

# Часть 1

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

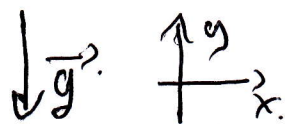
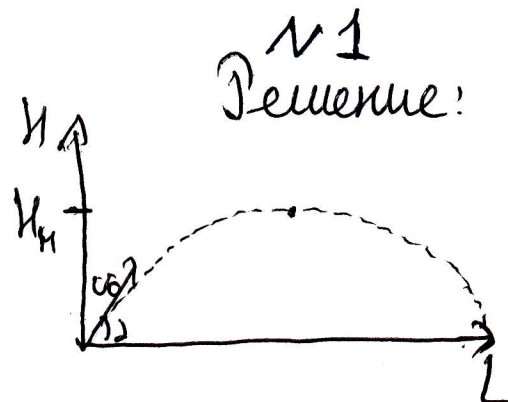
Шифр: **21205083**

ID профиля: **831623**

Вариант 4

# Числовик (1)

1) Дано:  
 $\alpha = 45^\circ$   
 $H_n = 10 \text{ м.}$   
 $v_0 = ?$



в верхней точке скорость по оси y равна 0.  
 Тогда  $v_y = gt = 0$   $v_y = gt_0$

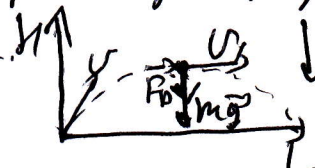
$v_y = v_0 \sin \alpha$   $gt_0 = v_0 \sin \alpha$   $t_0 = \frac{v_0 \sin \alpha}{g}$

$$H = v_y t - \frac{gt^2}{2} = v_0 \sin \alpha \frac{v_0 \sin \alpha}{g} - \frac{g}{2} \left( \frac{v_0 \sin \alpha}{g} \right)^2 = \frac{2v_0^2 \sin^2 \alpha - v_0^2 \sin^2 \alpha}{2g} = \frac{v_0^2 \sin^2 \alpha}{2g}$$

$$v_0 = \sqrt{\frac{2Hg}{\sin^2 \alpha}} = \frac{\sqrt{2gH}}{\sin \alpha} = \frac{\sqrt{2 \cdot 10 \cdot 10}}{\frac{\sqrt{2}}{2}} = \frac{\sqrt{2} \cdot 10 \cdot 2}{\sqrt{2}} = 20 \frac{\text{м}}{\text{с}}$$

Ответ:  $v_0 = 20 \frac{\text{м}}{\text{с}}$

2) Т.к самолёт движется равномерно, то ускорения вдоль оси Ox нет, значит равнодействующая сила направлена вниз,



с ~~по~~  $F_p$  Ньютона

Тогда  $F_p \cos \alpha = mg$   $\frac{1}{2} mg = ma$   $a = \frac{1}{2} g = 5 \frac{\text{м}}{\text{с}}$

Траектория движения не изменилась, ~~и скорость~~

~~и~~ ~~равномерно~~ скорость постоянна  $v_0^2 \sin^2 \alpha + v_0^2 \cos^2 \alpha = v_1^2$   $v_0 = v_1$

Скорость ~~из~~ ~~полученной~~ в начале 1 формулы  $v = \sqrt{\frac{2Hg}{\sin^2 \alpha}} = \frac{\sqrt{Hg}}{\sin \alpha}$   
 $v = \frac{\sqrt{10 \cdot 10}}{\frac{\sqrt{2}}{2}} = 10\sqrt{2}$  ответ:  $10\sqrt{2} \frac{\text{м}}{\text{с}}$

# Условие (2).

u2.

1) Дано!  
 $\cos \alpha = \frac{24}{25}$

$\mu_1 = 0,5$

$\mu_2 = 0,06$

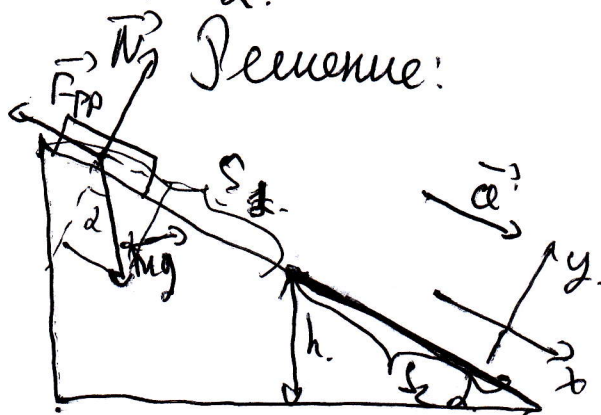
$h = 1,4 \text{ м}$

$v_0 = 0$

$v_n = 0$

$g = 10 \frac{\text{м}}{\text{с}^2}$

$v_{\text{max}} = ?$   
 $S = ?$



$$\sin \alpha = \sqrt{1 - \cos^2 \alpha} = \sqrt{1 - \frac{576}{625}} = \sqrt{\frac{59}{625}} = \frac{7}{25}$$

Найдём ускорение на 1-ой границе

на 1-ой.

1) Oy:  $N = mg \cos \alpha$

Ox:  $F_{\text{тр}1} - mg \sin \alpha = ma_1$

$g \sin \alpha - g \cos \alpha \mu_1 = a_1$

$a_1 = 10 \cdot \frac{7}{25} - 10 \cdot 0,06 \cdot \frac{24}{25} = 2,224 \frac{\text{м}}{\text{с}^2}$

Снег по коридору не попадает.

