

Часть 1

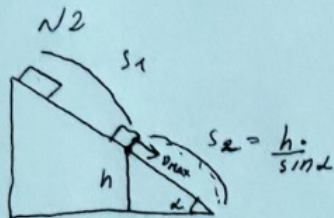
Олимпиада: **Физика, 10 класс (1 часть)**

Шифр: **21204428**

ID профиля: **222543**

Вариант 4

Чистовые сравнения * 6-10-04



$$\cos \alpha = \frac{24}{25}, \quad \sin \alpha = \frac{7}{25}$$

1) Наибольшая скорость коробки будет в момент, когда она будет на высоте h . так как до этого коробка разогнана ($a_1 > 0$), а после пришла ($a_2 < 0$) т.е. коробка полностью остановилась у основания, то

$$S_2 = \frac{-v_{\max}^2 + 0}{2a_2} \quad \frac{h}{\sin \alpha} = \frac{v_{\max}^2}{-2a_2} \quad v_{\max} = \sqrt{\frac{h \cdot 2(g \cdot (\sin \alpha - \cos \alpha \cdot \mu_1))}{\sin \alpha}} = \sqrt{\frac{2 \cdot 10 \cdot (7/25 - 24/25 \cdot 1/2)}{7/25}} = 2\sqrt{5}$$

$$m a_2 = m g \cdot \sin \alpha - m g \cos \alpha \cdot \mu_1$$

$$= 2\sqrt{5} \cdot 10 = 20\sqrt{5}$$

$$a_2 = g(\sin \alpha - \cos \alpha \cdot \mu_1) = 10 \cdot \left(\frac{7}{25} - \frac{24}{25} \cdot \frac{1}{2} \right) = 10 \cdot \frac{-5}{25} = -2$$

$$a_1 = g(\sin \alpha - \cos \alpha \cdot \mu_2) = 10 \cdot \left(\frac{7}{25} - \frac{24}{25} \cdot \frac{3}{10} \right) > 0$$

2) т.е. начальная скорость коробки равна 0, то

$$S_1 = \frac{v_{\max}^2}{2a_1}$$

$$S_1 = \frac{20}{2 \cdot 10 \left(\frac{139}{625} \right)} = \frac{20 \cdot 625}{139} \approx 4,5$$

$$S_2 = \frac{h}{\sin \alpha} = \frac{1,4}{7/25} = 25 \cdot 0,2 = 5$$

$$\text{Отв: } v_{\max} = 2\sqrt{5} \text{ м/с} \approx 4,47 \text{ м/с}$$

$$S_{\text{обг}} = 9,5$$

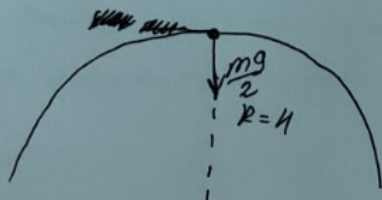
№1. Условие задачи 2

$$a) H_{\max} = \frac{v_0^2 \cdot \sin^2 \alpha}{2g}$$

$$\frac{v_0^2 \cdot \frac{1}{2}}{20} = 10$$

$$v_0 = 20 \text{ м/с}$$

б)



Равнодействующая сила = $\frac{mg}{2}$ и будет направлена вниз по вертикали.

$$\frac{v^2}{R} \cdot m = \frac{mg}{2}$$

$$v^2 = \frac{Rg}{2}$$

$$v = \sqrt{\frac{Hg}{2}} = \sqrt{50} = 5\sqrt{2}$$

$$H = v_0$$

Через время

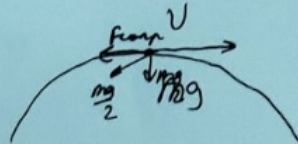
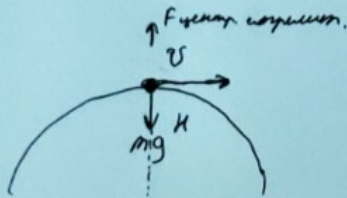
$$v_0 \sin \alpha = gt$$

$$t = \frac{v_0 \sin \alpha}{g} \quad \frac{1,4}{\frac{7}{25}} = 25 \cdot 0,2 = 5$$

