

## Трение качения

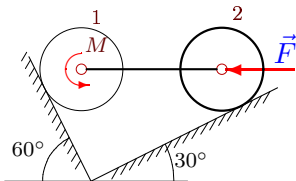
Система состоит из двух цилиндров весом  $P_1$  и  $P_2$  с одинаковыми радиусами  $R$ , соединенных однородным стержнем весом  $P_3$ . Цилиндры могут кататься без проскальзывания, цилиндр 1 без сопротивления, а цилиндр 2 с трением качения ( $\delta$ ). В каких пределах меняется внешний момент  $M$  при условии равновесия системы?

В ответах даны нормальные реакции опор и момент  $M$  для движения цилиндра 2 по часовой стрелке и против (последние три столбца).

Кирсанов М.Н. **Решебник. Теоретическая механика**/Под ред. А. И. Кириллова.– М.: ФИЗМАТЛИТ, 2008. — 384 с. (с.80.)

### Задача S-18.1.

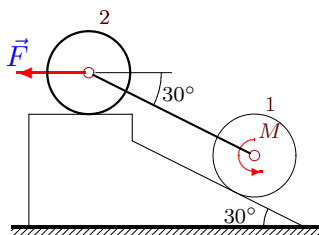
6



$$P_1 = 22 \text{ Н}, P_2 = 26 \text{ Н}, P_3 = 40 \text{ Н}, \\ F = 10 \text{ Н}, R = 40 \text{ см}, \delta = 3 \text{ мм}.$$

### Задача S-18.2.

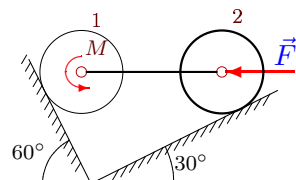
6



$$P_1 = 23 \text{ Н}, P_2 = 27 \text{ Н}, P_3 = 30 \text{ Н}, \\ F = 15 \text{ Н}, R = 25 \text{ см}, \delta = 1 \text{ мм}.$$

### Задача S-18.3.

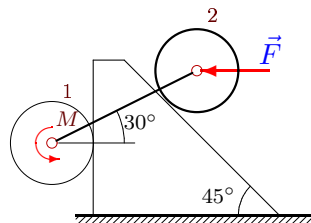
6



$$P_1 = 23 \text{ Н}, P_2 = 24 \text{ Н}, P_3 = 10 \text{ Н}, \\ F = 15 \text{ Н}, R = 25 \text{ см}, \delta = 1 \text{ мм}.$$

### Задача S-18.4.

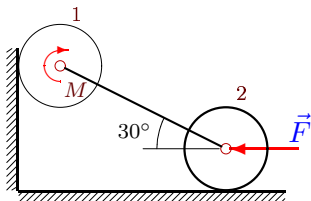
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$$P_1 = 25 \text{ Н}, P_2 = 27 \text{ Н}, P_3 = 10 \text{ Н}, \\ F = 25 \text{ Н}, R = 35 \text{ см}, \delta = 1 \text{ мм}.$$

### Задача S-18.5.

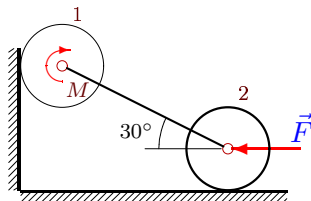
6



$$P_1 = 6 \text{ Н}, P_2 = 27 \text{ Н}, P_3 = 40 \text{ Н}, \\ F = 50 \text{ Н}, R = 75 \text{ см}, \delta = 5 \text{ мм}.$$

### Задача S-18.6.

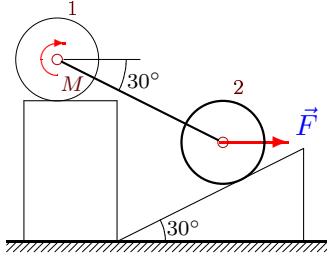
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$$P_1 = 5 \text{ Н}, P_2 = 28 \text{ Н}, P_3 = 40 \text{ Н}, \\ F = 30 \text{ Н}, R = 35 \text{ см}, \delta = 2 \text{ мм}.$$

Задача S-18.7.

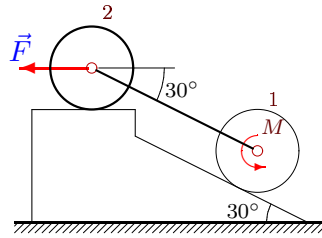
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$$P_1 = 24 \text{ H}, P_2 = 27 \text{ H}, P_3 = 20 \text{ H}, \\ F = 20 \text{ H}, R = 40 \text{ см}, \delta = 2 \text{ мм.}$$

Задача S-18.8.

