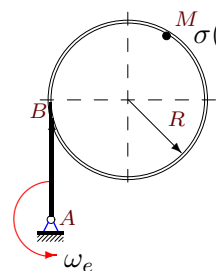
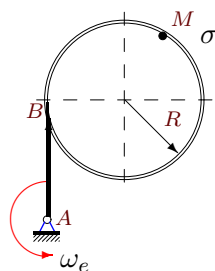
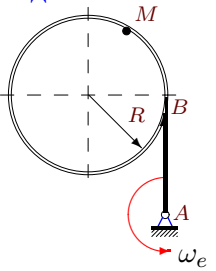
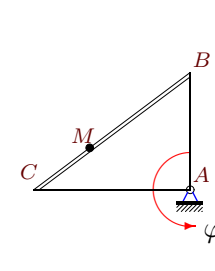
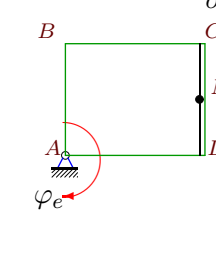
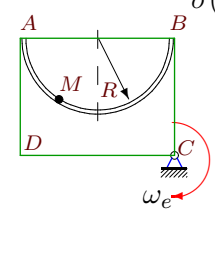
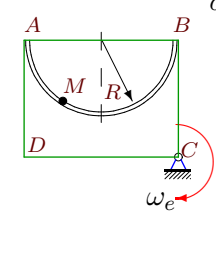
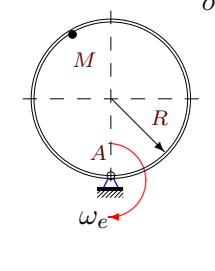


## Сложное движение точки, плоская траектория

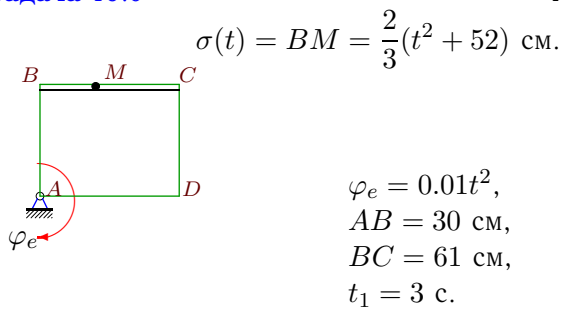
Геометрическая фигура вращается вокруг оси, перпендикулярной ее плоскости. По каналу, расположенному на фигуре, движется точка  $M$  по известному закону  $\sigma(t)$ . Найти абсолютную скорость и абсолютное ускорение точки при  $t = t_1$ . Даны функция  $\sigma(t)$ , закон вращения фигуры  $\varphi_e(t)$  (или постоянная угловая скорость  $\omega_e$ ), время  $t_1$  и размеры фигуры.  $BM$  или  $AM$  — длина отрезка прямой или дуги окружности.

Кирсанов М.Н. **Решебник. Теоретическая механика**/Под ред. А. И. Кириллова. — М.: ФИЗМАТЛИТ, 2002. — 384 с. (с.195.)

