

Полярные координаты

Задан закон движения точки в полярных координатах: $\rho = \rho(t)$ (в метрах), $\varphi = \varphi(t)$. В указанный момент времени найти скорость и ускорение точки в полярных, декартовых и естественных координатах.

Кирсанов М.Н. **Решбник. Теоретическая механика**/Под ред. А. И. Кириллова.– М.: ФИЗМАТЛИТ, 2008. — 384 с. (с.144.)

Задача К4.1.

8

$$r = 7t \sin(t/2),$$
$$\varphi = t, t = 6 \text{ с.}$$

Задача К4.2.

8

$$r = \frac{30}{1 + \cos(t/3)},$$
$$\varphi = \frac{t}{3}, t = 2 \text{ с.}$$

Задача К4.3.

8

$$r = 7 + 7t \operatorname{tg}^2(\pi t/31),$$
$$\varphi = \cos^2(\pi t/31), t = 10 \text{ с.}$$

Задача К4.4.

8

$$r = 4t/11 + 11,$$
$$\varphi = \arccos(t/11), t = 9 \text{ с.}$$

Задача К4.5.

8

$$r = 8(t/18 + 0.5)^{-5},$$
$$\varphi = (t/18 + 0.5)^5, t = 9 \text{ с.}$$

Задача К4.6.

8

$$r = 4(t/16 + 0.5)^{-5},$$
$$\varphi = (t/16 + 0.5)^5, t = 8 \text{ с.}$$

Задача К4.7.

8

$$r = 29/(1 + t/2),$$
$$\varphi = \arccos(t/2), t = 1 \text{ с.}$$

Задача К4.8.

8

$$r = \frac{15 \sin^2(t/13)}{\cos(t/13)},$$
$$\varphi = \frac{t}{13}, t = 10 \text{ с.}$$

Задача К4.9.

8

$$r = 9 + 9t \operatorname{tg}^2(\pi t/28),$$
$$\varphi = \cos^2(\pi t/28), t = 8 \text{ с.}$$

Задача К4.10.

8

$$r = 22 \cos^2(\pi t/13),$$
$$\varphi = \cos^2(\pi t/13), t = 10 \text{ с.}$$

Задача К4.11.

8

$$r = 11t/5 + 5,$$
$$\varphi = \arccos(t/5), t = 1 \text{ с.}$$

Задача К4.12.

8

$$r = 24(1 - (t/8)^2)/t,$$
$$\varphi = \arccos(t/8), t = 5 \text{ с.}$$

Задача К4.13.

8

$$r = \frac{26}{1 + \cos(t/12)},$$
$$\varphi = \frac{t}{12}, t = 9 \text{ с.}$$

Задача К4.14.

8

$$r = 8(t/6 + 0.5)^{-3},$$
$$\varphi = (t/6 + 0.5)^3, t = 3 \text{ с.}$$

Задача K4.15.

8

$$r = -\frac{20 \cos(2t/7)}{\cos(t/7)},$$
$$\varphi = \frac{t}{7}, t = 5 \text{ c.}$$

Задача K4.16.

8

$$r = 5t \sin(t/8),$$
$$\varphi = t, t = 4 \text{ c.}$$

Задача K4.17.

8

$$r = 9t/10 + 10,$$
$$\varphi = \arccos(t/10), t = 6 \text{ c.}$$

Задача K4.18.

8

$$r = \frac{17 \sin^2(t/7)}{\cos(t/7)},$$
$$\varphi = \frac{t}{7}, t = 2 \text{ c.}$$

Задача K4.19.

8

$$r = \frac{23}{1 + 0.2 \cos(t/9)},$$
$$\varphi = \frac{t}{9}, t = 8 \text{ c.}$$

Задача K4.20.

8

$$r = 28/(1 + t/4),$$
$$\varphi = \arccos(t/4), t = 1 \text{ c.}$$

Задача K4.21.

