

## 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.

8

$$r = 20(t/7)^5,$$
$$\varphi = (t/7)^5, t = 6 \text{ с.}$$

### Задача 4.2.

8

$$r = 26/(1 + t/10),$$
$$\varphi = \arccos(t/10), t = 9 \text{ с.}$$

### Задача 4.3.

8

$$r = 13e^{t/10},$$
$$\varphi = e^{t/10}, t = 7 \text{ с.}$$

### Задача 4.4.

8

$$r = t/4 + 12,$$
$$\varphi = \arccos(t/12), t = 8 \text{ с.}$$

### Задача 4.5.

8

$$r = 13 \cos^2(\pi t/11),$$
$$\varphi = \cos^2(\pi t/11), t = 8 \text{ с.}$$

### Задача 4.6.

8

$$r = 66(1 - (t/6)^2)/t,$$
$$\varphi = \arccos(t/6), t = 4 \text{ с.}$$

### Задача 4.7.

8

$$r = 2t - \frac{49}{t},$$
$$\varphi = \arccos(t/7), t = 5 \text{ с.}$$

### Задача 4.8.

8

$$r = 9e^{-t/6},$$
$$\varphi = e^{t/6}, t = 1 \text{ с.}$$

### Задача 4.9.

8

$$r = 9e^{t/8},$$
$$\varphi = e^{t/8}, t = 6 \text{ с.}$$

### Задача 4.10.

8

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

### Задача 4.11.

8

$$r = t - \frac{8}{t},$$
$$\varphi = \arccos(t/4), t = 2 \text{ с.}$$

### Задача 4.12.

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$$r = 42(1 - (t/7)^2)/t,$$
$$\varphi = \arccos(t/7), t = 5 \text{ с.}$$

**Задача 4.13.**

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$$r = 24 \cos^2(\pi t/16),$$
$$\varphi = \cos^2(\pi t/16), \quad t = 10 \text{ c.}$$

**Задача 4.14.**

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$$r = 5 + 5 \operatorname{tg}^2(\pi t/23),$$
$$\varphi = \cos^2(\pi t/23), \quad t = 7 \text{ c.}$$

**Задача 4.15.**

8

$$r = 20/t + 4,$$
$$\varphi = \arccos(t/4), \quad t = 1 \text{ c.}$$

**Задача 4.16.**

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$$r = 48(1 - (t/8)^2)/t,$$
$$\varphi = \arccos(t/8), \quad t = 3 \text{ c.}$$

**Задача 4.17.**

8

$$r = \frac{26}{1+0.6 \cos(t/12)},$$
$$\varphi = \frac{t}{12}, \quad t = 9 \text{ c.}$$

**Задача 4.18.**

8

$$r = 23/(1 + 2t/25),$$
$$\varphi = \arccos(t/5), \quad t = 3 \text{ c.}$$

**Задача 4.19.**

8

$$r = -\frac{19 \cos(t/5)}{\cos(t/10)},$$
$$\varphi = \frac{t}{10}, \quad t = 8 \text{ c.}$$

**Задача 4.20.**

8

$$r = 3e^{t/28},$$
$$\varphi = t/4, \quad t = 3 \text{ c.}$$

**Задача 4.21.**

8

$$r = \frac{8}{5}t - \frac{80}{t},$$
$$\varphi = \arccos(t/10), \quad t = 6 \text{ c.}$$

**Задача 4.22.**

8

$$r = 9(t/3)^4,$$
$$\varphi = (t/3)^4, \quad t = 2 \text{ c.}$$

**Задача 4.23.**

8

$$r = \frac{25}{1+0.4 \cos(t/11)},$$
$$\varphi = \frac{t}{11}, \quad t = 9 \text{ c.}$$

**Задача 4.24.**

8

$$r = 19 \cos^2(\pi t/10),$$
$$\varphi = \cos^2(\pi t/10), \quad t = 6 \text{ c.}$$

**Задача 4.25.**

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$$r = \frac{15 \sin^2(t/13)}{\cos(t/13)},$$
$$\varphi = \frac{t}{13}, \quad t = 8 \text{ c.}$$

**Задача 4.26.**

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$$r = 4t \cos(t/11),$$
$$\varphi = t, \quad t = 10 \text{ c.}$$

**Задача 4.27.**

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$$r = 11t \sin(t/9),$$
$$\varphi = t, \quad t = 10 \text{ c.}$$

