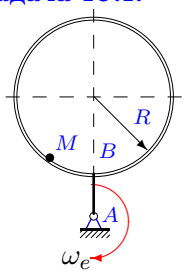
Сложное движение точки, плоская траектория

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.)

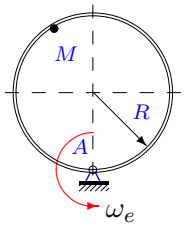
Задача 10.1. 8



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

$\omega_e = 0.72$ рад/с,
$R = 3$ см,
$AB = 2$ см,
$t_1 = 1$ с.

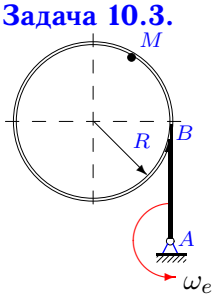
Задача 10.2. 8



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

$\omega_e = 0.89$ рад/с,
$R = 31$ см,
$t_1 = 3$ с.

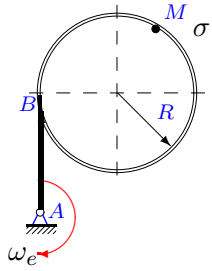
Задача 10.3. 8



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

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

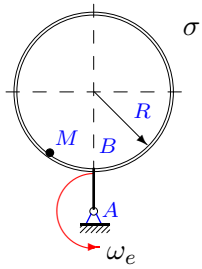
Задача 10.4. 8



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

$\omega_e = 0.62$ рад/с,
$R = 3$ см,
$AB = 8$ см,
$t_1 = 1$ с.

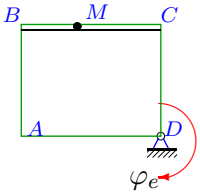
Задача 10.5. 8



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

$\omega_e = 2.04$ рад/с,
$R = 31$ см,
$AB = 2$ см,
$t_1 = 3$ с.

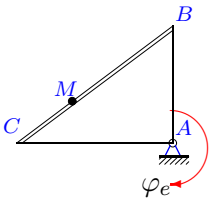
Задача 10.6. 8



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

$\varphi_e = 0.08t^2$,
$AB = 14$ см,
$BC = 27$ см,
$t_1 = 3$ с.

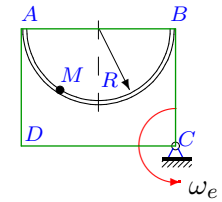
Задача 10.7. 8



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

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

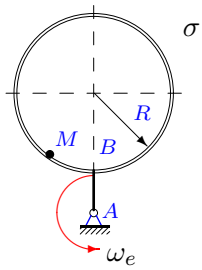
Задача 10.8. 8



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

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

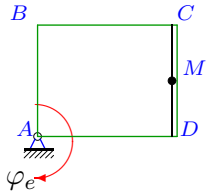
Задача 10.9. 8



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

$\omega_e = 2.04$ рад/с,
$R = 31$ см,
$AB = 2$ см,
$t_1 = 3$ с.

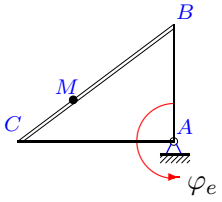
Задача 10.10. 8



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

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

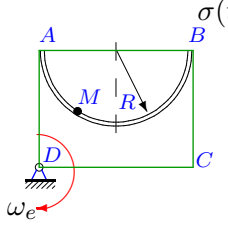
Задача 10.11. 8



$\sigma(t) = BM = \dfrac{5}{6}(t^3 + 3)$ см.

$\varphi_e = 0.3t^2$,
$AB = 6$ см,
$AC = 11$ см,
$t_1 = 2$ с.

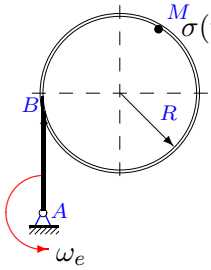
Задача 10.12. 8



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

$\omega_e = 1.48$ рад/с,
$R = 3$ см,
$AD = 5$ см,
$t_1 = 1$ с.

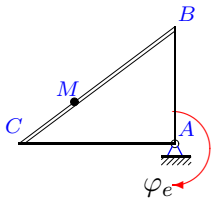
Задача 10.13. 8



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

$\omega_e = 0.08$ рад/с,
$R = 61$ см,
$AB = 66$ см,
$t_1 = 3$ с.

