

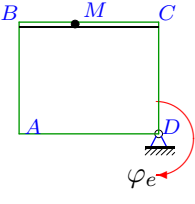
Сложное движение точки, плоская траектория

Геометрическая фигура вращается вокруг оси, перпендикулярной ее плоскости. По каналу, расположенному на фигуре, движется точка M по известному закону $\sigma(t)$. Найти абсолютную скорость и абсолютное ускорение точки при $t = t_1$. Даны функция $\sigma(t)$, закон вращения фигуры $\varphi_e(t)$ (или постоянная угловая скорость ω_e), время t_1 и размеры фигуры. BM или AM — длина отрезка прямой или дуги окружности.

Кирсанов М.Н. **Решбник. Теоретическая механика**/Под ред. А. И. Кириллова. — М.: ФИЗМАТЛИТ, 2002. — 384 с. (с.195.)

Задача 10.1. 10

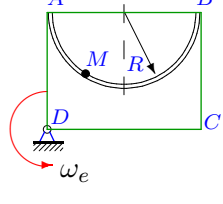
$\sigma(t) = BM = \frac{1}{2}(t^2 + 3)t$ см.



$\varphi_e = 0.19t^2$,
 $AB = 7$ см,
 $BC = 14$ см,
 $t_1 = 2$ с.

Задача 10.2. 10

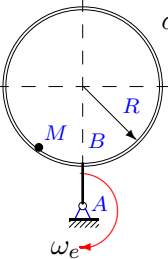
$\sigma(t) = AM = \frac{\pi}{6}(t^3 + 3)$ см.



$\omega_e = 0.82$ рад/с,
 $R = 11$ см,
 $AD = 13$ см,
 $t_1 = 2$ с.

Задача 10.3. 10

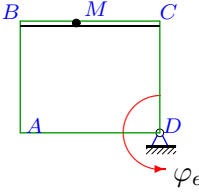
$\sigma(t) = BM = \frac{3\pi}{2}(t^2 + 4t)$ см.



$\omega_e = 2.04$ рад/с,
 $R = 12$ см,
 $AB = 2$ см,
 $t_1 = 2$ с.

Задача 10.4. 10

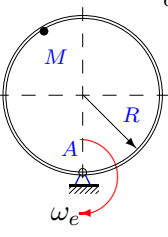
$\sigma(t) = BM = \frac{3}{4}(t^2 + 4t)$ см.



$\varphi_e = 0.22t^2$,
 $AB = 6$ см,
 $BC = 12$ см,
 $t_1 = 2$ с.

Задача 10.5. 10

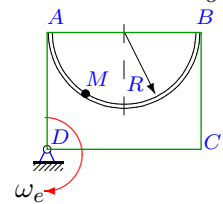
$\sigma(t) = AM = \frac{3\pi}{4}(t^2 + 2t)$ см.



$\omega_e = 1.7$ рад/с,
 $R = 3$ см,
 $t_1 = 1$ с.

Задача 10.6. 10

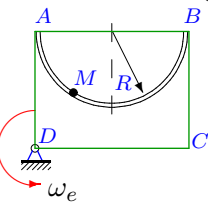
$\sigma(t) = AM = \frac{\pi}{4}(t^2 + 2t)$ см.



$\omega_e = 1.04$ рад/с,
 $R = 3$ см,
 $AD = 5$ см,
 $t_1 = 1$ с.

Задача 10.7. 10

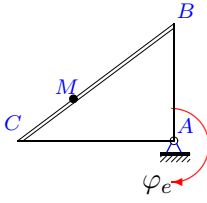
$\sigma(t) = AM = \frac{\pi}{3}(t^3 + 4)$ см.



$\omega_e = 1.7$ рад/с,
 $R = 31$ см,
 $AD = 33$ см,
 $t_1 = 3$ с.

