

Сферическое движение

Твердое тело совершает сферическое движение, заданном углами Эйлера. Найти скорость и ускорение точки, положение которой дано относительно подвижных осей координат.

Кирсанов М.Н. **Решбник. Теоретическая механика**/Под ред. А. И. Кириллова. – М.: ФИЗМАТЛИТ, 2008. – 384 с. (с.222.)

Задача К-15.1.

15

$$\begin{aligned}\psi &= \pi/4, \quad \theta = 3 \ln(4t + 2), \\ \varphi &= t^2 + 4t + 4, \quad x = 1, \quad y = 3, \quad z = 4. \\ t &= 3 \text{ с.}\end{aligned}$$

Задача К-15.2.

15

$$\begin{aligned}\psi &= 2t^2 + 3t + 3, \quad \theta = \pi/3, \\ \varphi &= 3\sqrt{3t + 3}, \quad x = 2, \quad y = 2, \quad z = 3. \\ t &= 3 \text{ с.}\end{aligned}$$

Задача К-15.3.

15

$$\begin{aligned}\psi &= 3t^2 + 3t + 2, \quad \theta = 3\sqrt{2t + 3}, \\ \varphi &= \pi/3, \quad x = 3, \quad y = 2, \quad z = 3. \\ t &= 3 \text{ с.}\end{aligned}$$

Задача К-15.4.

15

$$\begin{aligned}\psi &= \pi/2, \quad \theta = (t/2) \sin^2 4t - 2t, \\ \varphi &= 12e^{t/2}, \quad x = 1, \quad y = 1, \quad z = 4. \\ t &= 1 \text{ с.}\end{aligned}$$

Задача К-15.5.

15

$$\begin{aligned}\psi &= 3t^2 + 10t + 2, \quad \theta = 20e^{t/4}, \\ \varphi &= \pi/2, \quad x = 3, \quad y = 9, \quad z = 3. \\ t &= 2 \text{ с.}\end{aligned}$$

Задача К-15.6.

15

$$\begin{aligned}\psi &= 16e^{t/4}, \quad \theta = 5 \ln(2t + 2), \\ \varphi &= \pi/2, \quad x = 3, \quad y = 5, \quad z = 2. \\ t &= 1 \text{ с.}\end{aligned}$$

Задача К-15.7.

15

$$\begin{aligned}\psi &= 15e^{t/4}, \quad \theta = 4 \ln(2t + 2), \\ \varphi &= \pi/6, \quad x = 3, \quad y = 4, \quad z = 2. \\ t &= 3 \text{ с.}\end{aligned}$$

Задача К-15.8.

15

$$\begin{aligned}\psi &= 10(t + 1)^{1/5}, \quad \theta = \pi/2, \\ \varphi &= 2t^2 + 2t + 3, \quad x = 2, \quad y = 8, \quad z = 2. \\ t &= 1 \text{ с.}\end{aligned}$$

Задача К-15.9.

15

$$\begin{aligned}\psi &= \pi/3, \quad \theta = 6/(t + 2), \\ \varphi &= 3\sqrt{4t + 3}, \quad x = 1, \quad y = 2, \quad z = 4. \\ t &= 1 \text{ с.}\end{aligned}$$

Задача К-15.10.

15

$$\begin{aligned}\psi &= 6(t + 1)^{3/10}, \quad \theta = 8/(3t + 4), \\ \varphi &= \pi/6, \quad x = 3, \quad y = 4, \quad z = 2. \\ t &= 2 \text{ с.}\end{aligned}$$

Задача К-15.11.

15

$$\begin{aligned}\psi &= 4(t + 1)^{3/10}, \quad \theta = (t/2) \sin 8t + 3t, \\ \varphi &= \pi/3, \quad x = 3, \quad y = 2, \quad z = 2. \\ t &= 2 \text{ с.}\end{aligned}$$

Задача К-15.12.

15

$$\begin{aligned}\psi &= (t/2) \sin^2 8t - 9t, \quad \theta = 8 \ln(2t + 2), \\ \varphi &= \pi/2, \quad x = 3, \quad y = 8, \quad z = 3. \\ t &= 1 \text{ с.}\end{aligned}$$

Задача К-15.13.

15

$$\begin{aligned}\psi &= 7/(2t + 3), \quad \theta = \pi/4, \\ \varphi &= 3 \ln(3t + 2), \quad x = 2, \quad y = 3, \quad z = 2. \\ t &= 2 \text{ с.}\end{aligned}$$

Задача К-15.14.

15

$$\begin{aligned}\psi &= (t/2) \sin^2 6t - 10t, \quad \theta = \pi/2, \\ \varphi &= \ln(3t + 2), \quad x = 2, \quad y = 9, \quad z = 3. \\ t &= 3 \text{ с.}\end{aligned}$$

Задача К-15.15.

