

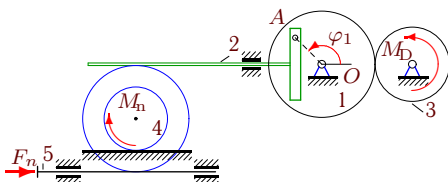
Кулиса. Уравнение Лагранжа

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.

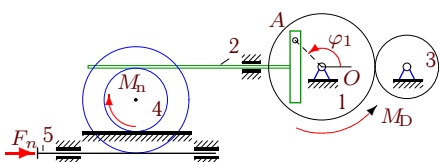
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$$\begin{aligned} M_{Dz} &= M_0 - k\omega_{3z}, \quad M_{nz} = -\mu\omega_{4z}, \\ F_{nx} &= -\nu v_{5x}, \quad \varphi_{1,0} = 1.4, \quad \omega_{1z,0} = 0.2 \frac{1}{c}, \\ M_0 &= 10 \text{ Нм}, \quad k = 12 \text{ Нмс}, \\ \nu &= 8 \text{ кНс/м}, \quad \mu = 11 \text{ Нмс}, \\ I_1 &= 7 \text{ кгм}^2, \quad m_2 = 17 \text{ кг}, \quad m_3 = 35 \text{ кг}, \\ m_4 &= 27 \text{ кг}, \quad R_1 = 35 \text{ см}, \quad r_1 = 24 \text{ см}, \\ R_3 &= 25 \text{ см}, \quad R_4 = 20 \text{ см}, \quad r_4 = 12 \text{ см}, \quad i_4 = 16 \text{ см}. \end{aligned}$$

Задача D31.2.

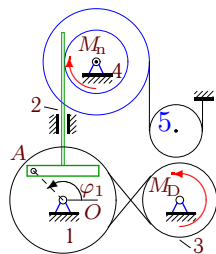
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$$\begin{aligned} M_{Dz} &= M_0 - k\omega_{1z}, \quad M_{nz} = -\mu\omega_{4z}, \\ F_{nx} &= -\nu v_{5x}, \quad \varphi_{1,0} = 1.4, \quad \omega_{1z,0} = 0.1 \frac{1}{c}, \\ M_0 &= 13 \text{ Нм}, \quad k = 11 \text{ Нмс}, \\ \nu &= 8 \text{ кНс/м}, \quad \mu = 11 \text{ Нмс}, \\ I_1 &= 19 \text{ кгм}^2, \quad m_2 = 17 \text{ кг}, \quad m_3 = 35 \text{ кг}, \\ m_4 &= 27 \text{ кг}, \quad R_1 = 34 \text{ см}, \quad r_1 = 23 \text{ см}, \\ R_3 &= 24 \text{ см}, \quad R_4 = 20 \text{ см}, \quad r_4 = 12 \text{ см}, \quad i_4 = 16 \text{ см}. \end{aligned}$$

Задача D31.3.

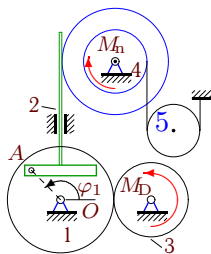
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$$\begin{aligned} M_{Dz} &= M_0 - k\omega_{3z}, \quad M_{nz} = -\mu\omega_{4z}, \\ M_0 &= 10 \text{ Нм}, \quad k = 11 \text{ Нмс}, \\ \varphi_{1,0} &= 1.2, \quad \omega_{1z,0} = 0.1 \frac{1}{c}, \\ \mu &= 13 \text{ Нмс}, \quad I_1 = 9 \text{ кгм}^2, \\ m_2 &= 15 \text{ кг}, \quad m_3 = 33 \text{ кг}, \quad m_4 = 25 \text{ кг}, \\ m_5 &= 4 \text{ кг}, \quad R_1 = 34 \text{ см}, \quad r_1 = 23 \text{ см}, \\ R_3 &= 24 \text{ см}, \quad R_4 = 20 \text{ см}, \quad r_4 = 12 \text{ см}, \quad i_4 = 14 \text{ см}, \\ r_5 &= 12 \text{ см}. \end{aligned}$$

Задача D31.4.

