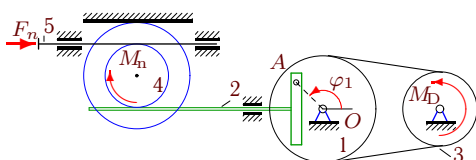


Кулиса. Уравнение Лагранжа

Кулисный механизм расположен в вертикальной плоскости и состоит из однородных цилиндров, блоков (радиус инерции i_k), штока и груза¹. Используя уравнение Лагранжа 2-го рода, получить уравнение движения механизма. Найти значение углового ускорения $\ddot{\varphi}_1$ при $t = 0$. Кинетическую энергию представить в форме $T = (\dot{\varphi}^2/2)(A + B \sin^2 \varphi)$ или $T = (\dot{\varphi}^2/2)(A + B \cos^2 \varphi)$ (варианты помечены *)

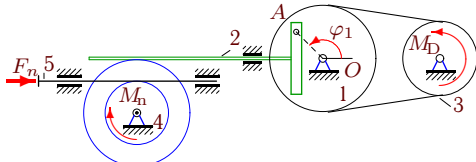
Кирсанов М.Н. **Решебник. Теоретическая механика**/Под ред. А. И. Кириллова.– М.: ФИЗМАТЛИТ, 2008. — 384 с. (с.307.)

Задача D31.1.



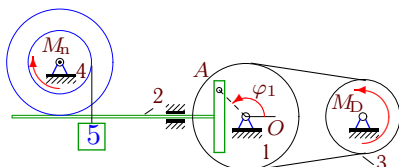
$$\begin{aligned} M_{D_z} &= M_0 - k\omega_{3z}, M_{n_z} = -\mu\omega_{4z}, \\ F_{n_x} &= -\nu v_{5x}, \varphi_{1,0} = 1.4, \omega_{1z,0} = 0.1 \frac{1}{c}, \\ M_0 &= 11 \text{ Нм}, k = 11 \text{ Нмс}, \\ \nu &= 8 \text{ кНс/м}, \mu = 11 \text{ Нмс}, \\ I_1 &= 11 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг}, \\ m_4 &= 27 \text{ кг}, R_1 = 34 \text{ см}, r_1 = 23 \text{ см}, \\ R_3 &= 24 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 16 \text{ см}. \end{aligned}$$

Задача D31.2.



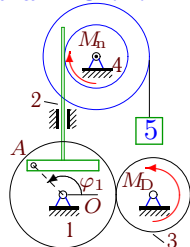
$$\begin{aligned} M_{D_z} &= M_0 - k\omega_{3z}, M_{n_z} = -\mu\omega_{4z}, \\ F_{n_x} &= -\nu v_{5x}, \varphi_{1,0} = 1.5, \omega_{1z,0} = 0.5 \frac{1}{c}, \\ M_0 &= 12 \text{ Нм}, k = 15 \text{ Нмс}, \\ \nu &= 20 \text{ Нс/м}, \mu = 11 \text{ Нмс}, \\ I_1 &= 13 \text{ кгм}^2, m_2 = 18 \text{ кг}, m_3 = 36 \text{ кг}, \\ m_4 &= 28 \text{ кг}, R_1 = 38 \text{ см}, r_1 = 27 \text{ см}, \\ R_3 &= 28 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 17 \text{ см}. \end{aligned}$$

Задача D31.3.



$$\begin{aligned} M_{D_z} &= M_0 - k\omega_{3z}, M_{n_z} = -\mu\omega_{4z}, \\ M_0 &= 9 \text{ Нм}, k = 14 \text{ Нмс}, \\ \varphi_{1,0} &= 1.2, \omega_{1z,0} = 0.4 \frac{1}{c}, \\ \mu &= 14 \text{ Нмс}, I_1 = 7 \text{ кгм}^2, \\ m_2 &= 15 \text{ кг}, m_3 = 33 \text{ кг}, m_4 = 25 \text{ кг}, \\ m_5 &= 4 \text{ кг}, R_1 = 37 \text{ см}, r_1 = 26 \text{ см}, \\ R_3 &= 27 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 14 \text{ см}. \end{aligned}$$

Задача D31.4.

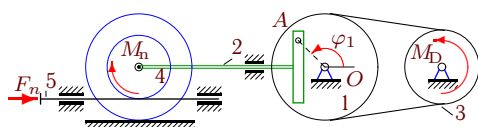


$$\begin{aligned} M_{D_z} &= M_0 - k\omega_{3z}, M_{n_z} = -\mu\omega_{4z}, \\ M_0 &= 8 \text{ Нм}, k = 13 \text{ Нмс}, \\ \varphi_{1,0} &= 1.2, \omega_{1z,0} = 0.3 \frac{1}{c}, \\ \mu &= 13 \text{ Нмс}, I_1 = 5 \text{ кгм}^2, \\ m_2 &= 15 \text{ кг}, m_3 = 33 \text{ кг}, m_4 = 25 \text{ кг}, \\ m_5 &= 2 \text{ кг}, R_1 = 36 \text{ см}, r_1 = 25 \text{ см}, \\ R_3 &= 26 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 14 \text{ см}. \end{aligned}$$

¹В некоторых вариантах содержатся не все элементы.

