

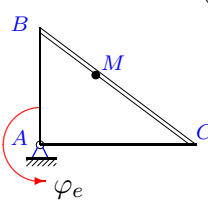
Сложное движение точки, плоская траектория

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 ω_e), время t_1 и размеры фигуры. BM или AM — длина отрезка прямой или дуги окружности.

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

Задача 10.1. 5

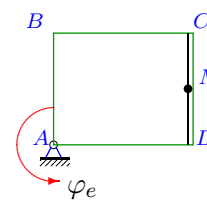
$\sigma(t) = BM = \frac{5}{6}(t^2 + 52)$ см.



$\varphi_e = 0.02t^2$,
 $AB = 30$ см,
 $AC = 54$ см,
 $t_1 = 3$ с.

Задача 10.2. 5

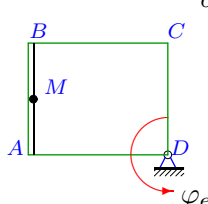
$\sigma(t) = DM = \frac{1}{2}(t^2 + 3)t$ см.



$\varphi_e = 0.11t^2$,
 $AB = 14$ см,
 $BC = 16$ см,
 $t_1 = 2$ с.

Задача 10.3. 5

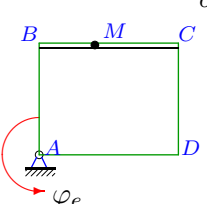
$\sigma(t) = AM = \frac{2}{3}(t^2 + 51)$ см.



$\varphi_e = 0.01t^2$,
 $AB = 55$ см,
 $BC = 57$ см,
 $t_1 = 2$ с.

Задача 10.4. 5

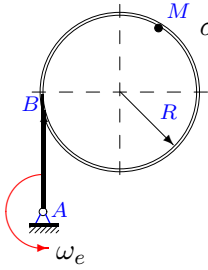
$\sigma(t) = BM = \frac{1}{3}(t^2 + 4t)$ см.



$\varphi_e = 0.09t^2$,
 $AB = 6$ см,
 $BC = 12$ см,
 $t_1 = 2$ с.

Задача 10.5. 5

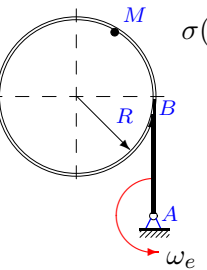
$\sigma(t) = BM = \frac{\pi}{3}(t^2 + 2t)$ см.



$\omega_e = 0.39$ рад/с,
 $R = 3$ см,
 $AB = 8$ см,
 $t_1 = 1$ с.

Задача 10.6. 5

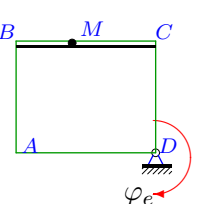
$\sigma(t) = BM = \frac{5\pi}{3}(t^2 + 4t)$ см.



$\omega_e = 4.69$ рад/с,
 $R = 12$ см,
 $AB = 17$ см,
 $t_1 = 2$ с.

Задача 10.7. 5

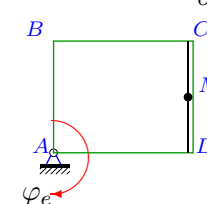
$\sigma(t) = BM = \frac{1}{3}(t^3 + 4)$ см.



$\varphi_e = 0.06t^2$,
 $AB = 16$ см,
 $BC = 31$ см,
 $t_1 = 3$ с.

Задача 10.8. 5

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

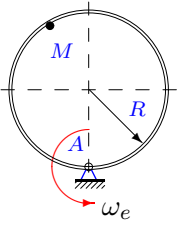


$\varphi_e = 0.02t^2$,
 $AB = 39$ см,
 $BC = 41$ см,
 $t_1 = 3$ с.

Задача 10.9.

5

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



$$\omega_e = 0.08 \text{ рад/с,}$$

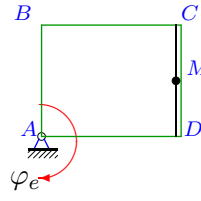
$$R = 55 \text{ см,}$$

$$t_1 = 2 \text{ с.}$$

Задача 10.10.