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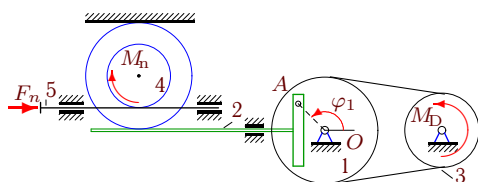


$$\begin{aligned} M_{Dz} &= M_0 - k\omega_{3z}, \quad M_{nz} = -\mu\omega_{4z}, \\ M_0 &= 7 \text{ Нм}, \quad k = 15 \text{ Нмс}, \\ \varphi_{1,0} &= 1.1, \quad \omega_{1z,0} = 0.5 \frac{1}{c}, \\ \mu &= 15 \text{ Нмс}, \quad I_1 = 4 \text{ кгм}^2, \\ m_2 &= 14 \text{ кг}, \quad m_3 = 32 \text{ кг}, \quad m_4 = 24 \text{ кг}, \\ m_5 &= 2 \text{ кг}, \quad R_1 = 38 \text{ см}, \quad r_1 = 27 \text{ см}, \\ R_3 &= 28 \text{ см}, \quad R_4 = 20 \text{ см}, \quad r_4 = 12 \text{ см}, \quad i_4 = 13 \text{ см}, \\ r_5 &= 10 \text{ см}. \end{aligned}$$

¹В некоторых вариантах содержатся не все элементы.

Задача D31.5.

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

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

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

$$\nu = 20 \text{ Нс/м}, \mu = 11 \text{ Нмс},$$

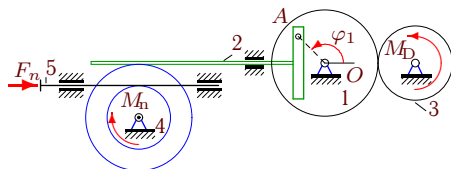
$$I_1 = 13 \text{ кгм}^2, m_2 = 18 \text{ кг}, m_3 = 36 \text{ кг},$$

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

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

Задача D31.6.

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

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

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

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

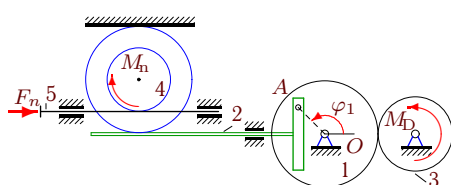
$$I_1 = 7 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг},$$

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

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

Задача D31.7.

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

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

$$M_0 = 9 \text{ Нм}, k = 14 \text{ Нмс},$$

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

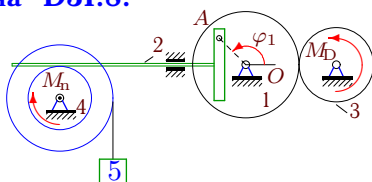
$$I_1 = 6 \text{ кгм}^2, m_2 = 16 \text{ кг}, m_3 = 34 \text{ кг},$$

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

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

Задача D31.8.

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

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

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

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

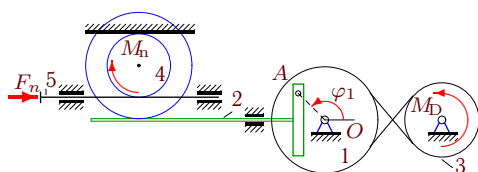
$$m_2 = 14 \text{ кг}, m_3 = 32 \text{ кг}, m_4 = 24 \text{ кг},$$

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

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

Задача D31.9.

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

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

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

$$\nu = 50 \text{ Нс/м}, \mu = 14 \text{ Нмс},$$

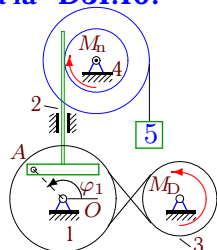
$$I_1 = 9 \text{ кгм}^2, m_2 = 15 \text{ кг}, m_3 = 33 \text{ кг},$$

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

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

Задача D31.10.