Задача 10.8. 10

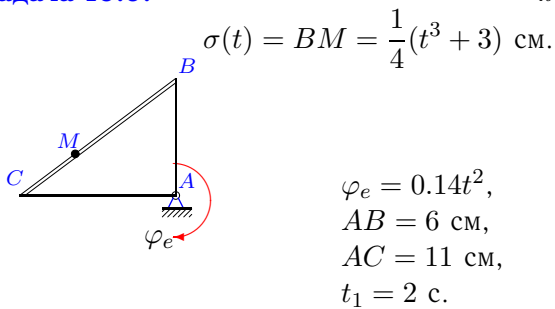
$\sigma(t) = BM = \frac{2}{3}(t^2 + 2t)$ см.



$\varphi_e = 0.63t^2$,
 $AB = 2$ см,
 $AC = 4$ см,
 $t_1 = 1$ с.

Задача 10.9.

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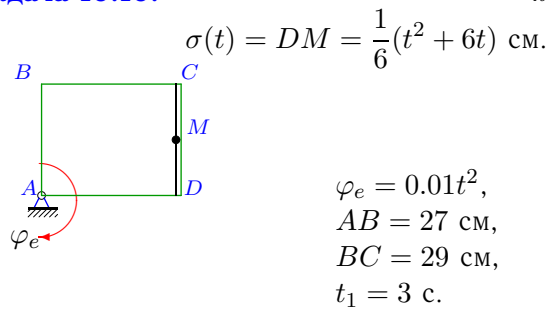


$$\sigma(t) = BM = \frac{1}{4}(t^3 + 3) \text{ см.}$$

$$\begin{aligned} \varphi_e &= 0.14t^2, \\ AB &= 6 \text{ см,} \\ AC &= 11 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

Задача 10.10.

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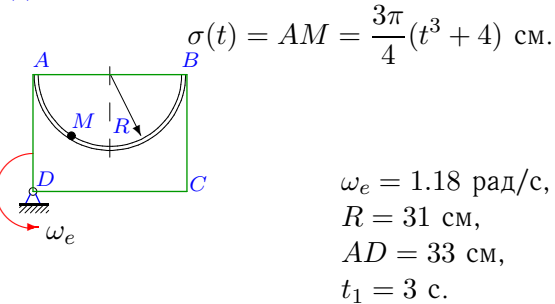


$$\sigma(t) = DM = \frac{1}{6}(t^2 + 6t) \text{ см.}$$

$$\begin{aligned} \varphi_e &= 0.01t^2, \\ AB &= 27 \text{ см,} \\ BC &= 29 \text{ см,} \\ t_1 &= 3 \text{ с.} \end{aligned}$$

Задача 10.11.

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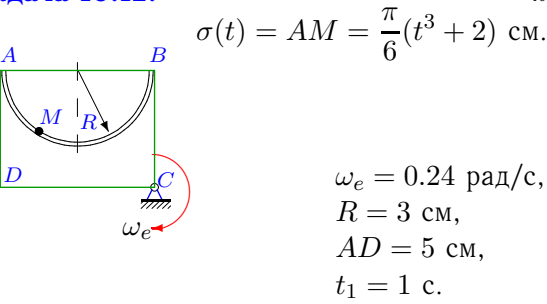


$$\sigma(t) = AM = \frac{3\pi}{4}(t^3 + 4) \text{ см.}$$

$$\begin{aligned} \omega_e &= 1.18 \text{ рад/с,} \\ R &= 31 \text{ см,} \\ AD &= 33 \text{ см,} \\ t_1 &= 3 \text{ с.} \end{aligned}$$

Задача 10.12.

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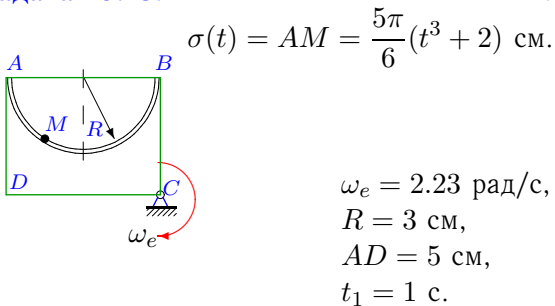


$$\sigma(t) = AM = \frac{\pi}{6}(t^3 + 2) \text{ см.}$$

$$\begin{aligned} \omega_e &= 0.24 \text{ рад/с,} \\ R &= 3 \text{ см,} \\ AD &= 5 \text{ см,} \\ t_1 &= 1 \text{ с.} \end{aligned}$$

Задача 10.13.

