$  рад/с,  $\alpha = 30^\circ$ ,  
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 $DB = 60$ ,  $DF = 40$ ,  
 $NC = 40$ ,  $EH = 30$ ,  
 $FE = 35$ ,  $FG = 30$ ,  
 $OA = 30$ ,  $KG = 20$ .  
 $a_A$ ,  $a_B$ ,  $a_C$  - ?

Задача K9.5.

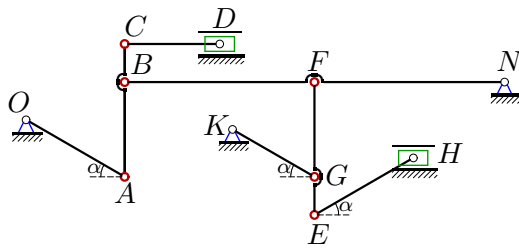
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 $NB = 50$ ,  $NF = 40$ ,  
 $CD = 40$ ,  $EH = 30$ ,  
 $FE = 15$ ,  $FG = 10$ ,  
 $OA = 20$ ,  $KG = 25$ .  
 $a_A$ ,  $a_B$ ,  $a_C$  - ?

Задача K9.6.

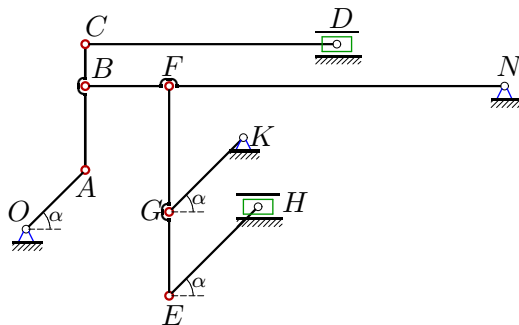
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$\omega_{KG} = 4$  рад/с,  $\alpha = 30^\circ$ ,  
 $AB = 25$ ,  $BC = 10$ ,  
 $BF = 50$ ,  $NF = 50$ ,  
 $CD = 25$ ,  $EH = 30$ ,  
 $FG = 25$ ,  $GE = 10$ ,  
 $OA = 30$ ,  $KG = 25$ .  
 $a_G$ ,  $a_F$ ,  $a_E$  - ?

Задача K9.7.

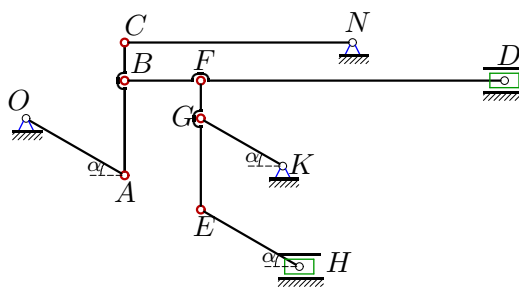
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 $BF = 20$ ,  $NF = 80$ ,  
 $CD = 60$ ,  $EH = 30$ ,  
 $FG = 30$ ,  $GE = 20$ ,  
 $OA = 20$ ,  $KG = 25$ .  
 $a_A$ ,  $a_B$ ,  $a_C$  - ?

Задача K9.8.

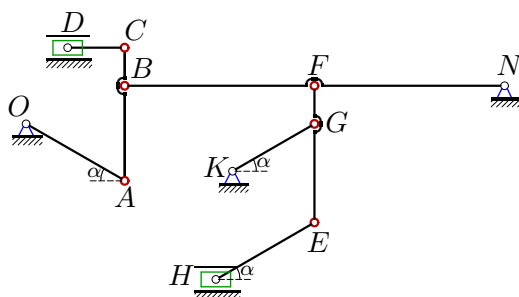
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$\omega_{NC} = 1$  рад/с,  $\alpha = 30^\circ$ ,  
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 $BF = 20$ ,  $FD = 80$ ,  
 $NC = 60$ ,  $EH = 30$ ,  
 $FE = 34$ ,  $FG = 10$ ,  
 $OA = 30$ ,  $KG = 25$ .  
 $a_A$ ,  $a_B$ ,  $a_C$  - ?

