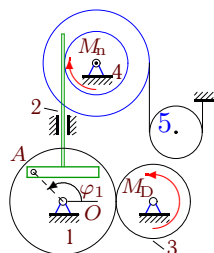


## Кулиса. Уравнение Лагранжа

Кулисный механизм расположен в вертикальной плоскости и состоит из однородных цилиндров, блоков (радиус инерции  $i_k$ ), штока и груза<sup>1</sup>. 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.



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

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

$$\varphi_{1,0} = 1.4, \quad \omega_{1z,0} = 0.3 \frac{1}{\text{с}},$$

$$\mu = 11 \text{ Нмс}, \quad I_1 = 7 \text{ кгм}^2,$$

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

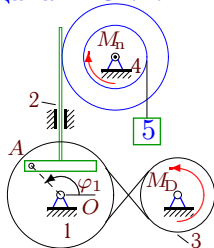
$$m_5 = 4 \text{ кг}, \quad R_1 = 36 \text{ см}, \quad r_1 = 25 \text{ см},$$

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

$$r_5 = 10 \text{ см}.$$

9

### Задача D31.2.



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

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

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

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

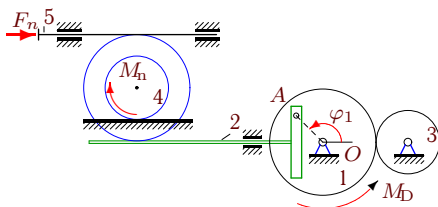
$$m_2 = 17 \text{ кг}, \quad m_3 = 35 \text{ кг}, \quad m_4 = 27 \text{ кг},$$

$$m_5 = 7 \text{ кг}, \quad R_1 = 35 \text{ см}, \quad r_1 = 24 \text{ см},$$

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

9

### Задача D31.3.



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

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

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

$$\nu = 40 \text{ Нс/м}, \quad \mu = 15 \text{ Нмс},$$

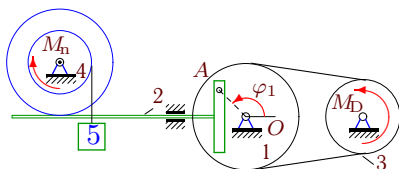
$$I_1 = 7 \text{ кгм}^2, \quad m_2 = 14 \text{ кг}, \quad m_3 = 32 \text{ кг},$$

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

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

9

### Задача D31.4.



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

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

$$\varphi_{1,0} = 1.4, \quad \omega_{1z,0} = 0.3 \frac{1}{\text{с}},$$

$$\mu = 12 \text{ Нмс}, \quad I_1 = 11 \text{ кгм}^2,$$

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

$$m_5 = 6 \text{ кг}, \quad R_1 = 36 \text{ см}, \quad r_1 = 25 \text{ см},$$

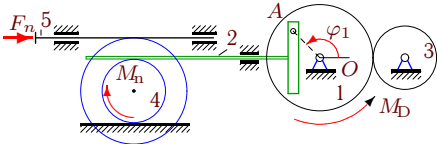
$$R_3 = 26 \text{ см}, \quad R_4 = 20 \text{ см}, \quad r_4 = 12 \text{ см}, \quad i_4 = 16 \text{ см}.$$

9

<sup>1</sup>В некоторых вариантах содержатся не все элементы.

**Задача D31.5.**

9



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

$$F_{nx} = -\nu v_{5x}, \varphi_{1,0} = 1.2, \omega_{1z,0} = 0.1 \frac{1}{c},$$

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

$$\nu = 35 \text{ Нс/м}, \mu = 14 \text{ Нмс},$$

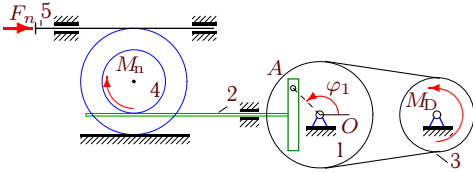
$$I_1 = 11 \text{ кгм}^2, m_2 = 15 \text{ кг}, m_3 = 33 \text{ кг},$$