5

$$\sigma(t) = DM = \frac{1}{2}(t^2 + 50) \text{ см.}$$



$$\varphi_e = 0.01t^2,$$

$$AB = 51 \text{ см,}$$

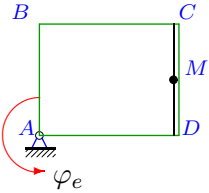
$$BC = 53 \text{ см,}$$

$$t_1 = 1 \text{ с.}$$

Задача 10.11.

5

$$\sigma(t) = DM = \frac{5}{6}(t^2 + 4t) \text{ см.}$$



$$\varphi_e = 0.1t^2,$$

$$AB = 12 \text{ см,}$$

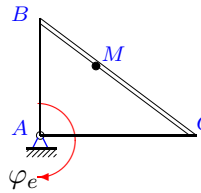
$$BC = 14 \text{ см,}$$

$$t_1 = 2 \text{ с.}$$

Задача 10.12.

5

$$\sigma(t) = BM = \frac{1}{4}(t^2 + 52) \text{ см.}$$



$$\varphi_e = 0.01t^2,$$

$$AB = 30 \text{ см,}$$

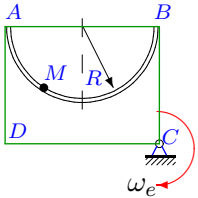
$$AC = 54 \text{ см,}$$

$$t_1 = 3 \text{ с.}$$

Задача 10.13.

5

$$\sigma(t) = AM = \frac{5\pi}{6}(t^2 + 2)t \text{ см.}$$



$$\omega_e = 3.72 \text{ рад/с,}$$

$$R = 3 \text{ см,}$$

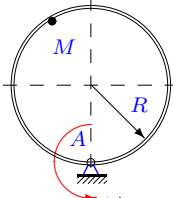
$$AD = 5 \text{ см,}$$

$$t_1 = 1 \text{ с.}$$

Задача 10.14.

5

$$\sigma(t) = AM = \frac{5\pi}{3}(t^2 + 6t) \text{ см.}$$



$$\omega_e = 2.33 \text{ рад/с,}$$

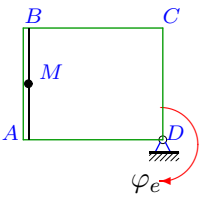
$$R = 27 \text{ см,}$$

$$t_1 = 3 \text{ с.}$$

Задача 10.15.

5

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



$$\varphi_e = 0.12t^2,$$

$$AB = 3 \text{ см,}$$

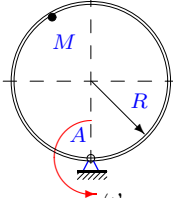
$$BC = 5 \text{ см,}$$

$$t_1 = 1 \text{ с.}$$

Задача 10.16.

5

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



$$\omega_e = 2.22 \text{ рад/с,}$$

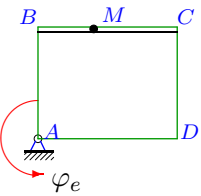
$$R = 12 \text{ см,}$$

$$t_1 = 2 \text{ с.}$$

Задача 10.17.

5

$$\sigma(t) = BM = \frac{1}{3}(t^2 + 4t) \text{ см.}$$



$$\varphi_e = 0.09t^2,$$

$$AB = 6 \text{ см,}$$

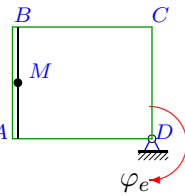
$$BC = 12 \text{ см,}$$

$$t_1 = 2 \text{ с.}$$

Задача 10.18.

5

$$\sigma(t) = AM = \frac{1}{3}(t^2 + 51) \text{ см.}$$



$$\varphi_e = 0.01t^2,$$

$$AB = 55 \text{ см,}$$

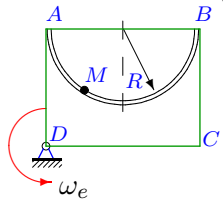
$$BC = 57 \text{ см,}$$

$$t_1 = 2 \text{ с.}$$

Задача 10.19.