Задача D31.5.

1



$$M_{Dz} = M_0 - k\omega_{3z}, M_{nz} = -\mu\omega_{4z},$$

$$F_{nx} = -\nu v_{5x}, \varphi_{1,0} = 1.4, \omega_{1z,0} = 0.3 \frac{1}{c},$$

$$M_0 = 11 \text{ Нм}, k = 13 \text{ Нмс},$$

$$\nu = 8 \text{ кНс/м}, \mu = 11 \text{ Нмс},$$

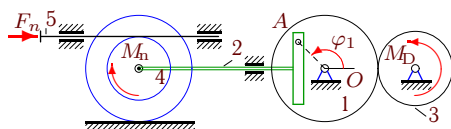
$$I_1 = 11 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг},$$

$$m_4 = 27 \text{ кг}, R_1 = 36 \text{ см}, r_1 = 25 \text{ см},$$

$$R_3 = 26 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 16 \text{ см}.$$

Задача D31.6.

1



$$M_{Dz} = M_0 - k\omega_{3z}, M_{nz} = -\mu\omega_{4z},$$

$$F_{nx} = -\nu v_{5x}, \varphi_{1,0} = 1.4, \omega_{1z,0} = 0.2 \frac{1}{c},$$

$$M_0 = 10 \text{ Нм}, k = 12 \text{ Нмс},$$

$$\nu = 25 \text{ Нс/м}, \mu = 12 \text{ Нмс},$$

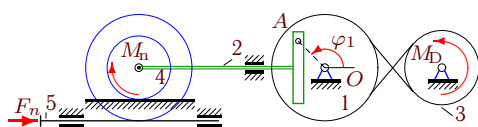
$$I_1 = 7 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг},$$

$$m_4 = 27 \text{ кг}, R_1 = 35 \text{ см}, r_1 = 24 \text{ см},$$

$$R_3 = 25 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 16 \text{ см}.$$

Задача D31.7.

1



$$M_{Dz} = M_0 - k\omega_{3z}, M_{nz} = -\mu\omega_{4z},$$

$$F_{nx} = -\nu v_{5x}, \varphi_{1,0} = 1.1, \omega_{1z,0} = 0.1 \frac{1}{c},$$

$$M_0 = 9 \text{ Нм}, k = 11 \text{ Нмс},$$

$$\nu = 8 \text{ кНс/м}, \mu = 14 \text{ Нмс},$$

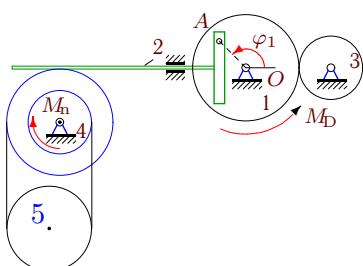
$$I_1 = 6 \text{ кгм}^2, m_2 = 14 \text{ кг}, m_3 = 32 \text{ кг},$$

$$m_4 = 24 \text{ кг}, R_1 = 34 \text{ см}, r_1 = 23 \text{ см},$$

$$R_3 = 24 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 13 \text{ см}.$$

Задача D31.8.

1



$$M_{Dz} = M_0 - k\omega_{1z}, M_{nz} = -\mu\omega_{4z},$$

$$M_0 = 10 \text{ Нм}, k = 13 \text{ Нмс},$$

$$\varphi_{1,0} = 1.1, \omega_{1z,0} = 0.3 \frac{1}{c},$$

$$\mu = 15 \text{ Нмс}, I_1 = 7 \text{ кгм}^2,$$

$$m_2 = 14 \text{ кг}, m_3 = 32 \text{ кг}, m_4 = 24 \text{ кг},$$

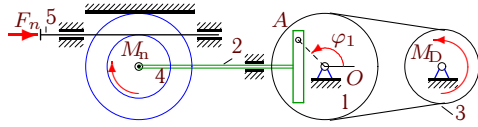
$$m_5 = 50 \text{ кг}, R_1 = 36 \text{ см}, r_1 = 25 \text{ см},$$

$$R_3 = 26 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 13 \text{ см},$$

$$r_5 = 16 \text{ см}.$$

Задача D31.9.