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

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

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

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

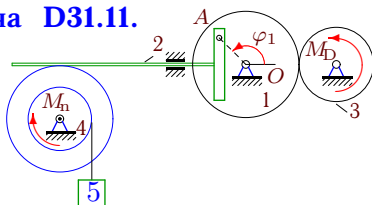
$$m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг}, m_4 = 27 \text{ кг},$$

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

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

Задача D31.11.

6



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

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

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

$$\mu = 13 \text{ Нмс}, I_1 = 6 \text{ кгм}^2,$$

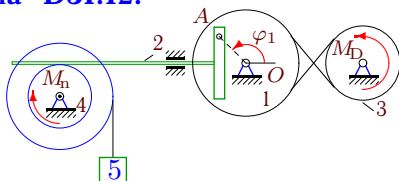
$$m_2 = 16 \text{ кг}, m_3 = 34 \text{ кг}, m_4 = 26 \text{ кг},$$

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

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

Задача D31.12.

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

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

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

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

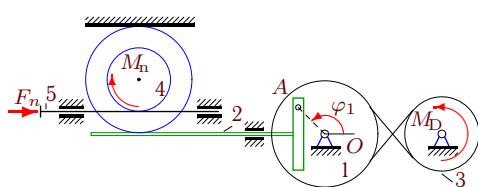
$$m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг}, m_4 = 27 \text{ кг},$$

$$m_5 = 6 \text{ кг}, R_1 = 38 \text{ см}, r_1 = 27 \text{ см},$$

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

Задача D31.13.

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

$$F_{nx} = -\nu v_{5x}, \varphi_{1,0} = 1.2, \omega_{1z,0} = 0.2 \frac{1}{\text{с}},$$

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

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

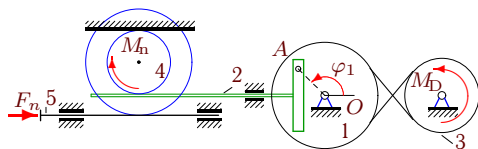
$$I_1 = 9 \text{ кгм}^2, m_2 = 15 \text{ кг}, m_3 = 33 \text{ кг},$$

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

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

Задача D31.14.

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

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

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

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

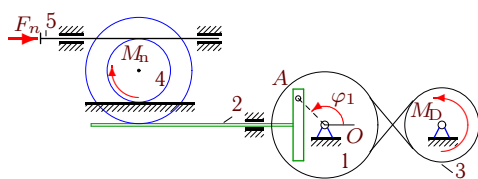
$$I_1 = 9 \text{ кгм}^2, m_2 = 15 \text{ кг}, m_3 = 33 \text{ кг},$$

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

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

Задача D31.15.

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

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

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

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

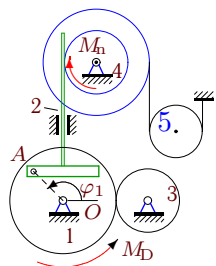
$$I_1 = 15 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг},$$

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

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

Задача D31.16.

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

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

$$\varphi_{1,0} = 1.2, \omega_{1z,0} = 0.3 \frac{1}{\text{с}},$$

$$\mu = 13 \text{ Нмс}, I_1 = 11 \text{ кгм}^2,$$

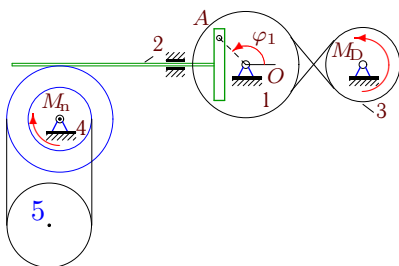
$$m_2 = 15 \text{ кг}, m_3 = 33 \text{ кг}, m_4 = 25 \text{ кг},$$

$$m_5 = 5 \text{ кг}, R_1 = 36 \text{ см}, r_1 = 25 \text{ см},$$

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

$$r_5 = 13 \text{ см}.$$

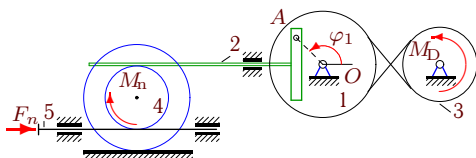
Задача D31.17.



