

Часть 1

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

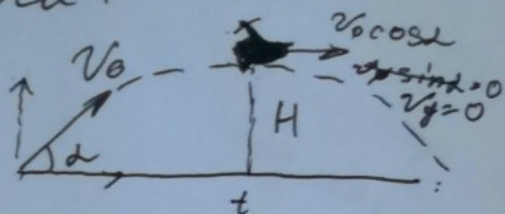
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ID профиля: **865951**

Вариант 4

Цикстовик

Задача 1



$$1) v_0 \sin \alpha = g t$$

$$t = \frac{v_0 \sin \alpha}{g}$$

$$H = \frac{g t^2}{2}$$

$$2H = g t^2$$

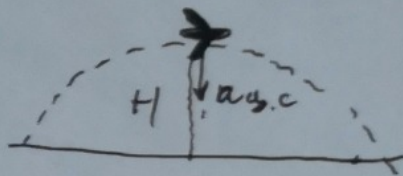
$$2H = g \cdot \frac{v_0^2 \sin^2 \alpha}{g^2}$$

$$\frac{2H g^2}{\sin^2 \alpha} = v_0^2$$

$$v_0 = \sqrt{\frac{2H g}{\sin^2 \alpha}} = 2\sqrt{H g} = 20 \text{ м/с}$$

Ответ: 20 м/с; 7,07 м/с

2)



$$F_{\text{растр}} = m a_{y,c}$$

$$F_{\text{рабл}} = \frac{m g}{2}$$

$$\frac{m g}{2} = m a_{y,c}$$

$$a_{y,c} = \frac{g}{2} = 5 \text{ м/с}^2$$

$$a_{y,c} = \frac{v^2}{R}$$

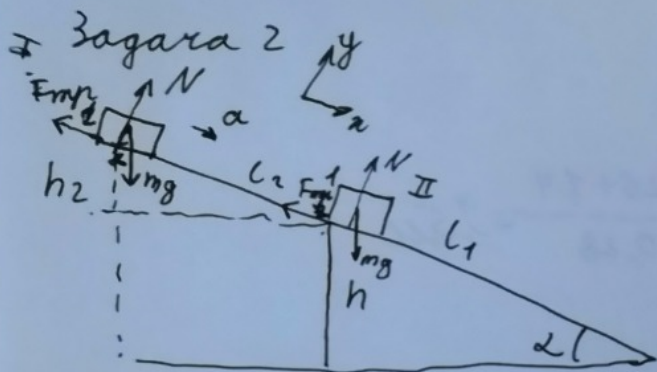
$$R = H$$

$$v^2 = H a_{y,c}$$

$$v = \sqrt{10 \cdot 5} = 5\sqrt{2} = 7,07 \text{ м/с}$$

1 см

Чистовик



$$2) m g(h+h_2) = A F_{f1} + A F_{f2}$$

$$m g(h+h_2) = \mu m g \cos \alpha (\mu l_1 + l_2)$$

$$h+h_2 = \cos \alpha (\mu l_1 + \mu l_2)$$

I
1) 234. II: OX: $m g \cdot \sin \alpha - F_{f2} = m a_2$ $l_1 = \frac{h}{\sin \alpha}$

$$OY: N = m g \cos \alpha$$

$$F_{f2} = \mu_2 m g \cos \alpha$$

$$m g \sin \alpha - \mu_2 m g \cos \alpha = m a_2$$

$$a_2 = g(\sin \alpha - \mu_2 \cos \alpha)$$

II:
 $F_{f1} = \mu_1 m g \cos \alpha$
 $a_1 = g(\sin \alpha - \mu_1 \cos \alpha)$

$$3) \frac{h_2}{\sin \alpha} = \frac{a_2 t^2}{2}$$

$$2 l_2 = a_2 t^2$$

$$\frac{1,26}{4} \cdot \frac{5}{25} = \frac{g}{2} \left(\frac{4}{25} - 0,06 \cdot \frac{24}{25} \right) \cdot t^2$$