15

$$\psi = 3t^2 + 5t + 2, \theta = (t/2) \sin^2 8t - 5t,$$

$$\varphi = \pi/6, x = 3, y = 4, z = 3.$$

$$t = 2 \text{ с.}$$

Задача К-15.16.

15

$$\psi = 6 \ln(2t + 2), \theta = 7\sqrt{2t + 7},$$

$$\varphi = \pi/2, x = 3, y = 6, z = 3.$$

$$t = 2 \text{ с.}$$

Задача К-15.17.

15

$$\psi = 2t^2 + 2t + 3, \theta = \pi/2,$$

$$\varphi = \ln(3t + 2), x = 2, y = 1, z = 3.$$

$$t = 3 \text{ с.}$$

Задача К-15.18.

15

$$\psi = \pi/2, \theta = 5/(t + 2),$$

$$\varphi = 3t + (t/4) \cos^2 8t, x = 1, y = 5, z = 4.$$

$$t = 1 \text{ с.}$$

Задача К-15.19.

15

$$\psi = 6t + (t/2) \cos^2 6t, \theta = \pi/6,$$

$$\varphi = (t/2) \sin 6t + 5t, x = 2, y = 4, z = 4.$$

$$t = 3 \text{ с.}$$

Задача К-15.20.

15

$$\psi = \pi/3, \theta = (t/2) \sin^2 4t - 3t,$$

$$\varphi = 6/(t + 2), x = 1, y = 2, z = 4.$$

$$t = 3 \text{ с.}$$

Задача К-15.21.

15

$$\psi = \pi/2, \theta = 2\sqrt{4t + 2},$$

$$\varphi = t^2 + 2t + 4, x = 1, y = 6, z = 4.$$

$$t = 2 \text{ с.}$$

Задача К-15.22.

15

$$\psi = 3(t + 1)^{3/10}, \theta = (t/2) \sin 8t + 2t,$$

$$\varphi = \pi/2, x = 3, y = 1, z = 2.$$

$$t = 1 \text{ с.}$$

Задача К-15.23.

15

$$\psi = \pi/2, \theta = (t/2) \sin^2 4t - 2t,$$

$$\varphi = 2\sqrt{4t + 2}, x = 1, y = 8, z = 4.$$

$$t = 2 \text{ с.}$$

Задача К-15.24.

15

$$\psi = 2 \ln(3t + 2), \theta = \pi/3,$$

$$\varphi = 4t + (t/2) \cos^2 6t, x = 2, y = 2, z = 3.$$

$$t = 1 \text{ с.}$$

Задача К-15.25.

15

$$\psi = 6/(2t + 3), \theta = \pi/3,$$

$$\varphi = 2t^2 + 3t + 3, x = 2, y = 2, z = 2.$$

$$t = 3 \text{ с.}$$

Задача К-15.26.

15

$$\psi = \pi/4, \theta = (t/2) \sin^2 4t - 4t,$$

$$\varphi = 5t + (t/4) \cos^2 8t, x = 1, y = 3, z = 4.$$

$$t = 2 \text{ с.}$$

Задача К-15.27.

15

$$\psi = 5 \ln(3t + 2), \theta = \pi/2,$$

$$\varphi = 12e^{t/3}, x = 2, y = 5, z = 3.$$

$$t = 3 \text{ с.}$$

Задача К-15.28.

15

$$\psi = \ln(3t + 2), \theta = \pi/2,$$

$$\varphi = 3t + (t/2) \cos^2 6t, x = 2, y = 1, z = 3.$$

$$t = 1 \text{ с.}$$

Задача К-15.29.

15

$$\psi = (t/2) \sin^2 6t - 5t, \theta = \pi/6,$$

$$\varphi = 2t^2 + 5t + 3, x = 2, y = 4, z = 3.$$

$$t = 2 \text{ с.}$$

Задача К-15.30.