$$\begin{aligned} M_{D_z} &= M_0 - k\omega_{3_z}, \quad M_{n_z} = -\mu\omega_{4_z}, \\ M_0 &= 12 \text{ HМ}, \quad k = 12 \text{ HМс}, \\ \varphi_{1,0} &= 1.4, \quad \omega_{1_z,0} = 0.2 \frac{1}{\text{с}}, \\ \mu &= 12 \text{ HМс}, \quad I_1 = 15 \text{ кгм}^2, \\ m_2 &= 17 \text{ кг}, \quad m_3 = 35 \text{ кг}, m_4 = 27 \text{ кг}, \\ m_5 &= 70 \text{ кг}, \quad R_1 = 35 \text{ см}, \quad r_1 = 24 \text{ см}, \\ R_3 &= 25 \text{ см}, \quad R_4 = 20 \text{ см}, \quad r_4 = 12 \text{ см}, \quad i_4 = 16 \text{ см}, \\ r_5 &= 16 \text{ см}. \end{aligned}$$

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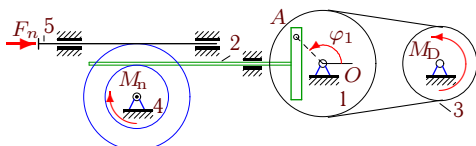
Задача D31.18.



$$\begin{aligned} M_{D_z} &= M_0 - k\omega_{3_z}, \quad M_{n_z} = -\mu\omega_{4_z}, \\ F_{n_x} &= -\nu v_{5_x}, \quad \varphi_{1,0} = 1.3, \quad \omega_{1,z,0} = 0.5 \frac{1}{c}, \\ M_0 &= 11 \text{ ММ}, \quad k = 15 \text{ Мс}, \\ \nu &= 8 \text{ кГц/М}, \quad \mu = 12 \text{ Мс}, \\ I_1 &= 12 \text{ кгМ}^2, \quad m_2 = 16 \text{ кг}, \quad m_3 = 34 \text{ кг}, \\ m_4 &= 26 \text{ кг}, \quad R_1 = 38 \text{ см}, \quad r_1 = 27 \text{ см}, \\ R_3 &= 28 \text{ см}, \quad R_4 = 20 \text{ см}, \quad r_4 = 12 \text{ см}, \quad i_4 = 15 \text{ см}. \end{aligned}$$

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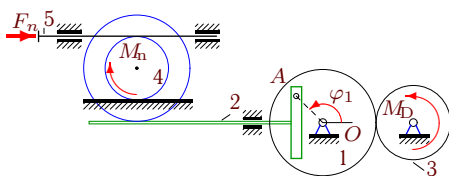
Задача D31.19.



$$\begin{aligned} M_{D_z} &= M_0 - k\omega_{3_z}, M_{n_z} = -\mu\omega_{4_z}, \\ F_{n_x} &= -\nu\nu_{5_x}, \varphi_{1,0} = 1.1, \omega_{1,z,0} = 0.4\frac{1}{c}, \\ M_0 &= 8 \text{ Hм}, k = 14 \text{ Hмс}, \\ \nu &= 40\text{Hс/м}, \mu = 15 \text{ Hмс}, \\ I_1 &= 5 \text{ кгм}^2, m_2 = 14 \text{ кг}, m_3 = 32 \text{ кг}, \\ m_4 &= 24 \text{ кг}, R_1 = 37 \text{ см}, r_1 = 26 \text{ см}, \\ R_3 &= 27 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 13 \text{ см}. \end{aligned}$$

