

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

**Задача S-18.1.** 7

$P_1 = 22 \text{ Н}, P_2 = 24 \text{ Н}, P_3 = 30 \text{ Н},$   
 $F = 10 \text{ Н}, R = 60 \text{ см}, \delta = 5 \text{ мм}.$

**Задача S-18.2.** 7

$P_1 = 25 \text{ Н}, P_2 = 29 \text{ Н}, P_3 = 20 \text{ Н},$   
 $F = 25 \text{ Н}, R = 35 \text{ см}, \delta = 1 \text{ мм}.$

**Задача S-18.3.** 7

$P_1 = 25 \text{ Н}, P_2 = 27 \text{ Н}, P_3 = 40 \text{ Н},$   
 $F = 25 \text{ Н}, R = 45 \text{ см}, \delta = 2 \text{ мм}.$

**Задача S-18.4.** 7

$P_1 = 23 \text{ Н}, P_2 = 27 \text{ Н}, P_3 = 10 \text{ Н},$   
 $F = 15 \text{ Н}, R = 65 \text{ см}, \delta = 5 \text{ мм}.$

**Задача S-18.5.** 7

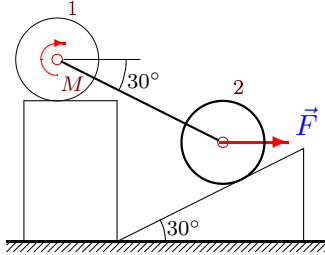
$P_1 = 5 \text{ Н}, P_2 = 24 \text{ Н}, P_3 = 40 \text{ Н},$   
 $F = 10 \text{ Н}, R = 45 \text{ см}, \delta = 4 \text{ мм}.$

**Задача S-18.6.** 7

$P_1 = 5 \text{ Н}, P_2 = 23 \text{ Н}, P_3 = 40 \text{ Н},$   
 $F = 10 \text{ Н}, R = 15 \text{ см}, \delta = 1 \text{ мм}.$

Задача S-18.7.

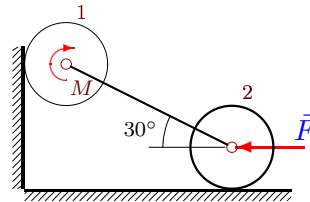
7



$P_1 = 21 \text{ H}, P_2 = 26 \text{ H}, P_3 = 50 \text{ H},$   
 $F = 5 \text{ H}, R = 15 \text{ см}, \delta = 1 \text{ мм}.$

Задача S-18.8.

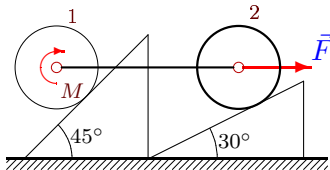
7



$P_1 = 5 \text{ H}, P_2 = 28 \text{ H}, P_3 = 20 \text{ H},$   
 $F = 30 \text{ H}, R = 35 \text{ см}, \delta = 2 \text{ мм}.$

Задача S-18.9.

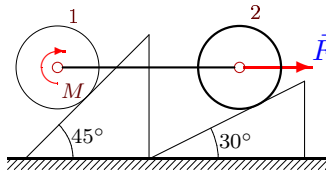
7



$P_1 = 22 \text{ H}, P_2 = 24 \text{ H}, P_3 = 40 \text{ H},$   
 $F = 10 \text{ H}, R = 60 \text{ см}, \delta = 5 \text{ мм}.$

Задача S-18.10.

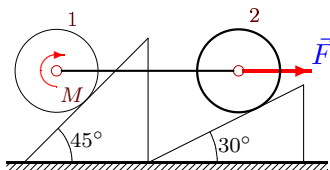
7



$P_1 = 25 \text{ H}, P_2 = 26 \text{ H}, P_3 = 20 \text{ H},$   
 $F = 25 \text{ H}, R = 35 \text{ см}, \delta = 1 \text{ мм}.$

Задача S-18.11.