**Задача 4.28.**

8

$$r = t - \frac{8}{t},$$
$$\varphi = \arccos(t/4), \quad t = 1 \text{ c.}$$

**Задача 4.29.**

8

$$r = \frac{29}{1 + \cos(t/13)},$$
$$\varphi = \frac{t}{13}, \quad t = 10 \text{ c.}$$

**Задача 4.30.**

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$$r = 70/t + 14,$$
$$\varphi = \arccos(t/14), \quad t = 10 \text{ c.}$$

**Задача 4.31.**

8

$$r = 29/(1 + t/5),$$
$$\varphi = \arccos(t/5), \quad t = 4 \text{ c.}$$

**Задача 4.32.**

8

$$r = 3e^{t/39},$$
$$\varphi = t/3, \quad t = 10 \text{ c.}$$

**Задача 4.33.**

8

$$r = 6(t/18 + 0.5)^{-4},$$
$$\varphi = (t/18 + 0.5)^4, \quad t = 9 \text{ c.}$$

**Задача 4.34.**

8

$$r = 4(t/18 + 0.5)^{-5},$$
$$\varphi = (t/18 + 0.5)^5, \quad t = 9 \text{ c.}$$

## Полярные координаты

№	$\rho$	$\dot{\rho}$	$\varphi$	$\dot{\varphi}$	$v_\rho$	$v_\varphi$	$v$	$v_x$	$v_y$	Кривая
1	9.253	7.711	0.463	0.386	7.711	3.568	8.496	5.308	6.634	Архимедова спираль
2	13.684	-0.720	0.451	-0.229	-0.720	-3.139	3.221	0.720	-3.139	Парабола
3	26.179	2.618	2.014	0.201	2.618	5.272	5.886	-5.885	0.106	Архимедова спираль
4	14.000	0.250	0.841	-0.112	0.250	-1.565	1.585	1.333	-0.857	Улитка Паскаля
5	5.575	3.675	0.429	0.283	3.675	1.576	3.999	2.687	2.961	Архимедова спираль
6	9.167	-5.958	0.841	-0.224	-5.958	-2.050	6.301	-2.444	-5.808	Циссоида
7	0.200	3.960	0.775	-0.204	3.960	-0.041	3.960	2.857	2.742	Строфоида
8	7.618	-1.270	1.181	0.197	-1.270	1.500	1.965	-1.870	-0.605	Гиперболическая спираль
9	19.053	2.382	2.117	0.265	2.382	5.042	5.576	-5.545	-0.584	Архимедова спираль
10	14.182	-0.645	0.586	-0.151	-0.645	-2.138	2.233	0.645	-2.138	Парабола
11	-2.000	3.000	1.047	-0.289	3.000	0.577	3.055	1.000	2.887	Строфоида
12	4.114	-2.537	0.775	-0.204	-2.537	-0.840	2.673	-1.224	-2.376	Циссоида
13	3.515	3.332	0.146	0.139	3.332	0.488	3.368	3.225	0.969	Архимедова спираль
14	15.035	5.819	0.333	-0.129	5.819	-1.935	6.132	6.132	0.071	Гиперболическая спираль
15	24.000	-20.000	1.318	-0.258	-20.000	-6.197	20.938	1.000	-20.914	Конхоида Никомеда
16	13.750	-6.083	1.186	-0.135	-6.083	-1.854	6.360	-0.562	-6.335	Циссоида
17	18.068	0.428	0.750	0.083	0.428	1.506	1.565	-0.713	1.393	Эллипс
18	18.548	-1.197	0.927	-0.250	-1.197	-4.637	4.789	2.992	-3.740	Эллипс
19	0.796	5.534	0.800	0.100	5.534	0.080	5.534	3.798	4.025	Строфоида
20	3.339	0.119	0.750	0.250	0.119	0.835	0.843	-0.482	0.692	Логарифмическая спираль
21	-3.733	3.822	0.927	-0.125	3.822	0.467	3.851	1.920	3.338	Строфоида
22	1.778	3.556	0.198	0.395	3.556	0.702	3.624	3.349	1.386	Архимедова спираль
23	19.632	0.409	0.818	0.091	0.409	1.785	1.831	-1.023	1.519	Эллипс
24	1.814	3.509	0.095	0.185	3.509	0.335	3.524	3.461	0.668	Архимедова спираль
25	6.122	1.665	0.615	0.077	1.665	0.471	1.730	1.088	1.346	Циссоида
26	24.579	-0.411	10.000	1.000	-0.411	24.579	24.582	13.716	-20.400	
27	98.581	15.281	10.000	1.000	15.281	98.581	99.758	40.809	-91.030	
28	-7.000	9.000	1.318	-0.258	9.000	1.807	9.180	0.500	9.166	Строфоида
29	16.876	0.525	0.769	0.077	0.525	1.298	1.400	-0.525	1.298	Парабола
30	21.000	-0.700	0.775	-0.102	-0.700	-2.143	2.255	1.000	-2.021	Конхоида Никомеда
31	16.111	-1.790	0.644	-0.333	-1.790	-5.370	5.661	1.790	-5.370	Парабола
32	3.877	0.099	3.333	0.333	0.099	1.292	1.296	0.149	-1.288	Логарифмическая спираль
33	6.000	-1.333	1.000	0.222	-1.333	1.333	1.886	-1.842	-0.402	Гиперболическая спираль
34	4.000	-1.111	1.000	0.278	-1.111	1.111	1.571	-1.535	-0.335	Гиперболическая спираль

