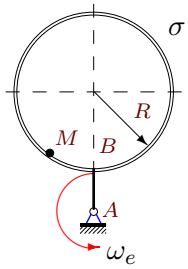
Сложное движение точки, плоская траектория

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

Задача 10.1

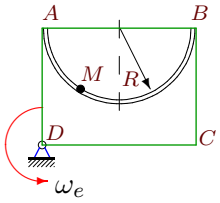
$\sigma(t) = BM = \dfrac{2\pi}{3}(t^2 + 50)$ см.



$\omega_e = 0.05$ рад/с,
$R = 51$ см,
$AB = 2$ см,
$t_1 = 1$ с.

Задача 10.2

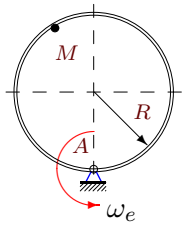
$\sigma(t) = AM = \dfrac{\pi}{4}(t^3 + 3)$ см.



$\omega_e = 1.54$ рад/с,
$R = 11$ см,
$AD = 13$ см,
$t_1 = 2$ с.

Задача 10.3

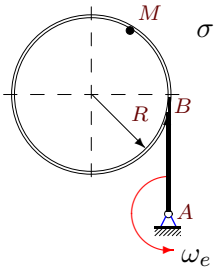
$\sigma(t) = AM = \dfrac{\pi}{3}(t^2 + 2t)$ см.



$\omega_e = 1.4$ рад/с,
$R = 3$ см,
$t_1 = 1$ с.

Задача 10.4

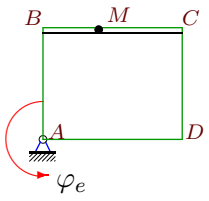
$\sigma(t) = BM = \dfrac{3\pi}{2}(t^2 + 4)t$ см.



$\omega_e = 3.72$ рад/с,
$R = 39$ см,
$AB = 44$ см,
$t_1 = 3$ с.

Задача 10.5

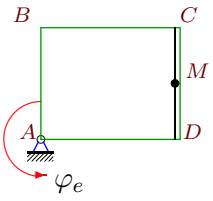
$\sigma(t) = BM = \dfrac{2}{3}(t^2 + 50)$ см.



$\varphi_e = 0.02t^2$,
$AB = 26$ см,
$BC = 51$ см,
$t_1 = 1$ с.

Задача 10.6

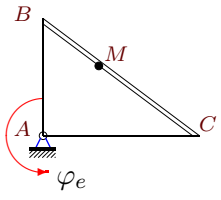
$\sigma(t) = DM = \dfrac{3}{4}(t^3 + 3)$ см.



$\varphi_e = 0.15t^2$,
$AB = 11$ см,
$BC = 13$ см,
$t_1 = 2$ с.

Задача 10.7

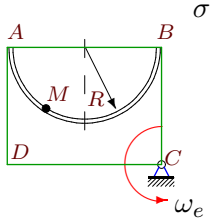
$\sigma(t) = BM = \dfrac{5}{6}(t^2 + 2t)$ см.



$\varphi_e = 0.69t^2$,
$AB = 2$ см,
$AC = 4$ см,
$t_1 = 1$ с.

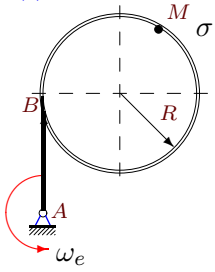
Задача 10.8

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



$\omega_e = 0.67$ рад/с,
$R = 3$ см,
$AD = 5$ см,
$t_1 = 1$ с.

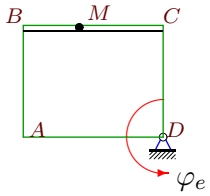
Задача 10.9



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

$\omega_e = 0.04$ рад/с,
$R = 55$ см,
$AB = 60$ см,
$t_1 = 2$ с.

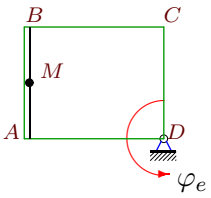
Задача 10.10



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

$\varphi_e = 0.1t^2$,
$AB = 16$ см,
$BC = 31$ см,
$t_1 = 3$ с.

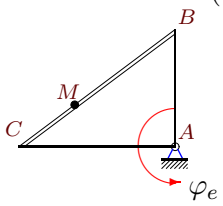
Задача 10.11



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

$\varphi_e = 0.04t^2$,
$AB = 27$ см,
$BC = 29$ см,
$t_1 = 3$ с.

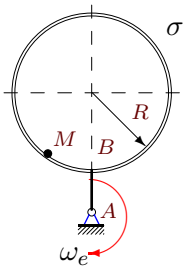
Задача 10.12



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

$\varphi_e = 0.15t^2$,
$AB = 20$ см,
$AC = 35$ см,
$t_1 = 3$ с.