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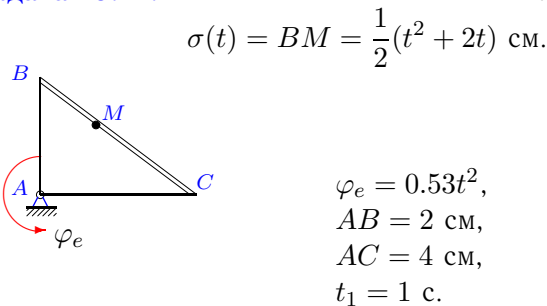


$$\sigma(t) = AM = \frac{5\pi}{6}(t^3 + 2) \text{ см.}$$

$$\begin{aligned} \omega_e &= 2.23 \text{ рад/с,} \\ R &= 3 \text{ см,} \\ AD &= 5 \text{ см,} \\ t_1 &= 1 \text{ с.} \end{aligned}$$

Задача 10.14.

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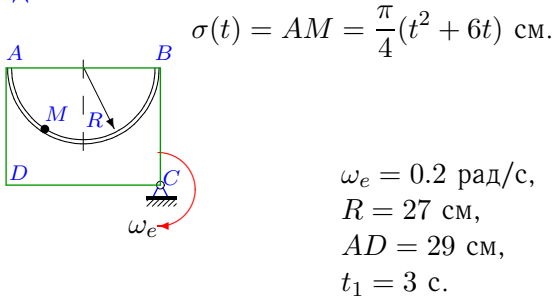


$$\sigma(t) = BM = \frac{1}{2}(t^2 + 2t) \text{ см.}$$

$$\begin{aligned} \varphi_e &= 0.53t^2, \\ AB &= 2 \text{ см,} \\ AC &= 4 \text{ см,} \\ t_1 &= 1 \text{ с.} \end{aligned}$$

Задача 10.15.

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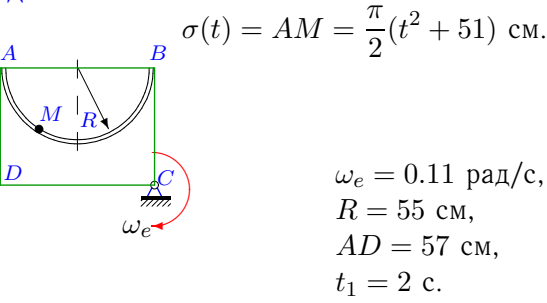


$$\sigma(t) = AM = \frac{\pi}{4}(t^2 + 6t) \text{ см.}$$

$$\begin{aligned} \omega_e &= 0.2 \text{ рад/с,} \\ R &= 27 \text{ см,} \\ AD &= 29 \text{ см,} \\ t_1 &= 3 \text{ с.} \end{aligned}$$

Задача 10.16.

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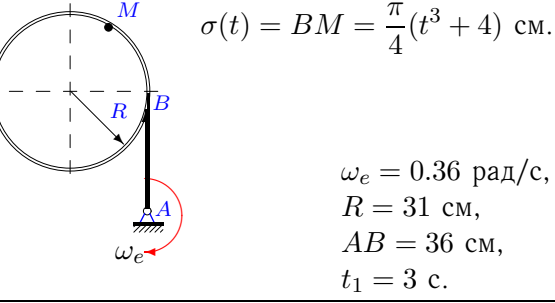


$$\sigma(t) = AM = \frac{\pi}{2}(t^2 + 51) \text{ см.}$$

$$\begin{aligned} \omega_e &= 0.11 \text{ рад/с,} \\ R &= 55 \text{ см,} \\ AD &= 57 \text{ см,} \\ t_1 &= 2 \text{ с.} \end{aligned}$$

Задача 10.17.

