

## 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.

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### Задача 4.1.

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$$r = 30/(1 + \frac{4}{7}t),$$
$$\varphi = \arccos(t/7), t = 6 \text{ с.}$$

### Задача 4.2.

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$$r = 18e^{t/9},$$
$$\varphi = e^{t/9}, t = 7 \text{ с.}$$

### Задача 4.3.

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$$r = 30/t + 10,$$
$$\varphi = \arccos(t/10), t = 8 \text{ с.}$$

### Задача 4.4.

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$$r = 19e^{t/14},$$
$$\varphi = e^{t/14}, t = 9 \text{ с.}$$

### Задача 4.5.

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$$r = 16(t/10)^5,$$
$$\varphi = (t/10)^5, t = 9 \text{ с.}$$

### Задача 4.6.

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$$r = 22/(1 + \frac{2}{9}t),$$
$$\varphi = \arccos(t/9), t = 8 \text{ с.}$$

### Задача 4.7.

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$$r = \frac{27}{1+3\cos(t/10)},$$
$$\varphi = \frac{t}{10}, t = 9 \text{ с.}$$

### Задача 4.8.

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$$r = 18 \cos^2(\pi t/13),$$
$$\varphi = \cos^2(\pi t/13), t = 7 \text{ с.}$$

### Задача 4.9.

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$$r = \frac{4}{7}t - \frac{14}{t},$$
$$\varphi = \arccos(t/7), t = 2 \text{ с.}$$

### Задача 4.10.

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$$r = 27/(1 + t/9),$$
$$\varphi = \arccos(t/9), t = 5 \text{ с.}$$

### Задача 4.11.

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$$r = 25/(1 + \frac{3}{7}t),$$
$$\varphi = \arccos(t/7), t = 6 \text{ с.}$$

### Задача 4.12.

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$$r = 21(t/10)^5,$$
$$\varphi = (t/10)^5, t = 9 \text{ с.}$$

**Задача 4.13.**

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$$r = 26/(1 + t/30),$$
$$\varphi = \arccos(t/12), \quad t = 10 \text{ c.}$$

**Задача 4.14.**

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$$r = 6t \cos(t/9),$$
$$\varphi = t, \quad t = 8 \text{ c.}$$

**Задача 4.15.**

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$$r = 99(1 - (t/11)^2)/t,$$
$$\varphi = \arccos(t/11), \quad t = 9 \text{ c.}$$

**Задача 4.16.**

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$$r = 10e^{t/24},$$
$$\varphi = t/2, \quad t = 10 \text{ c.}$$

**Задача 4.17.**

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$$r = \frac{22}{1+0.2 \cos(t/5)},$$
$$\varphi = \frac{t}{5}, \quad t = 4 \text{ c.}$$

**Задача 4.18.**

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$$r = 9 + 9 \operatorname{tg}^2(\pi t/21),$$
$$\varphi = \cos^2(\pi t/21), \quad t = 6 \text{ c.}$$

**Задача 4.19.**

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$$r = 15 \cos^2(\pi t/13),$$
$$\varphi = \cos^2(\pi t/13), \quad t = 10 \text{ c.}$$

**Задача 4.20.**

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$$r = \frac{24}{1+5 \cos(t/2)},$$
$$\varphi = \frac{t}{2}, \quad t = 1 \text{ c.}$$

**Задача 4.21.**

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$$r = 29/(1 + t/40),$$
$$\varphi = \arccos(t/8), \quad t = 7 \text{ c.}$$

**Задача 4.22.**

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$$r = 13(t/9)^4,$$
$$\varphi = (t/9)^4, \quad t = 8 \text{ c.}$$

**Задача 4.23.**

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$$r = -\frac{19 \cos(t/4)}{\cos(t/8)},$$
$$\varphi = \frac{t}{8}, \quad t = 5 \text{ c.}$$

**Задача 4.24.**

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$$r = 25/(1 + 3t/35),$$
$$\varphi = \arccos(t/7), \quad t = 4 \text{ c.}$$

**Задача 4.25.**

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$$r = \frac{29}{1+0.2 \cos(t/6)},$$
$$\varphi = \frac{t}{6}, \quad t = 5 \text{ c.}$$

**Задача 4.26.**

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$$r = 54(1 - (t/6)^2)/t,$$
$$\varphi = \arccos(t/6), \quad t = 2 \text{ c.}$$

**Задача 4.27.**

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$$r = 10 \cos^2(\pi t/4),$$
$$\varphi = \cos^2(\pi t/4), t = 1 \text{ c.}$$