1



$$M_{Dz} = M_0 - k\omega_{3z}, M_{nz} = -\mu\omega_{4z},$$

$$F_{nx} = -\nu v_{5x}, \varphi_{1,0} = 1.3, \omega_{1z,0} = 0.5 \frac{1}{c},$$

$$M_0 = 10 \text{ Нм}, k = 15 \text{ Нмс},$$

$$\nu = 8 \text{ кНс/м}, \mu = 13 \text{ Нмс},$$

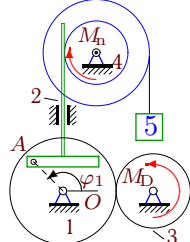
$$I_1 = 9 \text{ кгм}^2, m_2 = 16 \text{ кг}, m_3 = 34 \text{ кг},$$

$$m_4 = 26 \text{ кг}, R_1 = 38 \text{ см}, r_1 = 27 \text{ см},$$

$$R_3 = 28 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 15 \text{ см}.$$

Задача D31.10.

1



$$M_{Dz} = M_0 - k\omega_{3z}, M_{nz} = -\mu\omega_{4z},$$

$$M_0 = 7 \text{ Нм}, k = 14 \text{ Нмс},$$

$$\varphi_{1,0} = 1.1, \omega_{1z,0} = 0.4 \frac{1}{c},$$

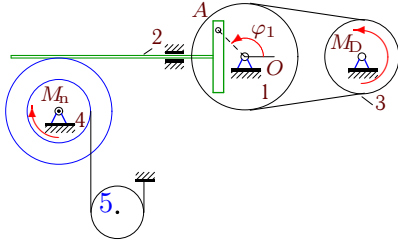
$$\mu = 14 \text{ Нмс}, I_1 = 4 \text{ кгм}^2,$$

$$m_2 = 14 \text{ кг}, m_3 = 32 \text{ кг}, m_4 = 24 \text{ кг},$$

$$m_5 = 1 \text{ кг}, R_1 = 37 \text{ см}, r_1 = 26 \text{ см},$$

$$R_3 = 27 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 13 \text{ см}.$$

Задача D31.11.



$$M_{Dz} = M_0 - k\omega_{3z}, M_{nz} = -\mu\omega_{4z},$$

$$M_0 = 11 \text{ Нм}, k = 12 \text{ Нм/с},$$

$$\varphi_{1,0} = 1.4, \omega_{1z,0} = 0.2 \frac{1}{\text{с}},$$

$$\mu = 12 \text{ Нм/с}, I_1 = 11 \text{ кгм}^2,$$

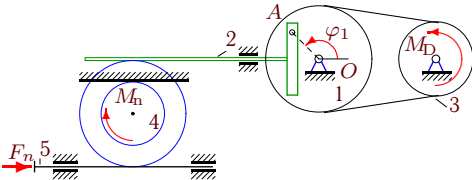
$$m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг}, m_4 = 27 \text{ кг},$$

$$m_5 = 6 \text{ кг}, R_1 = 35 \text{ см}, r_1 = 24 \text{ см},$$

$$R_3 = 25 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 16 \text{ см},$$

$$r_5 = 11 \text{ см}.$$

Задача D31.12.



$$M_{Dz} = M_0 - k\omega_{3z}, M_{nz} = -\mu\omega_{4z},$$

$$F_{nx} = -\nu v_{5x}, \varphi_{1,0} = 1.4, \omega_{1z,0} = 0.4 \frac{1}{\text{с}},$$

$$M_0 = 11 \text{ Нм}, k = 14 \text{ Нм/с},$$

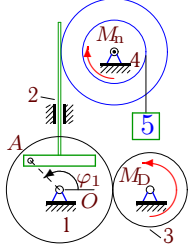
$$\nu = 25 \text{ Нс/м}, \mu = 12 \text{ Нм/с},$$

$$I_1 = 11 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг},$$

$$m_4 = 27 \text{ кг}, R_1 = 37 \text{ см}, r_1 = 26 \text{ см},$$

$$R_3 = 27 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 16 \text{ см}.$$

Задача D31.13.



$$M_{Dz} = M_0 - k\omega_{3z}, M_{nz} = -\mu\omega_{4z},$$

$$M_0 = 10 \text{ Нм}, k = 11 \text{ Нм/с},$$

$$\varphi_{1,0} = 1.4, \omega_{1z,0} = 0.1 \frac{1}{\text{с}},$$

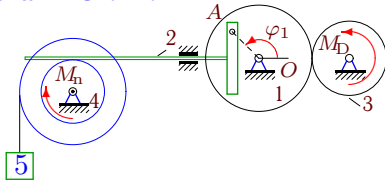
$$\mu = 12 \text{ Нм/с}, I_1 = 7 \text{ кгм}^2,$$

$$m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг}, m_4 = 27 \text{ кг},$$

$$m_5 = 5 \text{ кг}, R_1 = 34 \text{ см}, r_1 = 23 \text{ см},$$

$$R_3 = 24 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 16 \text{ см}.$$

Задача D31.14.