Задача K9.9.

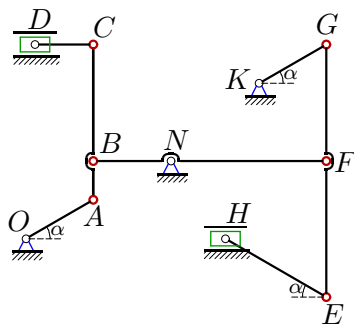
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$\omega_{KG} = 4$  рад/с,  $\alpha = 30^\circ$ ,  
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 $BF = 50$ ,  $NF = 50$ ,  
 $CD = 15$ ,  $EH = 30$ ,  
 $FG = 10$ ,  $GE = 26$ ,  
 $OA = 30$ ,  $KG = 25$ .  
 $a_G$ ,  $a_F$ ,  $a_E$  - ?

**Задача K9.10.**

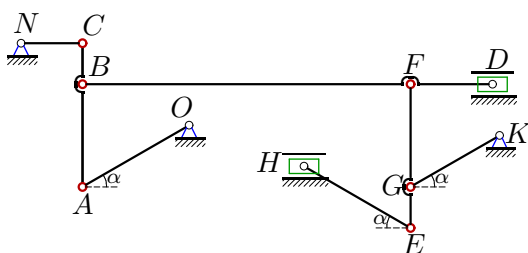
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$\omega_{BF} = 1$  рад/с,  $\alpha = 30^\circ$ ,  
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 $NB = 20$ ,  $NF = 40$ ,  
 $CD = 15$ ,  $EH = 30$ ,  
 $FE = 35$ ,  $FG = 30$ ,  
 $OA = 20$ ,  $KG = 20$ .  
 $a_A$ ,  $a_B$ ,  $a_C$  - ?

**Задача K9.11.**

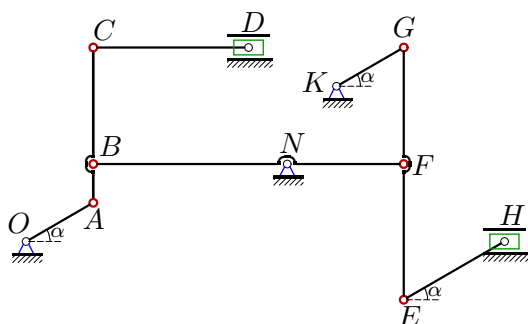
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$\omega_{NC} = 4$  рад/с,  $\alpha = 30^\circ$ ,  
 $AB = 25$ ,  $BC = 10$ ,  
 $BF = 80$ ,  $FD = 20$ ,  
 $NC = 15$ ,  $EH = 30$ ,  
 $FE = 35$ ,  $FG = 25$ ,  
 $OA = 30$ ,  $KG = 25$ .  
 $a_A$ ,  $a_B$ ,  $a_C$  - ?

**Задача K9.12.**

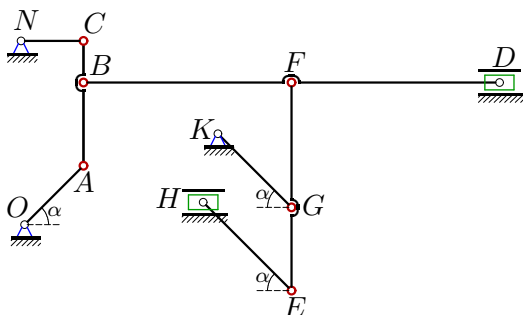
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$\omega_{KG} = 3$  рад/с,  $\alpha = 30^\circ$ ,  
 $AB = 10$ ,  $BC = 30$ ,  
 $NB = 50$ ,  $NF = 30$ ,  
 $CD = 40$ ,  $EH = 30$ ,  
 $FE = 35$ ,  $FG = 30$ ,  
 $OA = 20$ ,  $KG = 20$ .  
 $a_G$ ,  $a_F$ ,  $a_E$  - ?