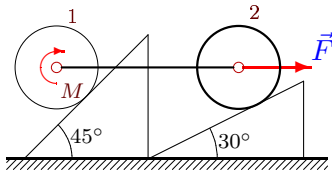
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$$P_1 = 25 \text{ H}, P_2 = 29 \text{ H}, P_3 = 10 \text{ H}, \\ F = 25 \text{ H}, R = 75 \text{ см}, \delta = 5 \text{ мм.}$$

Задача S-18.9.

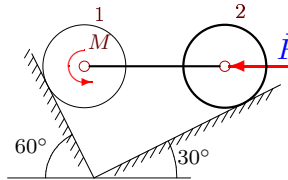
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$$P_1 = 24 \text{ H}, P_2 = 28 \text{ H}, P_3 = 30 \text{ H}, \\ F = 20 \text{ H}, R = 70 \text{ см}, \delta = 5 \text{ мм.}$$

Задача S-18.10.

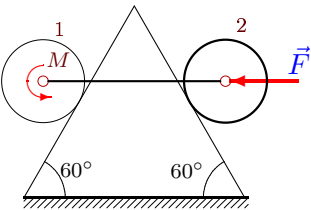
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$$P_1 = 21 \text{ H}, P_2 = 24 \text{ H}, P_3 = 20 \text{ H}, \\ F = 5 \text{ H}, R = 45 \text{ см}, \delta = 4 \text{ мм.}$$

Задача S-18.11.

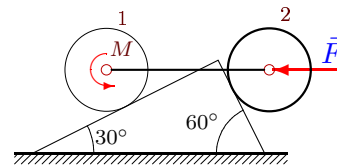
6



$$P_1 = 10 \text{ H}, P_2 = 23 \text{ H}, P_3 = 10 \text{ H}, \\ F = 5 \text{ H}, R = 15 \text{ см}, \delta = 1 \text{ мм.}$$

Задача S-18.12.

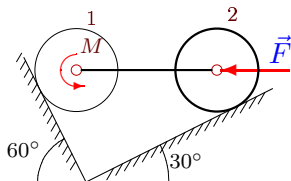
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$$P_1 = 23 \text{ H}, P_2 = 28 \text{ H}, P_3 = 30 \text{ H}, \\ F = 15 \text{ H}, R = 25 \text{ см}, \delta = 1 \text{ мм.}$$

Задача S-18.13.

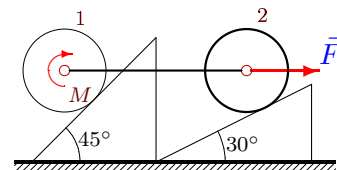
6



$$P_1 = 23 \text{ H}, P_2 = 25 \text{ H}, P_3 = 30 \text{ H}, \\ F = 15 \text{ H}, R = 25 \text{ см}, \delta = 1 \text{ мм.}$$

Задача S-18.14.

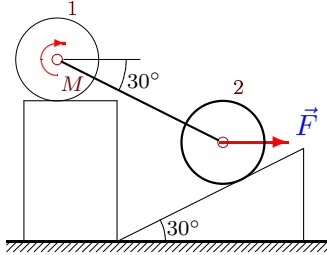
6



$$P_1 = 22 \text{ H}, P_2 = 27 \text{ H}, P_3 = 30 \text{ H}, \\ F = 10 \text{ H}, R = 20 \text{ см}, \delta = 1 \text{ мм.}$$

Задача S-18.15.

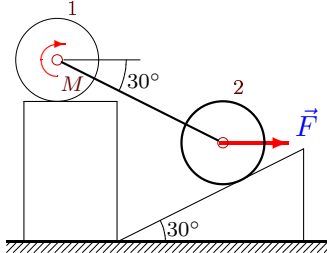
6



$P_1 = 22 \text{ H}, P_2 = 23 \text{ H}, P_3 = 20 \text{ H},$   
 $F = 10 \text{ H}, R = 40 \text{ см}, \delta = 3 \text{ мм}.$

Задача S-18.17.

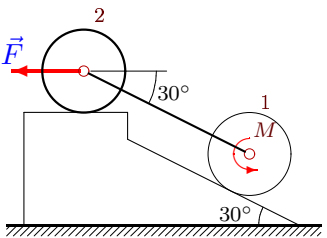
6



$P_1 = 23 \text{ H}, P_2 = 27 \text{ H}, P_3 = 40 \text{ H},$   
 $F = 15 \text{ H}, R = 35 \text{ см}, \delta = 2 \text{ мм}.$

Задача S-18.19.

