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

Задача К4.1.

$$r = 8e^{t/48},$$
$$\varphi = t/4,\ t = 8\ c.$$

Задача К4.2.

$$r = \tfrac{12}{13}t - \frac{78}{t},$$
$$\varphi = \arccos(t/13),\ t = 8\ c.$$

Задача К4.3.

$$r = 36(1 - (t/4)^2)/t,$$
$$\varphi = \arccos(t/4),\ t = 1\ c.$$

Задача К4.4.

$$r = 9t\cos(t/11),$$
$$\varphi = t,\ t = 10\ c.$$

Задача К4.5.

$$r = 7\cos(t/13) + 9,$$
$$\varphi = t/13,\ t = 10\ c.$$

Задача К4.6.

$$r = 27/(1 + t/9),$$
$$\varphi = \arccos(t/9),\ t = 6\ c.$$

Задача К4.7.

$$r = 17(t/5)^2,$$
$$\varphi = (t/5)^2,\ t = 4\ c.$$

Задача К4.8.

$$r = -\frac{20\cos(t/3)}{\cos(t/6)},$$
$$\varphi = \frac{t}{6},\ t = 2\ c.$$

Задача К4.9.

$$r = 28/(1 + \tfrac{2}{5}t),$$
$$\varphi = \arccos(t/5),\ t = 4\ c.$$

Задача К4.10.

$$r = 30/(1 + 2t),$$
$$\varphi = \arccos(t/2),\ t = 1\ c.$$

Задача К4.11.

$$r = \frac{26}{1 + \cos(t/2)},$$
$$\varphi = \frac{t}{2},\ t = 1\ c.$$

Задача К4.12.

$$r = 5t\sin(t/6),$$
$$\varphi = t,\ t = 4\ c.$$

Задача К4.13.

$$r = -\frac{11\cos(2t/13)}{\cos(t/13)},$$
$$\varphi = \frac{t}{13},\ t = 10\ c.$$

Задача К4.14.

$$r = 4t\cos(t/4),$$
$$\varphi = t,\ t = 3\ c.$$

Задача К4.15.

$$r = 49/t + 7,$$
$$\varphi = \arccos(t/7),\ t = 6\ c.$$

Задача К4.16.

$$r = 28/(1 + t/9),$$
$$\varphi = \arccos(t/9),\ t = 7\ c.$$

Задача К4.17.

$$r = 3\cos(t/7) + 6,$$
$$\varphi = t/7,\ t = 3\ c.$$

Задача К4.18.

$$r = \frac{24}{1 + 0.4\cos(t/10)},$$
$$\varphi = \frac{t}{10},\ t = 8\ c.$$

Задача К4.19.

$$r = \frac{28}{1 + \cos(t/11)},$$
$$\varphi = \frac{t}{11},\ t = 7\ c.$$

Задача К4.20.

$$r = 17e^{-t/14},$$
$$\varphi = e^{t/14},\ t = 9\ c.$$

Задача К4.21.

$$r = 13e^{-t/5},$$
$$\varphi = e^{t/5},\ t = 2\ c.$$

Задача К4.22.

$$r = 4t\cos(t/2),$$
$$\varphi = t,\ t = 1\ c.$$

Задача К4.23.

$$r = 10t\cos(t/5),$$
$$\varphi = t,\ t = 4\ c.$$

Задача К4.24.

$$r = \frac{27}{1 + 3\cos(t/3)},$$
$$\varphi = \frac{t}{3},\ t = 2\ c.$$

Задача К4.25.

$$r = 15\cos^2(\pi t/5),$$
$$\varphi = \cos^2(\pi t/5),\ t = 2\ c.$$

Задача К4.26.

$$r = 18\cos^2(\pi t/12),$$
$$\varphi = \cos^2(\pi t/12),\ t = 8\ c.$$

Задача К4.27.

$$r = 21/(1 + 3t/65),$$
$$\varphi = \arccos(t/13),\ t = 10\ c.$$

Задача К4.28.