$$m_4 = 25 \text{ кг}, R_1 = 34 \text{ см}, r_1 = 23 \text{ см},$$

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

**Задача D31.6.**

9



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

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

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

$$\nu = 15 \text{ Нс/м}, \mu = 12 \text{ Нмс},$$

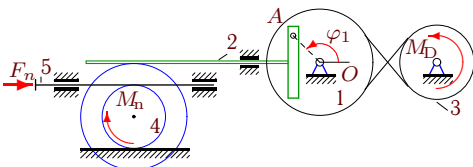
$$I_1 = 11 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг},$$

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

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

**Задача D31.7.**

9



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

$$F_{nx} = -\nu v_{5x}, \varphi_{1,0} = 1.3, \omega_{1z,0} = 0.2 \frac{1}{c},$$

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

$$\nu = 45 \text{ Нс/м}, \mu = 13 \text{ Нмс},$$

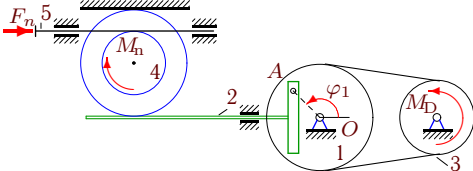
$$I_1 = 12 \text{ кгм}^2, m_2 = 16 \text{ кг}, m_3 = 34 \text{ кг},$$

$$m_4 = 26 \text{ кг}, R_1 = 35 \text{ см}, r_1 = 24 \text{ см},$$

$$R_3 = 25 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 15 \text{ см}.$$

**Задача D31.8.**

9



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

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

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

$$\nu = 8 \text{ Нс/м}, \mu = 12 \text{ Нмс},$$

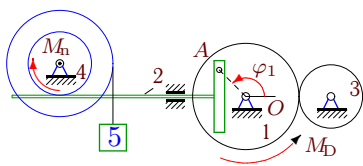
$$I_1 = 11 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг},$$

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

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

**Задача D31.9.**

9



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

$$M_0 = 14 \text{ Нм}, k = 13 \text{ Нмс},$$

$$\varphi_{1,0} = 1.5, \omega_{1z,0} = 0.3 \frac{1}{c},$$

$$\mu = 10 \text{ Нмс}, I_1 = 23 \text{ кгм}^2,$$

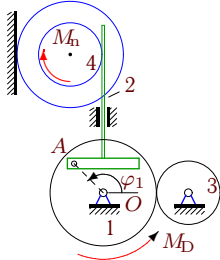
$$m_2 = 18 \text{ кг}, m_3 = 36 \text{ кг}, m_4 = 28 \text{ кг},$$

$$m_5 = 8 \text{ кг}, R_1 = 36 \text{ см}, r_1 = 25 \text{ см},$$

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

**Задача D31.10.**

9



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

$$\varphi_{1,0} = 1.4, \omega_{1z,0} = 0.4 \frac{1}{c},$$

$$M_0 = 13 \text{ Нм}, k = 14 \text{ Нмс},$$

$$\mu = 11 \text{ Нмс},$$

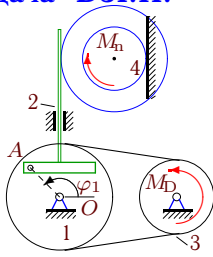
$$I_1 = 19 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг},$$

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

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

**Задача D31.11.**

9



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

$$\varphi_{1,0} = 1.3, \omega_{1z,0} = 0.3 \frac{1}{c},$$

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

$$\mu = 13 \text{ Нмс},$$

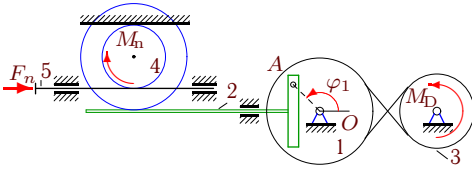
$$I_1 = 9 \text{ кгм}^2, m_2 = 16 \text{ кг}, m_3 = 34 \text{ кг},$$

