

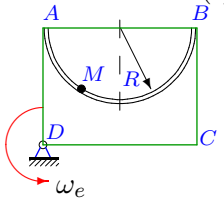
Сложное движение точки, плоская траектория

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. 6

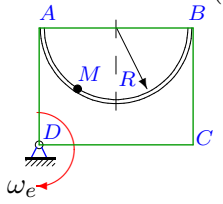
$\sigma(t) = AM = \frac{3\pi}{4}(t^2 + 50)$ см.



$\omega_e = 0.05$ рад/с,
 $R = 51$ см,
 $AD = 53$ см,
 $t_1 = 1$ с.

Задача 10.2. 6

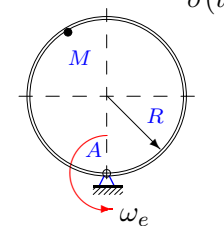
$\sigma(t) = AM = \frac{3\pi}{4}(t^3 + 3)$ см.



$\omega_e = 1.45$ рад/с,
 $R = 11$ см,
 $AD = 13$ см,
 $t_1 = 2$ с.

Задача 10.3. 6

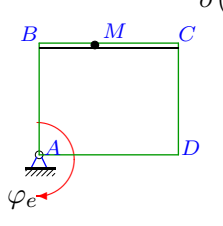
$\sigma(t) = AM = \frac{3\pi}{2}(t^2 + 2t)$ см.



$\omega_e = 4.44$ рад/с,
 $R = 3$ см,
 $t_1 = 1$ с.

Задача 10.4. 6

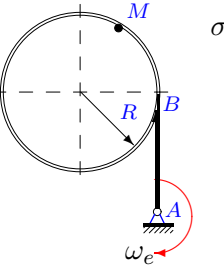
$\sigma(t) = BM = \frac{1}{6}(t^2 + 2t)$ см.



$\varphi_e = 0.16t^2$,
 $AB = 2$ см,
 $BC = 3$ см,
 $t_1 = 1$ с.

Задача 10.5. 6

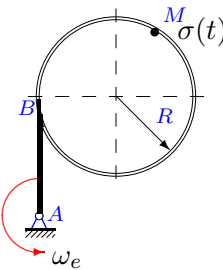
$\sigma(t) = BM = \frac{\pi}{3}(t^3 + 3)$ см.



$\omega_e = 0.48$ рад/с,
 $R = 11$ см,
 $AB = 16$ см,
 $t_1 = 2$ с.

Задача 10.6. 6

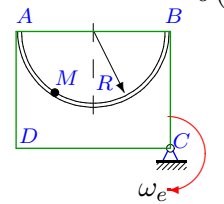
$\sigma(t) = BM = \frac{3\pi}{4}(t^2 + 52)$ см.



$\omega_e = 0.09$ рад/с,
 $R = 61$ см,
 $AB = 66$ см,
 $t_1 = 3$ с.

Задача 10.7. 6

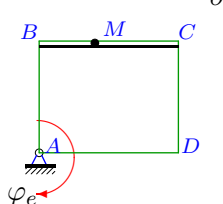
$\sigma(t) = AM = \frac{\pi}{4}(t^2 + 50)$ см.



$\omega_e = 0.02$ рад/с,
 $R = 51$ см,
 $AD = 53$ см,
 $t_1 = 1$ с.

Задача 10.8. 6

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

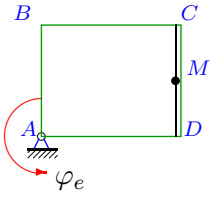


$\varphi_e = 0.18t^2$,
 $AB = 6$ см,
 $BC = 11$ см,
 $t_1 = 2$ с.

Задача 10.9.

6

$$\sigma(t) = DM = \frac{5}{6}(t^2 + 51) \text{ см.}$$

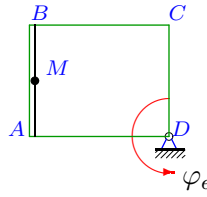


$$\begin{aligned} \varphi_e &= 0.01t^2, \\ AB &= 55 \text{ см,} \\ BC &= 57 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

Задача 10.10.