$$0,9 = 0,2224 \cdot t^2$$

$$t^2 \approx 0,247$$

$$t = 0,5 \text{ c}$$

V_{max} V_{max} выгем на высоте h, m.k.
гареез кородка нахрдем морулозамбса

$$a_1 = g(\sin \alpha - \mu_1 \cos \alpha) = -2 \mu \text{ c}$$

но 2 закону Ньютона

$$c \text{tg} \alpha \mu_1 h - h = h_2(1 - \mu_2 \cdot \text{tg} \alpha)$$

$$h_2 = h \frac{c \text{tg} \alpha \mu_1 - 1}{1 - \mu_2 c \text{tg} \alpha}$$

$$c \text{tg} \alpha = \frac{1}{\sin \alpha}$$

$$\text{tg}^2 \alpha = \frac{1}{\cos^2 \alpha} - 1 =$$

$$\text{tg}^2 \alpha = \frac{49}{576}$$

$$\text{tg} \alpha = \frac{7}{24}$$

$$c \text{tg} \alpha = \frac{24}{7}$$

2 cмр.

$$h_2 = 1,4 \cdot \frac{\frac{24}{7} \cdot 0,5 - 1}{1 - \frac{24}{7} \cdot 0,06} \approx 1,26 \text{ м}$$

$$V_{\text{max}} = \frac{2,224 \cdot 0,5}{\sqrt{2 \cdot \frac{1,26}{0,28} \cdot 2,224}} \approx 4,47 \text{ м/с}$$

УСТОЯВКА

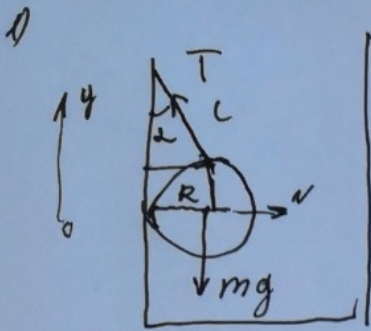
$$V_{\max} = 4,47 \mu/c$$

$$4) S = l_2 + l_1 = \frac{h_2 + h_1}{\sin \alpha} = \frac{1,26 + 1,4}{0,28} = 9,5 \mu$$

Ответ: $4,47 \mu/c$; $9,5 \mu$

3 стр

Задача 3



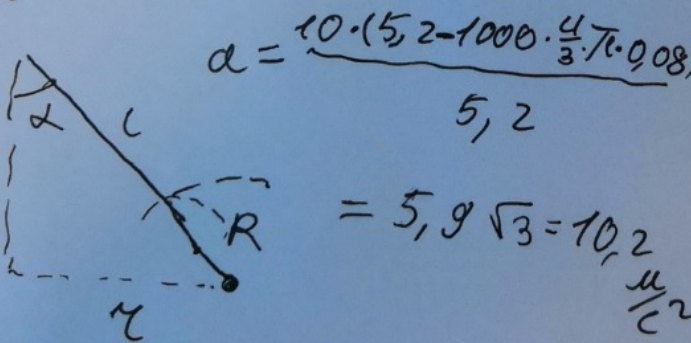
$$\sin \alpha = \frac{R}{L+R} \quad \cos \alpha = \sqrt{1 - \frac{R^2}{(L+R)^2}}$$

$$T \cdot \cos \alpha = mg$$

$$T = F$$

$$F = \frac{mg}{\cos \alpha} = \frac{5,2 \cdot 10}{\sqrt{1 - \frac{64}{256}}} = \frac{52}{0,87} \approx 60 \text{ Н}$$

$$r = (L+R) \cdot \sin \alpha$$



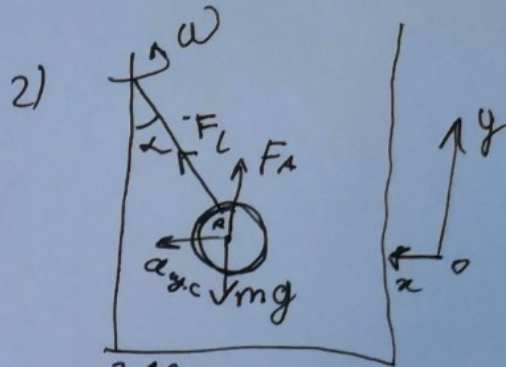
$$a = \frac{10 \cdot (5,2 - 1000 \cdot \frac{4}{3} \cdot \pi \cdot 0,08^3) \cdot \sqrt{3}}{5,2}$$