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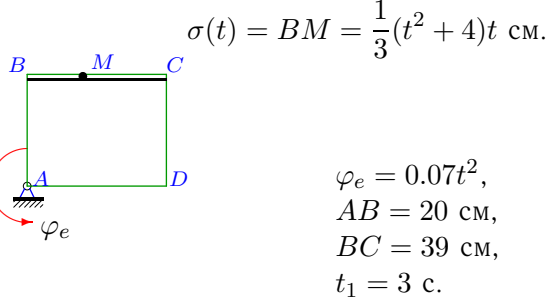


$$\sigma(t) = BM = \frac{\pi}{4}(t^3 + 4) \text{ см.}$$

$$\begin{aligned} \omega_e &= 0.36 \text{ рад/с,} \\ R &= 31 \text{ см,} \\ AB &= 36 \text{ см,} \\ t_1 &= 3 \text{ с.} \end{aligned}$$

Задача 10.18.

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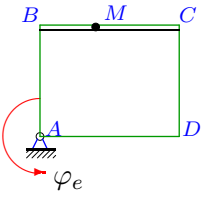
$$\sigma(t) = BM = \frac{1}{3}(t^2 + 4)t \text{ см.}$$

$$\begin{aligned} \varphi_e &= 0.07t^2, \\ AB &= 20 \text{ см,} \\ BC &= 39 \text{ см,} \\ t_1 &= 3 \text{ с.} \end{aligned}$$

Задача 10.19.

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$$\sigma(t) = BM = \frac{2}{3}(t^2 + 3)t \text{ см.}$$

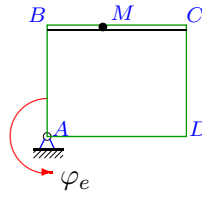


$$\begin{aligned} \varphi_e &= 0.21t^2, \\ AB &= 7 \text{ см}, \\ BC &= 14 \text{ см}, \\ t_1 &= 2 \text{ с.} \end{aligned}$$

Задача 10.20.

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$$\sigma(t) = BM = \frac{1}{3}(t^2 + 2)t \text{ см.}$$

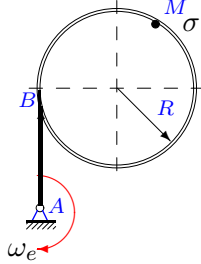


$$\begin{aligned} \varphi_e &= 0.37t^2, \\ AB &= 2 \text{ см}, \\ BC &= 3 \text{ см}, \\ t_1 &= 1 \text{ с.} \end{aligned}$$

Задача 10.21.

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$$\sigma(t) = BM = \frac{3\pi}{4}(t^2 + 2t) \text{ см.}$$

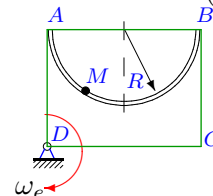


$$\begin{aligned} \omega_e &= 0.83 \text{ рад/с}, \\ R &= 3 \text{ см}, \\ AB &= 8 \text{ см}, \\ t_1 &= 1 \text{ с.} \end{aligned}$$

Задача 10.22.

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$$\sigma(t) = AM = \frac{3\pi}{4}(t^2 + 52) \text{ см.}$$

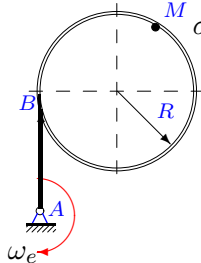


$$\begin{aligned} \omega_e &= 0.13 \text{ рад/с}, \\ R &= 61 \text{ см}, \\ AD &= 63 \text{ см}, \\ t_1 &= 3 \text{ с.} \end{aligned}$$

Задача 10.23.