**Задача K9.13.**

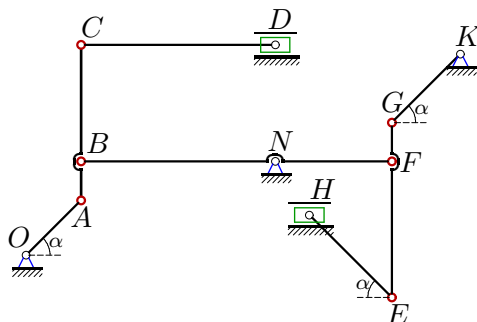
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$\omega_{OA} = 1$  рад/с,  $\alpha = 45^\circ$ ,  
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 $BF = 50$ ,  $FD = 50$ ,  
 $NC = 15$ ,  $EH = 30$ ,  
 $FE = 50$ ,  $FG = 30$ ,  
 $OA = 20$ ,  $KG = 25$ .  
 $a_A$ ,  $a_B$ ,  $a_C$  - ?

**Задача K9.14.**

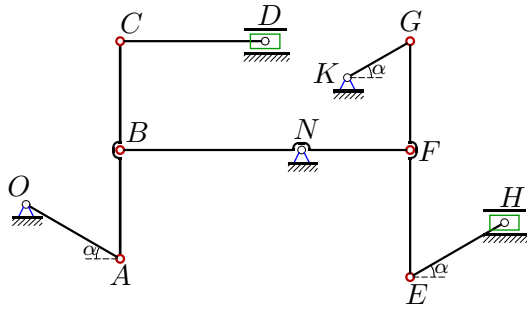
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$\omega_{BF} = 3$  рад/с,  $\alpha = 45^\circ$ ,  
 $AB = 10$ ,  $BC = 30$ ,  
 $NB = 50$ ,  $NF = 30$ ,  
 $CD = 50$ ,  $EH = 30$ ,  
 $FE = 35$ ,  $FG = 10$ ,  
 $OA = 20$ ,  $KG = 25$ .  
 $a_A$ ,  $a_B$ ,  $a_C$  - ?

Задача K9.15.

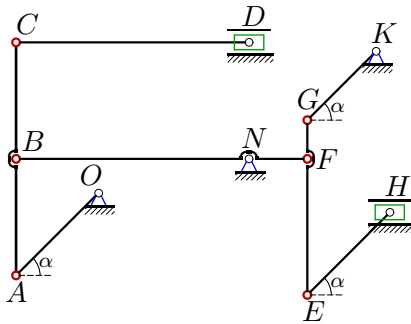
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$\omega_{OA} = 1 \text{ рад/с}, \alpha = 30^\circ,$   
 $AB = 30, BC = 30,$   
 $NB = 50, NF = 30,$   
 $CD = 40, EH = 30,$   
 $FE = 35, FG = 30,$   
 $OA = 30, KG = 20.$   
 $a_A, a_B, a_C - ?$

Задача K9.16.

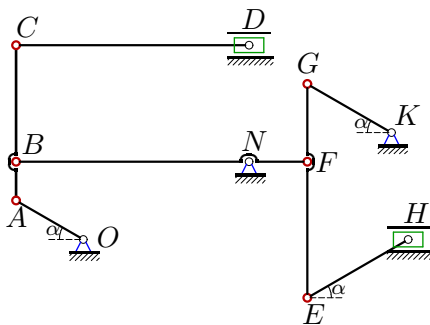
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$\omega_{BF} = 4 \text{ рад/с}, \alpha = 45^\circ,$   
 $AB = 30, BC = 30,$   
 $NB = 60, NF = 15,$   
 $CD = 60, EH = 30,$   
 $FE = 35, FG = 10,$   
 $OA = 30, KG = 25.$   
 $a_A, a_B, a_C - ?$

Задача K9.17.