$$\frac{v_0 \sin \alpha \cdot t - \frac{g t^2}{2}}{0,2} = \frac{v_0^2 \sin^2 \alpha}{g} - \frac{v_0^2 \sin^2 \alpha}{2g} = \frac{v_0^2 \sin^2 \alpha}{2g} = H$$

$$5 \cdot \frac{7 \cdot 25}{25} = 5 \quad v_0 = \sqrt{\frac{H \cdot 2g}{\sin^2 \alpha}} = \sqrt{\frac{10 \cdot 20}{\frac{1}{2}}} = 20$$

$$\frac{s_1}{s_2} = \frac{a_2}{a_1}$$



$$\frac{v^2}{H} \cdot m = mg - F_{тяж} = \frac{mg}{2}$$

$$\frac{7}{25} - \frac{20}{25} \cdot \frac{3}{25}$$

$$\frac{7}{25} - \frac{36}{625}$$

$$\frac{s_1}{s_2} = \frac{2}{5} = \frac{139}{625}$$

$$\frac{7}{25} - \frac{36}{25^2} = \frac{139}{625}$$

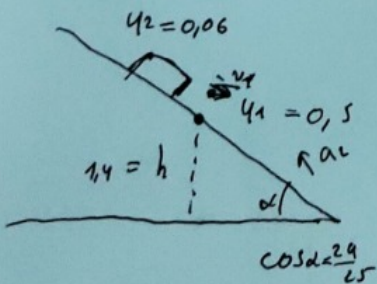
7,25

$$v^2 = \frac{gH}{2}$$

$$v = \sqrt{\frac{gH}{2}}$$

$$4 \cdot \frac{25 \cdot 625}{139}$$

$$a_1 = g \cdot \left(\frac{7}{25} - \frac{24}{25} \cdot \frac{3}{50} \right) > 0$$



$$ma = mg \sin \alpha - mg \cos \alpha \sin \alpha =$$

$$a = g(\sin \alpha - \cos \alpha \sin \alpha) =$$

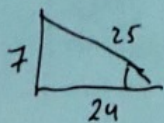
$$= 10 \cdot \left(\frac{7}{25} - \frac{1}{2} \cdot \frac{24}{25} \right) =$$

$$= 10 \cdot \left(\frac{7}{25} - \frac{12}{25} \right) = -\frac{1}{5} \cdot 10 = -2$$

$$\sin \alpha = \frac{7}{25}$$

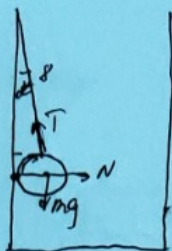
$$\sin \alpha = \frac{7}{25}$$

$$\frac{1,4}{\frac{7}{25}} = \frac{v_1^2}{2a}$$



$$\frac{25}{0,2} = \frac{v_1^2}{2 \cdot (-2)} = 500 \quad v_1 = 10\sqrt{5}$$

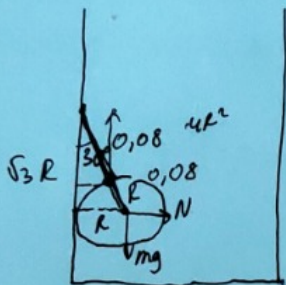
Черобие



$$mg \cdot R = T \cdot \sin \alpha = 0,08$$

$$\cos \alpha T = N$$

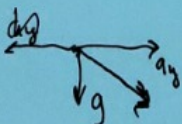
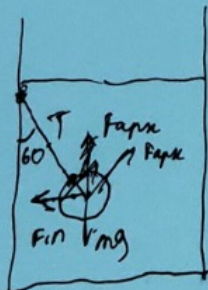
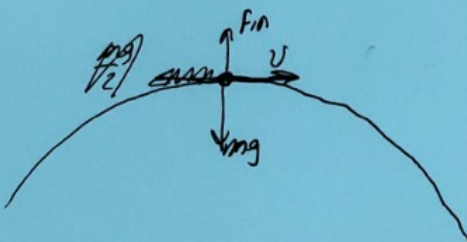
$$\sin \alpha T = mg$$



