

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

Задача K1.1.

6

$$\begin{aligned}x &= 5(5t - \sin(5t)), \\y &= 5(1 - \cos(5t)), \\t_1 &= \pi/30.\end{aligned}$$

Задача K1.2.

6

$$\begin{aligned}x &= 7e^{-4t}, \\y &= 21\sqrt{1 - e^{-8t}}, \\t_1 &= 0.09.\end{aligned}$$

Задача K1.3.

6

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

Задача K1.4.

6

$$\begin{aligned}x &= \cos(2t)(10 + 9\cos(2t)), \\y &= \sin(2t)(10 + 9\cos(2t)), \\t_1 &= 2\pi/3.\end{aligned}$$

Задача K1.5.

6

$$\begin{aligned}x &= \frac{1}{7} \left(\frac{44}{\sin(3t)+2} + 1 \right), \\y &= 7\sin(3t), \\t_1 &= 5\pi/18.\end{aligned}$$

Задача K1.6.

6

$$\begin{aligned}x &= 200/(t+5), \\y &= (t-300)/(t+5)^2, \\t_1 &= 1.\end{aligned}$$

Задача K1.7.

6

$$\begin{aligned}x &= 9\sin(4t), \\y &= 17\cos(4t) + 10, \\t_1 &= 5\pi/12.\end{aligned}$$

Задача K1.8.

6

$$\begin{aligned}x &= \frac{1}{8}(990/(t^3+1) + 1), \\y &= t^3, \\t_1 &= 1.9.\end{aligned}$$

Задача K1.9.

6

$$\begin{aligned}x &= 8\sin(4t), \\y &= \frac{8}{1+\sin^2(4t)}, \\t_1 &= 11\pi/24.\end{aligned}$$

Задача K1.10.

6

$$\begin{aligned}x &= 15e^{t/15}, \\y &= 15e^{t/15}(0.1e^{2t/15} - 1), \\t_1 &= 9.\end{aligned}$$

Задача K1.11.

6

$$\begin{aligned}x &= 8\cos^3(5t), \\y &= 8\sin^3(5t), \\t_1 &= 2\pi/15.\end{aligned}$$

Задача K1.12.

6

$$\begin{aligned}x &= t, \\y &= 14(e^{t/28} + e^{-t/28}), \\t_1 &= 6.\end{aligned}$$

Задача K1.13.

6

$$\begin{aligned}x &= 4(3t - \sin(3t)), \\y &= 4(1 - \cos(3t)), \\t_1 &= 13\pi/18.\end{aligned}$$

Задача K1.14.

6

$$\begin{aligned}x &= \frac{4(t^2-1)}{1+t^2}, \\y &= \frac{4(t^2-1)t}{1+t^2}, \\t_1 &= 10.\end{aligned}$$

Задача K1.15.

6

$$\begin{aligned}x &= 7e^{t/7}, \\y &= 7e^{t/7}(0.1e^{2t/7} - 1), \\t_1 &= 2.\end{aligned}$$

Задача K1.16.

6

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

Задача K1.17.

6

$$\begin{aligned}x &= 4e^{2t} + 5, \\y &= e^{4t}/4, \\t_1 &= 0.6.\end{aligned}$$

Задача K1.18.

6

$$\begin{aligned}x &= 4\cos(2t)(1 + \cos(2t)), \\y &= 4\sin(2t)(1 + \cos(2t)), \\t_1 &= \pi/12.\end{aligned}$$

Задача K1.19.

6

$$\begin{aligned}x &= 800/(t+7), \\y &= (t-4900)/(t+7)^2, \\t_1 &= 6.\end{aligned}$$

Задача K1.20.

6

$$\begin{aligned}x &= 3\cos^3(2t), \\y &= 3\sin^3(2t), \\t_1 &= 7\pi/12.\end{aligned}$$

Задача K1.21.

6

$$\begin{aligned}x &= 3\cos(14t), \\y &= 4\sin^2(7t), \\t_1 &= \pi/9.\end{aligned}$$

Задача K1.22. 6
 $x = \frac{1}{3}(130/(t^5 + 1) + 1),$
 $y = t^5,$
 $t_1 = 1.3.$

Задача K1.23. 6
 $x = 9 \sin(4t),$
 $y = 17 \cos(4t) + 10,$
 $t_1 = \pi/12.$

Задача K1.24. 6
 $x = 31/(t + 3),$
 $y = (60 - 135t)/(t + 3)^3,$
 $t_1 = 0.4.$

Задача K1.25. 6
 $x = 10e^{2t} + 11,$
 $y = e^{4t}/2,$
 $t_1 = 1.$

Задача K1.26. 6
 $x = 9(3t - \sin(3t)),$
 $y = 9(1 - \cos(3t)),$
 $t_1 = 5\pi/18.$

Задача K1.27. 6
 $x = 11e^{-3t},$
 $y = 33\sqrt{1 - e^{-6t}},$
 $t_1 = 0.06.$

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	3.35	12.50	12.94	62.50	108.25	125.00	120.74	32.35	5.18
2	-19.53	57.07	60.32	78.14	-673.08	677.60	-662.11	144.04	25.26
3	0.36	3.48	3.50	-0.31	-0.22	0.38	-0.25	0.29	42.48
4	1.73	-19.00	19.08	56.00	-27.71	62.48	32.68	53.25	6.84
5	2.61	-18.19	18.37	9.96	-31.50	33.04	32.60	5.38	62.80
6	-5.56	2.80	6.22	1.85	-1.40	2.32	-2.28	0.42	92.01
7	18.00	58.89	61.58	124.71	-136.00	184.52	-93.61	159.01	23.85
8	-21.70	10.83	24.25	36.96	11.40	38.68	-27.98	26.71	22.02
9	27.71	17.74	32.90	64.00	16.38	66.06	62.74	20.70	52.30
10	1.82	-0.01	1.82	0.12	0.24	0.27	0.12	0.24	13.72
11	-25.98	-45.00	51.96	-375.00	-129.90	396.86	300.00	259.81	10.39
12	1.00	0.22	1.02	0.00	0.04	0.04	0.01	0.04	29.31
13	1.61	6.00	6.21	18.00	31.18	36.00	34.77	9.32	4.14
14	0.02	4.08	4.08	-0.00	-0.02	0.02	-0.02	0.00	3626.22
15	1.33	-0.62	1.47	0.19	0.11	0.22	0.12	0.18	11.81
16	-0.65	9.03	9.05	-4.96	0.42	4.97	0.78	4.91	16.67
17	26.56	11.02	28.76	53.12	44.09	69.04	65.97	20.36	40.61
18	-10.93	10.93	15.45	-29.86	-35.71	46.55	-4.14	46.36	5.15
19	-4.73	4.46	6.50	0.73	-1.03	1.26	-1.24	0.25	169.19
20	6.75	-3.90	7.79	7.79	-22.50	23.81	18.00	15.59	3.90
21	41.36	-27.57	49.71	-102.11	68.07	122.72	-122.72	0.00	∞
22	-27.86	14.28	31.31	83.11	43.94	94.01	-53.92	77.01	12.73
23	18.00	-58.89	61.58	-124.71	-136.00	184.52	93.61	159.01	23.85
24	-2.68	-3.57	4.46	1.58	6.22	6.42	-5.92	2.47	8.05
25	147.78	109.20	183.75	295.56	436.79	527.39	497.28	175.64	192.22
26	50.38	13.50	52.16	40.50	-70.15	81.00	20.96	78.24	34.77
27	-27.56	125.62	128.61	82.69	-1623.38	1625.49	-1603.38	267.16	61.91