$$= 5,9 \sqrt{3} = 10,2 \frac{\text{м}}{\text{с}^2}$$

$$r = 0,16 \cdot \frac{\sqrt{3}}{2} = 0,08 \sqrt{3} = 0,14 \text{ м}$$

$$T = \frac{2 \cdot 3,14 \cdot \sqrt{0,14}}{\sqrt{10,2}} = \frac{2,34}{3,2} \approx 0,73 \text{ с}$$

Ответ: 60 Н, 0,73 с



2.3.2

$$Ox: F \cdot \sin \alpha = ma$$

$$Oy: F_a - mg + F \cdot \cos \alpha = 0$$

$$F_a = \rho_b V g$$

$$-\rho_b V g + mg = F \cos \alpha$$

$$\rho_b V$$

$$V = \frac{4}{3} \pi R^3$$

$$F = \frac{g}{\cos \alpha} (m - \rho_b V)$$

$$\frac{g}{\cos \alpha} (m - \rho_b V) \cdot \sin \alpha = ma$$

$$a = \frac{g(m - \rho_b V) \cdot \tan \alpha}{m}$$

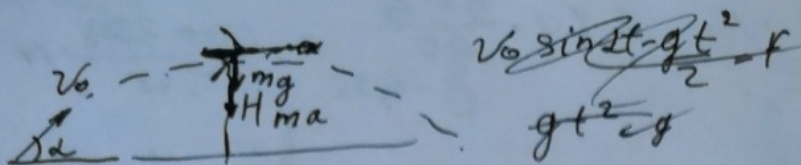
$$\frac{v^2}{R} = a \quad v^2 = a r$$

$$T = \frac{2\pi r}{v}$$

$$T = \frac{2\pi r}{\sqrt{a r}} = \frac{2\pi \sqrt{r}}{\sqrt{a}}$$

0,73 с

Чертовик



$$H \rightarrow v_0 \cdot \sin \alpha = gt$$

$$gt = t = \frac{v_0 \sin \alpha}{g}$$

$$\frac{gt^2}{2} = H$$

$$g \cdot \frac{v_0^2 \sin^2 \alpha}{g^2} = 2H$$

$$v_0^2 = \frac{2Hg}{\sin^2 \alpha}$$

$$v_0 = \sqrt{\frac{2Hg}{\frac{1}{2}}} = \sqrt{4Hg} = 2\sqrt{100} = 20 \text{ м/с}$$

$$\frac{\sqrt{2Hg}}{\frac{\sqrt{2}}{2}}$$

$$2\sqrt{Hg}$$

$$ma = mg + F$$

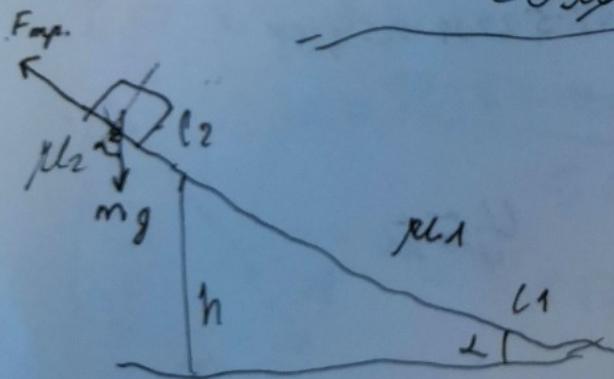
$$\frac{mg}{2} = ma$$

$$a = \frac{v^2}{H}$$

$$v^2 = aH$$

$$v = \sqrt{aH}$$

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



$$N = mg \cos \alpha$$

$$F = mg \sin \alpha$$

$$\frac{h}{l_1} = \sin \alpha$$

$$\frac{h_2}{l_2} = \sin \alpha$$

$$\mu_2 mg l_1 + \mu_1 mg l_2$$

$$l_1 = \frac{h}{\sin \alpha}$$

$$l_2 = \frac{h_2}{\sin \alpha}$$

$$F_{mp} = \mu \cdot mg \cdot \cos \alpha$$

$$\mu mg \cos \alpha (\mu_1 l_1 + \mu_2 l_2) = mg h$$

$$\cos \alpha \mu_1 \frac{h}{\sin \alpha} \frac{1}{\sin \alpha} (\mu_1 h + \mu_2 \cdot h_2) = (h_2 + h)$$