8

$$r = 11t \sin(t/8),$$
$$\varphi = t, t = 10 \text{ c.}$$

Задача K4.22.

8

$$r = 33/t + 11,$$
$$\varphi = \arccos(t/11), t = 8 \text{ c.}$$

Задача K4.23.

8

$$r = 8t \sin(t/7),$$
$$\varphi = t, t = 7 \text{ c.}$$

Задача K4.24.

8

$$r = 6e^{t/36},$$
$$\varphi = t/4, t = 5 \text{ c.}$$

Задача K4.25.

8

$$r = 20(1 - (t/10)^2)/t,$$
$$\varphi = \arccos(t/10), t = 8 \text{ c.}$$

Задача K4.26.

8

$$r = -\frac{18 \cos(2t/11)}{\cos(t/11)},$$
$$\varphi = \frac{t}{11}, t = 8 \text{ c.}$$

Задача K4.27.

8

$$r = 15e^{-t/11},$$
$$\varphi = e^{t/11}, t = 6 \text{ c.}$$

Задача K4.28.

8

$$r = -\frac{18 \cos(2t/7)}{\cos(t/7)},$$
$$\varphi = \frac{t}{7}, t = 5 \text{ c.}$$

К4 Ответы.
Полярные координаты

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№	ρ	$\dot{\rho}$	φ	$\dot{\varphi}$	v_ρ	v_φ	v	v_x	v_y	Кривая
1	5.927	-19.802	6.000	1.000	-19.802	5.927	20.670	-17.357	11.224	
2	16.798	1.939	0.667	0.333	1.939	5.599	5.926	-1.939	5.599	Парабола
3	25.018	8.135	0.280	-0.091	8.135	-2.276	8.448	8.447	0.059	Гиперболическая спираль
4	14.273	0.364	0.613	-0.158	0.364	-2.257	2.286	1.595	-1.637	Улитка Паскаля
5	8.000	-2.222	1.000	0.278	-2.222	2.222	3.143	-3.071	-0.669	Гиперболическая спираль
6	4.000	-1.250	1.000	0.313	-1.250	1.250	1.768	-1.727	-0.376	Гиперболическая спираль
7	19.333	-6.444	1.047	-0.577	-6.444	-11.162	12.889	6.444	-11.162	Парабола
8	10.102	2.358	0.769	0.077	2.358	0.777	2.482	1.153	2.198	Циссоида
9	23.152	6.515	0.389	-0.109	6.515	-2.532	6.990	6.988	0.126	Гиперболическая спираль
10	12.326	5.278	0.560	0.240	5.278	2.957	6.050	2.899	5.310	Архимедова спираль
11	7.200	2.200	1.369	-0.204	2.200	-1.470	2.646	1.880	1.862	Улитка Паскаля
12	2.925	-1.335	0.896	-0.160	-1.335	-0.468	1.415	-0.469	-1.335	Циссоида
13	15.014	0.493	0.750	0.083	0.493	1.251	1.345	-0.493	1.251	Парабола
14	8.000	-4.000	1.000	0.500	-4.000	4.000	5.657	-5.527	-1.205	Гиперболическая спираль
15	-3.752	7.022	0.714	0.143	7.022	-0.536	7.042	5.657	4.195	Строфоида
16	9.589	4.591	4.000	1.000	4.591	9.589	10.631	4.256	-9.742	
17	15.400	0.900	0.927	-0.125	0.900	-1.925	2.125	2.080	-0.435	Улитка Паскаля
18	1.407	1.428	0.286	0.143	1.428	0.201	1.442	1.313	0.595	Циссоида
19	20.425	0.313	0.889	0.111	0.313	2.269	2.291	-1.565	1.673	Эллипс
20	22.400	-4.480	1.318	-0.258	-4.480	-5.784	7.316	4.480	-5.784	Парабола
21	104.388	14.775	10.000	1.000	14.775	104.388	105.429	44.393	-95.627	
22	15.125	-0.516	0.756	-0.132	-0.516	-2.003	2.069	1.000	-1.811	Конхоида Никомеда
23	47.122	11.054	7.000	1.000	11.054	47.122	48.402	-22.625	42.788	
24	6.894	0.191	1.250	0.250	0.191	1.723	1.734	-1.575	0.725	Логарифмическая спираль
25	0.900	-0.513	0.644	-0.167	-0.513	-0.150	0.534	-0.320	-0.428	Циссоида
26	-2.795	4.126	0.727	0.091	4.126	-0.254	4.133	3.251	2.553	Строфоида
27	8.694	-0.790	1.725	0.157	-0.790	1.364	1.576	-1.226	-0.991	Гиперболическая спираль
28	-3.377	6.320	0.714	0.143	6.320	-0.482	6.338	5.091	3.775	Строфоида