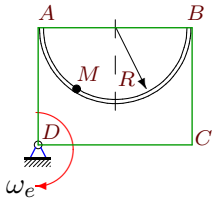
Задача 10.13



$\sigma(t) = BM = \dfrac{5\pi}{3}(t^2 + 50)$ см.

$\omega_e = 0.2$ рад/с,
$R = 51$ см,
$AB = 2$ см,
$t_1 = 1$ с.

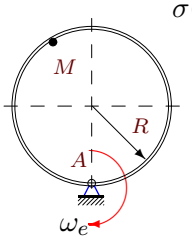
Задача 10.14



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

$\omega_e = 1.37$ рад/с,
$R = 31$ см,
$AD = 33$ см,
$t_1 = 3$ с.

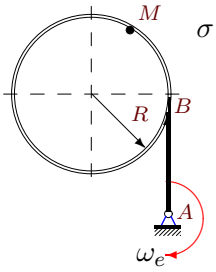
Задача 10.15



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

$\omega_e = 1.61$ рад/с,
$R = 12$ см,
$t_1 = 2$ с.

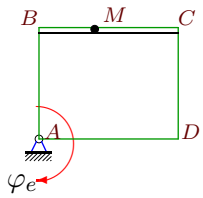
Задача 10.16



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

$\omega_e = 0.94$ рад/с,
$R = 14$ см,
$AB = 19$ см,
$t_1 = 2$ с.

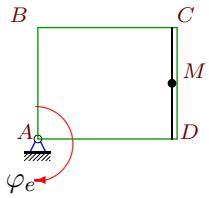
Задача 10.17



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

$\varphi_e = 0.02t^2$,
$AB = 26$ см,
$BC = 51$ см,
$t_1 = 1$ с.

Задача 10.18

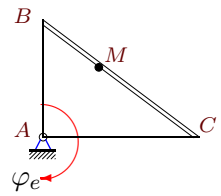


$\sigma(t) = DM = \dfrac{1}{2}(t^3 + 4)$ см.

$\varphi_e = 0.06t^2$,
$AB = 31$ см,
$BC = 33$ см,
$t_1 = 3$ с.

Задача 10.19

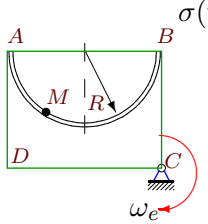
$\sigma(t) = BM = \dfrac{2}{3}(t^2 + 6t)$ см.



$\varphi_e = 0.08t^2$,
$AB = 14$ см,
$AC = 24$ см,
$t_1 = 3$ с.

Задача 10.20

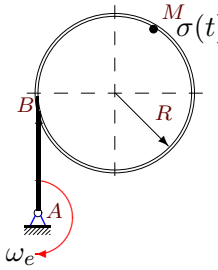
$\sigma(t) = AM = \dfrac{3\pi}{4}(t^2 + 4)t$ см.



$\omega_e = 4.14$ рад/с,
$R = 39$ см,
$AD = 41$ см,
$t_1 = 3$ с.

Задача 10.21

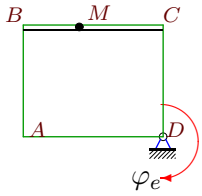
$\sigma(t) = BM = \dfrac{5\pi}{3}(t^2 + 52)$ см.



$\omega_e = 0.95$ рад/с,
$R = 61$ см,
$AB = 66$ см,
$t_1 = 3$ с.

Задача 10.22

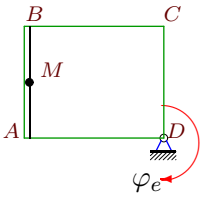
$\sigma(t) = BM = \dfrac{1}{6}(t^3 + 2)$ см.



$\varphi_e = 0.08t^2$,
$AB = 2$ см,
$BC = 3$ см,
$t_1 = 1$ с.

Задача 10.23

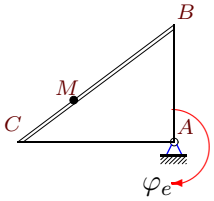
$\sigma(t) = AM = \dfrac{1}{4}(t^2 + 6t)$ см.



$\varphi_e = 0.02t^2$,
$AB = 27$ см,
$BC = 29$ см,
$t_1 = 3$ с.

Задача 10.24

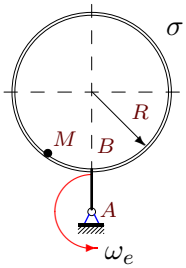
$\sigma(t) = BM = \dfrac{1}{3}(t^2 + 2)t$ см.