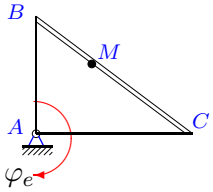
Задача 10.14. 8



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

$\varphi_e = 0.29t^2$,
$AB = 6$ см,
$AC = 11$ см,
$t_1 = 2$ с.

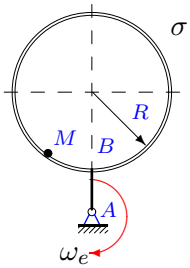
Задача 10.15. 8



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

$\varphi_e = 0.08t^2$,
$AB = 16$ см,
$AC = 28$ см,
$t_1 = 3$ с.

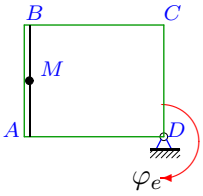
Задача 10.16. 8



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

$\omega_e = 3.32$ рад/с,
$R = 14$ см,
$AB = 2$ см,
$t_1 = 2$ с.

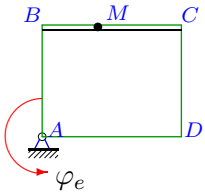
Задача 10.17. 8



$\sigma(t) = AM = \dfrac{1}{6}(t^3 + 4)$ см.

$\varphi_e = 0.02t^2$,
$AB = 31$ см,
$BC = 33$ см,
$t_1 = 3$ с.

Задача 10.18. 8

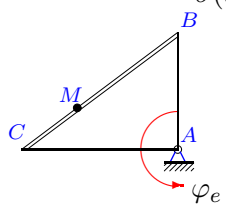


$\sigma(t) = BM = \dfrac{1}{6}(t^2 + 51)$ см.

$\varphi_e = 0.01t^2$,
$AB = 28$ см,
$BC = 55$ см,
$t_1 = 2$ с.

Задача 10.19. 8

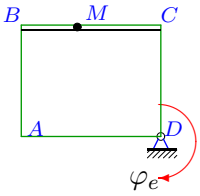
$\sigma(t) = BM = \dfrac{1}{4}(t^2+3)t$ см.



$\varphi_e = 0.15t^2$,
$AB = 7$ см,
$AC = 13$ см,
$t_1 = 2$ с.

Задача 10.20. 8

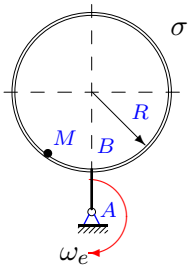
$\sigma(t) = BM = \dfrac{3}{4}(t^2+52)$ см.



$\varphi_e = 0.02t^2$,
$AB = 30$ см,
$BC = 61$ см,
$t_1 = 3$ с.

Задача 10.21. 8

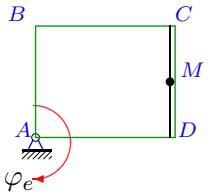
$\sigma(t) = BM = \dfrac{4\pi}{3}(t^2+3)t$ см.



$\omega_e = 2.42$ рад/с,
$R = 14$ см,
$AB = 2$ см,
$t_1 = 2$ с.

Задача 10.22. 8

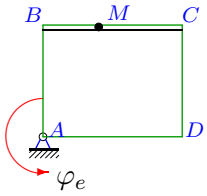
$\sigma(t) = DM = \dfrac{1}{4}(t^3+4)$ см.



$\varphi_e = 0.03t^2$,
$AB = 31$ см,
$BC = 33$ см,
$t_1 = 3$ с.

Задача 10.23. 8

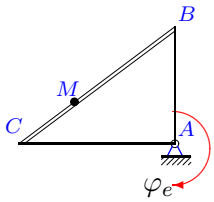
$\sigma(t) = BM = \dfrac{1}{2}(t^2+50)$ см.



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

Задача 10.24. 8

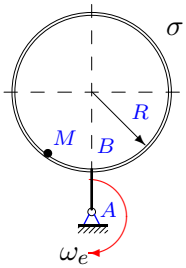
$\sigma(t) = BM = \dfrac{1}{4}(t^3+2)$ см.



$\varphi_e = 0.21t^2$,
$AB = 2$ см,
$AC = 4$ см,
$t_1 = 1$ с.

Задача 10.25. 8

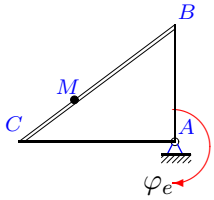
$\sigma(t) = BM = \dfrac{3\pi}{2}(t^2+51)$ см.