$$M_{Dz} = M_0 - k\omega_{3z}, M_{nz} = -\mu\omega_{4z},$$

$$M_0 = 7 \text{ Нм}, k = 11 \text{ Нм/с},$$

$$\varphi_{1,0} = 1.1, \omega_{1z,0} = 0.1 \frac{1}{\text{с}},$$

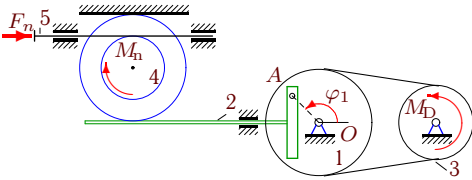
$$\mu = 14 \text{ Нм/с}, I_1 = 4 \text{ кгм}^2,$$

$$m_2 = 14 \text{ кг}, m_3 = 32 \text{ кг}, m_4 = 24 \text{ кг},$$

$$m_5 = 1 \text{ кг}, R_1 = 34 \text{ см}, r_1 = 23 \text{ см},$$

$$R_3 = 24 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 13 \text{ см}.$$

Задача D31.15.



$$M_{Dz} = M_0 - k\omega_{3z}, M_{nz} = -\mu\omega_{4z},$$

$$F_{nx} = -\nu v_{5x}, \varphi_{1,0} = 1.3, \omega_{1z,0} = 0.4 \frac{1}{\text{с}},$$

$$M_0 = 10 \text{ Нм}, k = 14 \text{ Нм/с},$$

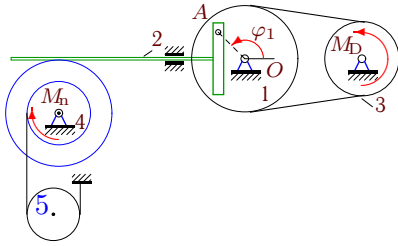
$$\nu = 8 \text{ Нс/м}, \mu = 13 \text{ Нм/с},$$

$$I_1 = 9 \text{ кгм}^2, m_2 = 16 \text{ кг}, m_3 = 34 \text{ кг},$$

$$m_4 = 26 \text{ кг}, R_1 = 37 \text{ см}, r_1 = 26 \text{ см},$$

$$R_3 = 27 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 15 \text{ см}.$$

Задача D31.16.



$$M_{Dz} = M_0 - k\omega_{3z}, M_{nz} = -\mu\omega_{4z},$$

$$M_0 = 10 \text{ Нм}, k = 15 \text{ Нмс},$$

$$\varphi_{1,0} = 1.3, \omega_{1z,0} = 0.5 \frac{1}{\text{с}},$$

$$\mu = 13 \text{ Нмс}, I_1 = 9 \text{ кгм}^2,$$

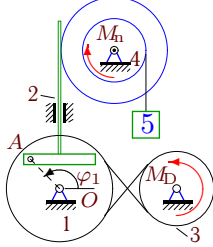
$$m_2 = 16 \text{ кг}, m_3 = 34 \text{ кг}, m_4 = 26 \text{ кг},$$

$$m_5 = 5 \text{ кг}, R_1 = 38 \text{ см}, r_1 = 27 \text{ см},$$

$$R_3 = 28 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 15 \text{ см},$$

$$r_5 = 11 \text{ см}.$$

Задача D31.17.



$$M_{Dz} = M_0 - k\omega_{3z}, M_{nz} = -\mu\omega_{4z},$$

$$M_0 = 10 \text{ Нм}, k = 14 \text{ Нмс},$$

$$\varphi_{1,0} = 1.2, \omega_{1z,0} = 0.4 \frac{1}{\text{с}},$$

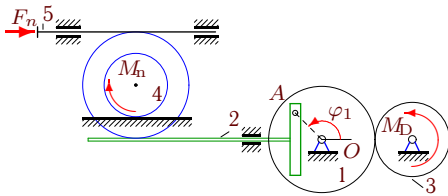
$$\mu = 14 \text{ Нмс}, I_1 = 9 \text{ кгм}^2,$$

$$m_2 = 15 \text{ кг}, m_3 = 33 \text{ кг}, m_4 = 25 \text{ кг},$$

$$m_5 = 5 \text{ кг}, R_1 = 37 \text{ см}, r_1 = 26 \text{ см},$$

$$R_3 = 27 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 14 \text{ см}.$$

Задача D31.18.



$$M_{Dz} = M_0 - k\omega_{3z}, M_{nz} = -\mu\omega_{4z},$$

$$F_{nx} = -\nu v_{5x}, \varphi_{1,0} = 1.4, \omega_{1z,0} = 0.4 \frac{1}{\text{с}},$$

$$M_0 = 10 \text{ Нм}, k = 14 \text{ Нмс},$$

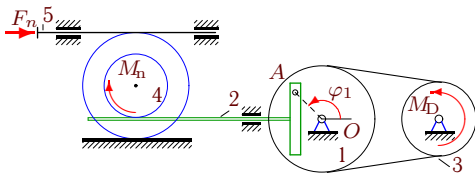
$$\nu = 25 \text{ Нс/м}, \mu = 12 \text{ Нмс},$$

$$I_1 = 7 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг},$$

$$m_4 = 27 \text{ кг}, R_1 = 37 \text{ см}, r_1 = 26 \text{ см},$$

$$R_3 = 27 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 16 \text{ см}.$$