№	$\ddot{\rho}$	$\ddot{\varphi}$	$W_\rho$	$W_\varphi$	$a$	$W_x$	$W_y$	$ W_\tau $	$W_n$
1	5.141	0.257	3.765	8.324	9.136	-0.346	9.130	6.913	5.974
2	0.076	-0.109	-0.644	-1.157	1.324	-0.076	-1.322	1.271	0.369
3	0.262	0.020	-0.800	1.582	1.772	-1.086	-1.400	1.061	1.420
4	0.000	-0.011	-0.175	-0.212	0.275	0.042	-0.272	0.182	0.206
5	0.302	0.023	-0.144	2.207	2.212	-1.048	1.948	0.738	2.085
6	2.063	-0.045	1.604	2.255	2.767	-0.611	2.699	-2.250	1.610
7	-0.784	-0.043	-0.792	-1.625	1.808	0.571	-1.715	-0.776	1.633
8	0.212	0.033	-0.084	-0.250	0.264	0.199	-0.172	-0.137	0.225
9	0.298	0.033	-1.037	1.891	2.156	-1.077	-1.868	1.267	1.745
10	0.059	-0.034	-0.264	-0.292	0.393	-0.059	-0.389	0.355	0.168
11	-2.000	-0.048	-1.833	-1.636	2.457	0.500	-2.406	-2.109	1.260
12	0.672	-0.043	0.501	0.861	0.996	-0.245	0.965	-0.746	0.660
13	1.309	0.055	1.241	1.117	1.669	1.065	1.286	1.390	0.925
14	3.939	0.012	3.690	-1.310	3.915	3.915	-0.034	3.915	0.079
15	40.000	-0.017	38.400	9.915	39.659	0.000	39.659	-39.614	1.894
16	3.556	-0.007	3.306	1.539	3.646	-0.188	3.642	-3.611	0.509
17	0.059	0.000	-0.067	0.071	0.098	-0.098	0.007	0.050	0.084
18	0.154	-0.047	-1.005	-0.271	1.041	-0.386	-0.967	0.514	0.905
19	1.116	0.000	1.108	1.107	1.566	-0.022	1.566	1.124	1.091
20	0.004	0.000	-0.204	0.060	0.213	-0.190	-0.096	0.030	0.211
21	-0.741	-0.012	-0.682	-0.912	1.139	0.320	-1.093	-0.788	0.822
22	5.333	0.593	5.056	3.863	6.363	4.199	4.780	5.709	2.810
23	0.052	0.000	-0.110	0.074	0.133	-0.130	-0.030	0.048	0.124
24	3.034	0.160	2.972	1.585	3.369	2.808	1.862	3.110	1.296
25	0.290	0.000	0.254	0.256	0.360	0.059	0.356	0.314	0.177
26	-0.777	0.000	-25.355	-0.822	25.369	20.828	14.484	-0.398	25.366
27	-0.133	0.000	-98.714	30.561	103.336	99.454	28.059	15.080	102.230
28	-16.000	-0.017	-15.533	-4.527	16.180	0.500	-16.172	-16.121	1.380
29	0.074	0.000	-0.025	0.081	0.085	-0.074	0.040	0.065	0.054
30	0.140	-0.011	-0.079	-0.080	0.113	0.000	-0.113	0.101	0.050
31	0.398	-0.148	-1.392	-1.193	1.834	-0.398	-1.790	1.572	0.943
32	0.003	0.000	-0.428	0.066	0.433	0.433	0.017	0.033	0.432
33	0.370	0.037	0.074	-0.370	0.378	0.352	-0.138	-0.314	0.210
34	0.370	0.062	0.062	-0.370	0.375	0.345	-0.148	-0.306	0.218