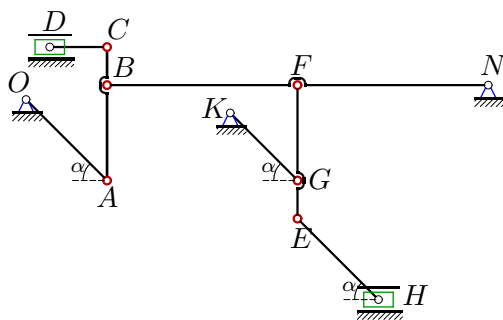
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$\omega_{OA} = 4 \text{ рад/с}, \alpha = 30^\circ,$   
 $AB = 10, BC = 30,$   
 $NB = 60, NF = 15,$   
 $CD = 60, EH = 30,$   
 $FE = 35, FG = 20,$   
 $OA = 20, KG = 25.$   
 $a_A, a_B, a_C - ?$

Задача K9.18.

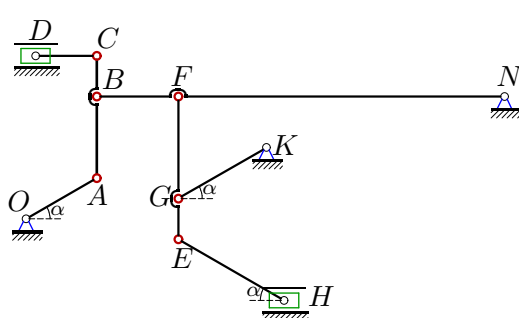
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$\omega_{KG} = 4 \text{ рад/с}, \alpha = 45^\circ,$   
 $AB = 25, BC = 10,$   
 $BF = 50, NF = 50,$   
 $CD = 15, EH = 30,$   
 $FG = 25, GE = 10,$   
 $OA = 30, KG = 25.$   
 $a_G, a_F, a_E - ?$

Задача K9.19.

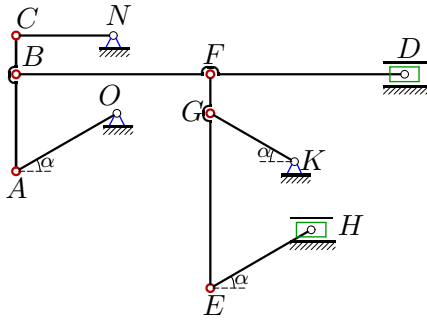
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$\omega_{OA} = 3 \text{ рад/с}, \alpha = 30^\circ,$   
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 $BF = 20, NF = 80,$   
 $CD = 15, EH = 30,$   
 $FG = 25, GE = 10,$   
 $OA = 20, KG = 25.$   
 $a_A, a_B, a_C - ?$

Задача K9.20.

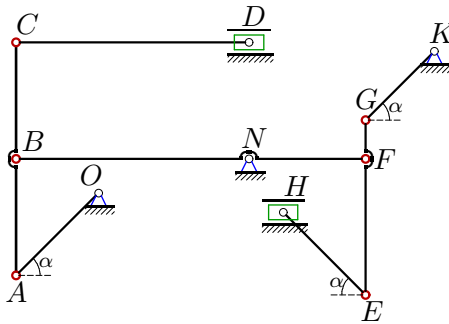
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$\omega_{NC} = 1$  рад/с,  $\alpha = 30^\circ$ ,  
 $AB = 25$ ,  $BC = 10$ ,  
 $BF = 50$ ,  $FD = 50$ ,  
 $NC = 25$ ,  $EH = 30$ ,  
 $FE = 55$ ,  $FG = 10$ ,  
 $OA = 30$ ,  $KG = 25$ .  
 $a_A$ ,  $a_B$ ,  $a_C$  - ?

Задача K9.21.