6

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

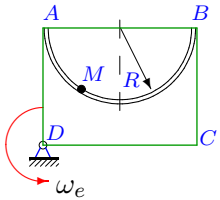


$$\begin{aligned} \varphi_e &= 0.11t^2, \\ AB &= 14 \text{ см,} \\ BC &= 16 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

Задача 10.11.

6

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

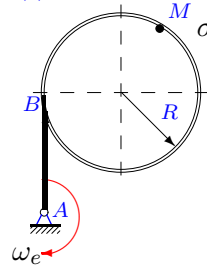


$$\begin{aligned} \omega_e &= 0.78 \text{ рад/с,} \\ R &= 3 \text{ см,} \\ AD &= 5 \text{ см,} \\ t_1 &= 1 \text{ с.} \end{aligned}$$

Задача 10.12.

6

$$\sigma(t) = BM = \frac{\pi}{4}(t^2 + 50) \text{ см.}$$

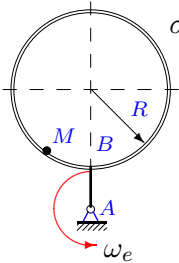


$$\begin{aligned} \omega_e &= 0.02 \text{ рад/с,} \\ R &= 51 \text{ см,} \\ AB &= 56 \text{ см,} \\ t_1 &= 1 \text{ с.} \end{aligned}$$

Задача 10.13.

6

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

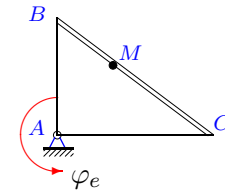


$$\begin{aligned} \omega_e &= 1.5 \text{ рад/с,} \\ R &= 3 \text{ см,} \\ AB &= 2 \text{ см,} \\ t_1 &= 1 \text{ с.} \end{aligned}$$

Задача 10.14.

6

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

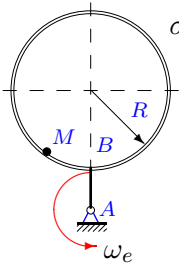


$$\begin{aligned} \varphi_e &= 0.15t^2, \\ AB &= 7 \text{ см,} \\ AC &= 13 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

Задача 10.15.

6

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

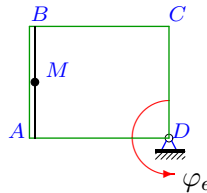


$$\begin{aligned} \omega_e &= 1.43 \text{ рад/с,} \\ R &= 27 \text{ см,} \\ AB &= 2 \text{ см,} \\ t_1 &= 3 \text{ с.} \end{aligned}$$

Задача 10.16.

6

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

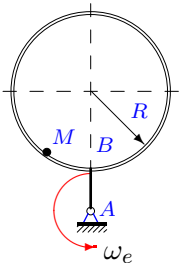


$$\begin{aligned} \varphi_e &= 0.25t^2, \\ AB &= 3 \text{ см,} \\ BC &= 5 \text{ см,} \\ t_1 &= 1 \text{ с.} \end{aligned}$$

Задача 10.17.

6

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

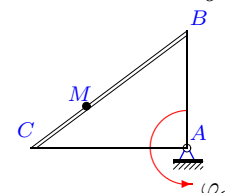


$$\begin{aligned} \omega_e &= 0.66 \text{ рад/с,} \\ R &= 3 \text{ см,} \\ AB &= 2 \text{ см,} \\ t_1 &= 1 \text{ с.} \end{aligned}$$

Задача 10.18.

6

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

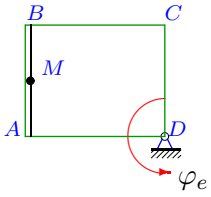


$$\begin{aligned} \varphi_e &= 0.08t^2, \\ AB &= 14 \text{ см,} \\ AC &= 24 \text{ см,} \\ t_1 &= 3 \text{ с.} \end{aligned}$$

Задача 10.19.