<p><b>Задача 10.1</b> <span style="float: right;">2</span></p>  <p><math>\sigma(t) = BM = \frac{2\pi}{3}(t^2 + 2)t</math> см.</p> <p><math>\omega_e = 0.91</math> рад/с,  <math>R = 3</math> см,  <math>AB = 8</math> см,  <math>t_1 = 1</math> с.</p>	<p><b>Задача 10.2</b> <span style="float: right;">2</span></p>  <p><math>\sigma(t) = BM = \frac{2\pi}{3}(t^3 + 4)</math> см.</p> <p><math>\omega_e = 0.72</math> рад/с,  <math>R = 31</math> см,  <math>AB = 36</math> см,  <math>t_1 = 3</math> с.</p>
<p><b>Задача 10.3</b> <span style="float: right;">2</span></p>  <p><math>\sigma(t) = BM = \frac{\pi}{4}(t^3 + 2)</math> см.</p> <p><math>\omega_e = 0.23</math> рад/с,  <math>R = 3</math> см,  <math>AB = 8</math> см,  <math>t_1 = 1</math> с.</p>	<p><b>Задача 10.4</b> <span style="float: right;">2</span></p>  <p><math>\sigma(t) = BM = \frac{2}{3}(t^3 + 3)</math> см.</p> <p><math>\varphi_e = 0.29t^2</math>,  <math>AB = 6</math> см,  <math>AC = 11</math> см,  <math>t_1 = 2</math> с.</p>
<p><b>Задача 10.5</b> <span style="float: right;">2</span></p>  <p><math>\sigma(t) = DM = \frac{1}{4}(t^2 + 51)</math> см.</p> <p><math>\varphi_e = 0t^2</math>,  <math>AB = 55</math> см,  <math>BC = 57</math> см,  <math>t_1 = 2</math> с.</p>	<p><b>Задача 10.6</b> <span style="float: right;">2</span></p>  <p><math>\sigma(t) = AM = \frac{2\pi}{3}(t^2 + 4)t</math> см.</p> <p><math>\omega_e = 3.12</math> рад/с,  <math>R = 39</math> см,  <math>AD = 41</math> см,  <math>t_1 = 3</math> с.</p>
<p><b>Задача 10.7</b> <span style="float: right;">2</span></p>  <p><math>\sigma(t) = AM = \frac{\pi}{6}(t^2 + 3)t</math> см.</p> <p><math>\omega_e = 0.28</math> рад/с,  <math>R = 14</math> см,  <math>AD = 16</math> см,  <math>t_1 = 2</math> с.</p>	<p><b>Задача 10.8</b> <span style="float: right;">2</span></p>  <p><math>\sigma(t) = AM = \frac{\pi}{4}(t^2 + 51)</math> см.</p> <p><math>\omega_e = 0.07</math> рад/с,  <math>R = 55</math> см,  <math>t_1 = 2</math> с.</p>