5

$$\sigma(t) = AM = \frac{\pi}{3}(t^2 + 50) \text{ см.}$$

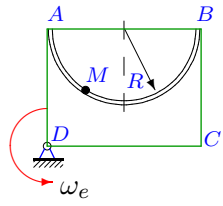


$$\begin{aligned} \omega_e &= 0.08 \text{ рад/с,} \\ R &= 51 \text{ см,} \\ AD &= 53 \text{ см,} \\ t_1 &= 1 \text{ с.} \end{aligned}$$

Задача 10.20.

5

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

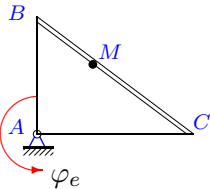


$$\begin{aligned} \omega_e &= 1.38 \text{ рад/с,} \\ R &= 39 \text{ см,} \\ AD &= 41 \text{ см,} \\ t_1 &= 3 \text{ с.} \end{aligned}$$

Задача 10.21.

5

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

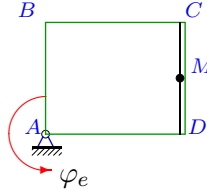


$$\begin{aligned} \varphi_e &= 0.5t^2, \\ AB &= 2 \text{ см,} \\ AC &= 4 \text{ см,} \\ t_1 &= 1 \text{ с.} \end{aligned}$$

Задача 10.22.

5

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

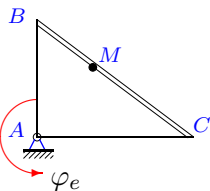


$$\begin{aligned} \varphi_e &= 0.02t^2, \\ AB &= 27 \text{ см,} \\ BC &= 29 \text{ см,} \\ t_1 &= 3 \text{ с.} \end{aligned}$$

Задача 10.23.

5

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

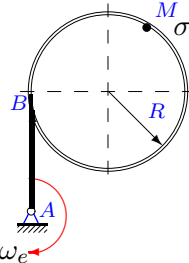


$$\begin{aligned} \varphi_e &= 0.15t^2, \\ AB &= 20 \text{ см,} \\ AC &= 35 \text{ см,} \\ t_1 &= 3 \text{ с.} \end{aligned}$$

Задача 10.24.

5

$$\sigma(t) = BM = \frac{5\pi}{3}(t^2 + 4)t \text{ см.}$$

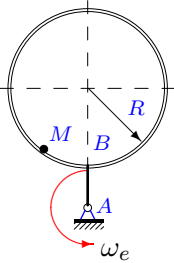


$$\begin{aligned} \omega_e &= 7.37 \text{ рад/с,} \\ R &= 39 \text{ см,} \\ AB &= 44 \text{ см,} \\ t_1 &= 3 \text{ с.} \end{aligned}$$

Задача 10.25.

5

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

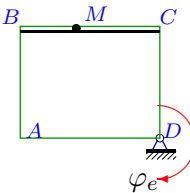


$$\begin{aligned} \omega_e &= 0.44 \text{ рад/с,} \\ R &= 27 \text{ см,} \\ AB &= 2 \text{ см,} \\ t_1 &= 3 \text{ с.} \end{aligned}$$

Задача 10.26.

5

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

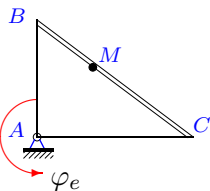


$$\begin{aligned} \varphi_e &= 0.05t^2, \\ AB &= 6 \text{ см,} \\ BC &= 11 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

Задача 10.27.

5

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

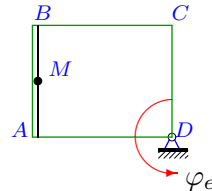


$$\begin{aligned} \varphi_e &= 0.18t^2, \\ AB &= 2 \text{ см,} \\ AC &= 4 \text{ см,} \\ t_1 &= 1 \text{ с.} \end{aligned}$$

Задача 10.28.

5

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

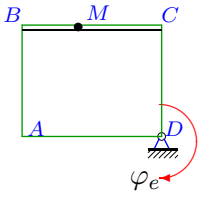


$$\begin{aligned} \varphi_e &= 0.05t^2, \\ AB &= 3 \text{ см,} \\ BC &= 5 \text{ см,} \\ t_1 &= 1 \text{ с.} \end{aligned}$$

Задача 10.29.

