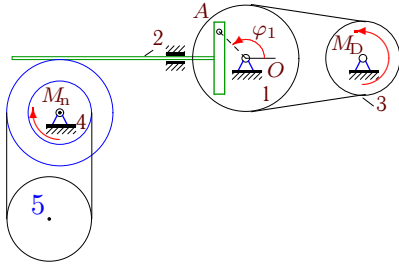


## Кулиса. Уравнение Лагранжа

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.



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

$$M_0 = 8 \text{ Нм}, \quad k = 13 \text{ Нмс},$$

$$\varphi_{1,0} = 1.1, \quad \omega_{1z,0} = 0.3 \frac{1}{\text{с}},$$

$$\mu = 15 \text{ Нмс}, \quad I_1 = 5 \text{ кгм}^2,$$

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

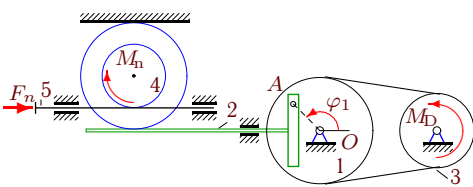
$$m_5 = 30 \text{ кг}, \quad R_1 = 36 \text{ см}, \quad r_1 = 25 \text{ см},$$

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

$$r_5 = 16 \text{ см}.$$

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### Задача D31.2.



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

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

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

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

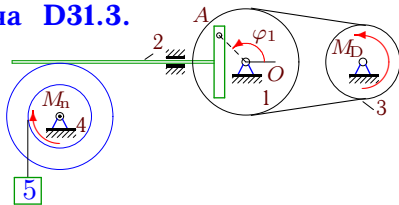
$$I_1 = 11 \text{ кгм}^2, \quad m_2 = 17 \text{ кг}, \quad m_3 = 35 \text{ кг},$$

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

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

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### Задача D31.3.



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

$$M_0 = 8 \text{ Нм}, \quad k = 11 \text{ Нмс},$$

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

$$\mu = 15 \text{ Нмс}, \quad I_1 = 5 \text{ кгм}^2,$$

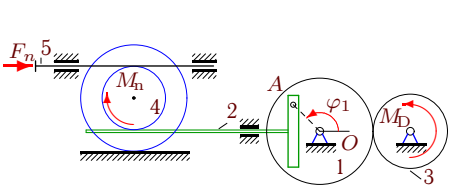
$$m_2 = 14 \text{ кг}, \quad m_3 = 32 \text{ кг}, \quad m_4 = 24 \text{ кг},$$

$$m_5 = 3 \text{ кг}, \quad R_1 = 34 \text{ см}, \quad r_1 = 23 \text{ см},$$

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

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### Задача D31.4.



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

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

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

$$\nu = 30 \text{ Нс/м}, \quad \mu = 12 \text{ Нмс},$$

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

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

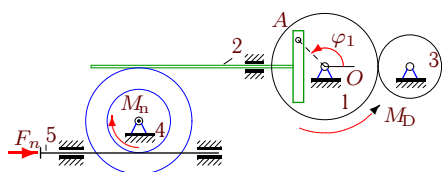
$$R_3 = 28 \text{ см}, \quad R_4 = 20 \text{ см}, \quad r_4 = 12 \text{ см}, \quad i_4 = 15 \text{ см}.$$

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

### Задача D31.5.

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

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

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

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

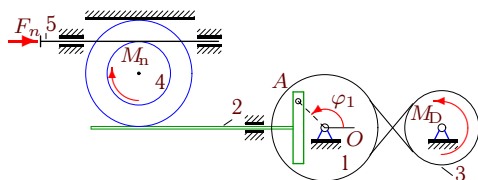
$$I_1 = 23 \text{ кгм}^2, m_2 = 18 \text{ кг}, m_3 = 36 \text{ кг},$$

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

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

### Задача D31.6.

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

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

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

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

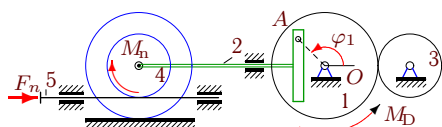
$$I_1 = 9 \text{ кгм}^2, m_2 = 15 \text{ кг}, m_3 = 33 \text{ кг},$$

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

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

### Задача D31.7.

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

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

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

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

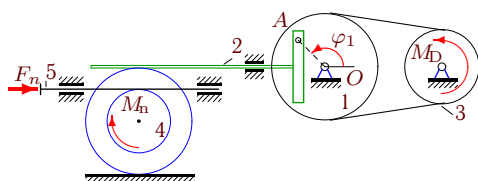
$$I_1 = 11 \text{ кгм}^2, m_2 = 15 \text{ кг}, m_3 = 33 \text{ кг},$$