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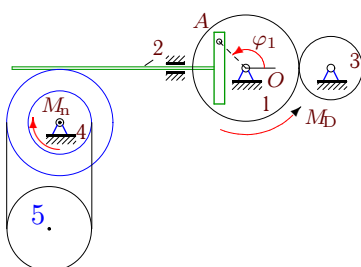
Задача D31.20.



$$\begin{aligned} M_{D_z} &= M_0 - k\omega_{3_z}, M_{n_z} = -\mu\omega_{4_z}, \\ F_{n_x} &= -\nu\nu_{5_x}, \varphi_{1,0} = 1.3, \omega_{1,z,0} = 0.2\frac{1}{c}, \\ M_0 &= 9 \text{ Hм}, k = 12 \text{ Hмс}, \\ \nu &= 45 \text{ Hс/м}, \mu = 12 \text{ Hмс}, \\ I_1 &= 6 \text{ кгм}^2, m_2 = 16 \text{ кг}, m_3 = 34 \text{ кг}, \\ m_4 &= 26 \text{ кг}, R_1 = 35 \text{ см}, r_1 = 24 \text{ см}, \\ R_3 &= 25 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 15 \text{ см}. \end{aligned}$$

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Задача D31.21.

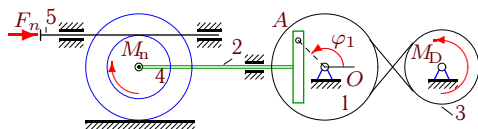


$$\begin{aligned} M_{D_z} &= M_0 - k\omega_{1_z}, M_{n_z} = -\mu\omega_{4_z}, \\ M_0 &= 14 \text{ HМ}, k = 14 \text{ HМс}, \\ \varphi_{1,0} &= 1.5, \omega_{1_z,0} = 0.4 \frac{1}{\text{с}}, \\ \mu &= 11 \text{ HМс}, I_1 = 23 \text{ кгм}^2, \\ m_2 &= 18 \text{ кг}, m_3 = 36 \text{ кг}, m_4 = 28 \text{ кг}, \\ m_5 &= 90 \text{ кг}, R_1 = 37 \text{ см}, r_1 = 26 \text{ см}, \\ R_3 &= 27 \text{ см}, R_4 = 20 \text{ см}, r_4 = 12 \text{ см}, i_4 = 17 \text{ см}, \\ r_5 &= 16 \text{ см}. \end{aligned}$$

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Задача D31.22.

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

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

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

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

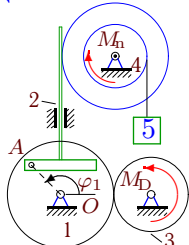
$$I_1 = 15 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг},$$

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

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

Задача D31.23.

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

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

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

$$\mu = 13 \text{ Нмс}, I_1 = 6 \text{ кгм}^2,$$

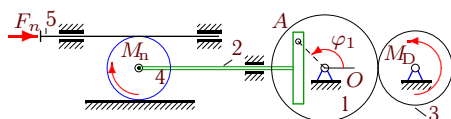
$$m_2 = 16 \text{ кг}, m_3 = 34 \text{ кг}, m_4 = 26 \text{ кг},$$

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

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

Задача D31.24.

6



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

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

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

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

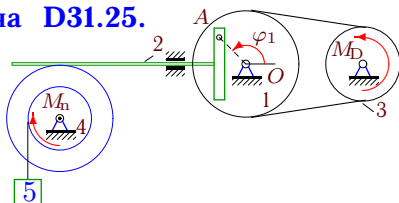
$$I_1 = 8 \text{ кгм}^2, m_2 = 18 \text{ кг}, m_3 = 36 \text{ кг},$$

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

$$R_3 = 27 \text{ см}, R_4 = 12 \text{ см}.$$

Задача D31.25.

6



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

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

$$\varphi_{1,0} = 1.2, \omega_{1z,0} = 0.5 \frac{1}{c},$$

$$\mu = 14 \text{ Нмс}, I_1 = 7 \text{ кгм}^2,$$

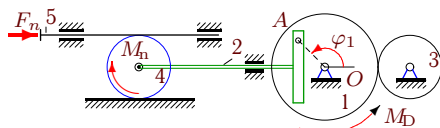
$$m_2 = 15 \text{ кг}, m_3 = 33 \text{ кг}, m_4 = 25 \text{ кг},$$

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

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

Задача D31.26.