15

$$\psi = \pi/3, \theta = t^2 + 3t + 4,$$

$$\varphi = (t/2) \sin 4t + 3t, x = 1, y = 2, z = 4.$$

$$t = 1 \text{ с.}$$

К-15

Ответы.**Сферическое движение**

23.11.2013

	v_x	v_y	v_z	v	a_x	a_y	a_z	a
1	-29.546	6.602	2.435	30.373	-105.853	-299.098	20.164	41.678
2	-39.708	49.690	-6.655	63.954	-356.062	-379.627	-872.915	71.288
3	48.651	-81.386	5.606	94.985	-1534.278	-974.611	-823.342	5.649
4	-9.824	9.943	-0.030	13.977	-95.312	-87.383	-3.168	10.751
5	-27.166	-65.183	222.716	233.643	-193.083	-5475.232	-1577.619	1723.694
6	-25.470	6.080	23.006	34.857	-46.258	-217.838	6.481	75.633
7	25.503	-19.486	0.718	32.103	-36.021	-115.492	-230.295	36.354
8	-46.268	10.491	4.305	47.637	-100.964	-282.645	96.888	64.324
9	-1.878	2.046	-0.553	2.832	-5.986	-10.755	4.869	7.474
10	-1.048	1.561	-1.549	2.436	-2.556	-0.414	1.694	1.102
11	0.196	2.748	-3.042	4.104	-18.934	-11.278	31.256	37.818
12	-4.314	-33.200	92.848	98.700	-27.493	-1244.376	98.596	664.216
13	-3.173	1.828	0.431	3.687	-0.644	-3.080	-1.531	1.456
14	26.194	26.899	-98.159	105.095	-926.676	-853.740	-502.632	24.279
15	85.204	-49.620	-19.044	100.422	-937.374	-1358.319	-613.036	283.816
16	-2.267	3.613	-4.959	6.541	-11.695	7.204	-16.974	29.320
17	-31.183	-27.889	30.085	51.530	-318.893	-293.502	-574.684	19.817
18	-17.577	1.374	2.677	17.833	-166.011	-33.292	3.617	164.265
19	-67.421	13.647	20.064	71.655	-428.573	-988.722	-80.592	204.006
20	18.417	6.733	-7.971	21.167	-61.295	-23.752	-84.813	29.293
21	-33.285	1.730	5.726	33.818	-44.657	-219.258	54.131	50.184
22	-2.394	-1.994	4.588	5.546	56.251	0.057	-99.783	114.947
23	-9.693	11.559	-20.695	25.610	0.754	-5.077	-154.003	140.212
24	-13.195	15.439	-1.496	20.365	-16.603	-142.382	-32.248	99.363
25	-29.891	29.598	0.293	42.067	-453.639	-437.422	6.239	15.063
26	-24.879	-8.796	12.816	29.335	-21.514	-155.430	-93.191	27.938
27	-52.896	17.928	5.384	56.111	-252.336	-589.686	101.553	80.340
28	-6.319	9.785	0.951	11.686	-11.637	-82.167	-10.376	63.350
29	-18.928	22.319	-17.139	33.914	-132.758	-242.036	27.834	100.343
30	-13.323	19.049	-6.194	24.057	-3.561	-19.609	-133.989	37.395

К-15 файл o15k15B

	ω_x	ω_y	ω_z	ω	ε_x	ε_y	ε_z	ε
1	0.850	0.113	10.000	10.037	0.892	-8.528	2.000	8.805
2	-10.697	-7.370	8.799	15.690	-12.426	11.931	1.838	17.325
3	7.995	3.461	-19.134	21.024	-14.484	-8.234	-14.121	21.841
4	-0.013	0.017	9.892	9.892	-1.213	1.998	4.946	5.471
5	21.998	-8.244	0.271	23.494	8.230	-2.061	-181.272	181.470
6	3.101	-2.500	4.094	5.712	11.011	1.250	-6.730	12.965
7	4.416	5.649	-3.551	8.001	-1.105	-1.413	-7.988	8.187
8	0.755	0.866	6.000	6.109	4.894	-4.874	4.000	7.982
9	0.055	0.664	2.268	2.364	1.470	-0.569	-0.648	1.704
10	0.091	0.638	0.581	0.868	-0.015	-0.314	0.008	0.314
11	-0.615	0.604	0.506	1.000	4.289	-8.162	-0.309	9.225
12	10.106	-4.000	-0.961	10.911	57.172	2.000	-46.225	73.548
13	0.009	-0.202	0.923	0.945	-0.232	0.105	-0.306	0.399
14	-8.784	9.549	0.273	12.978	-0.514	5.786	-0.074	5.809
15	1.905	8.888	-14.635	17.228	68.211	11.365	19.004	71.715
16	-1.882	-2.111	-0.677	2.908	-0.803	0.192	4.197	4.278
17	9.478	-10.304	0.273	14.003	-0.102	-5.529	-0.074	5.530
18	0.550	0.075	3.576	3.619	-0.097	-2.018	30.645	30.712
19	3.965	-2.101	14.754	15.421	-12.635	-28.760	17.507	35.962
20	-1.743	4.484	-0.240	4.817	1.383	-6.744	0.096	6.885
21	1.067	0.679	6.000	6.132	3.859	-6.540	2.000	7.853
22	0.334	-1.418	-0.442	1.522	-0.744	31.659	-0.319	31.670
23	-2.574	0.107	1.265	2.870	-15.175	3.889	-0.253	15.667
24	-1.007	-0.259	6.210	6.296	-0.846	5.802	-30.739	31.293
25	0.127	-0.020	14.926	14.926	-0.353	-1.893	4.033	4.469
26	3.173	-3.297	3.897	6.010	-2.222	-23.406	-26.695	35.573
27	1.273	0.490	10.873	10.958	4.978	-13.971	3.624	15.268
28	-0.188	-0.570	4.610	4.649	-2.513	1.210	-30.379	30.507
29	-3.228	2.113	6.317	7.402	33.861	37.784	17.225	53.581
30	-4.339	-2.484	1.693	5.279	-5.941	6.351	6.054	10.597