$\cos 30^\circ$

$$\frac{R}{2} \cdot \cos 30^\circ T = mg R$$

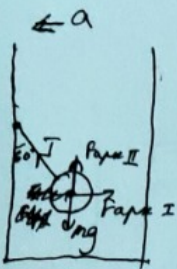
$$T = \frac{2mg}{\cos 30^\circ} = \frac{4mg}{\sqrt{3}}$$



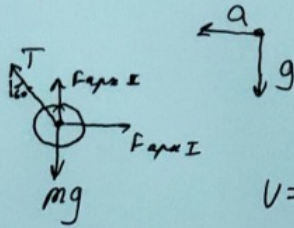
Числовое выражение 4

N3

2)



~~Векторный рисунок~~



$$V = \frac{4}{3} \pi \cdot 0,08^3 = 0,0021 \text{ м}^3$$

$$F_{\text{арх I}} = \rho \beta \cdot a \cdot V$$

$$F_{\text{арх II}} = \rho \beta \cdot g \cdot V$$

$$m \cdot a = -\rho \beta \cdot a \cdot V + T \cdot \sin 60^\circ$$

$$F_{\text{арх II}} + T \cdot \cos 60^\circ = mg, \quad T = \frac{mg - \rho \beta \cdot V \cdot g}{\cos 60^\circ} = \frac{52 - 1000 \cdot 10 \cdot 0,0021}{\frac{1}{2}} = 62 \text{ Н}$$

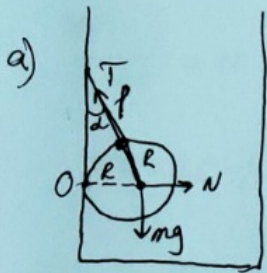
$$a = \frac{T \cdot \sin 60^\circ}{m + \rho \beta \cdot V} = \frac{62 \cdot \frac{\sqrt{3}}{2}}{5,2 + 2,1} = 7,3 \text{ м/с}^2$$

$$T = 2\pi \cdot \sqrt{\frac{R}{a}} = 2\pi \cdot \sqrt{\frac{0,08}{7,3}} = 2\pi \cdot \sqrt{0,0109} = 2\pi \cdot 0,105 = 0,6594 \text{ с.}$$

Омб: $T = 0,6594 \text{ с.}$

Страница 3 Чистовик

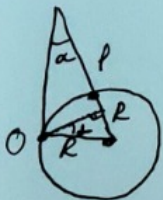
№3.



$$R = r = 0,08 \text{ м}$$

$$m = 5,2 \text{ кг}$$

т.к. стена гладкая, то продолжение веревки будет касаться в центр шара.



т.к. $l = r$, то $\alpha = 30^\circ$

Рассмотрим правило моментов относительно точки O

$$m \cdot g \cdot R = T \cdot \cos \alpha \cdot R \cdot \sin \alpha$$

$$\cancel{m \cdot g \cdot R} = \cancel{T \cdot \cos \alpha \cdot R} \cdot \frac{\sin \alpha}{\cos \alpha} = \frac{T \cdot \sin \alpha}{\cos \alpha}$$

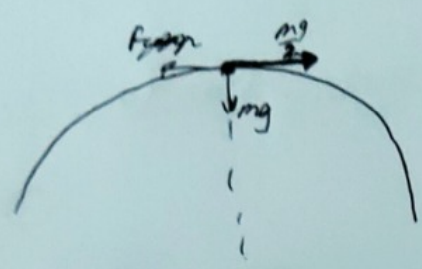
$$\cos \alpha \cdot R \cdot T = m \cdot g \cdot R$$

$$T = \frac{m \cdot g}{\cos \alpha} = \frac{5,2 \cdot 9,8}{\sqrt{3}} \approx 60 \text{ Н}$$