6



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

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

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

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

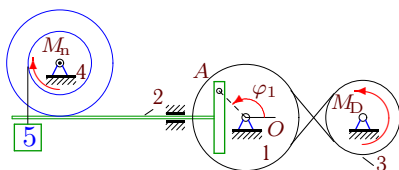
$$I_1 = 19 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг},$$

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

$$R_3 = 27 \text{ см}, R_4 = 12 \text{ см}.$$

Задача D31.27.

6



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

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

$$\varphi_{1,0} = 1.5, \omega_{1z,0} = 0.2 \frac{1}{c},$$

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

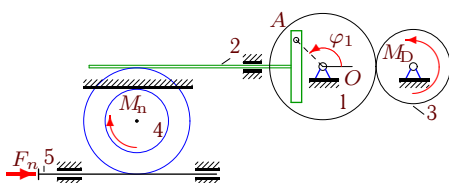
$$m_2 = 18 \text{ кг}, m_3 = 36 \text{ кг}, m_4 = 28 \text{ кг},$$

$$m_5 = 8 \text{ кг}, R_1 = 35 \text{ см}, r_1 = 24 \text{ см},$$

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

Задача D31.28.

6



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

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

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

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

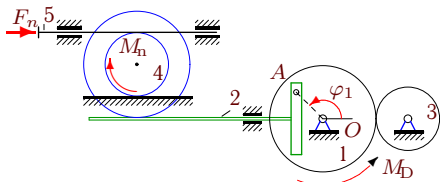
$$I_1 = 7 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг},$$

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

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

Задача D31.29.

6



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

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

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

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

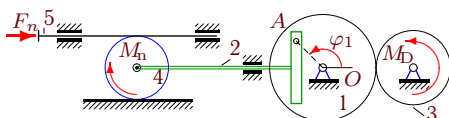
$$I_1 = 23 \text{ кгм}^2, m_2 = 18 \text{ кг}, m_3 = 36 \text{ кг},$$

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

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

Задача D31.30.

6



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

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

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

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

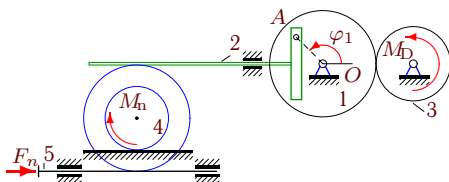
$$I_1 = 7 \text{ кгм}^2, m_2 = 17 \text{ кг}, m_3 = 35 \text{ кг},$$

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

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

Задача D31.31.

6



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

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

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

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

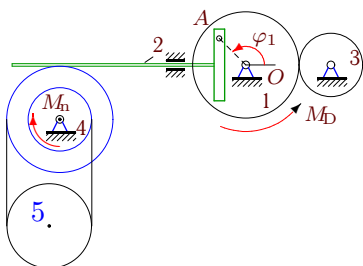
$$I_1 = 8 \text{ кгм}^2, m_2 = 18 \text{ кг}, m_3 = 36 \text{ кг},$$

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

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

Задача D31.32.