Задача D31.19.



$$M_{Dz} = M_0 - k\omega_{3z}, M_{nz} = -\mu\omega_{4z},$$

$$F_{nx} = -\nu v_{5x}, \varphi_{1,0} = 1.2, \omega_{1z,0} = 0.5 \frac{1}{\text{с}},$$

$$M_0 = 9 \text{ Нм}, k = 15 \text{ Нмс},$$

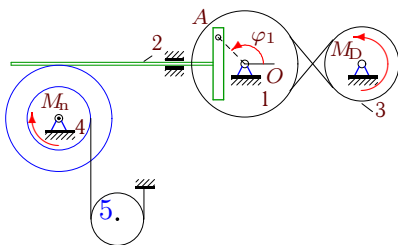
$$\nu = 25 \text{ Нс/м}, \mu = 14 \text{ Нмс},$$

$$I_1 = 7 \text{ кгм}^2, m_2 = 15 \text{ кг}, m_3 = 33 \text{ кг},$$

$$m_4 = 25 \text{ кг}, R_1 = 38 \text{ см}, r_1 = 27 \text{ см},$$

$$R_3 = 28 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 14 \text{ см}.$$

Задача D31.20.



$$M_{Dz} = M_0 - k\omega_{3z}, M_{nz} = -\mu\omega_{4z},$$

$$M_0 = 12 \text{ Нм}, k = 15 \text{ Нмс},$$

$$\varphi_{1,0} = 1.4, \omega_{1z,0} = 0.5 \frac{1}{\text{с}},$$

$$\mu = 12 \text{ Нмс}, I_1 = 15 \text{ кгм}^2,$$

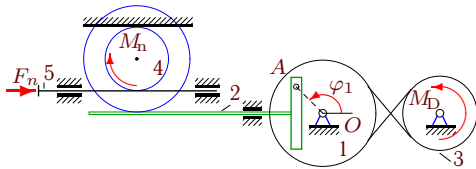
$$m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг}, m_4 = 27 \text{ кг},$$

$$m_5 = 7 \text{ кг}, R_1 = 38 \text{ см}, r_1 = 27 \text{ см},$$

$$R_3 = 28 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 16 \text{ см},$$

$$r_5 = 12 \text{ см}.$$

Задача D31.21.



$$M_{Dz} = M_0 - k\omega_{3z}, M_{nz} = -\mu\omega_{4z},$$

$$F_{nx} = -\nu v_{5x}, \varphi_{1,0} = 1.5, \omega_{1z,0} = 0.1 \frac{1}{c},$$

$$M_0 = 13 \text{ Нм}, k = 11 \text{ Нмс},$$

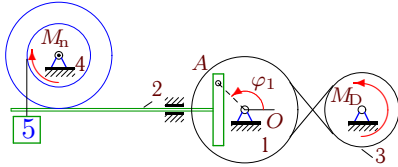
$$\nu = 35 \text{ Нс/м}, \mu = 11 \text{ Нмс},$$

$$I_1 = 18 \text{ кгм}^2, m_2 = 18 \text{ кг}, m_3 = 36 \text{ кг},$$

$$m_4 = 28 \text{ кг}, R_1 = 34 \text{ см}, r_1 = 23 \text{ см},$$

$$R_3 = 24 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 17 \text{ см}.$$

Задача D31.22.



$$M_{Dz} = M_0 - k\omega_{3z}, M_{nz} = -\mu\omega_{4z},$$

$$M_0 = 9 \text{ Нм}, k = 11 \text{ Нмс},$$

$$\varphi_{1,0} = 1.1, \omega_{1z,0} = 0.1 \frac{1}{c},$$

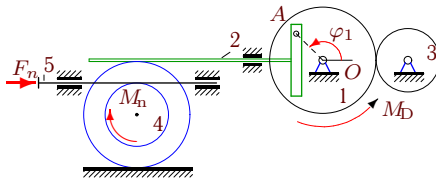
$$\mu = 15 \text{ Нмс}, I_1 = 6 \text{ кгм}^2,$$

$$m_2 = 14 \text{ кг}, m_3 = 32 \text{ кг}, m_4 = 24 \text{ кг},$$

$$m_5 = 4 \text{ кг}, R_1 = 34 \text{ см}, r_1 = 23 \text{ см},$$

$$R_3 = 24 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 13 \text{ см}.$$

Задача D31.23.



$$M_{Dz} = M_0 - k\omega_{1z}, M_{nz} = -\mu\omega_{4z},$$

$$F_{nx} = -\nu v_{5x}, \varphi_{1,0} = 1.4, \omega_{1z,0} = 0.3 \frac{1}{c},$$

$$M_0 = 13 \text{ Нм}, k = 13 \text{ Нмс},$$

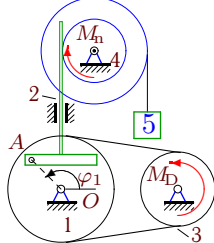
$$\nu = 25 \text{ Нс/м}, \mu = 12 \text{ Нмс},$$

$$I_1 = 19 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг},$$

$$m_4 = 27 \text{ кг}, R_1 = 36 \text{ см}, r_1 = 25 \text{ см},$$

$$R_3 = 26 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 16 \text{ см}.$$