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

Задача 10.26. 8

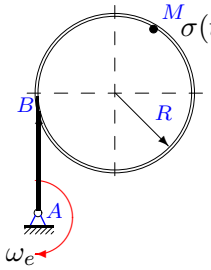
$\sigma(t) = BM = \dfrac{5}{6}(t^3+4)$ см.



$\varphi_e = 0.17t^2$,
$AB = 16$ см,
$AC = 28$ см,
$t_1 = 3$ с.

Задача 10.27. 8

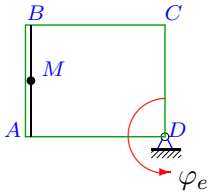
$\sigma(t) = BM = \dfrac{3\pi}{4}(t^2+2)t$ см.



$\omega_e = 1.04$ рад/с,
$R = 3$ см,
$AB = 8$ см,
$t_1 = 1$ с.

Задача 10.28. 8

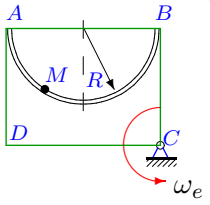
$\sigma(t) = AM = \dfrac{1}{2}(t^2+50)$ см.



$\varphi_e = 0.01t^2$,
$AB = 51$ см,
$BC = 53$ см,
$t_1 = 1$ с.

Задача 10.29. 8

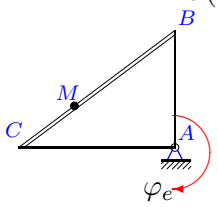
$\sigma(t) = AM = \dfrac{\pi}{4}(t^2 + 50)$ см.



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

Задача 10.30. 8

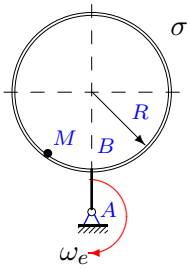
$\sigma(t) = BM = \dfrac{1}{4}(t^2 + 51)$ см.



$\varphi_e = 0.01t^2$,
$AB = 28$ см,
$AC = 49$ см,
$t_1 = 2$ с.

Задача 10.31. 8

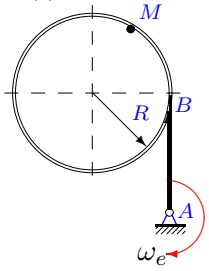
$\sigma(t) = BM = \dfrac{3\pi}{4}(t^2 + 2t)$ см.



$\omega_e = 1.27$ рад/с,
$R = 3$ см,
$AB = 2$ см,
$t_1 = 1$ с.

Задача 10.32. 8

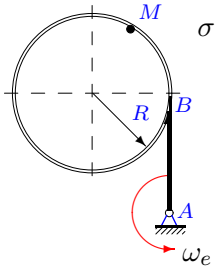
$\sigma(t) = BM = \dfrac{\pi}{4}(t^3 + 4)$ см.



$\omega_e = 0.36$ рад/с,
$R = 31$ см,
$AB = 36$ см,
$t_1 = 3$ с.

Задача 10.33. 8

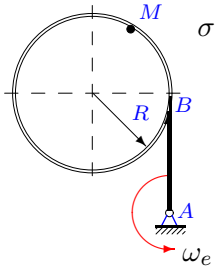
$\sigma(t) = BM = \dfrac{3\pi}{2}(t^2 + 2)t$ см.



$\omega_e = 4.04$ рад/с,
$R = 3$ см,
$AB = 8$ см,
$t_1 = 1$ с.

Задача 10.34. 8

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



$\omega_e = 1.04$ рад/с,
$R = 3$ см,
$AB = 8$ см,
$t_1 = 1$ с.