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

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

**Задача D31.12.**

9



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

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

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

$$\nu = 40 \text{ Нс/м}, \mu = 12 \text{ Нмс},$$

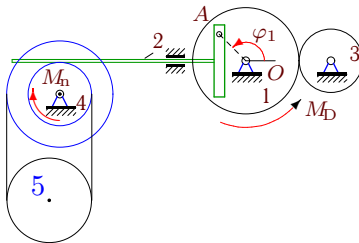
$$I_1 = 15 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг},$$

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

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

**Задача D31.13.**

9



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

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

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

$$\mu = 11 \text{ Нмс}, I_1 = 19 \text{ кгм}^2,$$

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

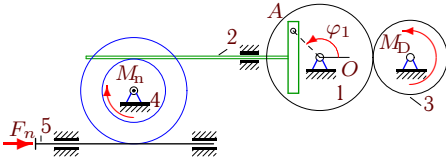
$$m_5 = 70 \text{ кг}, R_1 = 35 \text{ см}, r_1 = 24 \text{ см},$$

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

$$r_5 = 16 \text{ см}.$$

**Задача D31.14.**

9



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

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

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

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

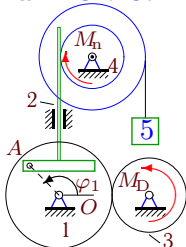
$$I_1 = 4 \text{ кгм}^2, m_2 = 14 \text{ кг}, m_3 = 32 \text{ кг},$$

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

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

**Задача D31.15.**

9



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

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

$$\varphi_{1,0} = 1.4, \omega_{1z,0} = 0.4 \frac{1}{c},$$

$$\mu = 11 \text{ Нмс}, I_1 = 7 \text{ кгм}^2,$$

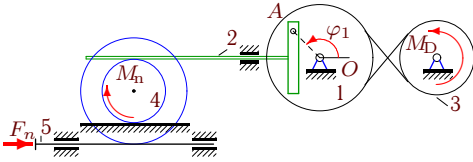
$$m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг}, m_4 = 27 \text{ кг},$$

$$m_5 = 4 \text{ кг}, R_1 = 37 \text{ см}, r_1 = 26 \text{ см},$$

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

**Задача D31.16.**

9



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

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

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

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

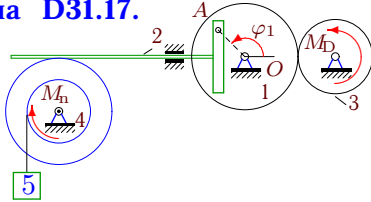
$$I_1 = 15 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг},$$

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

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

**Задача D31.17.**

9



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

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

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

$$\mu = 12 \text{ Нмс}, I_1 = 7 \text{ кгм}^2,$$

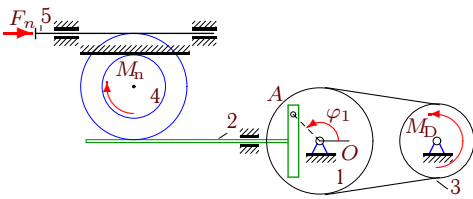
$$m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг}, m_4 = 27 \text{ кг},$$

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

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

**Задача D31.18.**

9



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

$$F_{nx} = -\nu v_{5x}, \varphi_{1,0} = 1.3, \omega_{1z,0} = 0.2 \frac{1}{c},$$

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

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

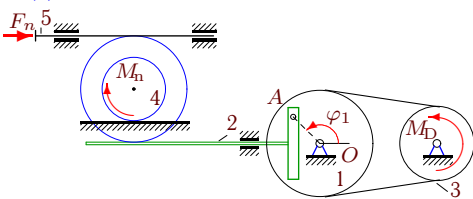
$$I_1 = 9 \text{ кгм}^2, m_2 = 16 \text{ кг}, m_3 = 34 \text{ кг},$$

$$m_4 = 26 \text{ кг}, R_1 = 35 \text{ см}, r_1 = 24 \text{ см},$$

$$R_3 = 25 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 15 \text{ см}.$$