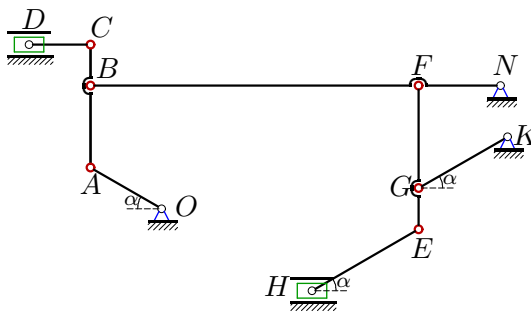
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$\omega_{OA} = 1$  рад/с,  $\alpha = 45^\circ$ ,  
 $AB = 30$ ,  $BC = 30$ ,  
 $NB = 60$ ,  $NF = 30$ ,  
 $CD = 60$ ,  $EH = 30$ ,  
 $FE = 35$ ,  $FG = 10$ ,  
 $OA = 30$ ,  $KG = 25$ .  
 $a_A$ ,  $a_B$ ,  $a_C$  - ?

Задача K9.22.

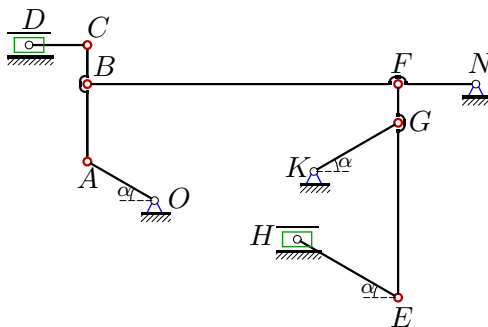
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$\omega_{KG} = 3$  рад/с,  $\alpha = 30^\circ$ ,  
 $AB = 20$ ,  $BC = 10$ ,  
 $BF = 80$ ,  $NF = 20$ ,  
 $CD = 15$ ,  $EH = 30$ ,  
 $FG = 25$ ,  $GE = 10$ ,  
 $OA = 20$ ,  $KG = 25$ .  
 $a_G$ ,  $a_F$ ,  $a_E$  - ?

Задача K9.23.

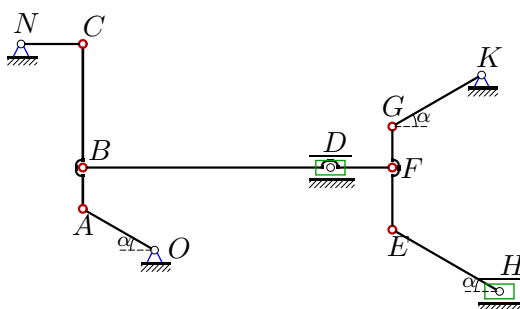
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$\omega_{OA} = 1$  рад/с,  $\alpha = 30^\circ$ ,  
 $AB = 20$ ,  $BC = 10$ ,  
 $BF = 80$ ,  $NF = 20$ ,  
 $CD = 15$ ,  $EH = 30$ ,  
 $FG = 10$ ,  $GE = 45$ ,  
 $OA = 20$ ,  $KG = 25$ .  
 $a_A$ ,  $a_B$ ,  $a_C$  - ?

Задача K9.24.

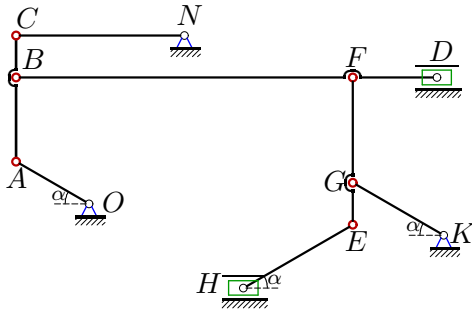
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$\omega_{OA} = 2$  рад/с,  $\alpha = 30^\circ$ ,  
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 $NC = 15$ ,  $EH = 30$ ,  
 $FE = 15$ ,  $FG = 10$ ,  
 $OA = 20$ ,  $KG = 25$ .  
 $a_A$ ,  $a_B$ ,  $a_C$  - ?