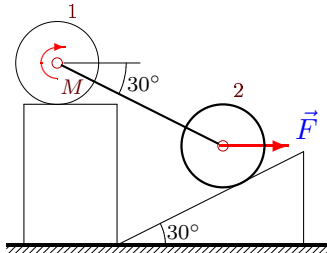
6



$P_1 = 23 \text{ H}, P_2 = 28 \text{ H}, P_3 = 10 \text{ H},$   
 $F = 15 \text{ H}, R = 65 \text{ см}, \delta = 5 \text{ мм}.$

Задача S-18.21.

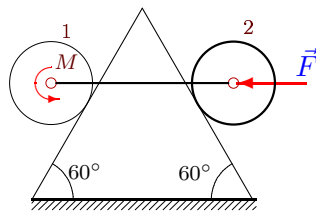
6



$P_1 = 21 \text{ H}, P_2 = 24 \text{ H}, P_3 = 10 \text{ H},$   
 $F = 5 \text{ H}, R = 55 \text{ см}, \delta = 5 \text{ мм}.$

Задача S-18.16.

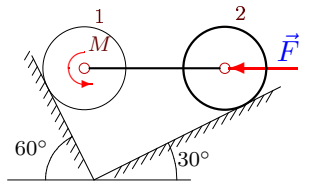
6



$P_1 = 12 \text{ H}, P_2 = 28 \text{ H}, P_3 = 10 \text{ H},$   
 $F = 25 \text{ H}, R = 55 \text{ см}, \delta = 3 \text{ мм}.$

Задача S-18.18.

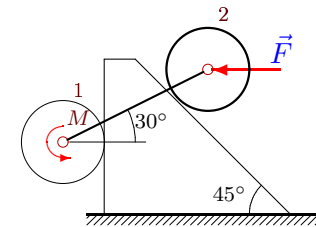
6



$P_1 = 23 \text{ H}, P_2 = 24 \text{ H}, P_3 = 10 \text{ H},$   
 $F = 15 \text{ H}, R = 55 \text{ см}, \delta = 4 \text{ мм}.$

Задача S-18.20.

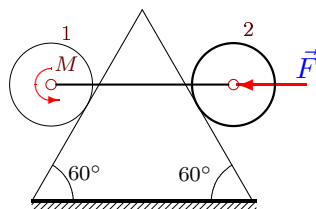
6



$P_1 = 21 \text{ H}, P_2 = 25 \text{ H}, P_3 = 30 \text{ H},$   
 $F = 5 \text{ H}, R = 25 \text{ см}, \delta = 2 \text{ мм}.$

Задача S-18.22.

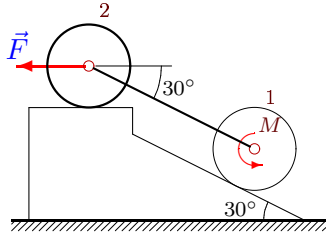
6



$P_1 = 12 \text{ H}, P_2 = 29 \text{ H}, P_3 = 50 \text{ H},$   
 $F = 20 \text{ H}, R = 30 \text{ см}, \delta = 1 \text{ мм}.$

Задача S-18.23.

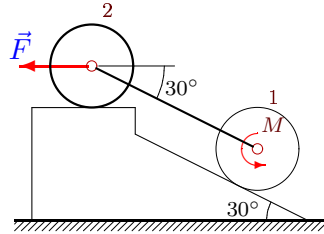
6



$P_1 = 25 \text{ H}, P_2 = 26 \text{ H}, P_3 = 40 \text{ H},$   
 $F = 25 \text{ H}, R = 75 \text{ см}, \delta = 5 \text{ мм}.$

Задача S-18.24.

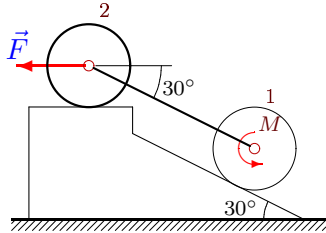
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$P_1 = 24 \text{ H}, P_2 = 26 \text{ H}, P_3 = 40 \text{ H},$   
 $F = 20 \text{ H}, R = 30 \text{ см}, \delta = 1 \text{ мм}.$

Задача S-18.25.

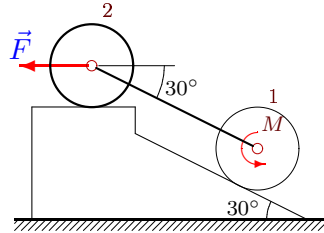
6



$P_1 = 21 \text{ H}, P_2 = 24 \text{ H}, P_3 = 50 \text{ H},$   
 $F = 5 \text{ H}, R = 55 \text{ см}, \delta = 5 \text{ мм}.$

Задача S-18.26.