5

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

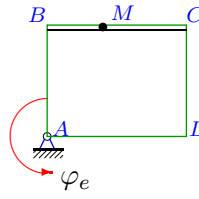


$$\begin{aligned} \varphi_e &= 0.05t^2, \\ AB &= 6 \text{ см}, \\ BC &= 12 \text{ см}, \\ t_1 &= 2 \text{ с.} \end{aligned}$$

Задача 10.30.

5

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

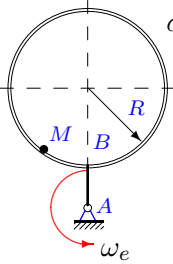


$$\begin{aligned} \varphi_e &= 0.3t^2, \\ AB &= 2 \text{ см}, \\ BC &= 3 \text{ см}, \\ t_1 &= 1 \text{ с.} \end{aligned}$$

Задача 10.31.

5

$$\sigma(t) = BM = \frac{5\pi}{3}(t^2 + 2)t \text{ см.}$$

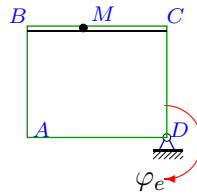


$$\begin{aligned} \omega_e &= 6.01 \text{ рад/с}, \\ R &= 3 \text{ см}, \\ AB &= 2 \text{ см}, \\ t_1 &= 1 \text{ с.} \end{aligned}$$

Задача 10.32.

5

$$\sigma(t) = BM = \frac{5}{6}(t^2 + 4t) \text{ см.}$$

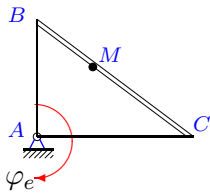


$$\begin{aligned} \varphi_e &= 0.26t^2, \\ AB &= 6 \text{ см}, \\ BC &= 12 \text{ см}, \\ t_1 &= 2 \text{ с.} \end{aligned}$$

Задача 10.33.

5

$$\sigma(t) = BM = \frac{5}{6}(t^2 + 50) \text{ см.}$$

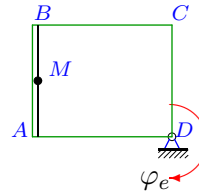


$$\begin{aligned} \varphi_e &= 0.02t^2, \\ AB &= 26 \text{ см}, \\ AC &= 45 \text{ см}, \\ t_1 &= 1 \text{ с.} \end{aligned}$$

Задача 10.34.

5

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



$$\begin{aligned} \varphi_e &= 0.13t^2, \\ AB &= 14 \text{ см}, \\ BC &= 16 \text{ см}, \\ t_1 &= 2 \text{ с.} \end{aligned}$$