**Задача K9.25.**

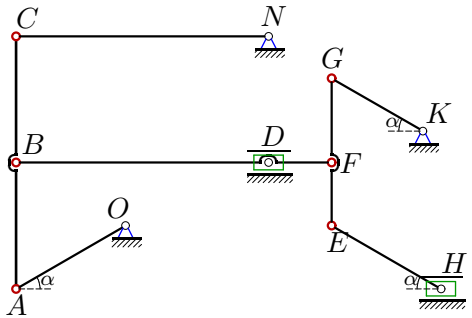
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$\omega_{NC} = 2 \text{ рад/с}, \alpha = 30^\circ,$   
 $AB = 20, BC = 10,$   
 $BF = 80, FD = 20,$   
 $NC = 40, EH = 30,$   
 $FE = 35, FG = 25,$   
 $OA = 20, KG = 25.$   
 $a_A, a_B, a_C - ?$

**Задача K9.26.**

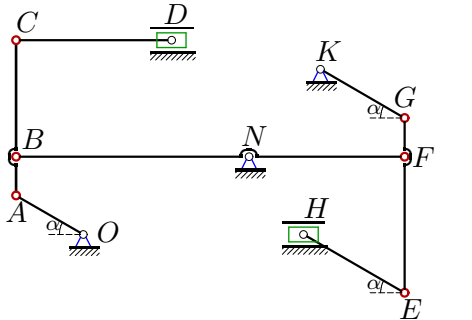
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$\omega_{NC} = 3 \text{ рад/с}, \alpha = 30^\circ,$   
 $AB = 30, BC = 30,$   
 $DB = 60, DF = 15,$   
 $NC = 60, EH = 30,$   
 $FE = 15, FG = 20,$   
 $OA = 30, KG = 25.$   
 $a_A, a_B, a_C - ?$

**Задача K9.27.**

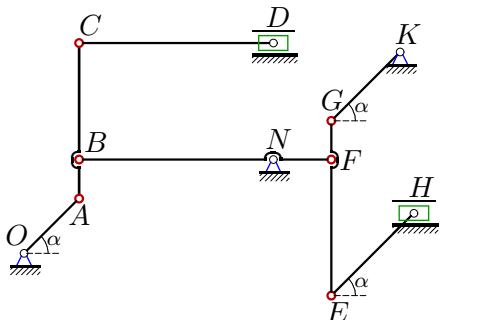
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$\omega_{KG} = 4 \text{ рад/с}, \alpha = 30^\circ,$   
 $AB = 10, BC = 30,$   
 $NB = 60, NF = 40,$   
 $CD = 40, EH = 30,$   
 $FE = 35, FG = 10,$   
 $OA = 20, KG = 25.$   
 $a_G, a_F, a_E - ?$

**Задача K9.28.**

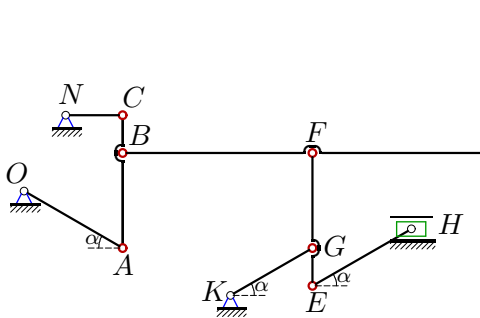
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$\omega_{KG} = 2 \text{ рад/с}, \alpha = 45^\circ,$   
 $AB = 10, BC = 30,$   
 $NB = 50, NF = 15,$   
 $CD = 50, EH = 30,$   
 $FE = 35, FG = 10,$   
 $OA = 20, KG = 25.$   
 $a_G, a_F, a_E - ?$