**Задача 4.28.**

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$$r = 15(t/2)^2,$$
$$\varphi = (t/2)^2, t = 1 \text{ c.}$$

**Задача 4.29.**

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$$r = 23e^{-t/14},$$
$$\varphi = e^{t/14}, t = 10 \text{ c.}$$

**Задача 4.30.**

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$$r = 5t/9 + 9,$$
$$\varphi = \arccos(t/9), t = 6 \text{ c.}$$

**Задача 4.31.**

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$$r = 4t \sin(t/5),$$
$$\varphi = t, t = 3 \text{ c.}$$

**Задача 4.32.**

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$$r = 12e^{t/7},$$
$$\varphi = e^{t/7}, t = 3 \text{ c.}$$

**Задача 4.33.**

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$$r = 4(t/6 + 0.5)^{-5},$$
$$\varphi = (t/6 + 0.5)^5, t = 3 \text{ c.}$$

**Задача 4.34.**

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$$r = 15(t/4)^5,$$
$$\varphi = (t/4)^5, t = 3 \text{ c.}$$

## Полярные координаты

№	$\rho$	$\dot{\rho}$	$\varphi$	$\dot{\varphi}$	$v_\rho$	$v_\varphi$	$v$	$v_x$	$v_y$	Кривая
1	6.774	-0.874	0.541	-0.277	-0.874	-1.879	2.072	0.219	-2.061	Гипербола
2	39.179	4.353	2.177	0.242	4.353	9.475	10.428	-10.268	-1.817	Архимедова спираль
3	13.750	-0.469	0.644	-0.167	-0.469	-2.292	2.339	1.000	-2.115	Конхоида Никомеда
4	36.136	2.581	1.902	0.136	2.581	4.909	5.546	-5.482	0.845	Архимедова спираль
5	9.448	5.249	0.590	0.328	5.249	3.099	6.096	2.634	5.497	Архимедова спираль
6	7.920	-0.634	0.476	-0.243	-0.634	-1.921	2.023	0.317	-1.998	Гипербола
7	9.425	0.773	0.900	0.100	0.773	0.942	1.219	-0.258	1.191	Гипербола
8	0.262	1.041	0.015	0.058	1.041	0.015	1.041	1.041	0.030	Архимедова спираль
9	-5.857	4.071	1.281	-0.149	4.071	0.873	4.164	0.327	4.151	Строфоида
10	17.357	-1.240	0.982	-0.134	-1.240	-2.319	2.630	1.240	-2.319	Парабола
11	7.000	-0.840	0.541	-0.277	-0.840	-1.941	2.115	0.280	-2.097	Гипербола
12	12.400	6.889	0.590	0.328	6.889	4.068	8.000	3.458	7.215	Архимедова спираль
13	19.500	-0.487	0.586	-0.151	-0.487	-2.940	2.980	1.219	-2.719	Эллипс
14	30.253	-0.359	8.000	1.000	-0.359	30.253	30.255	-29.879	-4.757	
15	3.636	-2.040	0.613	-0.158	-2.040	-0.575	2.120	-1.339	-1.644	Циссоида
16	15.169	0.632	5.000	0.500	0.632	7.584	7.611	7.452	1.545	Логарифмическая спираль
17	19.309	0.486	0.800	0.200	0.486	3.862	3.892	-2.432	3.039	Эллипс
18	23.152	8.686	0.389	-0.146	8.686	-3.377	9.319	9.318	0.168	Гиперболическая спираль
19	8.404	3.598	0.560	0.240	3.598	2.016	4.125	1.977	3.620	Архимедова спираль
20	4.454	0.991	0.500	0.500	0.991	2.227	2.438	-0.198	2.430	Гипербола
21	24.681	-0.525	0.505	-0.258	-0.525	-6.373	6.394	2.626	-5.830	Эллипс
22	8.116	4.058	0.624	0.312	4.058	2.533	4.784	1.812	4.427	Архимедова спираль
23	-7.388	4.892	0.625	0.125	4.892	-0.923	4.979	4.508	2.114	Строфоида
24	18.617	-1.188	0.963	-0.174	-1.188	-3.241	3.452	1.981	-2.827	Эллипс
25	25.562	0.556	0.833	0.167	0.556	4.260	4.297	-2.780	3.276	Эллипс
26	24.000	-15.000	1.231	-0.177	-15.000	-4.243	15.588	-1.000	-15.556	Циссоида
27	5.000	-7.854	0.500	-0.785	-7.854	-3.927	8.781	-5.010	-7.212	Архимедова спираль
28	3.750	7.500	0.250	0.500	7.500	1.875	7.731	6.803	3.672	Архимедова спираль
29	11.259	-0.804	2.043	0.146	-0.804	1.643	1.829	-1.098	-1.463	Гиперболическая спираль
30	12.333	0.556	0.841	-0.149	0.556	-1.839	1.921	1.741	-0.812	Улитка Паскаля
31	6.776	4.239	3.000	1.000	4.239	6.776	7.993	-5.153	-6.110	
32	18.421	2.632	1.535	0.219	2.632	4.040	4.821	-3.943	2.774	Архимедова спираль
33	4.000	-3.333	1.000	0.833	-3.333	3.333	4.714	-4.606	-1.004	Гиперболическая спираль
34	3.560	5.933	0.237	0.396	5.933	1.408	6.097	5.435	2.763	Архимедова спираль