К4 файл o4k8A

№	$\ddot{\rho}$	$\ddot{\varphi}$	a_ρ	a_φ	a	a_x	a_y	$ a_\tau $	a_n
1	-8.412	0.000	-14.339	-39.604	42.120	-24.834	-34.020	2.380	42.052
2	1.269	0.000	-0.598	1.293	1.424	-1.269	0.646	1.026	0.988
3	4.482	0.009	4.275	-1.254	4.455	4.455	-0.025	4.455	0.056
4	-0.000	-0.036	-0.357	-0.623	0.718	0.066	-0.715	0.558	0.451
5	0.741	0.062	0.123	-0.741	0.751	0.690	-0.296	-0.611	0.436
6	0.469	0.078	0.078	-0.469	0.475	0.437	-0.188	-0.387	0.276
7	4.296	-0.192	-2.148	3.721	4.296	-4.296	0.000	-2.148	3.721
8	0.419	0.000	0.359	0.363	0.510	0.006	0.510	0.455	0.232
9	3.333	0.006	3.056	-1.296	3.319	3.319	-0.041	3.317	0.100
10	-0.310	-0.014	-1.019	2.359	2.569	-2.117	1.457	0.264	2.556
11	0.000	-0.009	-0.300	-0.959	1.005	0.880	-0.486	0.283	0.964
12	0.384	-0.021	0.309	0.367	0.480	-0.094	0.471	-0.413	0.244
13	0.076	0.000	-0.028	0.082	0.087	-0.076	0.041	0.066	0.056
14	2.667	0.167	0.667	-2.667	2.749	2.604	-0.880	-2.357	1.414
15	1.969	0.000	2.046	2.006	2.865	0.231	2.856	1.887	2.156
16	0.947	0.000	-8.641	9.182	12.609	12.597	0.538	4.550	11.759
17	-0.000	-0.012	-0.241	-0.405	0.471	0.180	-0.436	0.265	0.390
18	0.757	0.000	0.728	0.408	0.835	0.584	0.597	0.778	0.302
19	0.038	0.000	-0.214	0.070	0.225	-0.189	-0.123	0.040	0.222
20	1.792	-0.017	0.299	1.928	1.951	-1.792	0.771	-1.707	0.944
21	-0.764	0.000	-105.152	29.549	109.225	104.306	32.411	14.522	108.256
22	0.129	-0.019	-0.136	-0.145	0.199	0.000	-0.199	0.174	0.096
23	0.273	0.000	-46.849	22.108	51.804	-49.845	-14.112	10.824	50.660
24	0.005	0.000	-0.426	0.096	0.436	-0.225	-0.374	0.048	0.434
25	0.078	-0.037	0.053	0.138	0.147	-0.040	0.142	-0.090	0.117
26	0.737	0.000	0.760	0.750	1.068	0.069	1.066	0.712	0.795
27	0.072	0.014	-0.142	-0.124	0.189	0.144	-0.121	-0.036	0.185
28	1.772	0.000	1.841	1.806	2.579	0.208	2.570	1.698	1.941