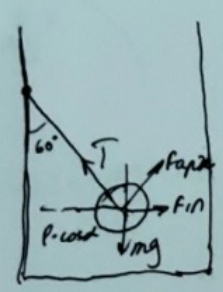
$H = v$

Углублен

Углублен



$$v = \frac{1}{2\pi R T}$$



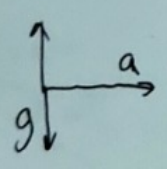
$$\omega = \frac{2\pi R}{T}$$



$$\cos 60^\circ \cdot T =$$

$$\frac{\omega \cdot R}{2\pi} \cdot 2\pi R = vR$$

$$\omega R = v$$



$$T = \frac{2\pi R}{T} = \frac{2\pi}{\omega}$$

$$\omega = \frac{2\pi}{T}$$

$$a = \omega^2 R$$

$$a = \frac{4\pi^2}{T^2} \cdot R$$

$$T = \sqrt{\frac{R}{a}} = 2.16$$

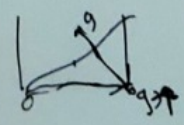


$$\Leftrightarrow T \cdot \cos 60^\circ = \rho \cdot V \cdot a + m \cdot a$$

$$\Downarrow mg = T \cdot \sin 60^\circ + \rho g V$$

$$T \cos 60^\circ = \rho (V + m)$$

$$T \sin 60^\circ = \rho g V - mg$$



0,011

Часть 2

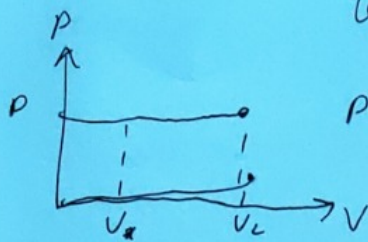
Олимпиада: **Физика, 10 класс (2 часть)**

Шифр: **21204428**

ID профиля: **222543**

Вариант 4

Черобук



PV_1

$$Q_1 = mc \cdot \Delta T$$

$$Q = \frac{i}{2} \nu R \Delta T + (v_2 - v_1) p$$

$$Q = 0,01 \cdot 4180 \cdot 80 =$$

20+273

$$\left(\frac{i}{2} + 1\right) \nu R \Delta T = Q$$

$$Q_2 = r \cdot m = 22600$$

$$Q_3 = 33000 - (22600 + 3344) = 7056$$

$$\Delta T \cdot m \cdot c_p = Q_3$$

357°C

H_2O
2 / 16

Q

100 100

$\left(\frac{6}{2} + 1\right) R$

0,018

$$Q = \frac{5}{2} R$$

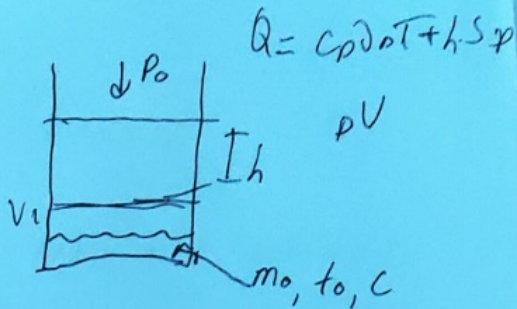
1 K

$$PV_1 = \nu RT$$

$$\downarrow$$

$$\frac{m}{m}$$

$$V_1 = \frac{m R T}{m P} = \frac{0,01 \cdot 8,31 \cdot (357 + 300)}{0,018 \cdot 10^5} = 0,03125 \text{ m}^3$$



