

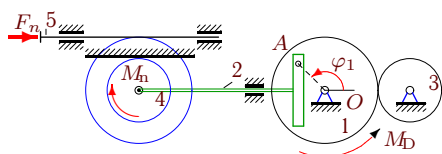
Кулиса. Уравнение Лагранжа

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.

Басараба Олег



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

$$F_{nx} = -\nu v_{5x}, \varphi_{1,0} = 1.5, \omega_{1z,0} = 0.4 \frac{1}{c},$$

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

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

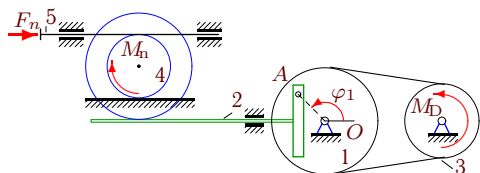
$$I_1 = 23 \text{ кгм}^2, m_2 = 18 \text{ кг}, m_3 = 36 \text{ кг},$$

$$m_4 = 28 \text{ кг}, R_1 = 37 \text{ см}, r_1 = 26 \text{ см},$$

$$R_3 = 27 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 17 \text{ см}.$$

Задача D31.2.

Булава Владислав



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

$$F_{nx} = -\nu v_{5x}, \varphi_{1,0} = 1.5, \omega_{1z,0} = 0.2 \frac{1}{c},$$

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

$$\nu = 35 \text{ Нс/м}, \mu = 10 \text{ Нмс},$$

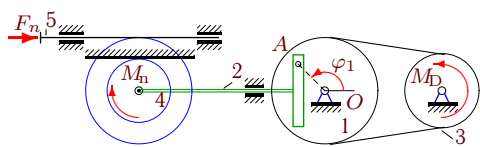
$$I_1 = 13 \text{ кгм}^2, m_2 = 18 \text{ кг}, m_3 = 36 \text{ кг},$$

$$m_4 = 28 \text{ кг}, R_1 = 35 \text{ см}, r_1 = 24 \text{ см},$$

$$R_3 = 25 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 17 \text{ см}.$$

Задача D31.3.

Васильев Игорь



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

$$F_{nx} = -\nu v_{5x}, \varphi_{1,0} = 1.3, \omega_{1z,0} = 0.3 \frac{1}{c},$$

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

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

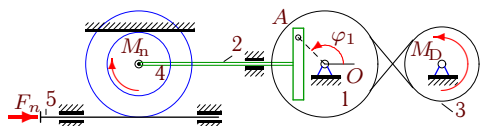
$$I_1 = 9 \text{ кгм}^2, m_2 = 16 \text{ кг}, m_3 = 34 \text{ кг},$$

$$m_4 = 26 \text{ кг}, R_1 = 36 \text{ см}, r_1 = 25 \text{ см},$$

$$R_3 = 26 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 15 \text{ см}.$$

Задача D31.4.

Вишняков Арсений



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

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

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

$$\nu = 25 \text{ Нс/м}, \mu = 11 \text{ Нмс},$$

$$I_1 = 15 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг},$$

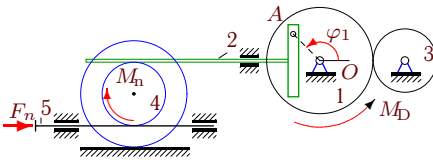
$$m_4 = 27 \text{ кг}, R_1 = 35 \text{ см}, r_1 = 24 \text{ см},$$

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

¹В некоторых вариантах содержатся не все элементы.

Задача D31.5.

Диянов Кирилл



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

$$F_{n_x} = -\nu v_{5_x}, \quad \varphi_{1,0} = 1.2, \quad \omega_{1z,0} = 0.2 \frac{1}{c},$$

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

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

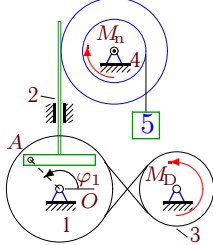
$$I_1 = 11 \text{ кгм}^2, \quad m_2 = 15 \text{ кг}, \quad m_3 = 33 \text{ кг},$$

$$m_4 = 25 \text{ кг}, \quad R_1 = 35 \text{ см}, \quad r_1 = 24 \text{ см},$$

$$R_3 = 25 \text{ см}, \quad R_4 = 20 \text{ см}, \quad r_4 = 12 \text{ см}, \quad i_4 = 14 \text{ см}.$$

Задача D31.6.