10.8

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	4.359	3.142	3.138	4.688	7.092	2.260	4.524	9.027
2	23.726	21.206	21.116	23.513	20.255	18.794	37.746	16.369
3	26.112	12.566	12.534	23.421	19.079	6.016	12.064	32.035
4	11.343	7.069	7.033	13.925	21.846	4.360	8.765	33.378
5	55.435	113.097	113.087	60.509	419.445	230.697	461.437	244.789
6	16.643	8.000	7.989	15.341	1.333	4.669	7.680	11.022
7	17.899	9.000	8.591	7.094	1.500	5.021	8.640	8.690
8	31.064	42.412	42.558	58.117	64.546	58.305	116.208	191.148
9	55.435	113.097	113.087	60.509	419.445	230.697	461.437	244.789
10	73.142	3.333	2.926	2.114	1.667	1.468	0.267	1.182
11	8.207	10.000	9.848	17.984	10.000	12.803	24.000	35.598
12	2.832	4.189	4.191	8.379	6.212	6.203	12.399	12.887
13	149.974	12.566	11.998	1.723	4.924	0.960	2.011	4.340
14	6.902	8.000	8.006	5.508	8.000	10.113	18.560	14.099
15	13.893	6.750	6.669	13.418	4.500	3.897	6.480	11.786
16	21.260	70.686	70.584	128.645	361.344	234.339	469.354	1007.841
17	33.402	4.500	4.008	8.483	3.000	1.420	1.080	4.597
18	29.462	0.667	1.178	0.583	0.333	0.591	0.053	0.308
19	6.166	3.750	3.700	7.449	3.000	2.889	4.500	8.292
20	33.654	4.500	4.038	8.304	1.500	1.431	1.080	3.056
21	26.000	62.832	62.920	120.818	286.434	152.266	304.106	726.913
22	33.898	6.750	6.102	1.613	4.500	2.311	2.430	2.912
23	36.418	1.000	0.728	0.700	1.000	0.728	0.040	0.715
24	1.795	0.750	0.754	0.061	1.500	0.818	0.630	0.815
25	79.209	18.850	19.010	34.847	11.426	4.562	9.048	22.589
26	22.654	22.500	23.107	20.064	15.000	24.796	45.900	38.447
27	11.343	11.781	11.797	23.282	48.376	12.269	24.504	84.360
28	58.815	1.000	1.176	0.514	1.000	1.177	0.040	0.533
29	88.695	1.571	1.774	2.955	1.572	0.035	0.063	1.606
30	24.311	1.000	0.972	0.028	0.500	0.488	0.080	0.041
31	7.431	9.425	9.437	18.285	29.981	11.985	23.939	64.097
32	58.628	21.206	21.106	19.179	20.255	7.598	15.268	8.817
33	5.831	23.562	23.557	12.578	187.203	95.170	190.381	303.810
34	11.343	11.781	11.797	23.282	48.376	12.269	24.504	84.360

№	a_r^n	a_r^τ	a_e^n	a_e^τ	a_x	a_y
1	3.290	6.283	2.260	0.000	4.972	7.534
2	14.506	14.137	18.794	0.000	-9.067	-13.629
3	14.356	12.566	6.016	0.000	-22.825	-22.478
4	16.655	14.137	4.360	0.000	-9.947	-31.862
5	412.613	75.398	230.697	0.000	-31.744	-242.722
6	0.000	1.333	3.835	-2.663	5.647	-9.466
7	0.000	1.500	4.124	-2.864	-1.012	8.631
8	58.024	28.274	58.305	0.000	86.458	170.477
9	412.613	75.398	230.697	0.000	-31.744	-242.722
10	0.000	1.667	0.117	-1.463	1.092	0.453
11	0.000	10.000	11.818	4.924	13.335	-33.006
12	5.849	2.094	6.203	0.000	-4.747	-11.981
13	2.589	4.189	0.960	0.000	2.753	-3.356
14	0.000	8.000	9.287	-4.003	-5.805	12.848
15	0.000	4.500	3.201	-2.223	1.087	-11.736
16	356.892	56.549	234.339	0.000	-980.559	-232.907
17	0.000	3.000	0.481	-1.336	1.762	4.246
18	0.000	0.333	0.047	0.589	-0.241	0.192
19	0.000	3.000	2.220	1.850	-1.001	-8.232
20	0.000	1.500	0.485	-1.346	2.920	-0.902
21	281.989	50.265	152.266	0.000	-553.445	-471.276
22	0.000	4.500	1.098	-2.034	1.826	2.269
23	0.000	1.000	0.015	0.728	0.470	0.540
24	0.000	1.500	0.317	-0.754	-0.806	-0.119
25	6.460	9.425	4.562	0.000	-18.676	-12.708
26	0.000	15.000	23.570	-7.702	-11.378	36.725
27	46.264	14.137	12.269	0.000	-45.583	-70.984
28	0.000	1.000	0.024	1.176	-0.529	-0.070
29	0.048	1.571	0.035	0.000	1.224	-1.039
30	0.000	0.500	0.039	-0.486	-0.031	0.026
31	29.609	4.712	11.985	0.000	44.618	-46.018
32	14.506	14.137	7.598	0.000	-8.281	3.029
33	185.055	28.274	95.170	0.000	77.239	293.828
34	46.264	14.137	12.269	0.000	45.583	-70.984