6



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

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

$$\varphi_{1,0} = 1.3, \omega_{1z,0} = 0.1 \frac{1}{c},$$

$$\mu = 13 \text{ Нм/с}, I_1 = 15 \text{ кгм}^2,$$

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

$$m_5 = 70 \text{ кг}, R_1 = 34 \text{ см}, r_1 = 23 \text{ см},$$

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

$$r_5 = 16 \text{ см}.$$

D31 Ответы.
Кулиса. Уравнение Лагранжа

23.03.2012

	A	B	Q	ε	B_2	B_4	B_5	Q_F	Q_M	Q_D	Q_T
1	9.144	1.587	-25.499	-2.388	0.98	0.61	0.00	-5.59	-1.20	-18.70	0.00
2	21.023	1.891	6.353	0.278	0.90	0.99	0.00	-4.57	-0.98	11.90	0.00
3*	10.907	2.814	-26.540	-2.353	0.79	1.80	0.22	0.00	-0.63	-16.37	-9.54
4*	6.310	1.779	-42.225	-6.298	1.02	0.74	0.02	0.00	-2.81	-23.31	-16.10
5	15.081	1.590	14.363	0.862	0.95	0.64	0.00	-0.07	-0.36	14.79	0.00
6	9.023	1.813	-17.962	-1.666	0.90	0.91	0.00	-0.05	-1.54	-16.37	0.00
7	8.327	1.768	-25.371	-2.552	1.08	0.69	0.00	-0.48	-2.04	-22.85	0.00
8	5.850	2.378	-19.561	-2.529	0.74	1.49	0.15	0.00	-4.08	-12.12	-3.35
9	11.021	1.342	-20.354	-1.672	0.86	0.48	0.00	-0.28	-1.37	-18.70	0.00
10*	17.268	5.104	-27.424	-1.570	1.06	3.00	1.04	0.00	-0.41	-24.09	-2.92
11	8.203	2.004	-31.268	-3.112	1.00	0.91	0.09	0.00	-5.66	-19.94	-5.67
12	17.527	5.953	-83.240	-3.582	1.24	3.50	1.22	0.00	-27.04	-30.10	-26.10
13	11.021	1.400	-19.804	-1.620	0.86	0.54	0.00	-0.22	-0.88	-18.70	0.00
14	11.259	2.012	-30.983	-2.391	1.01	1.00	0.00	-1.46	-5.30	-24.22	0.00
15	17.268	11.609	-61.943	-2.176	1.06	10.55	0.00	-6.56	-31.30	-24.09	0.00
16*	13.138	3.390	-4.750	-0.342	0.94	2.13	0.33	0.00	-2.22	7.10	-9.63
17	17.144	3.426	7.622	0.371	0.98	1.00	1.45	0.00	-3.36	-21.50	32.48
18	14.455	2.323	-49.629	-2.997	1.17	1.16	0.00	-16.92	-3.97	-28.74	0.00
19	7.190	2.850	-24.311	-2.591	0.95	1.90	0.00	-2.39	-22.37	0.45	0.00
20	8.083	9.556	-41.690	-2.465	0.92	8.63	0.00	-4.33	-20.05	-17.30	0.00
21	25.464	4.775	46.797	1.547	1.22	1.37	2.19	0.00	-7.40	8.40	45.80
22	17.396	4.143	-36.519	-1.710	1.15	2.99	0.00	-1.68	-7.88	-26.96	0.00
23*	8.455	2.338	-36.512	-4.217	1.17	1.07	0.10	0.00	-0.85	-26.03	-9.64
24	10.464	4.056	-49.909	-3.445	1.22	2.84	0.00	-3.77	-20.55	-25.59	0.00
25	9.383	2.092	-6.757	-0.619	1.09	0.89	0.10	0.00	-11.08	-1.60	5.92
26	21.396	3.887	-18.684	-0.746	1.15	2.74	0.00	-4.20	-21.88	7.40	0.00
27	20.205	2.368	-37.329	-1.655	1.04	1.17	0.17	0.00	-3.15	-22.90	-11.27
28	9.023	9.826	-28.061	-1.512	0.90	8.93	0.00	-2.05	-9.63	-16.37	0.00
29	25.081	10.973	3.018	0.084	0.95	10.02	0.00	-1.66	-8.22	12.90	0.00
30	9.527	4.192	-62.546	-4.613	1.24	2.95	0.00	-5.66	-29.50	-27.39	0.00
31	10.464	2.017	-41.670	-3.343	1.22	0.80	0.00	-13.45	-2.63	-25.59	0.00
32	16.965	2.953	39.741	2.016	0.85	0.77	1.33	0.00	-1.60	10.90	30.44

D31 файл o31d6A