**Задача K9.29.**

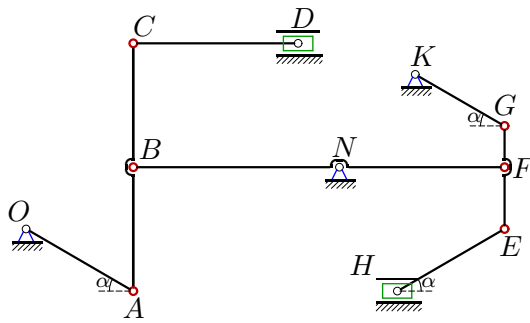
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$\omega_{NC} = 2 \text{ рад/с}, \alpha = 30^\circ,$   
 $AB = 25, BC = 10,$   
 $BF = 50, FD = 50,$   
 $NC = 15, EH = 30,$   
 $FE = 35, FG = 25,$   
 $OA = 30, KG = 25.$   
 $a_A, a_B, a_C - ?$

**Задача К9.30.**

9



$\omega_{BF} = 4 \text{ рад/с}, \alpha = 30^\circ,$   
 $AB = 30, BC = 30,$   
 $NB = 50, NF = 40,$   
 $CD = 40, EH = 30,$   
 $FE = 15, FG = 10,$   
 $OA = 30, KG = 25.$   
 $a_A, a_B, a_C - ?$

**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	120.000	84.853	91.389	33.941	29.197	16.971	24.000	40.729
2	80.000	69.282	72.111	20.000	17.817	13.856	16.000	19.200
3	50.000	43.301	45.069	12.500	27.839	21.651	25.000	30.000
4	138.564	124.900	120.000	34.641	151.743	87.178	92.376	82.754
5	115.470	100.000	200.000	173.205	105.830	80.000	92.376	23.094
6	200.000	173.205	177.764	40.000	111.355	86.603	100.000	120.000
7	282.843	200.000	223.607	100.000	310.984	160.000	226.274	106.667
8	69.282	60.811	60.000	9.897	85.264	49.010	55.426	42.757
9	200.000	173.205	177.764	40.000	199.750	86.603	100.000	130.000
10	23.094	20.000	40.000	34.641	48.228	40.000	46.188	3.849
11	69.282	60.811	60.000	9.897	13.302	15.555	13.856	12.669
12	100.000	86.603	173.205	150.000	62.650	51.962	60.000	65.000
13	20.000	14.907	14.142	4.714	16.518	8.498	10.000	7.857
14	212.132	150.000	474.342	450.000	327.605	90.000	127.279	225.000
15	30.000	25.981	30.000	15.000	18.795	15.588	18.000	19.500
16	339.411	240.000	339.411	240.000	218.403	60.000	84.853	270.000
17	80.000	69.282	138.564	120.000	24.622	17.321	20.000	7.500
18	200.000	141.421	152.315	56.569	121.655	70.711	100.000	28.284
19	60.000	51.962	54.083	15.000	53.451	41.569	48.000	57.600
20	28.868	25.338	25.000	4.124	59.577	13.163	14.434	65.467
21	30.000	21.213	30.000	21.213	38.609	10.607	15.000	26.517
22	375.000	324.760	338.020	93.750	83.516	64.952	75.000	15.000
23	20.000	17.321	18.028	5.000	11.533	3.464	4.000	13.000
24	40.000	37.749	34.641	15.000	31.225	17.321	10.000	35.000
25	92.376	81.468	80.000	15.396	17.375	22.204	18.475	16.012
26	207.846	187.350	180.000	51.962	84.437	68.739	51.962	45.466
27	150.000	129.904	259.808	225.000	195.256	86.603	100.000	225.000
28	166.667	117.851	372.678	353.553	128.695	35.355	50.000	159.099
29	34.641	30.405	30.000	4.949	20.589	15.795	17.321	5.444
30	230.940	200.000	230.940	115.470	211.660	160.000	184.752	46.188