Завидный Антон



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

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

$$\varphi_{1,0} = 1.1, \quad \omega_{1z,0} = 0.5 \frac{1}{c},$$

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

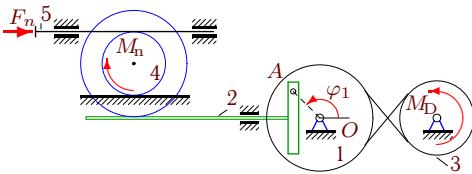
$$m_2 = 14 \text{ кг}, \quad m_3 = 32 \text{ кг}, \quad m_4 = 24 \text{ кг},$$

$$m_5 = 4 \text{ кг}, \quad R_1 = 38 \text{ см}, \quad r_1 = 27 \text{ см},$$

$$R_3 = 28 \text{ см}, \quad R_4 = 20 \text{ см}, \quad r_4 = 12 \text{ см}, \quad i_4 = 13 \text{ см}.$$

Задача D31.7.

Кренив Александр



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

$$F_{n_x} = -\nu v_{5_x}, \quad \varphi_{1,0} = 1.5, \quad \omega_{1z,0} = 0.3 \frac{1}{c},$$

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

$$\nu = 35 \text{ Нс/м}, \quad \mu = 10 \text{ Нмс},$$

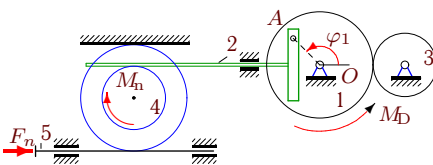
$$I_1 = 18 \text{ кгм}^2, \quad m_2 = 18 \text{ кг}, \quad m_3 = 36 \text{ кг},$$

$$m_4 = 28 \text{ кг}, \quad R_1 = 36 \text{ см}, \quad r_1 = 25 \text{ см},$$

$$R_3 = 26 \text{ см}, \quad R_4 = 20 \text{ см}, \quad r_4 = 12 \text{ см}, \quad i_4 = 17 \text{ см}.$$

Задача D31.8.

Леонтьева Ульяна



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

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

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

$$\nu = 30 \text{ Нс/м}, \quad \mu = 14 \text{ Нмс},$$

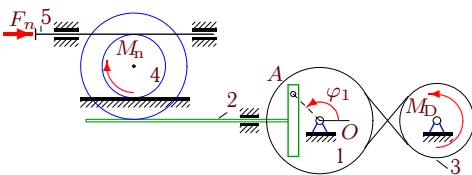
$$I_1 = 7 \text{ кгм}^2, \quad m_2 = 14 \text{ кг}, \quad m_3 = 32 \text{ кг},$$

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

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

Задача D31.9.

Максименко Антон



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

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

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

$$\nu = 40 \text{ Нс/м}, \quad \mu = 11 \text{ Нмс},$$

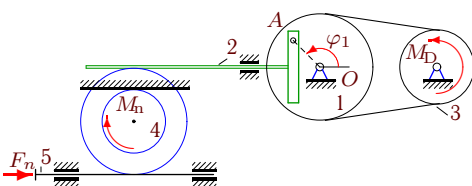
$$I_1 = 15 \text{ кгм}^2, \quad m_2 = 17 \text{ кг}, \quad m_3 = 35 \text{ кг},$$

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

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

Задача D31.10.

Минкин Герман



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

$$F_{n_x} = -\nu v_{5_x}, \quad \varphi_{1,0} = 1.4, \quad \omega_{1z,0} = 0.5 \frac{1}{c},$$

$$M_0 = 11 \text{ Нм}, \quad k = 15 \text{ Нмс},$$

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

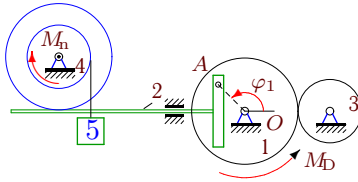
$$I_1 = 11 \text{ кгм}^2, \quad m_2 = 17 \text{ кг}, \quad m_3 = 35 \text{ кг},$$

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

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

Задача D31.11.

Нестеров Максим



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

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

$$\varphi_{1,0} = 1.2, \omega_{1z,0} = 0.1 \frac{1}{\text{с}},$$

$$\mu = 14 \text{ Нмс}, I_1 = 11 \text{ кгм}^2,$$

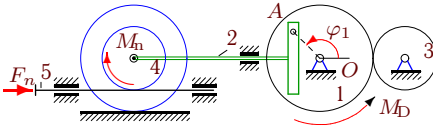
$$m_2 = 15 \text{ кг}, m_3 = 33 \text{ кг}, m_4 = 25 \text{ кг},$$

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

$$R_3 = 24 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 14 \text{ см}.$$

Задача D31.12.

