

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

Задача К-15.1.

13

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

Задача К-15.2.

13

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

Задача К-15.3.

13

$$\begin{aligned}\psi &= 2t^2 + 8t + 3, \quad \theta = \pi/2, \\ \varphi &= (t/2) \sin^2 6t - 2t, \quad x = 2, \quad y = 7, \quad z = 3. \\ t &= 2 \text{ с.}\end{aligned}$$

Задача К-15.4.

13

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

Задача К-15.5.

13

$$\begin{aligned}\psi &= 10\sqrt{3t + 10}, \quad \theta = \pi/2, \\ \varphi &= 12e^{t/3}, \quad x = 2, \quad y = 9, \quad z = 4. \\ t &= 1 \text{ с.}\end{aligned}$$

Задача К-15.6.

13

$$\begin{aligned}\psi &= \pi/2, \quad \theta = 3t + (t/4) \cos^2 8t, \\ \varphi &= 3(t + 1)^{1/10}, \quad x = 1, \quad y = 5, \quad z = 4. \\ t &= 3 \text{ с.}\end{aligned}$$

Задача К-15.7.

13

$$\begin{aligned}\psi &= (t/2) \sin 6t + 6t, \quad \theta = \pi/2, \\ \varphi &= 2\sqrt{3t + 2}, \quad x = 2, \quad y = 5, \quad z = 1. \\ t &= 3 \text{ с.}\end{aligned}$$

Задача К-15.8.

13

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

Задача К-15.9.

13

$$\begin{aligned}\psi &= 11(t + 1)^{1/5}, \quad \theta = \pi/2, \\ \varphi &= 2t^2 + 2t + 3, \quad x = 2, \quad y = 9, \quad z = 2. \\ t &= 2 \text{ с.}\end{aligned}$$

Задача К-15.10.

13

$$\begin{aligned}\psi &= 10\sqrt{2t + 10}, \quad \theta = (t/2) \sin 8t + 10t, \\ \varphi &= \pi/2, \quad x = 3, \quad y = 9, \quad z = 4. \\ t &= 1 \text{ с.}\end{aligned}$$

Задача К-15.11.

13

$$\begin{aligned}\psi &= 9(t + 1)^{1/5}, \quad \theta = \pi/2, \\ \varphi &= 3(t + 1)^{1/5}, \quad x = 2, \quad y = 7, \quad z = 2. \\ t &= 2 \text{ с.}\end{aligned}$$

Задача К-15.12.

13

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

Задача К-15.13.

13

$$\begin{aligned}\psi &= (t/2) \sin 8t + 7t, \quad \theta = 7\sqrt{2t + 7}, \\ \varphi &= \pi/2, \quad x = 3, \quad y = 6, \quad z = 1. \\ t &= 2 \text{ с.}\end{aligned}$$

Задача К-15.14.

13

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

Задача К-15.15.

13

$$\psi = 18e^{t/4}, \theta = (t/2) \sin^2 8t - 8t,$$
$$\varphi = \pi/2, x = 3, y = 7, z = 2.$$

$$t = 1 \text{ с.}$$

Задача К-15.16.

13

$$\psi = \pi/4, \theta = t^2 + 4t + 4,$$
$$\varphi = 14e^{t/2}, x = 1, y = 3, z = 4.$$

$$t = 2 \text{ с.}$$

Задача К-15.17.

13

$$\psi = 10\sqrt{3t+10}, \theta = \pi/2,$$
$$\varphi = 2t^2 + 2t + 3, x = 2, y = 9, z = 4.$$

$$t = 3 \text{ с.}$$

Задача К-15.18.

13

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

$$t = 1 \text{ с.}$$

Задача К-15.19.

13

$$\psi = (t/2) \sin 8t + 6t, \theta = 3t^2 + 6t + 2,$$
$$\varphi = \pi/2, x = 3, y = 5, z = 1.$$

$$t = 1 \text{ с.}$$

Задача К-15.20.

13

$$\psi = \pi/2, \theta = \ln(4t + 2),$$
$$\varphi = (t/2) \sin 4t + 2t, x = 1, y = 7, z = 4.$$

$$t = 3 \text{ с.}$$

Задача К-15.21.