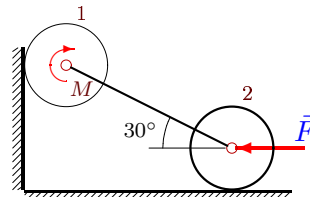
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$P_1 = 24 \text{ H}, P_2 = 28 \text{ H}, P_3 = 20 \text{ H},$   
 $F = 20 \text{ H}, R = 40 \text{ см}, \delta = 2 \text{ мм}.$

Задача S-18.12.

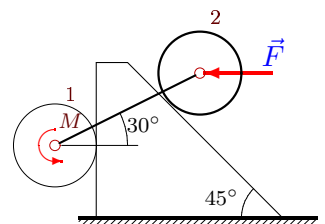
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$P_1 = 5 \text{ H}, P_2 = 27 \text{ H}, P_3 = 40 \text{ H},$   
 $F = 30 \text{ H}, R = 25 \text{ см}, \delta = 1 \text{ мм}.$

Задача S-18.13.

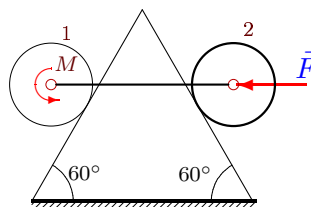
7



$P_1 = 25 \text{ H}, P_2 = 30 \text{ H}, P_3 = 30 \text{ H},$   
 $F = 25 \text{ H}, R = 55 \text{ см}, \delta = 3 \text{ мм}.$

Задача S-18.14.

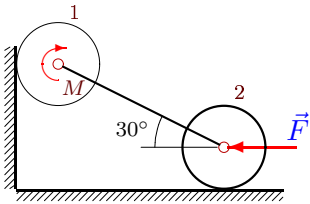
7



$P_1 = 11 \text{ H}, P_2 = 27 \text{ H}, P_3 = 50 \text{ H},$   
 $F = 10 \text{ H}, R = 40 \text{ см}, \delta = 3 \text{ мм}.$

Задача S-18.15.

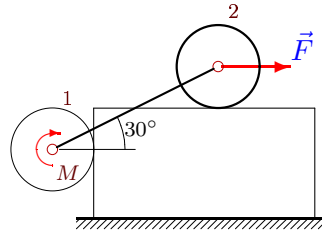
7



$P_1 = 6 \text{ H}, P_2 = 26 \text{ H}, P_3 = 40 \text{ H},$   
 $F = 40 \text{ H}, R = 40 \text{ см}, \delta = 2 \text{ мм}.$

Задача S-18.16.

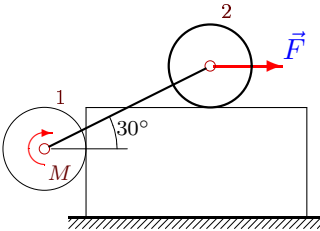
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$P_1 = 25 \text{ H}, P_2 = 28 \text{ H}, P_3 = 40 \text{ H},$   
 $F = 25 \text{ H}, R = 55 \text{ см}, \delta = 3 \text{ мм}.$

Задача S-18.17.

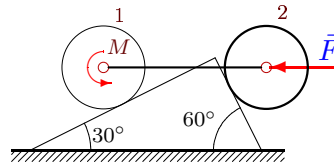
7



$P_1 = 21 \text{ H}, P_2 = 25 \text{ H}, P_3 = 50 \text{ H},$   
 $F = 5 \text{ H}, R = 55 \text{ см}, \delta = 5 \text{ мм}.$

Задача S-18.18.

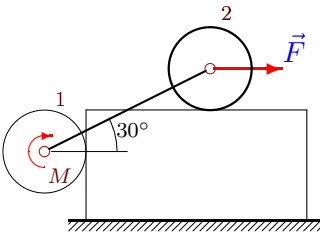
7



$P_1 = 25 \text{ H}, P_2 = 27 \text{ H}, P_3 = 10 \text{ H},$   
 $F = 25 \text{ H}, R = 65 \text{ см}, \delta = 4 \text{ мм}.$

Задача S-18.19.