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 ²			
1	44.753	5.000	5.370	4.730	1.667	1.903	1.200	2.275
2	17.464	7.500	7.684	14.863	6.000	5.118	6.600	13.891
3	67.775	2.667	2.711	1.517	1.333	1.360	0.213	0.866
4	7.211	2.667	2.596	1.527	0.667	1.599	1.920	2.082
5	10.704	4.189	4.174	2.727	6.212	1.628	3.267	4.014
6	8.925	41.888	41.860	8.929	146.591	196.323	392.909	351.151
7	26.136	9.000	9.409	16.529	6.000	4.616	6.480	12.215
8	41.512	5.167	4.981	0.818	3.000	1.765	1.240	1.559
9	55.000	4.189	4.400	4.298	2.119	0.352	0.670	1.798
10	58.815	1.000	1.176	0.514	1.000	1.177	0.040	0.533
11	17.205	6.667	6.882	12.902	1.667	4.407	5.333	9.993
12	26.234	1.500	1.574	3.074	0.500	0.533	0.180	1.062
13	3.523	13.090	13.106	23.397	59.236	48.753	97.389	73.169
14	27.000	62.832	62.910	62.871	146.591	146.580	292.796	155.737
15	5.056	1.250	1.213	2.457	1.500	1.248	0.600	2.863
16	16.971	37.699	37.675	28.844	118.810	83.638	167.384	69.319
17	7.211	2.667	2.596	1.527	0.667	1.599	1.920	2.082
18	59.876	1.333	2.395	3.687	0.667	1.201	0.107	1.865
19	26.986	2.094	2.159	1.487	2.096	0.173	0.335	2.003
20	17.625	24.347	24.323	1.954	20.758	33.566	67.199	51.754
21	2.244	2.250	2.244	1.432	4.500	3.174	4.500	4.287
22	29.775	3.000	3.573	6.530	0.500	1.266	0.720	2.103
23	25.982	23.250	23.384	18.991	13.500	22.443	41.850	34.381
24	22.018	162.316	162.274	90.365	682.090	1195.960	2392.532	2184.455
25	21.510	9.425	9.464	11.160	3.646	4.164	8.294	4.449
26	10.956	2.000	2.191	3.688	2.000	1.180	0.800	2.969
27	1.832	0.667	0.659	0.144	0.333	0.701	0.480	0.280
28	5.025	0.500	0.502	0.050	1.000	0.505	0.100	0.505
29	10.817	2.000	2.163	3.672	0.500	1.165	0.800	1.467
30	2.236	1.333	1.342	0.615	0.667	1.565	1.600	1.729
31	4.359	26.180	26.197	34.847	230.613	157.444	314.683	199.806
32	6.325	6.667	6.578	13.073	1.667	7.590	13.867	20.528
33	37.103	1.667	1.484	2.825	1.667	1.485	0.133	2.858
34	18.523	10.000	9.632	18.952	8.000	6.948	10.400	19.674

№	a_r^n	a_r^τ	a_e^n	a_e^τ	a_x	a_y
1	0.000	1.667	0.644	1.790	1.187	1.941
2	0.000	6.000	3.381	3.842	-11.238	8.165
3	0.000	1.333	0.108	1.355	-0.855	0.135
4	0.000	0.667	0.935	1.298	-0.932	1.862
5	5.849	2.094	1.628	0.000	2.876	-2.800
6	146.216	10.472	196.323	0.000	-128.517	326.788
7	0.000	6.000	3.387	-3.136	10.598	-6.074
8	0.000	3.000	0.598	-1.660	0.910	1.266
9	0.319	2.094	0.352	0.000	-1.046	1.462
10	0.000	1.000	0.024	-1.176	0.529	-0.070
11	0.000	1.667	2.753	3.441	-9.573	2.867
12	0.000	0.500	0.094	-0.525	0.754	-0.748
13	57.116	15.708	48.753	0.000	48.294	-54.968
14	146.216	10.472	146.580	0.000	-5.236	-155.649
15	0.000	1.500	0.291	-1.213	1.068	2.657
16	118.435	9.425	83.638	0.000	-10.192	-68.566
17	0.000	0.667	0.935	1.298	-0.932	1.862
18	0.000	0.667	0.096	-1.198	0.565	1.777
19	0.086	2.094	0.173	0.000	1.861	-0.739
20	15.200	14.137	33.566	0.000	46.507	22.706
21	0.000	4.500	2.244	2.244	3.031	3.031
22	0.000	0.500	0.429	1.191	-1.408	1.563
23	0.000	13.500	21.046	7.795	10.267	32.812
24	675.548	94.248	1195.960	0.000	393.239	2148.768
25	3.290	1.571	4.164	0.000	-0.953	-4.346
26	0.000	2.000	0.438	-1.096	2.967	-0.123
27	0.000	0.333	0.237	0.659	-0.185	0.211
28	0.000	1.000	0.050	0.502	-0.100	0.495
29	0.000	0.500	0.433	-1.082	1.460	-0.140
30	0.000	0.667	0.805	1.342	-0.893	1.480
31	228.463	31.416	157.444	0.000	-34.882	-196.737
32	0.000	1.667	6.841	-3.289	6.950	-19.316
33	0.000	1.667	0.059	-1.484	1.507	-2.429
34	0.000	8.000	5.009	-4.816	17.153	9.636