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$$\sigma(t) = BM = \frac{3\pi}{4}(t^3 + 2) \text{ см.}$$

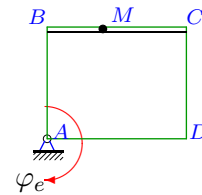


$$\begin{aligned} \omega_e &= 0.62 \text{ рад/с}, \\ R &= 3 \text{ см}, \\ AB &= 8 \text{ см}, \\ t_1 &= 1 \text{ с.} \end{aligned}$$

Задача 10.24.

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$$\sigma(t) = BM = \frac{1}{6}(t^3 + 3) \text{ см.}$$

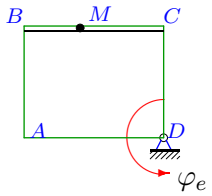


$$\begin{aligned} \varphi_e &= 0.08t^2, \\ AB &= 6 \text{ см}, \\ BC &= 11 \text{ см}, \\ t_1 &= 2 \text{ с.} \end{aligned}$$

Задача 10.25.

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$$\sigma(t) = BM = \frac{5}{6}(t^2 + 50) \text{ см.}$$

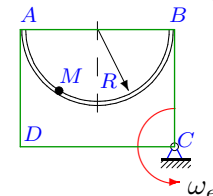


$$\begin{aligned} \varphi_e &= 0.03t^2, \\ AB &= 26 \text{ см}, \\ BC &= 51 \text{ см}, \\ t_1 &= 1 \text{ с.} \end{aligned}$$

Задача 10.26.

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$$\sigma(t) = AM = \frac{2\pi}{3}(t^2 + 2)t \text{ см.}$$

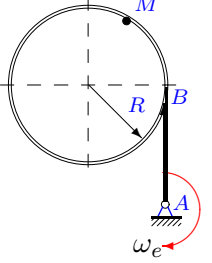


$$\begin{aligned} \omega_e &= 3.7 \text{ рад/с}, \\ R &= 3 \text{ см}, \\ AD &= 5 \text{ см}, \\ t_1 &= 1 \text{ с.} \end{aligned}$$

Задача 10.27.

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$$\sigma(t) = BM = \frac{\pi}{3}(t^3 + 3) \text{ см.}$$

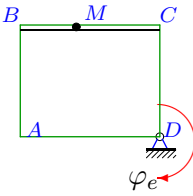


$$\begin{aligned} \omega_e &= 0.48 \text{ рад/с}, \\ R &= 11 \text{ см}, \\ AB &= 16 \text{ см}, \\ t_1 &= 2 \text{ с.} \end{aligned}$$

Задача 10.28.

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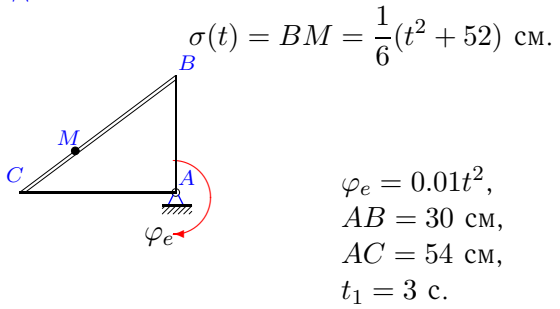
$$\sigma(t) = BM = \frac{2}{3}(t^2 + 6t) \text{ см.}$$



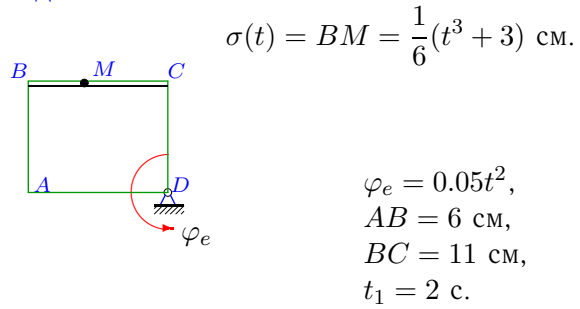
$$\begin{aligned} \varphi_e &= 0.08t^2, \\ AB &= 14 \text{ см}, \\ BC &= 27 \text{ см}, \\ t_1 &= 3 \text{ с.} \end{aligned}$$

Задача 10.29.