6

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

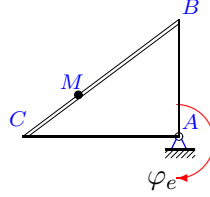


$$\begin{aligned} \varphi_e &= 0.11t^2, \\ AB &= 11 \text{ см,} \\ BC &= 13 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

Задача 10.20.

6

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

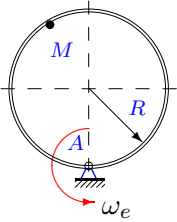


$$\begin{aligned} \varphi_e &= 0.15t^2, \\ AB &= 7 \text{ см,} \\ AC &= 13 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

Задача 10.21.

6

$$\sigma(t) = AM = \frac{\pi}{4}(t^2 + 51) \text{ см.}$$

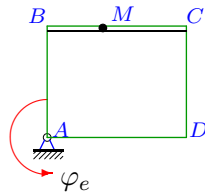


$$\begin{aligned} \omega_e &= 0.07 \text{ рад/с,} \\ R &= 55 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

Задача 10.22.

6

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

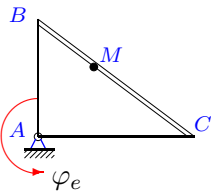


$$\begin{aligned} \varphi_e &= 0.21t^2, \\ AB &= 6 \text{ см,} \\ BC &= 11 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

Задача 10.23.

6

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

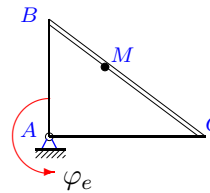


$$\begin{aligned} \varphi_e &= 0.14t^2, \\ AB &= 6 \text{ см,} \\ AC &= 11 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

Задача 10.24.

6

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

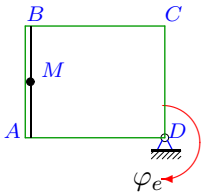


$$\begin{aligned} \varphi_e &= 0.05t^2, \\ AB &= 14 \text{ см,} \\ AC &= 24 \text{ см,} \\ t_1 &= 3 \text{ с.} \end{aligned}$$

Задача 10.25.

6

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

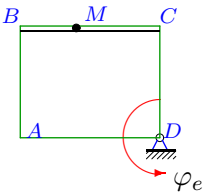


$$\begin{aligned} \varphi_e &= 0.37t^2, \\ AB &= 3 \text{ см,} \\ BC &= 5 \text{ см,} \\ t_1 &= 1 \text{ с.} \end{aligned}$$

Задача 10.26.

6

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

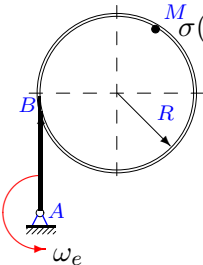


$$\begin{aligned} \varphi_e &= 0.02t^2, \\ AB &= 30 \text{ см,} \\ BC &= 61 \text{ см,} \\ t_1 &= 3 \text{ с.} \end{aligned}$$

Задача 10.27.

6

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

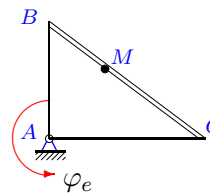


$$\begin{aligned} \omega_e &= 0.18 \text{ рад/с,} \\ R &= 51 \text{ см,} \\ AB &= 56 \text{ см,} \\ t_1 &= 1 \text{ с.} \end{aligned}$$

Задача 10.28.

6

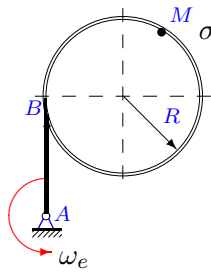
$$\sigma(t) = BM = \frac{1}{4}(t^2 + 4t) \text{ см.}$$



$$\begin{aligned} \varphi_e &= 0.09t^2, \\ AB &= 6 \text{ см,} \\ AC &= 11 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

Задача 10.29.