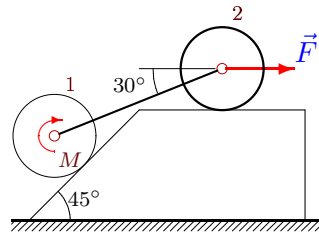
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$P_1 = 25 \text{ H}, P_2 = 29 \text{ H}, P_3 = 30 \text{ H},$   
 $F = 25 \text{ H}, R = 35 \text{ см}, \delta = 1 \text{ мм}.$

Задача S-18.20.

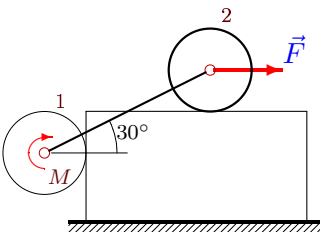
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$P_1 = 24 \text{ H}, P_2 = 25 \text{ H}, P_3 = 10 \text{ H},$   
 $F = 20 \text{ H}, R = 50 \text{ см}, \delta = 3 \text{ мм}.$

Задача S-18.21.

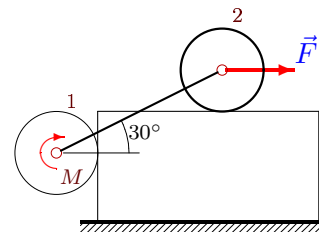
7



$P_1 = 22 \text{ H}, P_2 = 25 \text{ H}, P_3 = 10 \text{ H},$   
 $F = 10 \text{ H}, R = 30 \text{ см}, \delta = 2 \text{ мм}.$

Задача S-18.22.

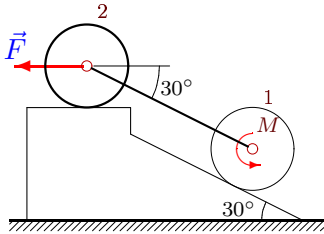
7



$P_1 = 24 \text{ H}, P_2 = 28 \text{ H}, P_3 = 30 \text{ H},$   
 $F = 20 \text{ H}, R = 40 \text{ см}, \delta = 2 \text{ мм}.$

Задача S-18.23.

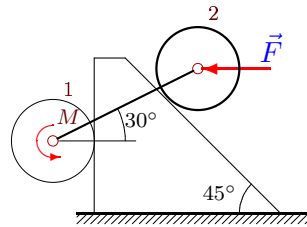
7



$P_1 = 25 \text{ H}, P_2 = 28 \text{ H}, P_3 = 30 \text{ H},$   
 $F = 25 \text{ H}, R = 45 \text{ см}, \delta = 2 \text{ мм}.$

Задача S-18.24.

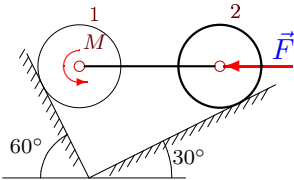
7



$P_1 = 22 \text{ H}, P_2 = 27 \text{ H}, P_3 = 30 \text{ H},$   
 $F = 10 \text{ H}, R = 40 \text{ см}, \delta = 3 \text{ мм}.$

Задача S-18.25.

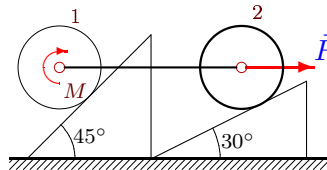
7



$P_1 = 22 \text{ H}, P_2 = 26 \text{ H}, P_3 = 40 \text{ H},$   
 $F = 10 \text{ H}, R = 50 \text{ см}, \delta = 4 \text{ мм}.$

Задача S-18.26.

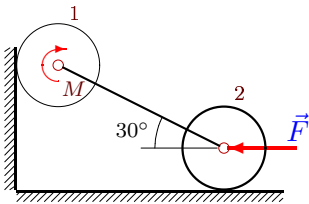
7



$P_1 = 21 \text{ H}, P_2 = 26 \text{ H}, P_3 = 30 \text{ H},$   
 $F = 5 \text{ H}, R = 15 \text{ см}, \delta = 1 \text{ мм}.$

Задача S-18.27.