$N_0$	$\omega_{OA}$	$\omega_{CA}$	$\omega_{CD}$	$\omega_{BF}$	$\omega_{FE}$	$\omega_{KG}$	$\omega_{EH}$	$\omega_{NC}$	$a_A$	$a_B$	$a_C$	$a_E$	$a_F$	$a_G$
1	4.000	3.394	-5.657	0.849	-0.679	-0.960	-0.800	-	4.800	0.885	0.727	-	-	-
2	4.000	-2.000	-4.619	0.693	-0.320	0.640	-0.533	-	3.200	2.448	2.878	-	-	-
3	2.500	-1.250	-2.887	0.433	0.500	1.000	0.833	-	-	-	-	0.305	0.113	0.250
4	4.619	1.155	-	2.000	2.694	4.619	3.079	3.000	6.974	5.279	3.600	-	-	-
5	-5.774	5.774	2.500	2.000	-4.619	3.695	3.079	-	10.184	2.000	38.200	-	-	-
6	6.667	4.000	-6.928	-1.732	2.000	4.000	-3.333	-	-	-	-	5.955	1.803	4.000
7	-14.142	10.000	3.333	2.000	5.333	9.051	7.542	-	79.137	4.000	45.399	-	-	-
8	-2.309	-0.990	-	0.600	-1.782	2.217	1.848	1.000	1.685	0.107	0.600	-	-	-
9	6.667	4.000	11.547	-1.732	-5.000	4.000	3.333	-	-	-	-	16.978	4.743	4.000
10	-1.155	1.155	-1.333	1.000	0.770	2.309	1.540	-	0.407	0.200	1.995	-	-	-
11	-2.309	-0.990	-	-0.600	0.119	-0.554	0.462	4.000	1.685	1.247	2.400	-	-	-
12	-5.000	5.000	2.165	1.732	1.000	3.000	-2.000	-	-	-	-	0.282	1.082	1.800
13	1.000	-0.471	-	-0.141	0.393	0.400	0.333	0.943	0.200	0.230	0.247	-	-	-
14	-10.607	15.000	3.000	3.000	9.000	-5.091	4.243	-	58.795	4.500	193.139	-	-	-
15	1.000	0.500	-0.650	-0.520	-0.300	-0.900	0.600	-	0.300	0.154	0.530	-	-	-
16	11.314	8.000	4.000	4.000	6.000	-3.394	-2.828	-	40.013	9.600	24.933	-	-	-
17	4.000	-4.000	1.155	1.155	-0.500	-0.800	-0.667	-	3.200	3.298	9.495	-	-	-
18	6.667	5.657	9.428	-1.414	2.828	4.000	-3.333	-	-	-	-	5.672	1.299	4.000
19	3.000	-1.500	3.464	-0.520	-0.960	-1.920	-1.600	-	1.800	1.377	1.971	-	-	-
20	0.962	0.412	-	0.250	-1.134	0.577	0.481	1.000	0.293	0.261	0.250	-	-	-
21	1.000	0.707	0.354	0.354	1.061	-0.600	0.500	-	0.300	0.097	0.108	-	-	-
22	18.750	-9.375	-21.651	3.248	1.500	3.000	-2.500	-	-	-	-	2.318	2.183	2.250
23	1.000	-0.500	-1.155	0.173	0.200	-0.160	-0.133	-	0.200	0.153	0.180	-	-	-
24	2.000	-0.500	-	0.577	-1.000	-0.400	-0.333	-2.309	0.800	0.532	0.943	-	-	-
25	4.619	-1.540	-	0.800	0.246	0.739	-0.616	2.000	5.384	2.856	1.600	-	-	-
26	6.928	1.732	-	3.000	1.299	-2.078	-1.732	3.000	15.692	10.533	5.400	-	-	-
27	7.500	-7.500	3.248	2.165	-5.000	4.000	3.333	-	-	-	-	13.753	4.875	4.000
28	8.333	-11.785	-2.357	-2.357	-3.536	2.000	1.667	-	-	-	-	8.879	2.127	1.000
29	1.155	0.495	-	-0.300	-0.544	0.693	-0.577	2.000	0.421	0.547	0.600	-	-	-
30	-7.698	-3.849	5.000	4.000	-9.238	7.390	6.158	-	18.504	8.000	34.252	-	-	-