$$h_2 = \frac{\mu_1 h - h \sin^2 \alpha}{\sin^2 \alpha - \mu_2} \quad \frac{\mu_1 h}{\sin \alpha} - h = h_2 \left(1 - \frac{\mu_2}{\sin \alpha}\right)$$

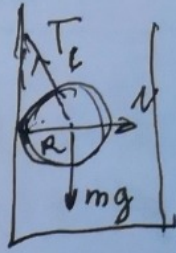
Чептობიწ

$$\sin \alpha = 1 - \frac{24^2}{25^2} = \frac{5+6}{25} = \frac{11}{25}$$

$$h_2 = \frac{\mu_1 h (\mu_1 - \sin \alpha)}{\sin \alpha - \mu_2} = 1,4 \cdot \frac{0,5 - \frac{11}{25}}{\frac{11}{25} - 0,06} = \frac{1,4 \cdot 0,308}{0,22} = 14$$

$$h_2 = h$$

$$S = \frac{h \cdot 81}{\sin \alpha} + \frac{h_2}{\sin \alpha} = \frac{2,8}{11} \cdot 25 = 10 \mu$$



$$T \cdot \cos \alpha = mg$$

$$\frac{R}{L} = \sin \alpha$$

მ.

~~$$\mu_2 mg \cos \alpha + mg \sin \alpha = ma \quad mg \cos \alpha$$~~

$$mg \sin \alpha - \mu_2 mg \cos \alpha = ma$$

$$a = 10 \cdot \left(\frac{11}{25} - 0,06 \cdot \frac{24}{25} \right) = 2,224$$

$$L_2 = \frac{a t^2}{2}$$

$$t = \sqrt{\frac{2L_2}{a}}$$

$$v_{max} = at = a \cdot \sqrt{\frac{2L_2}{a}} = \sqrt{2L_2 a} = \sqrt{2 \cdot 5 \cdot 2,224} \approx 4,71$$

2)

$$mg \cdot a = -2$$

$$\frac{4,71}{2} = 2,355 \quad 4,5 \mu$$

$$\frac{a t^2}{2} =$$

$$a \frac{2 \cdot t^2}{2} = 5 \quad v_{max} = 2 \cdot \sqrt{5}$$

$$t^2 = 5$$

$$v_{max} = \sqrt{4,5 \cdot 2,224 \cdot 2} \quad t = \sqrt{5}$$

$$\tan = \frac{\sqrt{3} \cdot 2}{2 \cdot 1} \quad 4,5$$

Часть 2

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

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Вариант 4

Чистовик

Задача 4

до испарения

$$1) Q_1 = c m \Delta t = 4180 \cdot 0,01 \cdot (373 - 293) = 3344 \text{ Дж}$$

2) Q_2 - затрата на испар

$$Q_2 = r \cdot m = 226 \cdot 10^6 \cdot 0,01 = 2,26 \cdot 10^4 = 22600 \text{ Дж}$$

Q_3 - на нагрев пара

$$Q_3 = c_p m \Delta T \quad Q = Q_1 + Q_2 + Q_3$$

$$\Delta T = \frac{Q - Q_1 - Q_2}{c_p m}$$

$$\Delta T = \frac{4056}{2200 \cdot 0,01} = 320,72 \text{ К}$$

$$T_{\text{кин}} = 373 \text{ К} \rightarrow T_{\text{кон}} = 693,72 \text{ К}$$

процесс изобарный

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \quad V_2 = \frac{T_{\text{кон}}}{T_{\text{кин}}} V_1 = 1,86 V_1$$

$$P_0 V_1 = \nu R T_{\text{кин}}$$

$$\nu = \frac{m}{M} = \frac{10}{18} = \frac{5}{9}$$

$$V_1 = \frac{5}{9} \cdot 8,31 \cdot 373 : 10^5 = 17220 \text{ см}^3 = 1722 \cdot 10^{-5} \text{ м}^3$$