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

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

### Задача D31.8.

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

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

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

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

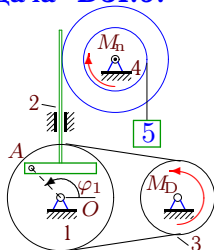
$$I_1 = 7 \text{ кгм}^2, m_2 = 15 \text{ кг}, m_3 = 33 \text{ кг},$$

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

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

### Задача D31.9.

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

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

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

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

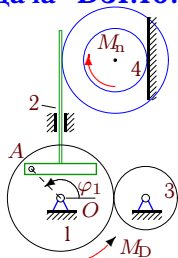
$$m_2 = 16 \text{ кг}, m_3 = 34 \text{ кг}, m_4 = 26 \text{ кг},$$

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

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

### Задача D31.10.

5



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

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

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

$$\mu = 15 \text{ Нмс},$$

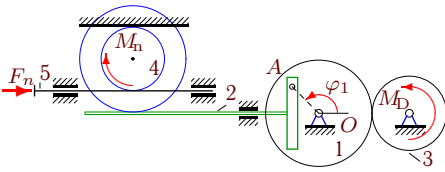
$$I_1 = 7 \text{ кгм}^2, m_2 = 14 \text{ кг}, m_3 = 32 \text{ кг},$$

$$m_4 = 24 \text{ кг}, R_1 = 37 \text{ см}, r_1 = 26 \text{ см},$$

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

**Задача D31.11.**

5



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

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

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

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

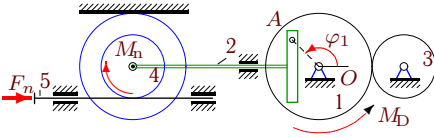
$$I_1 = 7 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг},$$

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

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

**Задача D31.12.**

5



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

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

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

$$\nu = 30 \text{ Нс/м}, \mu = 12 \text{ Нмс},$$

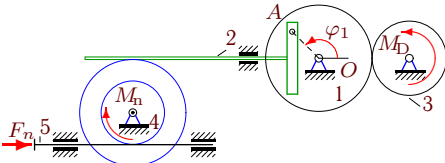
$$I_1 = 15 \text{ кгм}^2, m_2 = 16 \text{ кг}, m_3 = 34 \text{ кг},$$

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

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

**Задача D31.13.**

5



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

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

$$M_0 = 8 \text{ Нм}, k = 11 \text{ Нмс},$$

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

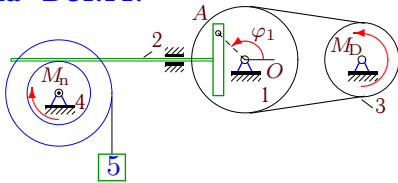
$$I_1 = 5 \text{ кгм}^2, m_2 = 15 \text{ кг}, m_3 = 33 \text{ кг},$$

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

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

**Задача D31.14.**

5



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

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

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

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

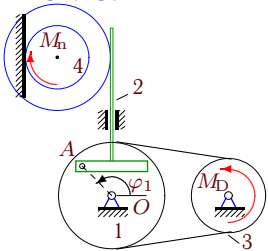
$$m_2 = 18 \text{ кг}, m_3 = 36 \text{ кг}, m_4 = 28 \text{ кг},$$

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

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

**Задача D31.15.**

5



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

$$\varphi_{1,0} = 1.4, \omega_{1z,0} = 0.3 \frac{1}{c},$$

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

$$\mu = 12 \text{ Нмс},$$

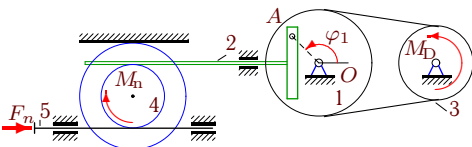
$$I_1 = 11 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг},$$

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

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

**Задача D31.16.**

5



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

$$F_{nx} = -\nu v_{5x}, \varphi_{1,0} = 1.1, \omega_{1z,0} = 0.2 \frac{1}{c},$$

$$M_0 = 8 \text{ Нм}, k = 12 \text{ Нмс},$$

$$\nu = 40 \text{ Нс/м}, \mu = 14 \text{ Нмс},$$

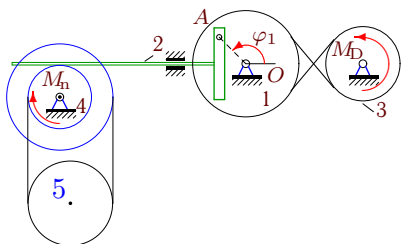
$$I_1 = 5 \text{ кгм}^2, m_2 = 14 \text{ кг}, m_3 = 32 \text{ кг},$$