Пархоменко Даниил



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

$$F_{nx} = -\nu v_{5x}, \varphi_{1,0} = 1.2, \omega_{1z,0} = 0.3 \frac{1}{\text{с}},$$

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

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

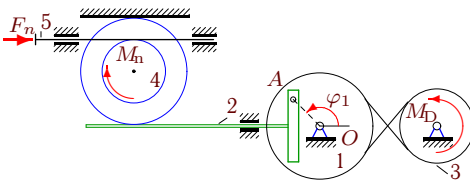
$$I_1 = 11 \text{ кгм}^2, m_2 = 15 \text{ кг}, m_3 = 33 \text{ кг},$$

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

$$R_3 = 26 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 14 \text{ см}.$$

Задача D31.13.

Попов Иван



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

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

$$M_0 = 11 \text{ Нм}, k = 15 \text{ Нмс},$$

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

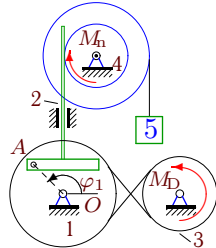
$$I_1 = 12 \text{ кгм}^2, m_2 = 16 \text{ кг}, m_3 = 34 \text{ кг},$$

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

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

Задача D31.14.

Руднев Никита



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

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

$$\varphi_{1,0} = 1.2, \omega_{1z,0} = 0.1 \frac{1}{\text{с}},$$

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

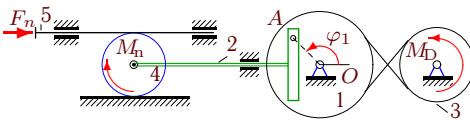
$$m_2 = 15 \text{ кг}, m_3 = 33 \text{ кг}, m_4 = 25 \text{ кг},$$

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

$$R_3 = 24 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 14 \text{ см}.$$

Задача D31.15.

Спамбетов Павел



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

$$F_{nx} = -\nu v_{5x}, \varphi_{1,0} = 1.1, \omega_{1z,0} = 0.3 \frac{1}{\text{с}},$$

$$M_0 = 9 \text{ Нм}, k = 13 \text{ Нмс},$$

$$\nu = 55 \text{ Нс/м}, \mu = 15 \text{ Нмс},$$

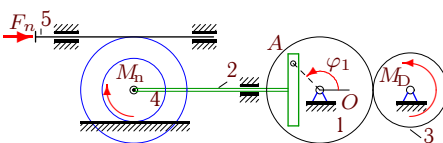
$$I_1 = 6 \text{ кгм}^2, m_2 = 14 \text{ кг}, m_3 = 32 \text{ кг},$$

$$m_4 = 24 \text{ кг}, R_1 = 36 \text{ см}, r_1 = 25 \text{ см},$$

$$R_3 = 26 \text{ см}, R_4 = 12 \text{ см}.$$

Задача D31.16.

Харизин Роман



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

$$F_{nx} = -\nu v_{5x}, \varphi_{1,0} = 1.3, \omega_{1z,0} = 0.1 \frac{1}{\text{с}},$$

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

$$\nu = 30 \text{ Нс/м}, \mu = 13 \text{ Нмс},$$

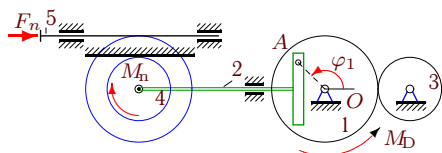
$$I_1 = 6 \text{ кгм}^2, m_2 = 16 \text{ кг}, m_3 = 34 \text{ кг},$$

$$m_4 = 26 \text{ кг}, R_1 = 34 \text{ см}, r_1 = 23 \text{ см},$$

$$R_3 = 24 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 15 \text{ см}.$$

Задача D31.17.

Самохин Иван



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

$$F_{nx} = -\nu v_{5x}, \quad \varphi_{1,0} = 1.3, \quad \omega_{1z,0} = 0.3 \frac{1}{c},$$

$$M_0 = 12 \text{ Нм}, \quad k = 13 \text{ Нмс},$$

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

$$I_1 = 15 \text{ кгм}^2, \quad m_2 = 16 \text{ кг}, \quad m_3 = 34 \text{ кг},$$

$$m_4 = 26 \text{ кг}, \quad R_1 = 36 \text{ см}, \quad r_1 = 25 \text{ см},$$

$$R_3 = 26 \text{ см}, \quad R_4 = 20 \text{ см}, \quad r_4 = 12 \text{ см}, \quad l = 15 \text{ см}.$$