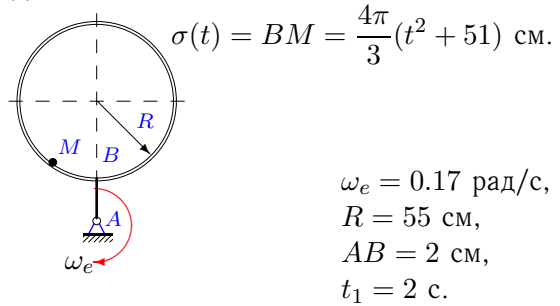
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**Задача 10.30.**

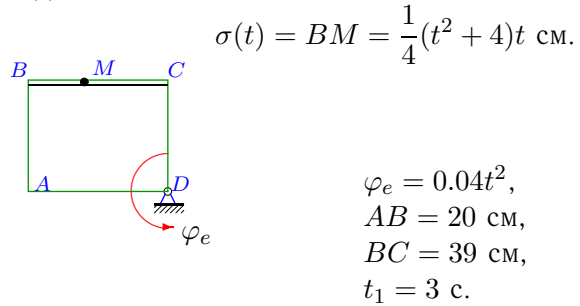
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**Задача 10.31.**

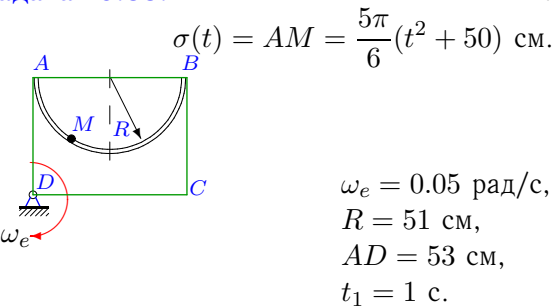
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**Задача 10.32.**

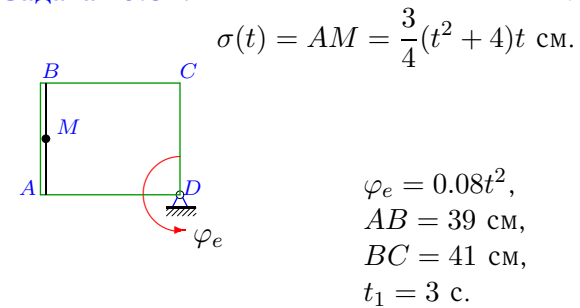
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**Задача 10.33.**

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**Задача 10.34.**

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Сложное движение точки, плоская траектория