Задача D31.24.



$$M_{Dz} = M_0 - k\omega_{3z}, M_{nz} = -\mu\omega_{4z},$$

$$M_0 = 12 \text{ Нм}, k = 11 \text{ Нмс},$$

$$\varphi_{1,0} = 1.5, \omega_{1z,0} = 0.1 \frac{1}{c},$$

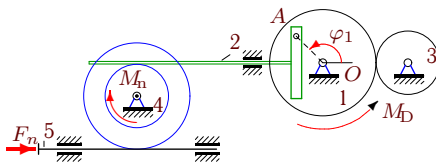
$$\mu = 10 \text{ Нмс}, I_1 = 13 \text{ кгм}^2,$$

$$m_2 = 18 \text{ кг}, m_3 = 36 \text{ кг}, m_4 = 28 \text{ кг},$$

$$m_5 = 6 \text{ кг}, R_1 = 34 \text{ см}, r_1 = 23 \text{ см},$$

$$R_3 = 24 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 17 \text{ см}.$$

Задача D31.25.



$$M_{Dz} = M_0 - k\omega_{1z}, M_{nz} = -\mu\omega_{4z},$$

$$F_{nx} = -\nu v_{5x}, \varphi_{1,0} = 1.2, \omega_{1z,0} = 0.4 \frac{1}{c},$$

$$M_0 = 11 \text{ Нм}, k = 14 \text{ Нмс},$$

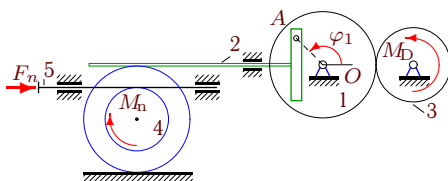
$$\nu = 8 \text{ Нс/м}, \mu = 13 \text{ Нмс},$$

$$I_1 = 11 \text{ кгм}^2, m_2 = 15 \text{ кг}, m_3 = 33 \text{ кг},$$

$$m_4 = 25 \text{ кг}, R_1 = 37 \text{ см}, r_1 = 26 \text{ см},$$

$$R_3 = 27 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 14 \text{ см}.$$

Задача D31.26.



$$M_{Dz} = M_0 - k\omega_{3z}, M_{nz} = -\mu\omega_{4z},$$

$$F_{nx} = -\nu v_{5x}, \varphi_{1,0} = 1.4, \omega_{1z,0} = 0.1 \frac{1}{c},$$

$$M_0 = 10 \text{ Нм}, k = 11 \text{ Нмс},$$

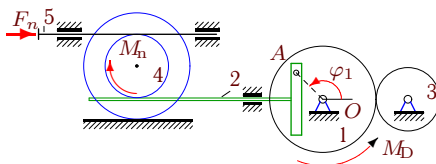
$$\nu = 25 \text{ Нс/м}, \mu = 12 \text{ Нмс},$$

$$I_1 = 7 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг},$$

$$m_4 = 27 \text{ кг}, R_1 = 34 \text{ см}, r_1 = 23 \text{ см},$$

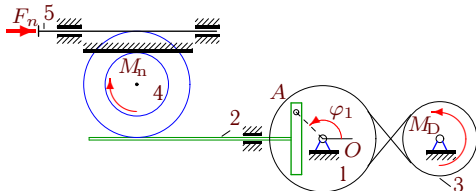
$$R_3 = 24 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 16 \text{ см}.$$

Задача D31.27.



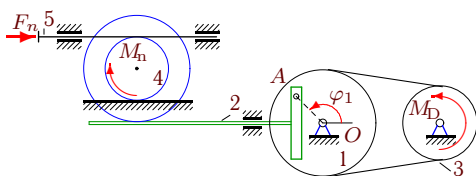
$$\begin{aligned} M_{D_z} &= M_0 - k\omega_{1z}, \quad M_{n_z} = -\mu\omega_{4z}, \\ F_{n_x} &= -\nu\nu_{5x}, \quad \varphi_{1,0} = 1.1, \quad \omega_{1z,0} = 0.5\frac{1}{c}, \\ M_0 &= 10 \text{ HМ}, \quad k = 15 \text{ HМс}, \\ \nu &= 40\text{Hс/М}, \quad \mu = 14 \text{ HМс}, \\ I_1 &= 7 \text{ кгМ}^2, \quad m_2 = 14 \text{ кг}, \quad m_3 = 32 \text{ кг}, \\ m_4 &= 24 \text{ кг}, \quad R_1 = 38 \text{ см}, \quad r_1 = 27 \text{ см}, \\ R_3 &= 28 \text{ см}, \quad R_4 = 20 \text{ см}, \quad r_4 = 12 \text{ см}, \quad i_4 = 13 \text{ см}. \end{aligned}$$

Задача D31.28.