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

$$R_3 = 25 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 13 \text{ см}.$$

### Задача D31.17.

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

$$M_0 = 13 \text{ Нм}, \quad k = 15 \text{ Нмс},$$

$$\varphi_{1,0} = 1.5, \quad \omega_{1z,0} = 0.5 \frac{1}{\text{с}},$$

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

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

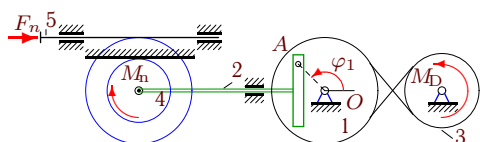
$$m_5 = 70 \text{ кг}, \quad R_1 = 38 \text{ см}, \quad r_1 = 27 \text{ см},$$

$$R_3 = 28 \text{ см}, \quad R_4 = 20 \text{ см}, \quad r_4 = 12 \text{ см}, \quad i_4 = 17 \text{ см},$$

$$r_5 = 16 \text{ см}.$$

### Задача D31.18.

5



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

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

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

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

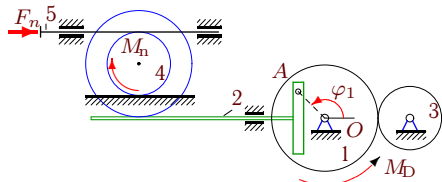
$$I_1 = 12 \text{ кгм}^2, \quad m_2 = 16 \text{ кг}, \quad m_3 = 34 \text{ кг},$$

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

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

### Задача D31.19.

5



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

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

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

$$\nu = 45 \text{ Нс/м}, \quad \mu = 12 \text{ Нмс},$$

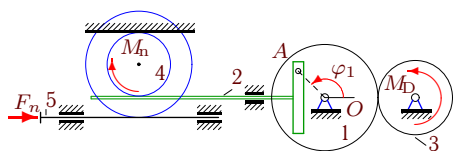
$$I_1 = 15 \text{ кгм}^2, \quad m_2 = 16 \text{ кг}, \quad m_3 = 34 \text{ кг},$$

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

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

### Задача D31.20.

5



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

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

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

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

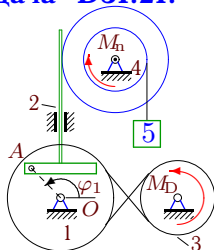
$$I_1 = 7 \text{ кгм}^2, \quad m_2 = 17 \text{ кг}, \quad m_3 = 35 \text{ кг},$$

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

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

### Задача D31.21.

5



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

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

$$\varphi_{1,0} = 1.5, \quad \omega_{1z,0} = 0.3 \frac{1}{\text{с}},$$

$$\mu = 11 \text{ Нмс}, \quad I_1 = 18 \text{ кгм}^2,$$

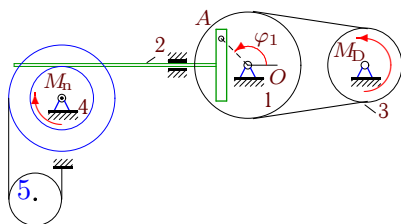
$$m_2 = 18 \text{ кг}, \quad m_3 = 36 \text{ кг}, \quad m_4 = 28 \text{ кг},$$

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

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

**Задача D31.22.**

5



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

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

$$\varphi_{1,0} = 1.2, \quad \omega_{1z,0} = 0.5 \frac{1}{\text{с}},$$

$$\mu = 13 \text{ Нмс}, \quad I_1 = 7 \text{ кгм}^2,$$

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

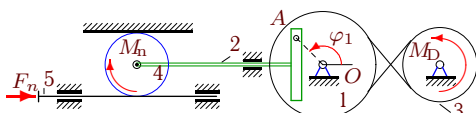
$$m_5 = 3 \text{ кг}, \quad R_1 = 38 \text{ см}, \quad r_1 = 27 \text{ см},$$