№	R_e	v_r	v_e	v	a_r	a_e	a_c	a
	Радиус, см	Скорости, см/с			Ускорения, см/с ²			
1	9.899	7.500	7.524	13.880	6.000	6.844	11.400	18.022
2	7.643	6.283	6.268	5.193	7.236	5.139	10.304	14.617
3	18.439	37.699	37.616	68.425	118.810	76.736	153.812	329.220
4	6.708	6.000	5.903	2.736	1.500	5.975	10.560	4.744
5	5.543	9.425	9.424	18.486	29.981	16.020	32.044	76.467
6	3.010	3.142	3.130	6.085	3.646	3.255	6.535	6.859
7	16.677	28.274	28.350	18.598	31.943	48.196	96.133	84.846
8	2.103	2.667	2.650	1.453	1.333	4.262	6.720	5.913
9	5.269	3.000	2.951	0.085	3.000	2.215	3.360	2.291
10	29.347	2.000	1.761	0.375	0.333	0.596	0.240	0.346
11	54.068	63.617	63.800	112.069	137.270	75.284	150.137	322.544
12	6.602	1.571	1.585	1.625	3.247	0.380	0.754	3.486
13	3.523	7.854	7.856	14.032	25.875	17.520	35.029	24.954
14	1.889	2.000	2.002	0.650	1.000	2.917	4.240	3.276
15	47.145	9.425	9.429	9.015	3.646	1.886	3.770	3.201
16	55.036	6.283	6.054	8.882	3.223	0.666	1.382	3.869
17	58.628	21.206	21.106	19.179	20.255	7.598	15.268	8.817
18	23.854	10.333	10.019	5.792	6.000	5.372	8.680	7.031
19	11.667	10.000	9.800	8.857	8.000	9.580	16.800	15.854
20	2.236	1.667	1.655	0.763	2.000	2.058	2.467	2.112
21	11.343	9.425	9.415	18.604	29.981	7.814	15.645	53.162
22	106.012	14.137	13.782	13.068	5.739	1.792	3.676	3.287
23	11.343	7.069	7.033	13.925	21.846	4.360	8.765	33.378
24	6.274	2.000	2.008	3.964	2.000	1.192	1.280	3.532
25	27.354	1.667	1.641	0.521	1.667	1.644	0.200	0.426
26	2.832	10.472	10.478	0.363	38.654	38.768	77.493	76.576
27	26.112	12.566	12.534	9.028	19.079	6.016	12.064	10.877
28	16.643	8.000	7.989	15.341	1.333	4.669	7.680	11.022
29	26.592	1.000	1.596	0.631	0.333	0.540	0.120	0.186
30	10.956	2.000	2.191	2.000	2.000	1.180	0.800	1.802
31	97.000	16.755	16.490	32.068	9.810	2.803	5.697	16.454
32	35.434	7.750	8.504	7.615	4.500	3.493	3.720	4.590
33	99.061	5.236	4.953	3.999	5.264	0.248	0.524	5.061
34	50.364	23.250	24.175	14.487	13.500	14.128	22.320	17.555

№	a_r^n	a_r^τ	a_e^n	a_e^τ	a_x	a_y
1	0.000	6.000	5.718	-3.762	12.703	-12.783
2	3.589	6.283	5.139	0.000	14.183	-3.538
3	118.435	9.425	76.736	0.000	-322.187	-67.687
4	0.000	1.500	5.195	2.952	1.183	4.594
5	29.609	4.712	16.020	0.000	53.058	-55.064
6	3.290	1.571	3.255	0.000	-2.134	-6.519
7	25.788	18.850	48.196	0.000	32.490	78.379
8	0.000	1.333	3.339	-2.650	0.035	5.913
9	0.000	3.000	1.652	-1.475	-2.174	0.721
10	0.000	0.333	0.106	-0.587	0.226	-0.263
11	130.553	42.412	75.284	0.000	-242.175	213.040
12	0.822	3.142	0.380	0.000	1.953	-2.888
13	20.562	15.708	17.520	0.000	22.382	-11.035
14	0.000	1.000	2.122	2.002	-0.126	3.274
15	3.290	1.571	1.886	0.000	2.615	-1.846
16	0.718	3.142	0.666	0.000	3.807	-0.689
17	14.506	14.137	7.598	0.000	-8.281	3.029
18	0.000	6.000	4.208	3.340	0.907	6.972
19	0.000	8.000	8.232	4.900	-1.526	15.781
20	0.000	2.000	1.224	1.655	-0.028	2.111
21	29.609	4.712	7.814	0.000	-32.195	-42.304
22	3.276	4.712	1.792	0.000	1.855	2.714
23	16.655	14.137	4.360	0.000	-9.947	-31.862
24	0.000	2.000	0.642	-1.004	2.772	-2.188
25	0.000	1.667	0.098	1.641	0.137	-0.404
26	36.554	12.566	38.768	0.000	-25.606	72.168
27	14.356	12.566	6.016	0.000	-10.762	-1.583
28	0.000	1.333	3.835	-2.663	5.647	-9.466
29	0.000	0.333	0.096	-0.532	0.184	0.031
30	0.000	2.000	0.438	1.096	1.767	-0.357
31	5.104	8.378	2.803	0.000	-6.542	-15.098
32	0.000	4.500	2.041	2.835	4.585	0.228
33	0.538	5.236	0.248	0.000	2.368	4.473
34	0.000	13.500	11.604	8.058	-17.554	0.201