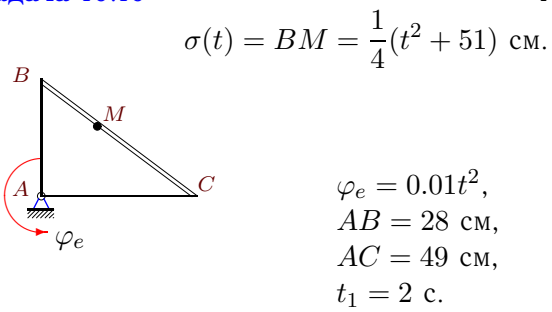
**Задача 10.9**

2



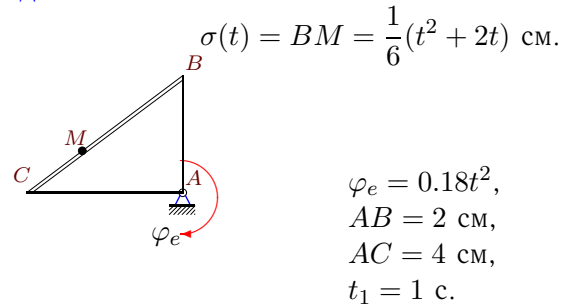
**Задача 10.10**

2



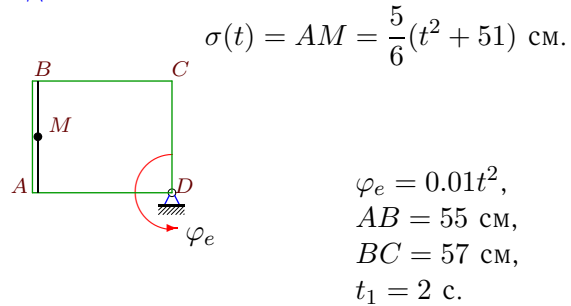
**Задача 10.11**

2



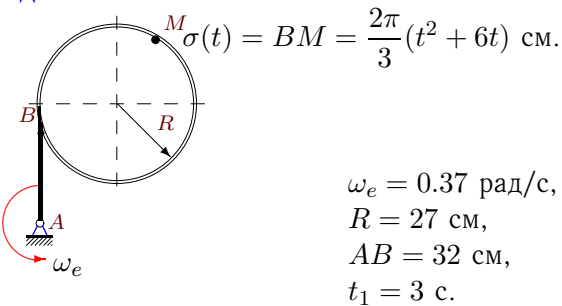
**Задача 10.12**

2



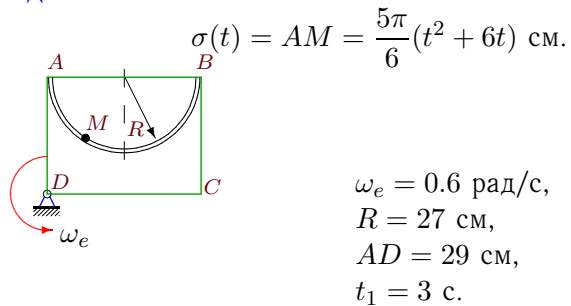
**Задача 10.13**

2



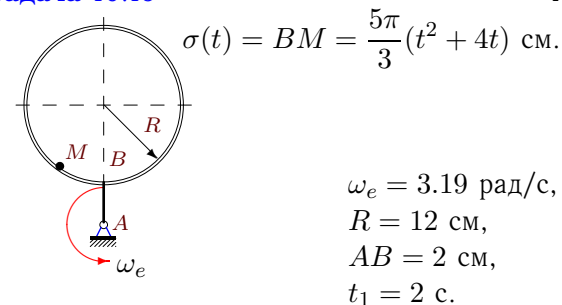
**Задача 10.14**

2



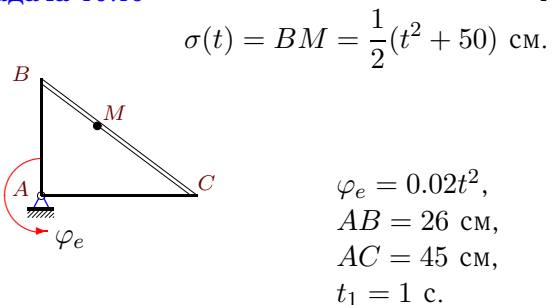
**Задача 10.15**

2



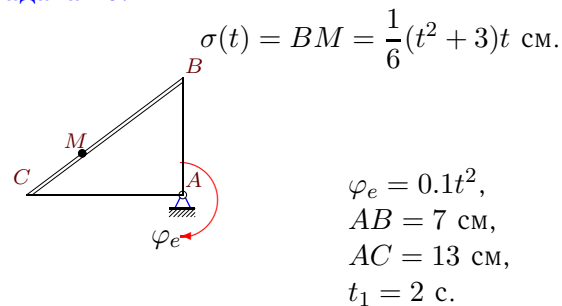
**Задача 10.16**

2



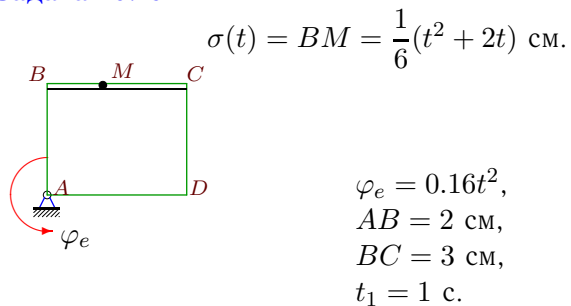
**Задача 10.17**

2



**Задача 10.18**

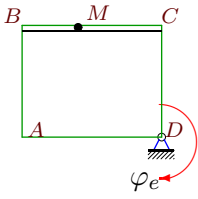
2



**Задача 10.19**

2

$$\sigma(t) = BM = \frac{1}{4}(t^2 + 6t) \text{ см.}$$

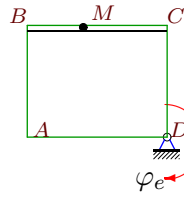


$$\begin{aligned} \varphi_e &= 0.02t^2, \\ AB &= 14 \text{ см,} \\ BC &= 27 \text{ см,} \\ t_1 &= 3 \text{ с.} \end{aligned}$$

**Задача 10.20**

2

$$\sigma(t) = BM = \frac{1}{4}(t^3 + 3) \text{ см.}$$

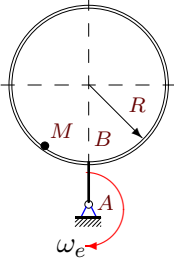


$$\begin{aligned} \varphi_e &= 0.07t^2, \\ AB &= 6 \text{ см,} \\ BC &= 11 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