6

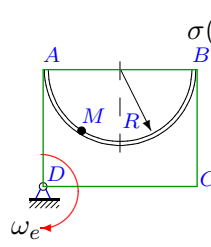


$$\sigma(t) = BM = \frac{3\pi}{4}(t^3 + 3) \text{ см.}$$

$$\begin{aligned} \omega_e &= 0.93 \text{ рад/с,} \\ R &= 11 \text{ см,} \\ AB &= 16 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

Задача 10.30.

6

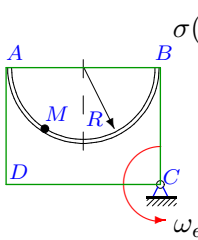


$$\sigma(t) = AM = \frac{2\pi}{3}(t^2 + 4t) \text{ см.}$$

$$\begin{aligned} \omega_e &= 0.91 \text{ рад/с,} \\ R &= 12 \text{ см,} \\ AD &= 14 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

Задача 10.31.

6

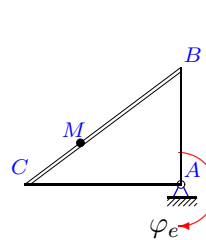


$$\sigma(t) = AM = \frac{2\pi}{3}(t^2 + 52) \text{ см.}$$

$$\begin{aligned} \omega_e &= 0.39 \text{ рад/с,} \\ R &= 61 \text{ см,} \\ AD &= 63 \text{ см,} \\ t_1 &= 3 \text{ с.} \end{aligned}$$

Задача 10.32.

6

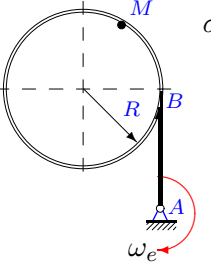


$$\sigma(t) = BM = \frac{1}{3}(t^3 + 2) \text{ см.}$$

$$\begin{aligned} \varphi_e &= 0.28t^2, \\ AB &= 2 \text{ см,} \\ AC &= 4 \text{ см,} \\ t_1 &= 1 \text{ с.} \end{aligned}$$

Задача 10.33.

6

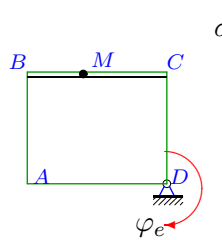


$$\sigma(t) = BM = \frac{\pi}{3}(t^2 + 4t) \text{ см.}$$

$$\begin{aligned} \omega_e &= 0.3 \text{ рад/с,} \\ R &= 12 \text{ см,} \\ AB &= 17 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

Задача 10.34.

6



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

$$\begin{aligned} \varphi_e &= 0.75t^2, \\ AB &= 2 \text{ см,} \\ BC &= 3 \text{ см,} \\ t_1 &= 1 \text{ с.} \end{aligned}$$