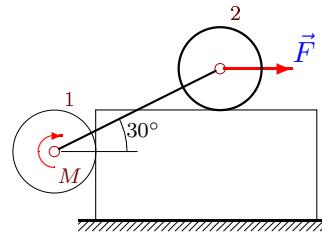
7



$P_1 = 6 \text{ H}, P_2 = 28 \text{ H}, P_3 = 50 \text{ H},$   
 $F = 40 \text{ H}, R = 30 \text{ см}, \delta = 1 \text{ мм}.$

Задача S-18.28.

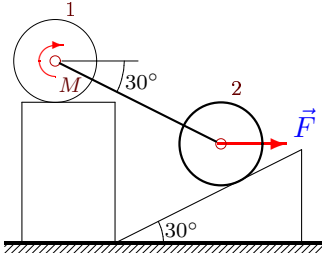
7



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

Задача S-18.29.

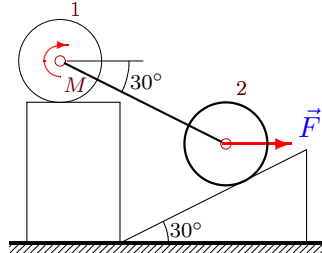
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$P_1 = 25 \text{ H}, P_2 = 27 \text{ H}, P_3 = 30 \text{ H},$   
 $F = 25 \text{ H}, R = 35 \text{ см}, \delta = 1 \text{ мм}.$

Задача S-18.30.

7



$P_1 = 22 \text{ H}, P_2 = 23 \text{ H}, P_3 = 50 \text{ H},$   
 $F = 10 \text{ H}, R = 40 \text{ см}, \delta = 3 \text{ мм}.$

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Ответы.

Трение качения

19.12.2014

	$N_1$	$N_2$	$M$	$N_1$	$N_2$	$M$
	H		Hm	H		Hm
1	32.043	44.990	3.912	32.043	44.559	4.429
2	37.028	42.762	-1.230	37.272	42.340	-1.377
3	39.210	61.277	1.908	39.373	61.592	1.634
4	24.675	40.972	3.743	25.297	39.894	3.043
5	10.445	50.030	-8.536	9.560	49.519	-8.766
6	10.326	48.962	-2.856	9.676	48.586	-2.912
7	24.268	84.308	5.646	25.379	82.383	5.357
8	30.317	55.504	0.876	29.685	55.139	0.749
9	18.459	51.052	24.563	19.151	50.564	24.148
10	27.632	41.638	7.653	27.826	41.501	7.585
11	22.491	44.006	10.237	22.849	43.752	10.094
12	30.258	64.469	-1.883	29.743	64.172	-1.957
13	45.491	100.236	-7.555	49.226	104.402	-6.369
14	86.006	102.666	3.235	88.709	105.369	3.859
15	40.346	69.294	-1.082	39.656	68.895	-1.242
16	24.661	62.238	16.919	25.342	62.631	16.703
17	4.522	52.611	23.864	5.483	53.166	23.559
18	40.804	63.325	6.938	41.592	64.690	7.825
19	24.833	58.338	8.982	25.167	58.530	8.914
20	26.409	41.404	-0.762	26.558	41.691	-1.040
21	9.762	35.636	6.409	10.239	35.912	6.326
22	19.728	54.390	11.044	20.274	54.705	10.918
23	34.641	57.582	-4.123	34.641	57.287	-3.858
24	72.754	117.916	2.002	78.842	124.707	3.408
25	53.087	53.363	8.924	52.237	52.872	9.169
26	11.995	47.526	5.838	12.510	47.161	5.760
27	40.254	76.241	-2.328	39.747	75.948	-2.416
28	14.806	48.548	7.363	15.195	48.773	7.307
29	40.514	47.984	-0.311	40.786	47.511	-0.477
30	31.104	74.101	11.013	32.202	72.201	10.253

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