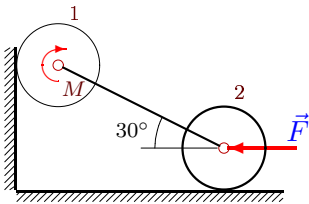
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$P_1 = 25 \text{ H}, P_2 = 28 \text{ H}, P_3 = 40 \text{ H},$   
 $F = 25 \text{ H}, R = 75 \text{ см}, \delta = 5 \text{ мм}.$

Задача S-18.27.

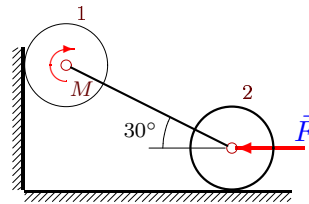
6



$P_1 = 5 \text{ H}, P_2 = 26 \text{ H}, P_3 = 30 \text{ H},$   
 $F = 10 \text{ H}, R = 35 \text{ см}, \delta = 3 \text{ мм}.$

Задача S-18.28.

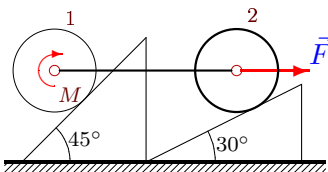
6



$P_1 = 5 \text{ H}, P_2 = 26 \text{ H}, P_3 = 20 \text{ H},$   
 $F = 20 \text{ H}, R = 60 \text{ см}, \delta = 5 \text{ мм}.$

Задача S-18.29.

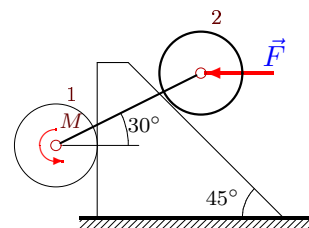
6



$P_1 = 22 \text{ H}, P_2 = 26 \text{ H}, P_3 = 10 \text{ H},$   
 $F = 10 \text{ H}, R = 40 \text{ см}, \delta = 3 \text{ мм}.$

Задача S-18.30.

6



$P_1 = 23 \text{ H}, P_2 = 26 \text{ H}, P_3 = 40 \text{ H},$   
 $F = 15 \text{ H}, R = 65 \text{ см}, \delta = 5 \text{ мм}.$

S-18

Ответы.

Трение качения

19.12.2014

	$N_1$	$N_2$	$M$	$N_1$	$N_2$	$M$
	H		Hm	H		Hm
1	53.060	53.347	7.145	52.264	52.887	7.329
2	32.909	50.778	0.361	32.909	50.544	0.478
3	41.625	33.564	2.075	41.357	33.409	2.114
4	16.006	58.158	-7.266	17.130	59.411	-7.038
5	50.508	76.161	2.370	49.496	75.577	1.932
6	30.374	65.537	-2.612	29.628	65.106	-2.763
7	32.598	44.471	0.971	33.039	43.707	0.666
8	25.981	48.621	-10.681	25.981	48.248	-10.122
9	23.874	49.858	21.896	24.453	49.448	21.491
10	37.181	39.462	6.448	36.483	39.059	6.630
11	44.531	55.361	1.258	45.824	56.654	1.370
12	62.306	85.408	7.979	62.994	86.600	8.277
13	52.176	46.295	3.439	51.806	46.082	3.492
14	15.889	48.638	7.287	16.285	48.358	7.208
15	23.802	47.778	5.680	24.509	46.553	5.190
16	35.732	65.382	0.550	36.979	66.629	0.946
17	32.107	67.070	6.603	32.866	65.756	6.143
18	41.735	33.628	4.530	41.248	33.346	4.684
19	24.249	41.846	-2.400	24.249	41.476	-1.919
20	79.583	120.583	2.487	86.237	128.005	3.447
21	15.412	45.953	10.086	16.235	44.528	9.302
22	81.560	107.380	1.309	82.807	108.627	1.525
23	38.971	60.667	-5.126	38.971	60.202	-4.428
24	38.105	57.658	-0.395	38.105	57.436	-0.262
25	39.837	52.161	9.173	39.837	51.616	9.773
26	38.971	62.675	-5.137	38.971	62.194	-4.417
27	10.403	47.006	-4.898	9.601	46.543	-5.060
28	20.398	47.777	-1.934	19.606	47.319	-2.208
29	13.287	35.951	9.959	13.726	35.641	9.783
30	70.221	121.454	-1.598	76.658	128.634	0.818

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