$$Q = c_p \nu \Delta T + h \cdot S \cdot p$$

PV

$\frac{5}{2} + 1$

0,032 K

$\left(\frac{i}{2} + 1\right) R$

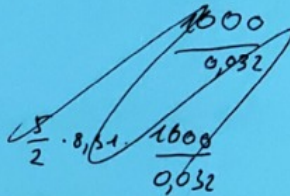
m

$\nu \cdot m$

$\frac{5}{2} R \cdot \nu$

88 r/mole

87



$\frac{5}{2} \cdot R$

0,018 K

Q

Упробав

$$18I_2 + 9 - aI_2 - 0,5a = 18I_1 + aI_1 - 9 - 0,5a$$

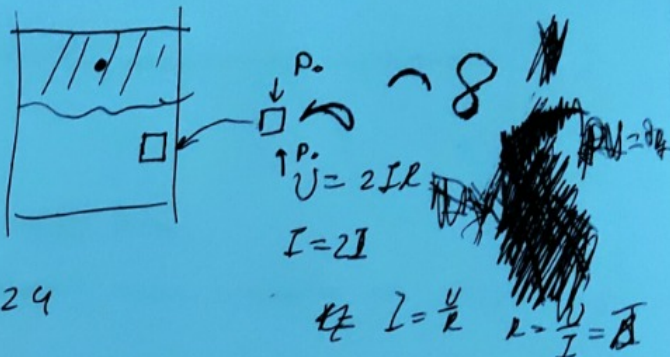
$$18I_2 - aI_2 + 18 = 18I_1 + aI_1$$

$$18I_1 - aI_1 = 18I_2 + aI_2$$

$$18I_1 - 18I_2 = aI_2 + aI_1$$

$$-aI_2 + 18 = aI_2 + aI_1 + aI_1$$

$$9 = a(I_1 + I_2)$$



$$(18+a)I_2 + (18-a)(I_2 + 0,5) = 24$$

$$L = \frac{1}{2} L = \frac{1}{2} L$$

$$18I_2 + aI_2 + 18I_2 - aI_2 + 9 - 0,5a = 24$$

$$(18-a)I_1 + (18+a)(I_1 + 0,5) = 24$$

$$36I_2 - 0,5a = 15$$

$$18I_1 - aI_1 + 18I_1 + aI_1 - 9 - 0,5a = 24$$

$$I_2 = \frac{15 + 0,5a}{36}$$

$$36I_1 - 0,5a = 33$$

$$I_1 = \frac{33 + 0,5a}{36}$$

$$9 = a \left(\frac{48+a}{36} \right)$$

$$\frac{\beta}{2\pi} \cdot 22 = 6$$

$$\frac{\beta}{2\pi} = \frac{1}{12}$$

$$\beta = \frac{2\pi}{12} = \frac{360}{12} = 30^\circ$$

87 87

$$324 = 48a + a^2$$

$$a^2 + 48a + 324 = 0$$

$$a = \frac{-24 \pm 30}{1}$$

$$\frac{D}{4} = 24^2 + 324 = 10800$$

$$a = 6$$

Условие задачи 4

~~100~~ N4
 $P = \text{const}, P = 10^5$

$m = 10\text{г}, t_0 = 20^\circ\text{C} = 293\text{K}$

1) Q_1 - тепло до испарения

$$Q_1 = m \cdot c \cdot \Delta t = 0,01 \cdot 4180 \cdot (100 + 273 - 20 - 273) = 0,01 \cdot 80 \cdot 4180 = 3344 \text{ Дж}$$

Омб: $Q_1 = 3344 \text{ Дж}$

2) Тепло нагрева воды до 100°C , начнется испарение.

Q_2 - тепло при испарении.

$$Q_2 = m \cdot r = 0,01 \cdot 2,26 \cdot 10^6 = 22600 \text{ Дж.}$$

Тепло испарения соответственно не пойдет на нагрев пара

$$(Q - Q_1 - Q_2) = m \cdot \Delta T \cdot c_p$$

$$\Delta T \approx \cancel{321} 321^\circ$$

$$\Rightarrow T_{\text{конечное}} = 100 + 273 + 321 = 694\text{K}$$

Две пара

$$P_0 V = \nu R T_k, \text{ где } \nu = \frac{m}{\mu_{\text{H}_2\text{O}}}$$

$$V = \frac{m R T_k}{P_0 \cdot \mu_{\text{H}_2\text{O}}} = \frac{8,31 \cdot 0,01 \cdot 694}{10^5 \cdot 0,018} = 0,032 \text{ м}^3$$

Омб: $0,032 \text{ м}^3 = V$

Чистовик страница 3

$$P_2 - ? \quad R_1 = 6 \text{ Ом}$$

$$P_2 = UI = U_{AB} \cdot (I_1 + I_2) = 24 \cdot (1 + 0,5) = 36 \text{ ВАТТ}$$

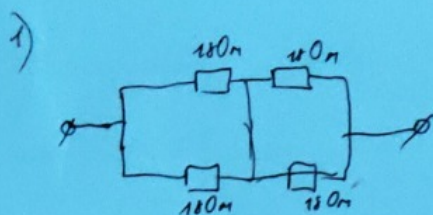
$$I_1 = \frac{33 + 0,5 \cdot R_1}{36} = \cancel{1,5} \text{ А}$$

$$\text{Omb: } P_2 = 36 \text{ ВАТТ}$$

$$I_2 = \frac{15 + 0,5 R_1}{36} = 0,5 \text{ А}$$

NS.