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

$$r_5 = 11 \text{ см}.$$

**Задача D31.23.**

5



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

$$F_{nx} = -\nu v_{5x}, \quad \varphi_{1,0} = 1.5, \quad \omega_{1z,0} = 0.5 \frac{1}{\text{с}},$$

$$M_0 = 13 \text{ Нм}, \quad k = 15 \text{ Нмс},$$

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

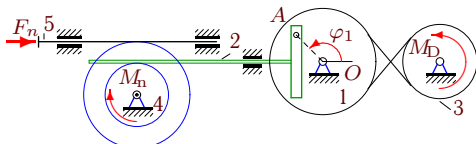
$$I_1 = 18 \text{ кгм}^2, \quad m_2 = 18 \text{ кг}, \quad m_3 = 36 \text{ кг},$$

$$m_4 = 28 \text{ кг}, \quad R_1 = 38 \text{ см}, \quad r_1 = 27 \text{ см},$$

$$R_3 = 28 \text{ см}, \quad R_4 = 12 \text{ см}.$$

**Задача D31.24.**

5



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

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

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

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

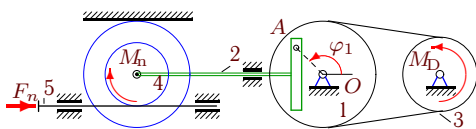
$$I_1 = 12 \text{ кгм}^2, \quad m_2 = 16 \text{ кг}, \quad m_3 = 34 \text{ кг},$$

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

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

**Задача D31.25.**

5



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

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

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

$$\nu = 30 \text{ Нс/м}, \quad \mu = 12 \text{ Нмс},$$

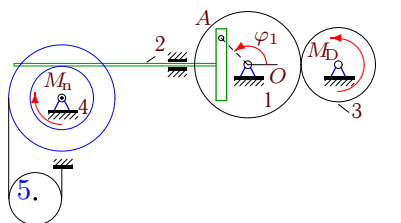
$$I_1 = 9 \text{ кгм}^2, \quad m_2 = 16 \text{ кг}, \quad m_3 = 34 \text{ кг},$$

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

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

**Задача D31.26.**

5



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

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

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

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

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

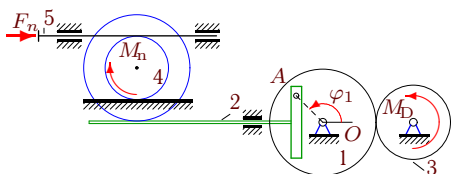
$$m_5 = 4 \text{ кг}, \quad R_1 = 35 \text{ см}, \quad r_1 = 24 \text{ см},$$

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

$$r_5 = 10 \text{ см}.$$

**Задача D31.27.**

5



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

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

$$M_0 = 7 \text{ Нм}, k = 13 \text{ Нмс},$$

$$\nu = 55 \text{ Нс/м}, \mu = 14 \text{ Нмс},$$

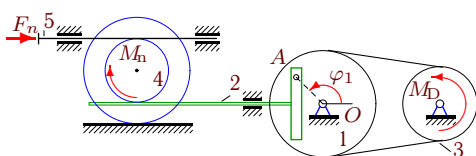
$$I_1 = 4 \text{ кгм}^2, m_2 = 14 \text{ кг}, m_3 = 32 \text{ кг},$$

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

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

**Задача D31.28.**

5



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

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

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

$$\nu = 35 \text{ Нс/м}, \mu = 13 \text{ Нмс},$$

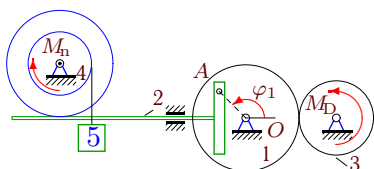
$$I_1 = 7 \text{ кгм}^2, m_2 = 15 \text{ кг}, m_3 = 33 \text{ кг},$$

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

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

**Задача D31.29.**

5



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

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

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

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

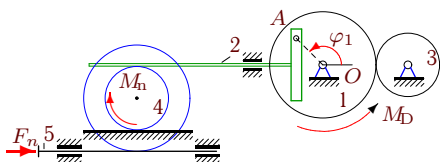
$$m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг}, m_4 = 27 \text{ кг},$$

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

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

**Задача D31.30.**

5



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

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

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

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

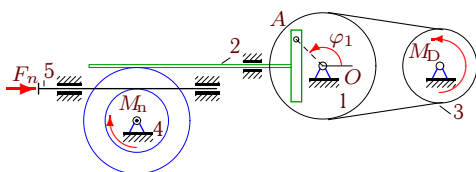
$$I_1 = 23 \text{ кгм}^2, m_2 = 18 \text{ кг}, m_3 = 36 \text{ кг},$$