$$r = 20/t + 10,$$
$$\varphi = \arccos(t/10),\ t = 6\ c.$$

К4 **Ответы.**
Полярные координаты 07.04.2012

№	ρ	$\dot{\rho}$	φ	$\dot{\varphi}$	v_ρ	v_φ	v	v_x	v_y	Кривая
1	9.451	0.197	2.000	0.250	0.197	2.363	2.371	−2.230	−0.804	Логарифмическая спираль
2	−2.365	2.142	0.908	−0.098	2.142	0.231	2.154	1.136	1.830	Строфоида
3	33.750	−38.250	1.318	−0.258	−38.250	−8.714	39.230	−1.125	−39.214	Циссоида
4	55.302	−0.925	10.000	1.000	−0.925	55.302	55.309	30.861	−45.899	
5	14.029	−0.375	0.769	0.077	−0.375	1.079	1.142	−1.020	0.515	Улитка Паскаля
6	16.200	−1.080	0.841	−0.149	−1.080	−2.415	2.645	1.080	−2.415	Парабола
7	10.880	5.440	0.640	0.320	5.440	3.482	6.459	2.284	6.041	Архимедова спираль
8	−16.633	3.403	0.333	0.167	3.403	−2.772	4.389	4.122	−1.506	Строфоида
9	10.769	−1.657	0.644	−0.333	−1.657	−3.590	3.954	0.828	−3.866	Гипербола
10	10.000	−6.667	1.047	−0.577	−6.667	−5.774	8.819	1.667	−8.660	Гипербола
11	13.848	1.768	0.500	0.500	1.768	6.924	7.146	−1.768	6.924	Парабола
12	12.367	5.711	4.000	1.000	5.711	12.367	13.623	5.626	−12.406	
13	−0.495	2.317	0.769	0.077	2.317	−0.038	2.318	1.691	1.585	Строфоида
14	8.780	0.882	3.000	1.000	0.882	8.780	8.824	−2.112	−8.568	
15	15.167	−1.361	0.541	−0.277	−1.361	−4.206	4.421	1.000	−4.307	Конхоида Никомеда
16	15.750	−0.984	0.680	−0.177	−0.984	−2.784	2.953	0.984	−2.784	Парабола
17	8.729	−0.178	0.429	0.143	−0.178	1.247	1.260	−0.680	1.060	Улитка Паскаля
18	18.769	0.421	0.800	0.100	0.421	1.877	1.924	−1.053	1.610	Эллипс
19	15.519	0.465	0.636	0.091	0.465	1.411	1.485	−0.465	1.411	Парабола
20	8.938	−0.638	1.902	0.136	−0.638	1.214	1.372	−0.941	−0.999	Гиперболическая спираль
21	8.714	−1.743	1.492	0.298	−1.743	2.600	3.130	−2.729	−1.532	Гиперболическая спираль
22	3.510	2.551	1.000	1.000	2.551	3.510	4.340	−1.575	4.044	
23	27.868	1.228	4.000	1.000	1.228	27.868	27.895	20.288	−19.145	
24	8.041	1.481	0.667	0.333	1.481	2.680	3.062	−0.494	3.022	Гипербола
25	1.432	−5.540	0.095	−0.369	−5.540	−0.529	5.565	−5.464	−1.055	Архимедова спираль
26	4.500	4.081	0.250	0.227	4.081	1.020	4.207	3.702	1.998	Архимедова спираль
27	14.368	−0.454	0.693	−0.120	−0.454	−1.730	1.788	0.756	−1.621	Эллипс
28	13.333	−0.556	0.927	−0.125	−0.556	−1.667	1.757	1.000	−1.444	Конхоида Никомеда

К4 файл o4k1A

№	$\ddot{\rho}$	$\ddot{\varphi}$	a_ρ	a_φ	a	a_x	a_y	$\lvert a_\tau \rvert$	a_n
1	0.004	0.000	−0.587	0.098	0.595	0.155	−0.574	0.049	0.593
2	−0.305	−0.007	−0.282	−0.400	0.490	0.142	−0.469	−0.323	0.368
3	72.000	−0.017	69.750	19.171	72.337	−1.125	72.328	−72.266	3.199
4	−1.748	0.000	−57.050	−1.850	57.080	46.863	32.588	−0.895	57.073
5	−0.030	0.000	−0.113	−0.058	0.127	−0.041	−0.120	−0.017	0.125
6	0.144	−0.020	−0.216	0.000	0.216	−0.144	−0.161	0.088	0.197
7	1.360	0.080	0.246	4.352	4.359	−2.402	3.638	2.553	3.533
8	1.779	0.000	2.241	1.134	2.512	1.746	1.805	1.021	2.295
9	0.510	−0.148	−0.687	−0.491	0.844	−0.255	−0.805	0.734	0.418
10	8.889	−0.192	5.556	5.774	8.012	−2.222	7.698	−7.979	0.727
11	2.070	0.000	−1.392	1.768	2.250	−2.070	0.884	1.368	1.786
12	0.966	0.000	−11.401	11.423	16.139	16.097	1.162	5.590	15.140
13	0.354	0.000	0.357	0.357	0.504	0.008	0.504	0.351	0.362
14	−1.912	0.000	−10.692	1.764	10.837	10.336	−3.255	0.686	10.815
15	0.454	−0.128	−0.713	−1.186	1.384	−0.000	−1.384	1.348	0.313
16	0.123	−0.039	−0.369	−0.261	0.452	−0.123	−0.435	0.369	0.261
17	−0.056	0.000	−0.234	−0.051	0.239	−0.192	−0.143	−0.017	0.239
18	0.060	0.000	−0.128	0.084	0.153	−0.150	−0.033	0.054	0.143
19	0.085	0.000	−0.043	0.084	0.095	−0.085	0.042	0.067	0.068
20	0.046	0.010	−0.119	−0.087	0.148	0.121	−0.085	−0.021	0.146
21	0.349	0.060	−0.427	−0.520	0.673	0.485	−0.467	−0.194	0.644
22	−2.795	0.000	−6.306	5.103	8.112	−7.701	−2.549	0.420	8.101
23	−3.984	0.000	−31.852	2.456	31.947	22.679	22.500	1.052	31.930
24	1.173	0.000	0.279	0.987	1.026	−0.391	0.949	0.999	0.233
25	9.582	0.639	9.386	5.007	10.638	8.866	5.879	−9.820	4.092
26	1.234	0.069	1.002	2.159	2.380	0.437	2.340	1.496	1.851
27	0.029	−0.017	−0.180	−0.141	0.229	−0.048	−0.224	0.182	0.138
28	0.185	−0.012	−0.023	−0.017	0.029	0.000	−0.029	0.024	0.016