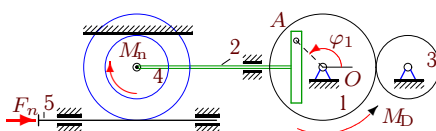
$$\begin{aligned} M_{D_z} &= M_0 - k\omega_{3_z}, M_{n_z} = -\mu\omega_{4_z}, \\ F_{n_x} &= -\nu\nu_{5_x}, \varphi_{1,0} = 1.3, \omega_{1,z,0} = 0.2\frac{1}{c}, \\ M_0 &= 11 \text{ ММ}, k = 12 \text{ ММС}, \\ \nu &= 8\text{кГц/М}, \mu = 13 \text{ ММС}, \\ I_1 &= 12 \text{ кгМ}^2, m_2 = 16 \text{ кг}, m_3 = 34 \text{ кг}, \\ m_4 &= 26 \text{ кг}, R_1 = 35 \text{ см}, r_1 = 24 \text{ см}, \\ R_3 &= 25 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 15 \text{ см}. \end{aligned}$$

Задача D31.29.



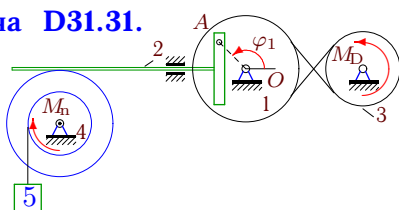
$$\begin{aligned} M_{D_z} &= M_0 - k\omega_{3_z}, M_{n_z} = -\mu\omega_{4_z}, \\ F_{n_x} &= -\nu v_{5_x}, \varphi_{1,0} = 1.5, \omega_{1,z,0} = 0.2 \frac{1}{c}, \\ M_0 &= 12 \text{ HМ}, k = 12 \text{ HМс}, \\ \nu &= 35 \text{ Hс/М}, \mu = 10 \text{ HМс}, \\ I_1 &= 13 \text{ кгМ}^2, m_2 = 18 \text{ кг}, m_3 = 36 \text{ кг}, \\ m_4 &= 28 \text{ кг}, R_1 = 35 \text{ см}, r_1 = 24 \text{ см}, \\ R_3 &= 25 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 17 \text{ см}. \end{aligned}$$

Задача D31.30.



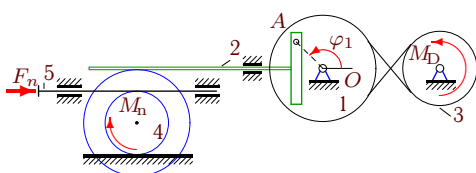
$$\begin{aligned} M_{D_z} &= M_0 - k\omega_{1z}, M_{n_z} = -\mu\omega_{4z}, \\ F_{n_x} &= -\nu\nu_{5x}, \varphi_{1,0} = 1.3, \omega_{1z,0} = 0.2\frac{1}{c}, \\ M_0 &= 12 \text{ ММ}, k = 12 \text{ ММС}, \\ \nu &= 30 \text{ МС/М}, \mu = 12 \text{ ММС}, \\ I_1 &= 15 \text{ КГМ}^2, m_2 = 16 \text{ КГ}, m_3 = 34 \text{ КГ}, \\ m_4 &= 26 \text{ КГ}, R_1 = 35 \text{ СМ}, r_1 = 24 \text{ СМ}, \\ R_3 &= 25 \text{ СМ}, R_4 = 20 \text{ СМ}, r_4 = 12 \text{ СМ}, i_4 = 15 \text{ СМ}. \end{aligned}$$

Задача D31.31.



$$\begin{aligned} M_{D_z} &= M_0 - k\omega_{3_z}, \quad M_{n_z} = -\mu\omega_{4_z}, \\ M_0 &= 11 \text{ Hм}, \quad k = 13 \text{ Hмс}, \\ \varphi_{1,0} &= 1.3, \quad \omega_{1_z,0} = 0.3 \frac{1}{\text{с}}, \\ \mu &= 13 \text{ Hмс}, \quad I_1 = 12 \text{ кгм}^2, \\ m_2 &= 16 \text{ кг}, \quad m_3 = 34 \text{ кг}, \quad m_4 = 26 \text{ кг}, \\ m_5 &= 6 \text{ кг}, \quad R_1 = 36 \text{ см}, \quad r_1 = 25 \text{ см}, \\ R_3 &= 26 \text{ см}, \quad R_4 = 20 \text{ см}, \quad r_4 = 12 \text{ см}, \quad i_4 = 15 \text{ см}. \end{aligned}$$

Задача D31.32.