**Задача 10.21**

2

$$\sigma(t) = BM = \frac{\pi}{3}(t^2 + 3)t \text{ см.}$$

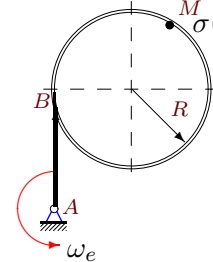


$$\begin{aligned} \omega_e &= 1.04 \text{ рад/с,} \\ R &= 14 \text{ см,} \\ AB &= 2 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

**Задача 10.22**

2

$$\sigma(t) = BM = \frac{4\pi}{3}(t^2 + 52) \text{ см.}$$

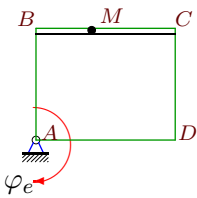


$$\begin{aligned} \omega_e &= 0.27 \text{ рад/с,} \\ R &= 61 \text{ см,} \\ AB &= 66 \text{ см,} \\ t_1 &= 3 \text{ с.} \end{aligned}$$

**Задача 10.23**

2

$$\sigma(t) = BM = \frac{1}{6}(t^2 + 3)t \text{ см.}$$

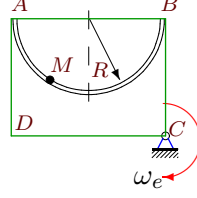


$$\begin{aligned} \varphi_e &= 0.08t^2, \\ AB &= 7 \text{ см,} \\ BC &= 14 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

**Задача 10.24**

2

$$\sigma(t) = AM = \frac{\pi}{4}(t^2 + 2t) \text{ см.}$$

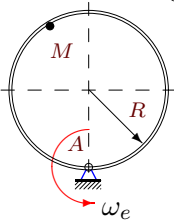


$$\begin{aligned} \omega_e &= 0.53 \text{ рад/с,} \\ R &= 3 \text{ см,} \\ AD &= 5 \text{ см,} \\ t_1 &= 1 \text{ с.} \end{aligned}$$

**Задача 10.25**

2

$$\sigma(t) = AM = \frac{3\pi}{4}(t^2 + 6t) \text{ см.}$$

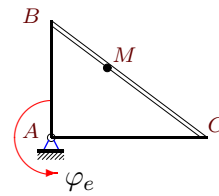


$$\begin{aligned} \omega_e &= 0.57 \text{ рад/с,} \\ R &= 27 \text{ см,} \\ t_1 &= 3 \text{ с.} \end{aligned}$$

**Задача 10.26**

2

$$\sigma(t) = BM = \frac{1}{2}(t^2 + 3)t \text{ см.}$$

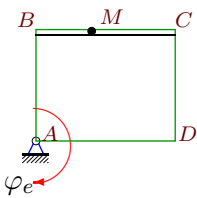


$$\begin{aligned} \varphi_e &= 0.26t^2, \\ AB &= 7 \text{ см,} \\ AC &= 13 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

**Задача 10.27**

2

$$\sigma(t) = BM = \frac{1}{2}(t^2 + 4t) \text{ см.}$$

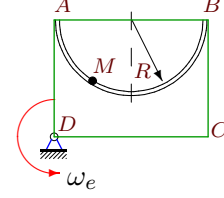


$$\begin{aligned} \varphi_e &= 0.12t^2, \\ AB &= 6 \text{ см,} \\ BC &= 12 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

**Задача 10.28**

2

$$\sigma(t) = AM = \frac{\pi}{3}(t^2 + 3)t \text{ см.}$$

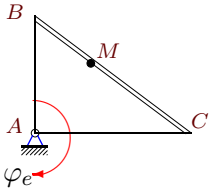


$$\begin{aligned} \omega_e &= 1.96 \text{ рад/с,} \\ R &= 14 \text{ см,} \\ AD &= 16 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