**Задача D31.19.**

9



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

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

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

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

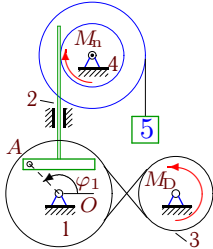
$$I_1 = 11 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг},$$

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

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

**Задача D31.20.**

9



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

$$M_0 = 13 \text{ Нм}, k = 14 \text{ Нмс},$$

$$\varphi_{1,0} = 1.5, \omega_{1z,0} = 0.4 \frac{1}{c},$$

$$\mu = 10 \text{ Нмс}, I_1 = 18 \text{ кгм}^2,$$

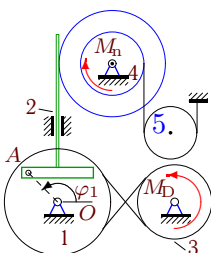
$$m_2 = 18 \text{ кг}, m_3 = 36 \text{ кг}, m_4 = 28 \text{ кг},$$

$$m_5 = 7 \text{ кг}, R_1 = 37 \text{ см}, r_1 = 26 \text{ см},$$

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

**Задача D31.21.**

9



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

$$M_0 = 12 \text{ Нм}, k = 14 \text{ Нмс},$$

$$\varphi_{1,0} = 1.4, \omega_{1z,0} = 0.4 \frac{1}{c},$$

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

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

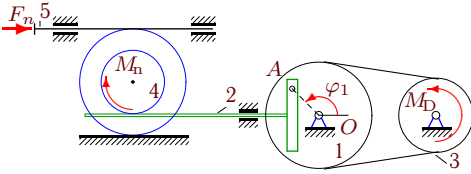
$$m_5 = 7 \text{ кг}, R_1 = 37 \text{ см}, r_1 = 26 \text{ см},$$

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

$$r_5 = 12 \text{ см}.$$

**Задача D31.22.**

9



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

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

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

$$\nu = 15 \text{ Нс/м}, \mu = 12 \text{ Нмс},$$

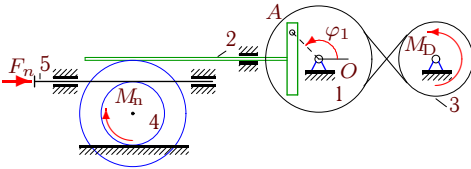
$$I_1 = 11 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг},$$

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

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

**Задача D31.23.**

9



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

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

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

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

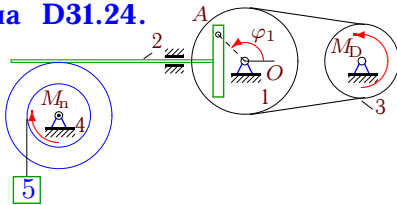
$$I_1 = 18 \text{ кгм}^2, m_2 = 18 \text{ кг}, m_3 = 36 \text{ кг},$$

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

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

**Задача D31.24.**

9



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

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

$$\varphi_{1,0} = 1.4, \omega_{1z,0} = 0.4 \frac{1}{c},$$

$$\mu = 12 \text{ Нмс}, I_1 = 11 \text{ кгм}^2,$$

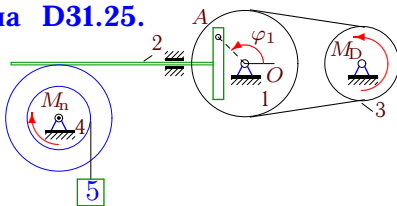
$$m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг}, m_4 = 27 \text{ кг},$$

$$m_5 = 6 \text{ кг}, R_1 = 37 \text{ см}, r_1 = 26 \text{ см},$$

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

**Задача D31.25.**

9



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

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

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

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

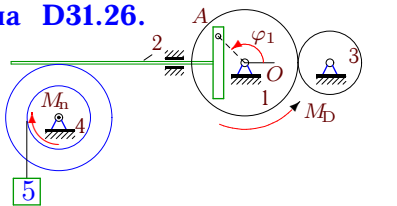
$$m_2 = 16 \text{ кг}, m_3 = 34 \text{ кг}, m_4 = 26 \text{ кг},$$

