

Декартовы координаты. Плоская траектория

Точка движется по закону $x = x(t), y = y(t)$. Для момента времени $t = t_1$ найти скорость, ускорение точки и радиус кривизны траектории (x и y даны в сантиметрах, t_1 — в секундах).

Кирсанов М.Н. **Решebник. Теоретическая механика**/Под ред. А. И. Кириллова.— М.: ФИЗМАТЛИТ, 2008. — 384 с. (с.131.)

Задача K1.1.

$$\begin{aligned}x &= 5 \sin(4t), \\y &= 9 \cos(4t) + 6, \\t_1 &= \pi/24.\end{aligned}$$

Задача K1.2.

$$\begin{aligned}x &= 10e^{t/10}, \\y &= 10e^{t/10}(0.1e^{t/5} - 1), \\t_1 &= 8.\end{aligned}$$

Задача K1.3.

$$\begin{aligned}x &= 4t^2, \\y &= 5\sqrt{1-t^4}, \\t_1 &= 0.81.\end{aligned}$$

Задача K1.4.

$$\begin{aligned}x &= 9t^3, \\y &= 10\sqrt{1-t^6}, \\t_1 &= 0.89.\end{aligned}$$

Задача K1.5.

$$\begin{aligned}x &= \frac{1}{7} \left(\frac{44}{\sin(5t)+2} + 1 \right), \\y &= 7 \sin(5t), \\t_1 &= \pi/6.\end{aligned}$$

Задача K1.6.

$$\begin{aligned}x &= 2t^2/(1+t^2), \\y &= 2t^3/(1+t^2), \\t_1 &= 10.\end{aligned}$$

Задача K1.7.

$$\begin{aligned}x &= 18t/(1+t^3), \\y &= 18t^2/(1+t^3), \\t_1 &= 0.7.\end{aligned}$$

Задача K1.8.

$$\begin{aligned}x &= \cos(5t)(11 + 10 \cos(5t)), \\y &= \sin(5t)(11 + 10 \cos(5t)), \\t_1 &= \pi/3.\end{aligned}$$

Задача K1.9.

$$\begin{aligned}x &= \cos(5t)(8 + 7 \cos(5t)), \\y &= \sin(5t)(8 + 7 \cos(5t)), \\t_1 &= 4\pi/15.\end{aligned}$$

Задача K1.10.

$$\begin{aligned}x &= 5 + 3 \cos(t), \\y &= 5 \operatorname{tg}(t) + 3 \sin t, \\t_1 &= \pi/3.\end{aligned}$$

Задача K1.11.

$$\begin{aligned}x &= 5e^{2t} + 6, \\y &= e^{4t}/2, \\t_1 &= 0.2.\end{aligned}$$

Задача K1.12.

$$\begin{aligned}x &= 6 \cos(14t), \\y &= 6 \sin^2(7t), \\t_1 &= 5\pi/36.\end{aligned}$$

Задача K1.13.

$$\begin{aligned}x &= 10 \cos(12t), \\y &= 6 \sin^2(6t), \\t_1 &= 13\pi/60.\end{aligned}$$

Задача K1.14.

$$\begin{aligned}x &= 5e^{-2t}, \\y &= 15\sqrt{1-e^{-4t}}, \\t_1 &= 0.03.\end{aligned}$$

Задача K1.15.

$$\begin{aligned}x &= t, \\y &= 16(e^{t/32} + e^{-t/32}), \\t_1 &= 6.\end{aligned}$$

Задача K1.16.

$$\begin{aligned}x &= 2 \cos^3(5t), \\y &= 2 \sin^3(5t), \\t_1 &= 13\pi/30.\end{aligned}$$

Задача K1.17.

$$\begin{aligned}x &= 2(5t - \sin(5t)), \\y &= 2(1 - \cos(5t)), \\t_1 &= \pi/15.\end{aligned}$$

Задача K1.18.

$$\begin{aligned}x &= t, \\y &= 18(e^{t/36} + e^{-t/36}), \\t_1 &= 6.\end{aligned}$$

Задача K1.19.

$$\begin{aligned}x &= \frac{8(t^2-1)}{1+t^2}, \\y &= \frac{8(t^2-1)t}{1+t^2}, \\t_1 &= 9.\end{aligned}$$

Задача K1.20.