13

$$\psi = \pi/3, \theta = 3\sqrt{4t+3},$$
$$\varphi = 4t + (t/4) \cos^2 8t, x = 1, y = 2, z = 4.$$

$$t = 1 \text{ с.}$$

Задача К-15.22.

13

$$\psi = 5/(3t+4), \theta = 12e^{t/4},$$
$$\varphi = \pi/2, x = 3, y = 1, z = 2.$$

$$t = 3 \text{ с.}$$

Задача К-15.23.

13

$$\psi = (t/2) \sin^2 8t - 10t, \theta = (t/2) \sin 8t + 10t,$$
$$\varphi = \pi/2, x = 3, y = 9, z = 3.$$

$$t = 1 \text{ с.}$$

Задача К-15.24.

13

$$\psi = \pi/2, \theta = 3(t+1)^{1/10},$$
$$\varphi = 12e^{t/2}, x = 1, y = 8, z = 4.$$

$$t = 3 \text{ с.}$$

Задача К-15.25.

13

$$\psi = 8/(3t+4), \theta = 5\sqrt{2t+5},$$
$$\varphi = \pi/6, x = 3, y = 4, z = 2.$$

$$t = 3 \text{ с.}$$

Задача К-15.26.

13

$$\psi = (t/2) \sin 6t + 6t, \theta = \pi/2,$$
$$\varphi = (t/2) \sin 6t + 2t, x = 2, y = 5, z = 1.$$

$$t = 3 \text{ с.}$$

Задача К-15.27.

13

$$\psi = \pi/2, \theta = (t/2) \sin^2 4t - 2t,$$
$$\varphi = 5/(t+2), x = 1, y = 1, z = 4.$$

$$t = 2 \text{ с.}$$

Задача К-15.28.

13

$$\psi = (t/2) \sin^2 6t - 8t, \theta = \pi/2,$$
$$\varphi = 5/(2t+3), x = 2, y = 7, z = 3.$$

$$t = 3 \text{ с.}$$

Задача К-15.29.

13

$$\psi = \pi/2, \theta = (t/2) \sin^2 4t - 2t,$$
$$\varphi = (t/2) \sin 4t + 2t, x = 1, y = 6, z = 4.$$

$$t = 2 \text{ с.}$$

Задача К-15.30.

13

$$\psi = \pi/2, \theta = 3t + (t/4) \cos^2 8t,$$
$$\varphi = (t/2) \sin^2 4t - 2t, x = 1, y = 9, z = 4.$$

$$t = 3 \text{ с.}$$

К-15

Ответы.**Сферическое движение**

23.11.2013

	v_x	v_y	v_z	v	a_x	a_y	a_z	a
1	-8.777	9.938	-4.087	13.875	-19.047	-38.894	-12.576	13.914
2	0.233	7.035	-5.334	8.832	-2.436	-6.300	-14.166	25.258
3	-3.245	-40.883	97.557	105.827	-1339.652	-1155.773	-143.226	358.346
4	-52.505	44.094	-17.842	70.848	-734.955	-1034.035	146.666	146.830
5	-58.675	25.511	-28.062	69.864	-18.941	-379.054	-357.920	164.078
6	5.010	17.397	-22.999	29.270	-6.626	-21.424	-185.747	132.135
7	2.974	-0.928	-1.308	3.379	1.871	-5.393	11.804	39.952
8	-12.153	10.579	-2.477	16.302	-23.592	-47.042	-25.811	14.593
9	-91.388	18.812	6.735	93.547	-240.304	-895.684	-104.623	74.116
10	-25.196	5.970	5.465	26.464	-132.222	172.033	-462.990	259.741
11	-2.982	1.337	-1.698	3.682	1.721	-1.503	-3.241	1.307
12	-26.727	-17.490	11.054	33.800	-81.266	-52.063	-252.273	10.699
13	4.331	-0.239	-11.560	12.347	5.296	-18.669	-56.328	71.787
14	-59.046	-65.405	93.338	128.360	-1655.170	-1290.712	-1909.642	133.737
15	4.685	16.718	-65.540	67.801	-164.603	-457.063	-451.854	576.113
16	-68.262	-10.956	25.283	73.613	-464.052	-1273.694	-283.449	639.114
17	-130.021	14.836	31.631	134.633	-459.481	-1859.061	-118.903	232.449
18	0.163	-0.052	-0.385	0.422	-6.439	-2.478	24.095	24.818
19	-12.120	5.490	8.910	16.013	-437.431	210.664	2.552	408.904
20	-25.215	2.714	1.554	25.408	-43.586	-91.002	8.753	34.165
21	-2.255	10.469	-4.671	11.683	-92.251	-19.795	-1.163	37.838
22	-12.616	-0.209	19.029	22.833	-124.238	3.167	-75.891	5.649
23	-76.450	-13.280	116.289	139.800	-364.894	-2047.562	-7.124	1181.308
24	-214.995	27.211	-0.673	216.712	-830.689	-5771.316	9.321	99.577
25	-1.683	-2.447	7.418	7.991	-3.556	-10.711	-5.170	1.412
26	-13.593	12.847	-37.047	41.501	-322.413	-224.904	47.020	45.625
27	10.090	2.936	-3.257	11.002	49.949	16.740	-46.932	64.431
28	-27.110	17.119	-21.870	38.811	191.780	-119.307	-351.578	14.808
29	-20.314	-0.516	5.853	21.147	-29.996	-41.934	-41.397	19.400
30	26.783	-20.327	39.040	51.523	-182.920	-359.706	191.416	246.899