$\varphi_e = 0.47t^2$,
$AB = 2$ см,
$AC = 4$ см,
$t_1 = 1$ с.

Задача 10.25

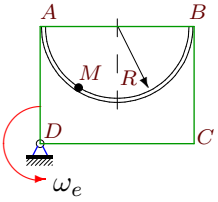
$\sigma(t) = BM = \dfrac{3\pi}{2}(t^2 + 51)$ см.



$\omega_e = 0.24$ рад/с,
$R = 55$ см,
$AB = 2$ см,
$t_1 = 2$ с.

Задача 10.26

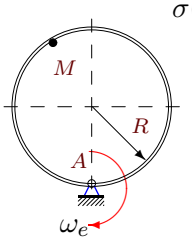
$\sigma(t) = AM = \dfrac{2\pi}{3}(t^3 + 4)$ см.



$\omega_e = 1.21$ рад/с,
$R = 31$ см,
$AD = 33$ см,
$t_1 = 3$ с.

Задача 10.27

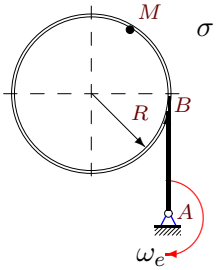
$\sigma(t) = AM = \dfrac{3\pi}{4}(t^2 + 4t)$ см.



$\omega_e = 0.85$ рад/с,
$R = 12$ см,
$t_1 = 2$ с.

Задача 10.28

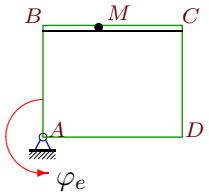
$\sigma(t) = BM = \dfrac{5\pi}{3}(t^2 + 2)t$ см.



$\omega_e = 4.67$ рад/с,
$R = 3$ см,
$AB = 8$ см,
$t_1 = 1$ с.

Задача 10.29

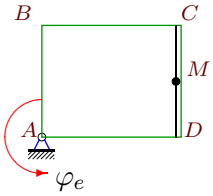
$$\sigma(t) = BM = \frac{1}{6}(t^2 + 50) \text{ см.}$$



$\varphi_e = 0.01t^2$,
$AB = 26$ см,
$BC = 51$ см,
$t_1 = 1$ с.

Задача 10.30

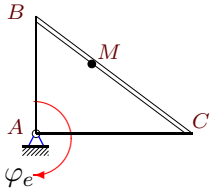
$$\sigma(t) = DM = \frac{1}{4}(t^3 + 2) \text{ см.}$$



$\varphi_e = 0.07t^2$,
$AB = 3$ см,
$BC = 5$ см,
$t_1 = 1$ с.

Задача 10.31

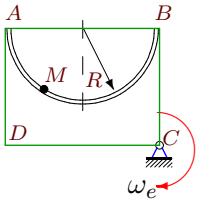
$$\sigma(t) = BM = \frac{1}{6}(t^2 + 4t) \text{ см.}$$



$\varphi_e = 0.06t^2$,
$AB = 6$ см,
$AC = 11$ см,
$t_1 = 2$ с.

Задача 10.32

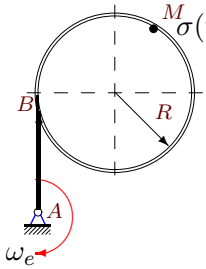
$$\sigma(t) = AM = \frac{\pi}{4}(t^2 + 2)t \text{ см.}$$



$\omega_e = 0.67$ рад/с,
$R = 3$ см,
$AD = 5$ см,
$t_1 = 1$ с.

Задача 10.33

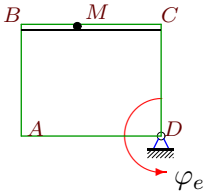
$$\sigma(t) = BM = \frac{2\pi}{3}(t^2 + 50) \text{ см.}$$



$\omega_e = 0.03$ рад/с,
$R = 51$ см,
$AB = 56$ см,
$t_1 = 1$ с.

Задача 10.34

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



$\varphi_e = 0.05t^2$,
$AB = 6$ см,
$BC = 11$ см,
$t_1 = 2$ с.