**Задача 10.29**

2

$$\sigma(t) = BM = \frac{1}{2}(t^2 + 4)t \text{ см.}$$

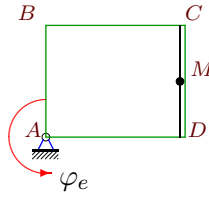


$$\begin{aligned} \varphi_e &= 0.13t^2, \\ AB &= 20 \text{ см,} \\ AC &= 35 \text{ см,} \\ t_1 &= 3 \text{ с.} \end{aligned}$$

**Задача 10.30**

2

$$\sigma(t) = DM = \frac{1}{3}(t^3 + 3) \text{ см.}$$

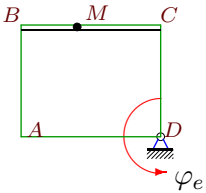


$$\begin{aligned} \varphi_e &= 0.07t^2, \\ AB &= 11 \text{ см,} \\ BC &= 13 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

**Задача 10.31**

2

$$\sigma(t) = BM = \frac{1}{2}(t^2 + 2t) \text{ см.}$$

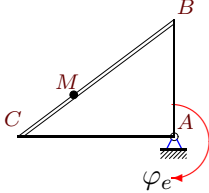


$$\begin{aligned} \varphi_e &= 0.4t^2, \\ AB &= 2 \text{ см,} \\ BC &= 3 \text{ см,} \\ t_1 &= 1 \text{ с.} \end{aligned}$$

**Задача 10.32**

2

$$\sigma(t) = BM = \frac{2}{3}(t^3 + 2) \text{ см.}$$

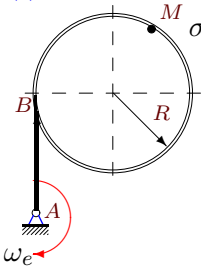


$$\begin{aligned} \varphi_e &= 0.48t^2, \\ AB &= 2 \text{ см,} \\ AC &= 4 \text{ см,} \\ t_1 &= 1 \text{ с.} \end{aligned}$$

**Задача 10.33**

2

$$\sigma(t) = BM = \frac{\pi}{3}(t^2 + 51) \text{ см.}$$

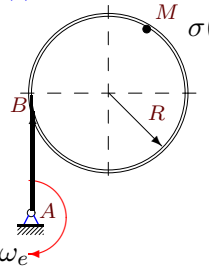


$$\begin{aligned} \omega_e &= 0.04 \text{ рад/с,} \\ R &= 55 \text{ см,} \\ AB &= 60 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

**Задача 10.34**

2

$$\sigma(t) = BM = \frac{\pi}{4}(t^2 + 3)t \text{ см.}$$



$$\begin{aligned} \omega_e &= 0.4 \text{ рад/с,} \\ R &= 14 \text{ см,} \\ AB &= 19 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