Ответ $V_2 = 1,86 \cdot 17220 = 32029,2 \text{ см}^3$

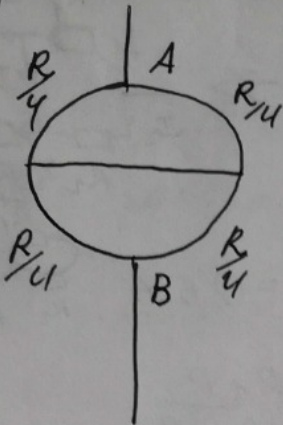
Ответ: 3344 Дж; 32029,2 см³.

1 см³

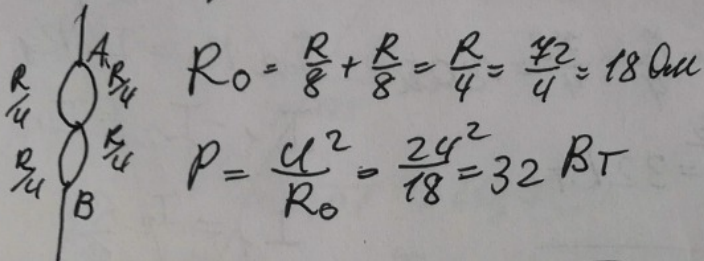
У И С Т О В И К

Задача 5

1)



т.к. сопр. перемычки можно пренебречь



$$\frac{24 \cdot R_2}{36 - R_2} - \frac{24 \cdot (36 - R_2)}{R_2} = 1 \cdot R_2(36 - R_2)$$

$$\begin{cases} 24R_2 - 24 \cdot 36 + 24R_2 - 36R_2 + R_2^2 = 0 \\ R_2 \neq 36 \\ R_2 \neq 0 \end{cases}$$

$$R_2^2 + 12R_2 - 864 = 0$$

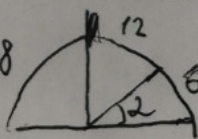
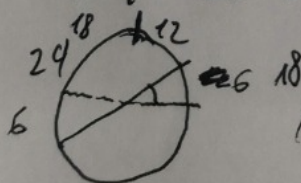
$$D_1 = 36 + 864 = 900$$

$$R_2 = -6 + 30$$

$$R_2 = -6 - 30 \text{ - не соотв. укл. } \text{заг.}$$

$$R_2 = 24 \text{ Ом}$$

$$R_1 = 36 - 24 = 12 \text{ Ом}$$



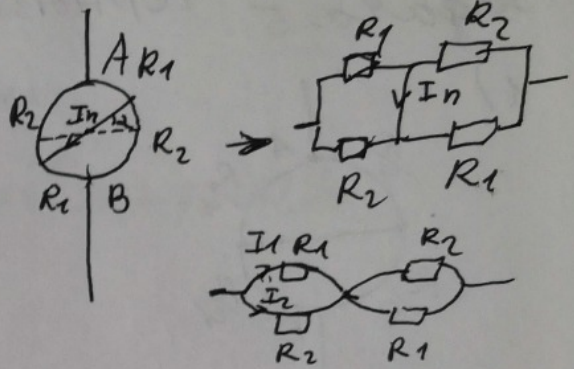
$$\frac{1}{6} \pi = 30^\circ$$

$$\pi - 36$$

$$\frac{6}{36} = \frac{1}{6} \Rightarrow \frac{1}{6} \pi = 30^\circ$$

$$R_2 > R_1$$

2)