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

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

**Задача D31.26.**

9



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

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

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

$$\mu = 13 \text{ Нмс}, I_1 = 15 \text{ кгм}^2,$$

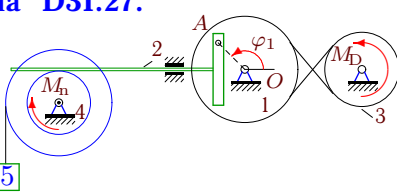
$$m_2 = 16 \text{ кг}, m_3 = 34 \text{ кг}, m_4 = 26 \text{ кг},$$

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

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

**Задача D31.27.**

9



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

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

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

$$\mu = 11 \text{ Нмс}, I_1 = 15 \text{ кгм}^2,$$

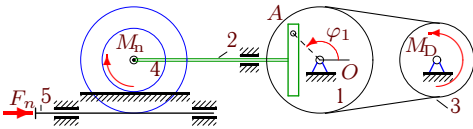
$$m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг}, m_4 = 27 \text{ кг},$$

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

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

**Задача D31.28.**

9



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

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

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

$$\nu = 8 \text{ кНс/м}, \mu = 10 \text{ Нмс},$$

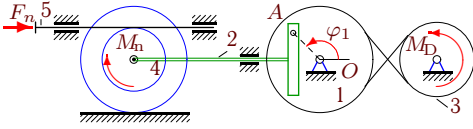
$$I_1 = 13 \text{ кгм}^2, m_2 = 18 \text{ кг}, m_3 = 36 \text{ кг},$$

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

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

**Задача D31.29.**

9



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

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

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

$$\nu = 40 \text{ Нс/м}, \mu = 15 \text{ Нмс},$$

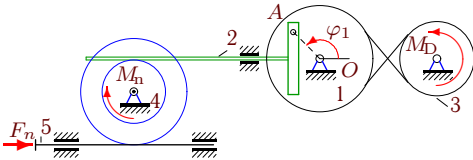
$$I_1 = 6 \text{ кгм}^2, m_2 = 14 \text{ кг}, m_3 = 32 \text{ кг},$$

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

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

**Задача D31.30.**

9



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

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

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

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

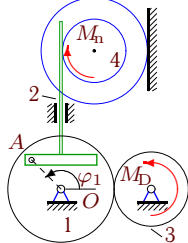
$$I_1 = 6 \text{ кгм}^2, m_2 = 14 \text{ кг}, m_3 = 32 \text{ кг},$$

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

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

**Задача D31.31.**

9



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

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

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

$$\mu = 11 \text{ Нмс},$$

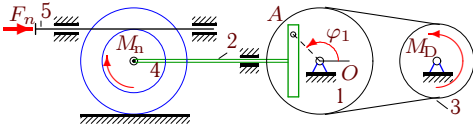
$$I_1 = 7 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг},$$