К-15 файл o15k13B

	ω_x	ω_y	ω_z	ω	ε_x	ε_y	ε_z	ε
1	-1.264	0.147	3.073	3.326	1.024	2.187	-1.844	3.038
2	-2.264	-1.458	-2.021	3.367	-2.144	-7.854	-2.328	8.468
3	10.483	-12.087	-4.717	16.681	59.633	46.425	15.270	77.101
4	-2.649	3.622	16.748	17.339	31.149	25.639	8.596	41.250
5	-3.587	-2.108	5.582	6.962	-11.355	20.265	1.861	23.304
6	-4.328	1.360	0.086	4.537	-19.425	6.515	-0.019	20.488
7	2.737	7.497	0.905	8.032	11.417	10.222	-0.123	15.325
8	-1.166	-0.510	3.541	3.762	-0.458	2.950	-1.250	3.237
9	0.594	-0.694	10.000	10.042	-7.098	-5.756	4.000	9.976
10	-2.532	-9.418	-1.386	9.850	-12.845	31.659	23.963	41.732
11	-0.419	-0.619	0.249	0.788	-0.042	0.269	-0.066	0.281
12	4.322	-6.732	-0.200	8.002	2.427	-0.818	0.080	2.562
13	-2.982	-2.111	-1.074	3.808	-10.934	0.192	3.173	11.387
14	15.414	-15.698	-1.249	22.036	-15.171	-23.657	4.539	28.468
15	-5.441	9.152	1.945	10.823	-19.164	61.290	-49.305	80.962
16	7.496	-2.794	19.028	20.641	-51.299	-143.333	9.514	152.534
17	3.291	-1.005	14.000	14.417	-14.334	-45.996	4.000	48.344
18	-1.988	-1.197	-0.680	2.418	28.614	11.144	9.004	32.000
19	-5.418	-12.000	0.024	13.166	31.947	-6.000	64.875	72.563
20	0.243	0.150	3.688	3.699	0.483	-0.940	4.293	4.421
21	-1.473	1.724	4.576	5.107	8.310	6.249	30.645	32.361
22	-0.024	-6.351	-0.086	6.352	-0.532	-1.588	0.191	1.685
23	9.782	-9.418	5.355	14.596	104.195	31.659	-62.692	125.655
24	-0.080	0.031	26.890	26.890	0.863	2.150	13.445	13.643
25	1.360	-0.659	0.091	1.514	-0.075	0.144	-0.206	0.263
26	-4.885	6.311	3.981	8.919	16.851	30.137	13.518	37.080
27	-0.812	2.444	-0.313	2.595	-5.595	14.287	0.156	15.344
28	-5.789	-9.325	-0.123	10.976	-1.278	-4.629	0.055	4.802
29	0.556	-2.515	1.709	3.091	-0.989	-15.912	-7.915	17.799
30	4.129	-1.879	-3.811	5.925	25.807	7.250	6.787	27.651