$$R_0 = 2 \frac{R_2 R_1}{R_2 + R_1}$$

$$I_1 - I_2 = I_n$$

$$R_2 + R_1 = \frac{R}{2} = 36 \text{ Ом}$$

$$I_2 R_2 = I_1 R_1$$

$$U_0 = 2 I_2 R_2$$

$$I_1 = I_2 \frac{R_2}{R_1}$$

$$I_2 \left(\frac{R_2}{R_1} - 1 \right) = I_n$$

$$I_2 = \frac{U_0}{2R_2}$$

$$\frac{U_0}{2R_1} - \frac{U_0}{2R_2} = I_n$$

$$\frac{U_0}{R_1} - \frac{U_0}{R_2} = 2I_n$$

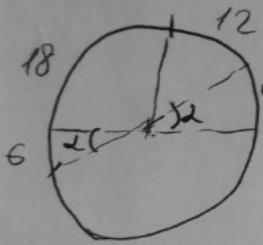
$$R_1 = 36 - R_2$$

$$\frac{U_0}{36 - R_2} - \frac{U_0}{R_2} = 2 \cdot 0,5$$

2 смчл

Чистовик

Задача 5 продолжение



$\frac{1}{6}$ полуокружности

т.к. полуокружность

36

$$\frac{6}{36} = \frac{1}{6}$$

полуокружность это $180^\circ \cdot \frac{1}{6} = \frac{180^\circ}{6} = 30^\circ$

$$3) P_2 = \frac{U_0^2}{R_0}$$

$$R_0 = 2 \frac{R_2 R_1}{R_1 + R_2} = 2 \cdot \frac{24 \cdot 12}{36} = 16 \text{ Ом}$$

$$P_2 = \frac{24^2}{16} = 36 \text{ Вт}$$

3 шаг

Ответ: 32 Вт; 30° ; 36 Вт

Черновик

$$m = 102$$

$$t_0 = 20^\circ\text{C}$$

$$P_A = 100000$$

$$P_0 = 1,0 \cdot 10^5 \text{ Па}$$

$$Q_T = (100 - 20) \cdot 4200$$

$$= 180 \cdot 0,01 =$$

$$Q = 33 \text{ кДж}$$

$$= 80 \cdot$$

$$(80 + 243) \cdot 41,8 = 44455,4 \text{ Дж}$$

$$= 3344 \text{ Дж}$$

$$Q_2 = r \cdot m = 2,26 \cdot 10^6 \cdot 0,01 = 2,26 \cdot 10^6 \cdot 10^{-2} = 2,26 \cdot 10^4$$

$$= 22600 \text{ Дж}$$

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

$$\Delta T = \frac{Q - Q_1 - Q_2}{c_p m}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$P V_1 = \nu R T_1$$

$$P V_2 = \nu R T_2$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\Delta T = \frac{4056}{2200 m} \approx 320,42$$

$$373 \text{ K} \rightarrow 693,4 \text{ K}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \quad V_2 = \frac{693,4}{373} \cdot V_1 = 1,86 V_1 = 32029,2 \text{ cm}^3$$

$$P_0 V_1 = \nu R T_0 \quad \nu = \frac{m}{M} = \frac{10}{18} = \frac{5}{9}$$

$$M = 2 + 16 = 18$$

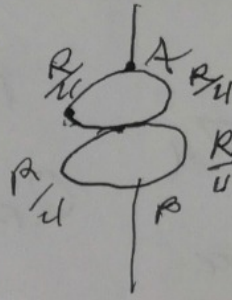
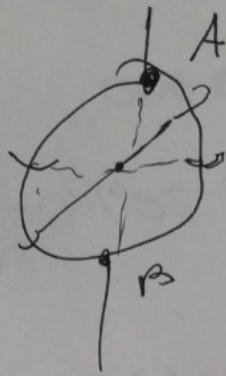
$$V_1 = \frac{\nu R T_0}{P_0} = \frac{5}{9} \cdot 8,31 \cdot \frac{293}{10^5} = 1352,8 \cdot 10^{-5} \text{ m}^3$$

$$= 1352,8 \cdot 10^{-5} \text{ m}^3$$

$$= 17220 \text{ cm}^3$$

Черновики

$R = 42 \text{ Ом}$
 $U = 24 \text{ В}$

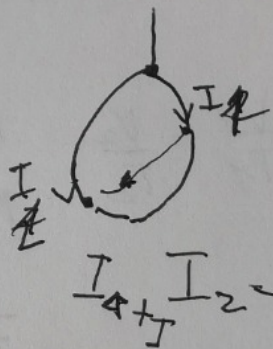


$$\frac{R}{8} + \frac{R}{8} = \frac{R}{4} = \frac{42}{4} = 10.5$$

$$= 18 \text{ Ом}$$

1) $P = \frac{U^2}{R} = \frac{24^2}{18} = 32 \text{ Вт}$

2)