$$\begin{aligned} M_{D_z} &= M_0 - k\omega_{3_z}, M_{n_z} = -\mu\omega_{4_z}, \\ F_{n_x} &= -\nu\nu_{5_x}, \varphi_{1,0} = 1.5, \omega_{1,z,0} = 0.3\frac{1}{c}, \\ M_0 &= 13 \text{ HM}, k = 13 \text{ HMc}, \\ \nu &= 35\text{Hc/M}, \mu = 11 \text{ HMc}, \\ I_1 &= 18 \text{ кгм}^2, m_2 = 18 \text{ кг}, m_3 = 36 \text{ кг}, \\ m_4 &= 28 \text{ кг}, R_1 = 36 \text{ см}, r_1 = 25 \text{ см}, \\ R_3 &= 26 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 17 \text{ см}. \end{aligned}$$

	A	B	Q	ε	B_2	B_4	B_5	Q_F	Q_M	Q_D	Q_T
1	13.023	1.814	10.255	0.693	0.90	0.92	0.00	-2.57	-0.55	13.38	0.00
2	15.599	2.787	-7.763	-0.425	1.31	1.47	0.00	-0.26	-9.97	2.47	0.00
3	9.259	1.939	-0.699	-0.073	1.01	0.83	0.10	0.00	-8.22	1.82	5.71
4*	7.138	3.411	-31.144	-4.092	0.94	2.13	0.35	0.00	-2.22	-18.55	-10.37
5	13.268	3.830	-20.560	-1.214	1.06	2.77	0.00	-23.31	-5.01	7.75	0.00
6	9.144	3.530	-22.776	-1.814	0.98	2.55	0.00	-0.72	-3.36	-18.70	0.00
7	7.850	3.500	-33.981	-3.198	0.74	2.76	0.00	-14.94	-4.08	-14.96	0.00
8	9.074	2.634	22.372	1.995	0.88	0.63	1.13	0.00	-5.58	6.10	21.86
9	11.455	4.128	-54.558	-3.586	1.17	2.96	0.00	-43.32	-11.00	-0.24	0.00
10*	6.190	3.038	-39.787	-5.809	0.95	1.90	0.19	0.00	-5.41	-20.11	-14.27
11	13.144	2.021	3.164	0.209	0.98	1.00	0.05	0.00	-3.36	10.70	-4.18
12	13.396	12.557	-55.181	-2.170	1.15	11.41	0.00	-10.50	-49.24	4.56	0.00
13*	9.023	1.909	-21.789	-2.400	0.90	0.91	0.10	0.00	-0.05	-16.37	-5.37
14	5.850	2.378	-12.858	-1.663	0.74	1.49	0.15	0.00	-4.08	-12.12	3.35
15	11.327	1.768	-6.886	-0.537	1.08	0.69	0.00	-8.03	-2.04	3.19	0.00
16	11.455	2.282	-7.413	-0.557	1.17	1.07	0.05	0.00	-11.00	-0.24	3.83
17*	11.259	1.964	-36.553	-3.165	1.01	0.83	0.12	0.00	-1.24	-24.22	-11.09
18	9.396	12.557	-83.959	-3.904	1.15	11.41	0.00	-10.50	-49.24	-24.22	0.00
19	9.383	18.066	-90.654	-3.676	1.09	16.97	0.00	-19.79	-69.27	-1.60	0.00
20	17.527	2.568	-46.200	-2.313	1.24	1.26	0.07	0.00	-10.62	-30.10	-5.48
21	20.081	1.579	-21.293	-0.984	0.95	0.63	0.00	-0.10	-0.57	-20.62	0.00
22	7.850	1.353	-21.359	-2.394	0.74	0.54	0.08	0.00	-1.58	-14.96	-4.83
23	21.268	1.754	7.443	0.323	1.06	0.69	0.00	-0.29	-1.37	9.10	0.00
24*	15.081	4.807	13.497	0.894	0.95	2.97	0.88	0.00	-0.02	14.79	-1.28
25	13.259	3.314	-537.796	-33.336	1.01	2.30	0.00	-521.99	-21.21	5.40	0.00
26	9.023	1.485	-16.842	-1.610	0.90	0.59	0.00	-0.08	-0.39	-16.37	0.00
27	9.310	16.576	-79.357	-3.605	1.02	15.56	0.00	-18.53	-63.33	2.50	0.00
28	14.083	1.461	-26.810	-1.737	0.92	0.54	0.00	-5.35	-1.36	-20.10	0.00
29	15.205	11.948	-9.425	-0.349	1.04	10.91	0.00	-3.61	-17.91	12.10	0.00
30	17.082	4.759	-1.595	-0.076	0.92	3.84	0.00	-2.28	-8.91	9.60	0.00
31	14.203	2.049	-19.858	-1.236	1.00	0.91	0.14	0.00	-5.66	-22.71	8.51
32	20.333	1.865	-27.848	-1.256	1.13	0.74	0.00	-0.37	-2.00	-25.48	0.00