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/c^2			
1	90.072	4.189	4.504	2.316	4.203	0.225	0.419	4.076
2	6.136	9.425	9.449	2.190	12.411	14.552	29.028	26.262
3	3.000	4.189	4.200	4.194	6.212	5.880	11.729	4.199
4	39.319	146.084	146.267	193.133	553.729	544.115	1086.865	1684.884
5	42.802	1.333	1.712	1.391	1.333	1.713	0.107	1.445
6	15.397	9.000	9.238	17.514	9.000	7.215	10.800	20.518
7	2.404	3.333	3.317	2.378	1.667	5.653	9.200	8.890
8	5.875	3.927	3.936	6.266	6.974	2.637	5.262	13.271
9	111.089	4.189	4.444	3.265	2.119	0.178	0.335	1.973
10	22.277	13.500	13.366	10.085	9.000	9.174	16.200	13.542
11	34.132	8.000	8.192	4.443	1.333	3.365	3.840	4.138
12	25.982	23.250	23.384	42.592	13.500	22.443	41.850	61.789
13	52.029	10.472	10.406	17.904	10.690	2.081	4.189	14.320
14	31.064	42.412	42.558	61.987	64.546	58.305	116.208	68.781
15	20.785	33.510	33.463	64.691	93.953	53.876	107.903	250.640
16	37.502	35.343	35.251	3.333	93.596	33.136	66.445	63.999
17	49.822	1.667	1.993	3.196	1.667	1.994	0.133	3.237
18	36.459	13.500	13.125	5.810	9.000	6.440	9.720	7.907
19	16.311	8.000	7.829	14.771	1.333	4.575	7.680	12.240
20	17.625	73.042	72.969	145.893	143.222	302.092	604.788	769.322
21	33.223	31.416	31.562	19.797	19.273	29.984	59.690	59.068
22	3.202	0.500	0.512	0.912	1.000	0.519	0.160	1.397
23	29.775	3.000	3.573	6.530	0.500	1.266	0.720	2.103
24	1.792	1.667	1.684	0.100	2.000	2.312	3.133	1.667
25	79.209	18.850	19.010	14.801	11.426	4.562	9.048	12.721
26	46.905	56.549	56.755	94.188	109.826	68.674	136.848	267.483
27	22.173	18.850	18.847	36.972	29.981	16.020	32.044	76.467
28	5.606	26.180	26.181	51.944	230.613	122.268	244.521	134.443
29	27.354	0.333	0.547	0.252	0.333	0.547	0.013	0.257
30	5.056	0.750	0.708	1.454	1.500	0.715	0.210	2.224
31	5.339	1.333	1.281	2.606	0.333	0.711	0.640	1.317
32	5.875	3.927	3.936	4.751	6.974	2.637	5.262	7.276
33	126.039	4.189	3.781	7.954	4.203	0.113	0.251	4.234
34	10.956	2.000	2.191	2.000	2.000	1.180	0.800	1.802

№	a_r^n	a_r^τ	a_e^n	a_e^τ	a_x	a_y
1	0.344	4.189	0.225	0.000	2.140	3.469
2	8.075	9.425	14.552	0.000	25.260	7.188
3	5.849	2.094	5.880	0.000	-1.047	-4.066
4	547.194	84.823	544.115	0.000	624.521	1564.867
5	0.000	1.333	0.068	1.712	0.239	1.425
6	0.000	9.000	5.543	4.619	-17.955	9.930
7	0.000	1.667	4.578	3.317	0.130	8.890
8	5.140	4.712	2.637	0.000	12.987	2.731
9	0.319	2.094	0.178	0.000	1.762	0.889
10	0.000	9.000	8.020	4.455	11.380	7.340
11	0.000	1.333	1.966	2.731	-3.610	-2.023
12	0.000	13.500	21.046	7.795	27.967	-55.098
13	2.150	10.472	2.081	0.000	-12.492	-6.999
14	58.024	28.274	58.305	0.000	-29.910	-61.938
15	93.578	8.378	53.876	0.000	-197.237	-154.654
16	89.223	28.274	33.136	0.000	17.231	-61.635
17	0.000	1.667	0.080	-1.993	2.639	-1.875
18	0.000	9.000	4.725	-4.375	7.303	3.031
19	0.000	1.333	3.758	-2.610	-5.511	-10.929
20	136.798	42.412	302.092	0.000	556.691	-530.991
21	16.180	10.472	29.984	0.000	1.340	59.053
22	0.000	1.000	0.082	-0.512	1.384	0.189
23	0.000	0.500	0.429	-1.191	1.408	1.563
24	0.000	2.000	1.583	-1.684	-0.940	1.377
25	6.460	9.425	4.562	0.000	-0.580	-12.708
26	103.153	37.699	68.674	0.000	-155.433	217.688
27	29.609	4.712	16.020	0.000	53.058	-55.064
28	228.463	31.416	122.268	0.000	67.949	-116.008
29	0.000	0.333	0.011	0.547	-0.190	0.173
30	0.000	1.500	0.099	0.708	-0.413	2.185
31	0.000	0.333	0.308	-0.641	0.490	-1.223
32	5.140	4.712	2.637	0.000	5.545	-4.710
33	0.344	4.189	0.113	0.000	3.261	-2.700
34	0.000	2.000	0.438	1.096	1.767	-0.357