$N_0$	$\ddot{\rho}$	$\ddot{\varphi}$	$W_\rho$	$W_\varphi$	$a$	$W_x$	$W_y$	$ W_\tau $	$W_n$
1	0.226	-0.128	-0.296	-0.382	0.483	-0.056	-0.480	0.471	0.107
2	0.484	0.027	-1.808	3.158	3.639	-1.567	-3.285	2.115	2.961
3	0.117	-0.037	-0.265	-0.353	0.441	-0.000	-0.441	0.399	0.189
4	0.184	0.010	-0.483	1.052	1.157	-0.838	-0.798	0.707	0.917
5	2.333	0.146	1.316	4.821	4.998	-1.591	4.738	3.585	3.482
6	0.101	-0.114	-0.365	-0.597	0.699	-0.051	-0.697	0.681	0.159
7	0.188	0.000	0.094	0.155	0.181	-0.063	0.170	0.179	0.025
8	2.041	0.113	2.040	0.150	2.046	2.038	0.180	2.042	0.120
9	-3.500	-0.007	-3.370	-1.175	3.569	0.163	-3.565	-3.541	0.442
10	0.177	-0.012	-0.133	0.124	0.182	-0.177	-0.041	-0.047	0.176
11	0.202	-0.128	-0.337	-0.430	0.546	-0.067	-0.542	0.529	0.138
12	3.062	0.146	1.727	6.328	6.559	-2.088	6.218	4.705	4.571
13	0.024	-0.034	-0.419	-0.521	0.669	-0.061	-0.666	0.583	0.328
14	-1.409	0.000	-31.662	-0.718	31.670	5.317	-31.220	-0.342	31.668
15	0.272	-0.036	0.181	0.516	0.547	-0.149	0.526	-0.314	0.448
16	0.026	0.000	-3.766	0.632	3.819	-0.462	3.791	0.317	3.805
17	0.119	0.000	-0.653	0.195	0.682	-0.595	-0.333	0.111	0.673
18	5.925	0.010	5.432	-2.303	5.900	5.900	-0.072	5.898	0.178
19	-0.211	-0.014	-0.695	1.608	1.752	-1.443	0.993	0.180	1.743
20	1.348	0.000	0.234	0.991	1.018	-0.270	0.982	1.001	0.189
21	0.022	-0.120	-1.623	-2.703	3.153	-0.112	-3.151	2.827	1.396
22	1.522	0.117	0.731	3.483	3.559	-1.443	3.254	2.465	2.568
23	1.229	0.000	1.344	1.223	1.817	0.374	1.778	1.094	1.451
24	0.152	-0.021	-0.412	0.021	0.413	-0.253	-0.327	0.122	0.394
25	0.108	0.000	-0.602	0.185	0.630	-0.542	-0.321	0.106	0.621
26	13.500	-0.011	12.750	5.038	13.709	-0.500	13.700	-13.640	1.378
27	-0.000	-0.000	-3.084	12.337	12.717	-8.621	9.348	-2.759	12.414
28	7.500	0.500	6.563	9.375	11.444	4.039	10.707	8.640	7.503
29	0.057	0.010	-0.182	-0.117	0.217	0.187	-0.109	-0.025	0.215
30	0.000	-0.020	-0.274	-0.411	0.494	0.123	-0.478	0.314	0.381
31	1.050	0.000	-5.726	8.479	10.231	4.472	-9.202	4.151	9.352
32	0.376	0.031	-0.510	1.731	1.805	-1.748	-0.448	1.172	1.372
33	3.333	0.556	0.556	-3.333	3.379	3.105	-1.334	-2.750	1.964
34	7.910	0.527	7.353	6.570	9.861	5.603	8.114	8.672	4.695