$$\begin{aligned}x &= \frac{1}{2}(150/(t^4+1) + 1), \\y &= t^4, \\t_1 &= 1.5.\end{aligned}$$

Задача K1.21.

$$\begin{aligned}x &= \cos(5t)(3 + 2 \cos(5t)), \\y &= \sin(5t)(3 + 2 \cos(5t)), \\t_1 &= \pi/3.\end{aligned}$$

Задача K1.22. 8
 $x = 10e^{t/10},$
 $y = 10e^{t/10}(0.1e^{t/5} - 1),$
 $t_1 = 11.$

Задача K1.23. 8
 $x = 5t^2/(1 + t^2),$
 $y = 5t^3/(1 + t^2),$
 $t_1 = 8.$

Задача K1.24. 8
 $x = 5e^{-2t},$
 $y = 15\sqrt{1 - e^{-4t}},$
 $t_1 = 0.07.$

Задача K1.25. 8
 $x = 2\cos^3(3t),$
 $y = 2\sin^3(3t),$
 $t_1 = 4\pi/9.$

Задача K1.26. 8
 $x = \cos(5t)(5 + 4\cos(5t)),$
 $y = \sin(5t)(5 + 4\cos(5t)),$
 $t_1 = 11\pi/30.$

Задача K1.27. 8
 $x = \frac{7(t^2-1)}{1+t^2},$
 $y = \frac{7(t^2-1)t}{1+t^2},$
 $t_1 = 10.$

K1 Ответы.
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	v_x	v_y	v	a_x	a_y	a	a_τ	a_n	R
№	см/с			см/с ²					см
1	17.32	-18.00	24.98	-40.00	-124.71	130.97	62.13	115.29	5.41
2	2.23	1.08	2.47	0.22	0.77	0.80	0.54	0.59	10.29
3	6.48	-7.04	9.57	8.00	-39.22	40.03	34.28	20.67	4.43
4	21.39	-23.62	31.86	48.06	-211.36	216.75	188.93	106.24	9.56
5	4.35	-30.31	30.62	27.66	-87.50	91.77	90.54	14.93	62.80
6	0.00	2.02	2.02	-0.00	-0.00	0.00	-0.00	0.00	3535.32
7	3.13	11.58	11.99	-36.20	-19.07	40.92	-27.87	29.96	4.80
8	90.93	2.50	90.97	112.50	671.17	680.53	130.90	667.82	12.39
9	4.33	-37.50	37.75	275.00	-129.90	304.14	160.59	258.28	5.52
10	-2.60	21.50	21.66	-1.50	66.68	66.70	66.38	6.51	72.03
11	14.92	4.45	15.57	29.84	17.80	34.74	33.68	8.53	28.41
12	14.59	-7.29	16.31	-1158.13	579.07	1294.83	-1294.83	0.00	∞
13	-114.13	34.24	119.15	444.98	-133.50	464.58	-464.58	0.00	∞
14	-9.42	79.13	79.68	18.84	-1557.71	1557.82	-1549.02	165.40	38.39
15	1.00	0.19	1.02	0.00	0.03	0.03	0.01	0.03	33.14
16	-11.25	6.50	12.99	-32.48	93.75	99.22	75.00	64.95	2.60
17	5.00	8.66	10.00	43.30	25.00	50.00	43.30	25.00	4.00
18	1.00	0.17	1.01	0.00	0.03	0.03	0.00	0.03	37.01
19	0.04	8.19	8.19	-0.01	-0.04	0.04	-0.04	0.01	4849.97
20	-27.55	13.50	30.68	67.59	27.00	72.79	-48.81	53.99	17.43
21	21.65	2.50	21.79	12.50	151.55	152.07	29.80	149.12	3.19
22	3.00	5.13	5.94	0.30	2.14	2.16	2.00	0.82	42.99
23	0.02	5.07	5.07	-0.01	-0.02	0.02	-0.02	0.01	3738.28
24	-8.69	45.88	46.70	17.39	-467.50	467.82	-462.57	69.95	31.17
25	3.90	-6.75	7.79	-33.75	11.69	35.72	-27.00	23.38	2.60
26	29.82	31.65	43.49	-208.25	235.71	314.53	28.74	313.21	6.04
27	0.03	7.14	7.14	-0.01	-0.03	0.03	-0.03	0.01	6345.88