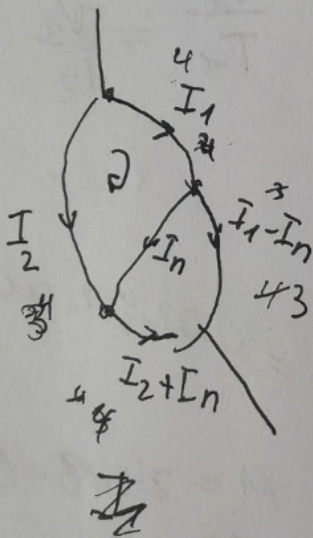


$$I_1 R_1 = I_2 R_2$$

$$\frac{I_1}{I_2} = \frac{R_2}{R_1}$$

$$R_0 = \frac{R_2 R_1 \cdot 2}{R_2 + R_1} I_1 + I_2$$

$$U =$$



$$I_1 R_1 + I_2 R_2 = U$$

$$\frac{I_1}{I_2} = \frac{R_2}{R_1}$$

$$\frac{I_2 + I_n}{I_1 - I_n} = \frac{I_1}{I_2}$$

$$I_1 = \frac{R_2}{R_1} I_2$$

$$(I_2 + I_n) R_1 = R_2 (I_1 - I_n)$$

$$I_1 - I_2 = I_n$$

$$I_2 + 0.5 R_1 = R_2 \frac{R_2 I_2 - I_n R_1}{R_1}$$

$$I_1 - I_2 = 0.5 I_n$$

$$I_2 \left(\frac{R_2^2}{R_1} - R_1 \right) = 0.5 (R_1 + R_2) I_n$$

$$\frac{I_1}{I_2} = \frac{R_2}{R_1}$$

$$\frac{R_2}{R_1} I_2 - I_2 = 0.5 I_n$$

$$I_1 + I_2 = \frac{U_0}{2R}$$

I_1

$$2 I_2 \cdot R_2 = U_0$$

$$\frac{R_2 \cdot U_0}{R_1 \cdot 2R_2} - \frac{U_0}{2R_2} = 0.5$$

$$I_2 = \frac{U_0}{2R_2}$$

Черновик

$$R_1 + R_2 = 36$$

$$I_1 - I_2 = 0,5$$

$$R_1 + R_2 = 36$$

$$I_1 - I_2 = 0,5$$

$$2I_2 R_2 = U_0$$

$$I_2 \cdot R_2$$

$$I_2 = \frac{U_0}{2R_2}$$

$$I_2 R_2 = 12$$

$$I_2 = \frac{12}{R_2}$$

$$I_1 - \frac{U_0}{2R_2} = 0,5$$

$$\frac{U_0}{2R_1} - \frac{U_0}{2R_2} = 0,5$$

$$\frac{12}{R_2} - \frac{12}{R_1}$$

$$\frac{U_0}{R_1} - \frac{U_0}{R_2} = 1$$

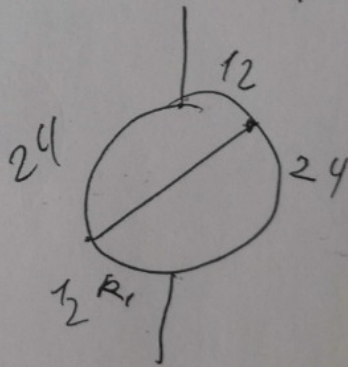
$$\frac{24}{36R_1} - \frac{24}{36-R_1} = 1$$