Черновик

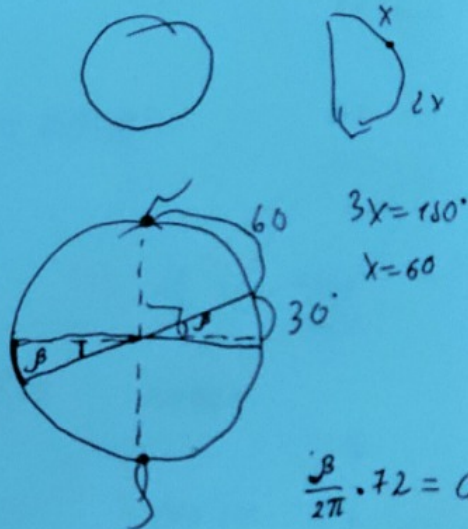
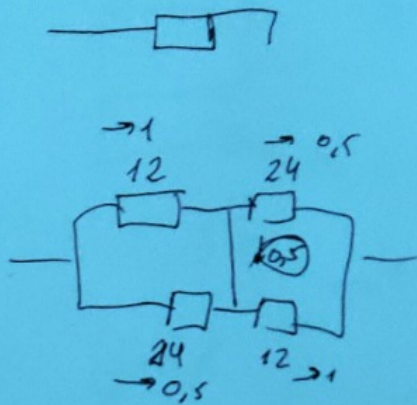


$$R_{\text{экв}} = \frac{1}{2R} + \frac{1}{2R} =$$

$$R = 100\text{m}$$

$$R_{\text{экв}} = R$$

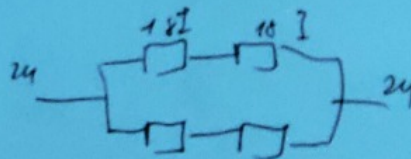
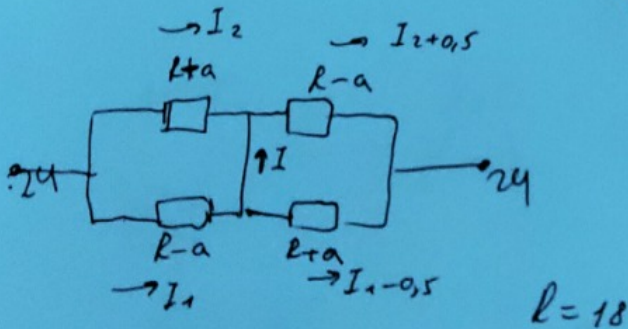
$$P_1 = \frac{U^2}{R} = \frac{24 \cdot 24}{78} = 32$$



$$3X = 180^\circ$$

$$X = 60$$

$$\frac{\beta}{2\pi} \cdot 72 = a$$



$$R I_{2+0.5} - a I_{2-0.5} =$$

$$36I = 24$$

$$24 \cdot \frac{4}{3} = 32 \quad I = \frac{2}{3}$$

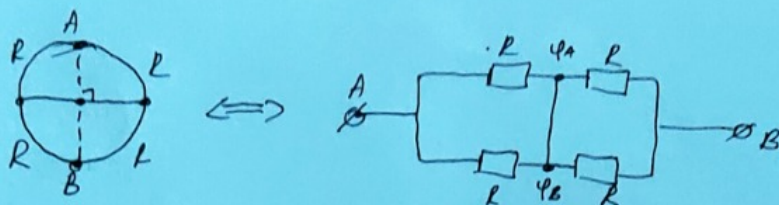
$$(R-a) I_{2+0.5} = (R+a) I_{1-0.5}$$

$$I_1 \cdot (R-a) = I_2 \cdot (R+a)$$

Числовой эталон № 5

страница 1 6-10-04

1)