### Сложное движение точки, плоская траектория

№	$R_e$	$v_r$	$v_e$	$v$	$a_r$	$a_e$	$a_c$	$a$
	Радиус, см	Скорости, см/с			Ускорения, см/с <sup>2</sup>			
1	11.514	10.472	10.478	1.278	38.654	9.535	19.059	30.253
2	78.179	56.549	56.289	6.400	109.826	40.528	81.430	70.280
3	10.159	2.356	2.337	4.254	5.063	0.537	1.084	5.409
4	6.902	8.000	8.006	15.029	8.000	10.113	18.560	28.683
5	58.635	1.000	0.000	1.000	0.500	0.000	0.000	0.500
6	20.795	64.926	64.882	122.107	114.473	202.431	405.140	482.655
7	27.631	7.854	7.737	6.467	7.674	2.166	4.398	8.046
8	42.095	3.142	2.947	5.063	1.581	0.206	0.440	1.547
9	50.535	4.000	3.032	6.292	1.333	1.027	0.480	2.271
10	24.311	1.000	0.972	0.028	0.500	0.488	0.080	0.041
11	1.832	0.667	0.659	0.144	0.333	0.701	0.480	0.280
12	73.142	3.333	2.926	2.114	1.667	1.468	0.267	1.182
13	68.611	25.133	25.386	2.734	23.767	9.393	18.598	14.488
14	52.713	31.416	31.628	57.793	36.927	18.977	37.699	87.601
15	13.115	41.888	41.836	46.569	146.591	133.458	267.245	151.118
16	25.746	1.000	1.030	0.510	1.000	1.031	0.080	0.549
17	6.242	2.500	2.497	0.396	2.000	1.599	2.000	1.234
18	2.062	0.667	0.660	0.162	0.333	0.693	0.427	0.523
19	24.618	3.000	2.954	5.273	0.500	1.047	0.720	1.356
20	10.201	3.000	2.856	5.219	3.000	1.637	1.680	4.596
21	15.100	15.708	15.704	26.256	21.646	16.332	32.673	56.838
22	92.443	25.133	24.960	28.081	13.320	6.739	13.572	14.652
23	7.379	2.500	2.361	4.798	2.000	1.402	1.600	3.942
24	5.875	3.142	3.114	3.779	3.646	1.650	3.330	3.186
25	49.889	28.274	28.437	11.065	29.981	16.209	32.233	12.441
26	7.179	7.500	7.466	3.981	6.000	8.616	15.600	10.913
27	8.485	4.000	4.073	7.458	1.000	2.823	3.840	6.746
28	8.001	15.708	15.683	8.396	21.646	30.738	61.575	52.961
29	19.831	15.500	15.468	29.990	9.000	13.121	24.180	38.020
30	13.507	4.000	3.782	7.709	4.000	2.167	2.240	6.696
31	2.500	2.000	2.000	1.265	1.000	2.561	3.200	0.805
32	2.103	2.000	2.019	1.098	4.000	2.799	3.840	3.490
33	111.089	4.189	4.444	7.995	2.119	0.178	0.335	2.119
34	29.189	11.781	11.676	20.985	13.679	4.670	9.425	22.864

№	$a_r^n$	$a_r^\tau$	$a_e^n$	$a_e^\tau$	$a_x$	$a_y$
1	36.554	12.566	9.535	0.000	-1.591	-30.211
2	103.153	37.699	40.528	0.000	-2.319	-70.242
3	1.851	4.712	0.537	0.000	-5.361	0.722
4	0.000	8.000	9.287	4.003	9.084	-27.207
5	0.000	0.500	0.000	0.000	0.000	0.500
6	108.088	37.699	202.431	0.000	370.995	-308.736
7	4.406	6.283	2.166	0.000	5.197	-6.143
8	0.179	1.571	0.206	0.000	-0.482	1.470
9	0.000	1.333	0.182	-1.011	1.787	-1.401
10	0.000	0.500	0.039	0.486	0.031	0.026
11	0.000	0.333	0.237	-0.659	0.185	0.211
12	0.000	1.667	0.117	1.463	-1.092	0.453
13	23.395	4.189	9.393	0.000	-4.315	-13.830
14	36.554	5.236	18.977	0.000	-79.825	36.081
15	146.216	10.472	133.458	0.000	-6.175	-150.992
16	0.000	1.000	0.041	1.030	0.341	0.431
17	0.000	2.000	0.999	-1.248	-1.202	0.281
18	0.000	0.333	0.211	0.660	-0.358	0.382
19	0.000	0.500	0.355	-0.985	1.352	-0.112
20	0.000	3.000	0.800	-1.428	4.487	-0.995
21	17.624	12.566	16.332	0.000	50.389	26.297
22	10.355	8.378	6.739	0.000	-12.317	-7.935
23	0.000	2.000	0.756	-1.181	2.881	-2.690
24	3.290	1.571	1.650	0.000	2.521	-1.948
25	29.609	4.712	16.209	0.000	7.680	-9.788
26	0.000	6.000	7.765	3.733	4.098	10.114
27	0.000	1.000	1.955	-2.036	1.058	-6.662
28	17.624	12.566	30.738	0.000	23.591	47.417
29	0.000	9.000	12.065	-5.156	-11.799	-36.143
30	0.000	4.000	1.059	1.891	-3.773	5.533
31	0.000	1.000	1.600	2.000	0.360	0.720
32	0.000	4.000	1.938	-2.019	-2.585	2.344
33	0.319	2.094	0.178	0.000	2.097	0.309
34	9.914	9.425	4.670	0.000	19.683	-11.634