$$24 \cdot 36 - 24R_1 - 24R_1 = 36R_1 - R_1^2$$

$$R_1^2 - 12R_1 + 864 = 0$$

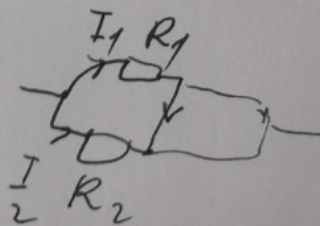
$$D = 36 - 864$$

$$R_0 = 2 \cdot \frac{24 \cdot 12}{36} = 16$$



$$R_2 + R_1 = 36$$

$$I_1 - I_2 = 0,5$$



$$I_2 R_2 + I_2 R_1 + 0,5 R_1 = \frac{U_0}{24}$$

$$U_0 = 2 \cdot I_2 \cdot 24$$

$$I_2 = I_2 = 0,5 A$$

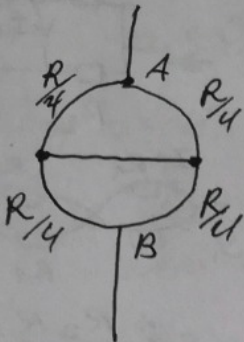
$$I_1 = 1 A$$

$$\frac{24}{16} = \frac{6}{4} = \frac{3}{2} = 1,5$$

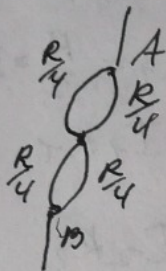
Чистовик
Черновик

Задача 5

1)



т.к. сопр. перемычки
можно преобразить



$$R_0 = \frac{R}{8} + \frac{R}{8} = \frac{R}{4} = \frac{72}{4} = 18 \Omega$$

$$P = \frac{U^2}{R_0} = \frac{24^2}{18} = 32 \text{ Вт}$$

~~$$\frac{U_0}{36 - R_2} - \frac{U_0}{R_2} = 2I_n$$~~

~~$$\begin{cases} 24R_2 - 36 \cdot 24 + 24R_2 - 36R_2 + R_2^2 = 0 \\ R_2 \neq 36 \\ R_2 \neq 0 \end{cases}$$~~

~~$$R_2^2 + 12R_2 - 864 = 0$$~~

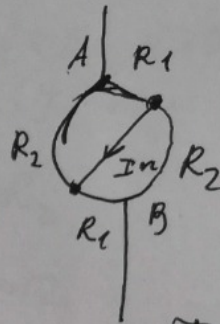
~~$$D_1 = 36 + 864 = 900$$~~

~~$$R_2 = \frac{30 + 30}{1} = 60$$~~

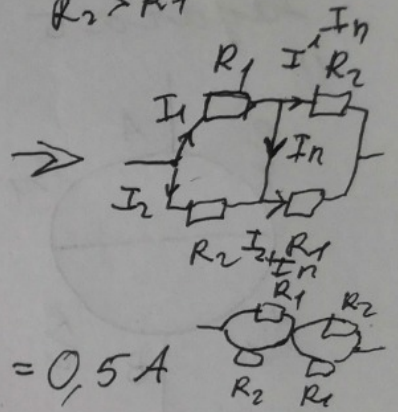
~~$$R_2 = \frac{-30 + 6}{1} < 0 - \text{не соотв. усл.}$$~~

~~$$R_2 = 36$$~~

2)



$R_2 > R_1$



$I_n = 0,5 \text{ А}$

$$R_0 = 2 \frac{R_1 R_2}{R_2 + R_1}$$

~~$$U_0 = 2I_2 R_2$$~~

~~$$I_2 R_2 = I_1 R_1$$~~

~~$$I_1 - I_2 = I_n$$~~

~~$$I_1 = I_2 \frac{R_2}{R_1}$$~~

~~$$I_2 \left(\frac{R_2}{R_1} - 1 \right) = I_n$$~~

~~$$I_2 = \frac{U_0}{2R_2}$$~~

~~$$R_1 + R_2 = R/2$$~~

~~$$R_1 = R/2 - R_2$$~~

~~$$\frac{U_0}{2R_2} \left(\frac{R_2}{R_1} - 1 \right) = I_n$$~~

~~$$\frac{U_0}{2R_1} - \frac{U_0}{2R_2} = I_n$$~~

~~$$\frac{U_0}{2(36 - R_2)} - \frac{U_0}{2R_2} = I_n$$~~