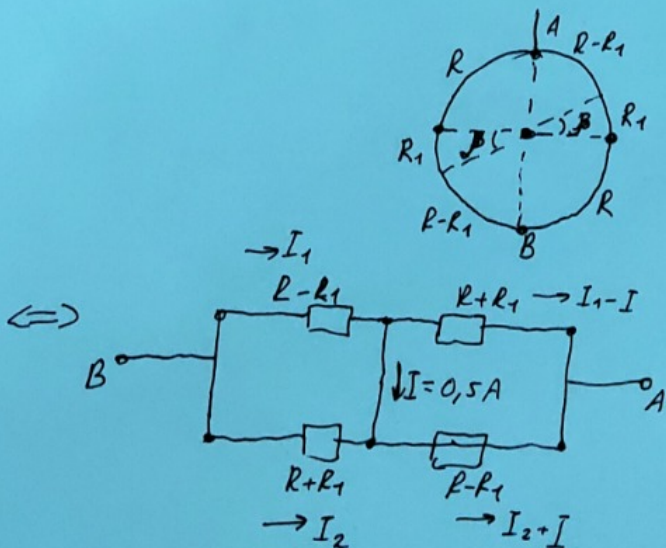
$$R = \frac{72}{4} = 18$$

м.к. $\varphi_A = \varphi_B$, но ток не нулевым по перемычке.

Общая сопротивлене $R_{общ} = R$, м.к. $\frac{1}{R_{общ}} = \frac{1}{R+R} + \frac{1}{R+R}$

$$P = \frac{U^2}{R} = \frac{24^2}{18} = 32 \text{ Ватт} \quad \text{Обв: } 1) 32 \text{ Ватт} = P_1$$

2)



$$R = \frac{72}{4} = 18 \text{ Ом}$$

Левый контур: $I_1 \cdot (R - R_1) = I_2 \cdot (R + R_1) \quad (I)$

Правый контур: $I_1 \cdot (R + R_1) = (I_1 - I) \cdot (R + R_1) = (I_2 + I) \cdot (R - R_1) \quad (II)$

Условие симметрии 2.

$$\begin{cases} I_1 \cdot 18 - I_1 \cdot R_1 = I_2 \cdot 18 + I_2 \cdot R_1 & I \\ 18I_1 - 9 + I_1 R_1 - 0,5 R_1 = 18I_2 - R_1 I_2 + 9 - 0,5 R_1 & II \end{cases}$$

$$\begin{cases} 18I_1 - 18I_2 = (I_1 + I_2) R_1 \\ 18I_1 - 18I_2 + I_1 R_1 = 18I_2 - R_1 I_2 \end{cases}$$

$$18 - R_1(I_1 + I_2) = R_1(I_1 + I_2)$$

$$18 = 2R_1(I_1 + I_2)$$

Верхний контур

$$I_1(18 - R_1) + (18 + R_1) \cdot (I_1 - 0,5) = 24 = U_{AB}$$

$$\underline{36I_1 - 0,5R_1 = 33}, \quad I_1 = \frac{33 + 0,5R_1}{36}$$

Нижний контур

$$I_2(18 + R_1) + (I_2 + 0,5)(R_1 - 18) = 24 = U_{AB}$$

$$36I_2 - 0,5R_1 = 15$$

$$\underline{I_2 = \frac{15 + 0,5R_1}{36}}$$

$$18 = 2R_1 \cdot \left(\frac{48 + R_1}{36} \right)$$

$$324 = 48R_1 + R_1^2$$

$$R_1^2 + 48R_1 - 324 = 0$$

$$\frac{D}{4} = 24^2 + 324 = 900$$

$$R_1 = -24 \pm 30$$

$$R_1 = 6$$

$$R_1 = -54 < 0$$

$$R_1 = \frac{\beta}{2\pi} \cdot 72$$

$$6 = \frac{\beta}{360} \cdot 72$$

$$\beta = \frac{360 \cdot 6}{72} = 30^\circ$$

$$\text{Отв: } \beta = 30^\circ$$