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

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

**Задача D31.32.**

9



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

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

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

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

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

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

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

**D31 Ответы.**  
**Кулиса. Уравнение Лагранжа**

21.03.2012

	$A$	$B$	$Q$	$\varepsilon$	$B_2$	$B_4$	$B_5$	$Q_F$	$Q_M$	$Q_D$	$Q_T$
1*	9.268	4.323	-27.434	-2.914	1.06	3.00	0.26	0.00	-0.41	-21.32	-5.70
2*	17.144	2.120	-26.726	-1.553	0.98	1.00	0.15	0.00	-0.10	-21.50	-5.12
3	8.850	6.950	-3.636	-0.255	0.74	6.21	0.00	-2.69	-9.85	8.90	0.00
4	13.268	2.278	10.992	0.708	1.06	1.08	0.14	0.00	-5.46	7.75	8.70
5	12.907	1.574	8.497	0.595	0.79	0.78	0.00	-0.29	-1.12	9.90	0.00
6	13.396	19.858	-54.525	-1.685	1.15	18.71	0.00	-9.85	-49.24	4.56	0.00
7	14.083	1.461	-21.733	-1.409	0.92	0.54	0.00	-0.27	-1.36	-20.10	0.00
8	13.268	1.754	0.562	0.036	1.06	0.69	0.00	-5.83	-1.37	7.75	0.00
9	25.333	6.026	29.762	0.949	1.13	3.51	1.39	0.00	-12.96	10.10	32.62
10*	21.396	2.318	-7.369	-0.340	1.15	1.17	0.00	0.00	-0.08	7.40	-14.69
11*	11.203	1.586	-10.694	-0.942	1.00	0.59	0.00	0.00	-0.17	6.37	-16.89
12	17.268	1.722	-26.636	-1.408	1.06	0.66	0.00	-0.41	-2.13	-24.09	0.00
13	21.144	7.776	56.191	1.956	0.98	2.76	4.03	0.00	-8.55	10.60	54.14
14	5.850	2.231	-109.578	-14.379	0.74	1.49	0.00	-93.37	-4.08	-12.12	0.00
15*	9.396	5.145	-29.296	-3.055	1.15	3.24	0.75	0.00	-0.60	-24.22	-4.48
16	17.268	2.234	-43.755	-2.253	1.06	1.17	0.00	-16.19	-3.48	-24.09	0.00
17	9.527	2.630	-30.174	-2.507	1.24	1.26	0.13	0.00	-10.62	-27.39	7.83
18	11.083	1.461	2.590	0.207	0.92	0.54	0.00	-5.35	-1.36	9.30	0.00
19	13.396	12.557	-55.181	-2.170	1.15	11.41	0.00	-10.50	-49.24	4.56	0.00
20*	20.464	6.330	-29.568	-1.439	1.22	3.80	1.31	0.00	-0.09	-28.33	-1.14
21*	17.396	2.381	-33.655	-1.923	1.15	1.17	0.06	0.00	-0.23	-26.96	-6.46
22	13.144	16.920	-14.475	-0.493	0.98	15.94	0.00	-4.20	-20.98	10.70	0.00
23	20.333	1.865	-27.848	-1.256	1.13	0.74	0.00	-0.37	-2.00	-25.48	0.00
24	13.396	2.463	5.729	0.359	1.15	1.17	0.15	0.00	-7.88	4.56	9.05
25	11.455	2.364	-18.897	-1.396	1.17	1.07	0.13	0.00	-11.00	-0.24	-7.66
26	17.455	2.416	4.221	0.206	1.17	1.07	0.18	0.00	-11.00	4.50	10.72
27	17.144	4.704	-6.848	-0.317	0.98	2.76	0.96	0.00	-8.55	-21.50	23.20
28	15.333	6.387	-70.150	-3.236	1.13	5.26	0.00	-66.33	-12.96	9.14	0.00
29	8.074	3.009	-27.048	-2.595	0.88	2.13	0.00	-1.52	-5.58	-19.94	0.00
30	7.850	2.231	-112.411	-11.685	0.74	1.49	0.00	-93.37	-4.08	-14.96	0.00
31*	9.527	2.500	-42.749	-4.442	1.24	1.26	0.00	0.00	-0.11	-27.39	-15.25
32	13.268	3.830	1.126	0.063	1.06	2.77	0.00	-1.17	-5.46	7.75	0.00

D31 файл o31d9A