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

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

**Задача D31.31.**

5



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

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

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

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

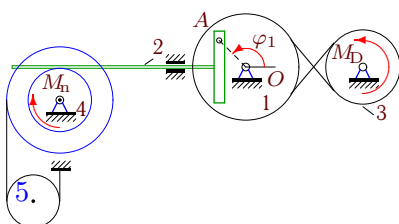
$$I_1 = 7 \text{ кгм}^2, m_2 = 15 \text{ кг}, m_3 = 33 \text{ кг},$$

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

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

**Задача D31.32.**

5



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

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

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

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

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

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

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

$$r_5 = 12 \text{ см}.$$

**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	7.074	2.184	11.130	1.255	0.88	0.63	0.67	0.00	-5.58	3.60	13.11
2	13.396	1.898	2.168	0.139	1.15	0.75	0.00	-0.42	-1.97	4.56	0.00
3	6.850	1.334	11.170	1.412	0.74	0.54	0.06	0.00	-1.58	9.13	3.62
4	8.455	19.676	-105.725	-4.004	1.17	18.51	0.00	-16.24	-63.45	-26.03	0.00
5	25.081	2.022	-3.575	-0.132	0.95	1.07	0.00	-15.16	-1.32	12.90	0.00
6	11.138	1.520	-27.960	-2.248	0.94	0.58	0.00	-5.21	-1.43	-21.32	0.00
7	13.259	3.532	-32.301	-1.990	1.01	2.52	0.00	-30.07	-7.63	5.40	0.00
8	9.138	1.520	3.195	0.301	0.94	0.58	0.00	-0.36	-1.43	4.98	0.00
9*	11.455	2.364	-10.301	-0.873	1.17	1.07	0.13	0.00	-0.85	-0.24	-9.21
10*	9.190	1.442	-23.025	-2.417	0.95	0.50	0.00	0.00	-0.81	4.40	-26.61
11	9.144	1.587	-20.267	-1.898	0.98	0.61	0.00	-0.25	-1.31	-18.70	0.00
12	16.965	2.995	9.049	0.458	0.85	2.15	0.00	-0.38	-1.47	10.90	0.00
13	6.907	1.442	-28.269	-3.465	0.79	0.65	0.00	-13.23	-1.49	-13.54	0.00
14	15.081	4.807	-11.369	-0.573	0.95	2.97	0.88	0.00	-3.66	14.79	-22.51
15*	13.268	1.722	-3.617	-0.270	1.06	0.66	0.00	0.00	-0.06	7.75	-11.31
16	6.960	13.097	-19.375	-1.128	0.81	12.29	0.00	-5.86	-20.02	6.50	0.00
17	20.599	10.512	-118.291	-3.815	1.31	4.10	5.10	0.00	-25.19	-31.46	-61.65
18	14.327	5.585	-137.517	-7.059	1.08	4.50	0.00	-89.26	-22.66	-25.59	0.00
19	17.455	12.095	-72.659	-2.560	1.17	10.93	0.00	-13.71	-63.45	4.50	0.00
20	9.144	2.059	-21.338	-1.916	0.98	1.08	0.00	-0.50	-2.14	-18.70	0.00
21*	20.333	2.569	-27.793	-1.365	1.13	1.26	0.18	0.00	-0.03	-25.48	-2.29
22	9.383	3.802	-24.013	-1.918	1.09	2.48	0.23	0.00	-28.59	-1.60	6.17
23	20.599	4.374	-61.720	-2.477	1.31	3.06	0.00	-5.08	-25.19	-31.46	0.00
24	14.455	4.128	-62.114	-3.411	1.17	2.96	0.00	-2.82	-30.55	-28.74	0.00
25	11.455	4.128	-12.994	-0.867	1.17	2.96	0.00	-2.60	-10.15	-0.24	0.00
26	9.144	3.984	-19.516	-1.502	0.98	2.76	0.24	0.00	-8.55	-18.70	7.73
27	6.074	8.211	-57.118	-4.559	0.88	7.34	0.00	-7.37	-32.58	-17.17	0.00
28	9.138	15.488	-37.222	-1.668	0.94	14.55	0.00	-9.12	-33.09	4.98	0.00
29	9.527	2.630	-30.174	-2.507	1.24	1.26	0.13	0.00	-10.62	-27.39	7.83
30	25.081	2.066	7.307	0.269	0.95	1.11	0.00	-4.68	-0.91	12.90	0.00
31	9.383	1.987	-13.081	-1.193	1.09	0.89	0.00	-0.40	-11.08	-1.60	0.00
32	17.144	4.104	-18.449	-0.874	0.98	2.76	0.36	0.00	-8.55	-21.50	11.60

D31 файл о31d5A