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	88.695	4.712	4.435	8.077	4.732	0.222	0.471	4.644
2	19.491	28.274	28.262	28.498	77.982	40.979	81.996	13.124
3	4.243	18.850	18.837	14.422	118.810	83.638	167.384	69.319
4	2.062	0.667	0.660	1.316	0.333	0.693	0.427	1.215
5	26.112	12.566	12.534	9.028	19.079	6.016	12.064	10.877
6	150.844	14.137	13.576	0.648	5.739	1.222	2.545	5.128
7	88.695	1.571	1.774	1.581	1.572	0.035	0.063	1.600
8	8.139	6.000	5.860	11.054	6.000	5.137	8.640	14.721
9	73.142	3.333	2.926	5.905	1.667	1.468	0.267	3.016
10	17.464	7.500	7.684	3.114	6.000	5.118	6.600	5.166
11	3.010	2.356	2.348	1.139	5.063	1.831	3.676	6.808
12	93.266	1.571	1.865	3.062	1.572	0.037	0.063	1.546
13	7.000	10.472	10.500	6.865	38.654	15.750	31.416	17.739
14	6.166	3.750	3.700	0.121	3.000	2.889	4.500	2.576
15	39.623	56.549	56.661	45.184	118.810	81.026	161.729	69.753
16	5.385	2.667	2.693	1.014	1.333	3.010	2.667	2.936
17	3.576	2.356	2.360	3.576	5.063	1.558	3.110	3.506
18	19.617	10.000	9.416	17.457	1.667	5.503	9.600	14.858
19	14.116	6.000	6.211	2.436	6.000	4.137	5.280	4.482
20	6.166	3.750	3.700	0.121	3.000	2.889	4.500	2.576
21	42.095	3.142	2.947	3.386	1.581	0.206	0.440	1.392
22	9.475	8.000	7.959	6.834	8.000	7.780	13.440	12.290
23	5.269	3.000	2.951	0.085	3.000	2.215	3.360	2.291
24	12.248	4.000	3.675	0.692	0.667	1.648	2.400	1.668
25	5.590	4.167	4.137	8.081	5.000	5.146	6.167	13.016
26	33.654	4.500	4.038	2.039	1.500	1.431	1.080	0.521
27	51.245	9.425	9.224	13.816	9.584	1.660	3.393	11.225
28	5.269	2.000	1.897	0.113	0.500	1.169	1.440	0.908
29	30.299	28.274	28.178	3.301	77.982	26.205	52.590	55.750
30	18.358	16.755	16.706	19.510	23.767	15.202	30.494	10.455
31	32.152	12.566	12.539	8.906	4.924	4.890	9.802	11.466
32	1.792	1.000	1.004	0.059	2.000	1.150	1.120	1.146
33	28.042	8.378	8.413	6.066	6.212	2.524	5.027	2.716
34	2.236	3.333	3.354	6.509	4.000	6.047	10.000	15.955

№	a_r^n	a_r^τ	a_e^n	a_e^τ	a_x	a_y
1	0.435	4.712	0.222	0.000	2.473	3.931
2	72.676	28.274	40.979	0.000	-12.898	2.424
3	118.435	9.425	83.638	0.000	-10.192	-68.566
4	0.000	0.333	0.211	-0.660	0.922	-0.791
5	14.356	12.566	6.016	0.000	-10.762	-1.583
6	3.276	4.712	1.222	0.000	1.971	-4.734
7	0.048	1.571	0.035	0.000	1.135	-1.128
8	0.000	6.000	4.219	-2.930	5.309	-13.730
9	0.000	1.667	0.117	1.463	-1.275	2.733
10	0.000	6.000	3.381	3.842	-5.042	1.125
11	1.851	4.712	1.831	0.000	6.705	-1.176
12	0.048	1.571	0.037	0.000	1.183	0.995
13	36.554	12.566	15.750	0.000	16.579	-6.311
14	0.000	3.000	2.220	1.850	2.063	1.542
15	118.435	9.425	81.026	0.000	-11.918	-68.727
16	0.000	1.333	1.346	2.693	-2.417	-1.667
17	1.851	4.712	1.558	0.000	-3.299	1.188
18	0.000	1.667	4.520	3.139	7.449	-12.855
19	0.000	6.000	2.733	3.105	-3.973	2.075
20	0.000	3.000	2.220	-1.850	-2.063	1.542
21	0.179	1.571	0.206	0.000	-1.104	0.848
22	0.000	8.000	6.686	3.980	0.306	12.286
23	0.000	3.000	1.652	1.475	2.174	0.721
24	0.000	0.667	1.102	1.225	0.139	1.663
25	0.000	5.000	3.061	-4.137	10.755	7.331
26	0.000	1.500	0.485	1.346	0.520	0.038
27	1.742	9.425	1.660	0.000	-11.077	-1.813
28	0.000	0.500	0.683	0.948	-0.034	0.907
29	72.676	28.274	26.205	0.000	-10.451	-54.762
30	23.395	4.189	15.202	0.000	-7.728	-7.042
31	2.589	4.189	4.890	0.000	2.071	11.278
32	0.000	2.000	0.562	-1.004	-1.140	0.121
33	5.849	2.094	2.524	0.000	-1.685	-2.130
34	0.000	4.000	5.031	-3.354	9.250	-13.000