2) Oy:  $N = mg \cos \alpha$

$F_{\text{тр}2} = \mu_2 mg \cos \alpha$

Ox:  $mg \sin \alpha - F_{\text{тр}2} = ma_2$

$a_2 = 10 \cdot \frac{7}{25} - \frac{1}{2} \cdot 10 \cdot \frac{24}{25} = -2 \frac{\text{м}}{\text{с}^2}$

Значит коридор застрахован.

$S_2 = h \sin \alpha = 1,4 \cdot \frac{7}{25} = \frac{1,4}{25} = \frac{1,4 \cdot 25}{25} = \frac{35}{25} = 1,4 \text{ м}$

$S_2 = \frac{v_n^2 - v_{\text{max}}^2}{2a_2} = \frac{-v_{\text{max}}^2}{2(-2)} = \frac{v_{\text{max}}^2}{4}$   $v_{\text{max}} = \sqrt{4S_2} = \sqrt{4 \cdot 1,4} = \sqrt{5,6} = 2,366 \text{ м/с}$

$S_1 + S_2 = S = 5 + \frac{v_{\text{max}}^2 - v_0^2}{2a_1} = 5 + \frac{5,6 - 0}{2 \cdot 2,224} = 5 + \frac{2,536}{4,448} = 5 + 0,57 = 5,57 \text{ м}$

$= 5,496 \approx 5,5 \text{ м}$

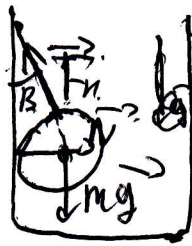
Ответ:  $v_{\text{max}} = 2,366 \frac{\text{м}}{\text{с}}$   $S = 5,5 \text{ м}$

# V3 Чучобук (3)

1) Дано:  
 $R = 0,08 \text{ м}$   
 $l = 0,08 \text{ м}$   
 $m = 5,2 \text{ кг}$   


---

 $F_n = ?$



Решение:

$$\sin \beta = \frac{R}{R+l} = \frac{0,08}{0,08+0,08} = \frac{1}{2}$$

$$\beta = 30^\circ$$

Ос:  $mg = T \cos \beta$      $T = \frac{mg}{\cos 30^\circ} = \frac{52}{\frac{\sqrt{3}}{2}} = \frac{104\sqrt{3}}{3}$

Ответ:  $T = 104 \frac{\sqrt{3}}{3}$

2)  $\alpha = 60^\circ$   
 $T = ?$



Не D3 Коротонн.

$$a_y = \omega^2 R_{cp} \quad R_{cp} = (R+l) \sin \alpha$$

Ос:  $F_{cp} + T \cos \alpha = mg$

Ох:  $F_n + T \sin \alpha = m a_y$      $g \sin \alpha + T \sin \alpha = m a_y$

$$T = \frac{mg - g \sin \alpha}{\cos \alpha}$$

$$a_y = \frac{T \sin \alpha}{m - g \sin \alpha}$$

$$a_y = \frac{g(m - g \sin \alpha)}{m - g \sin \alpha} = g \sin \alpha$$

$$\omega = \sqrt{\frac{a_y}{R_{cp}}} = \sqrt{\frac{g \sin \alpha}{2R \sin \alpha}} = \sqrt{\frac{10 \cdot \sin 60^\circ}{2 \cdot 0,08 \cdot \cos 60^\circ}}$$

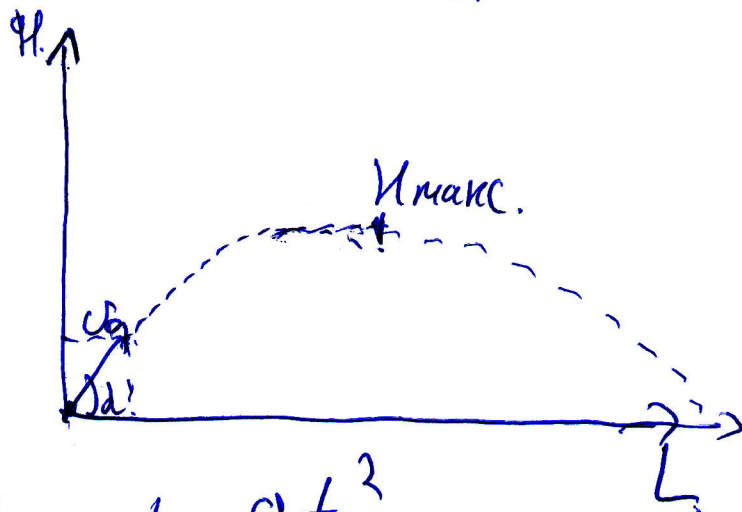
$$= \sqrt{\frac{10 \cdot 5}{0,08 \cdot \frac{\sqrt{3}}{2}}} = \sqrt{\frac{10\sqrt{3}}{0,08 \cdot 3}} = \sqrt{\frac{10\sqrt{3}}{0,24}}$$

$$T = \frac{250}{\omega} = \frac{250}{\sqrt{\frac{10\sqrt{3}}{0,24}}} = \frac{6,28 \cdot \sqrt{0,24}}{\sqrt{10\sqrt{3}}}$$

$$= \frac{6,28 \cdot 0,489}{4,1617} = 0,737$$

Ответ: 0,737

1)  $\alpha = 45^\circ$   $H = 10\text{m}$   $\mu = 1$



$$v_0 > 0$$

$$H = v_{y0} t_0 - \frac{g t_0^2}{2}$$

$$\text{due } v_{y0} - g t_0 = 0$$

$$H = v_0 \sin \alpha \frac{v_0 \sin \alpha}{g} - \frac{g}{2} \left( \frac{v_0 \sin \alpha}{g} \right)^2 t_0^2 = \frac{v_0 \sin \alpha}{g}$$

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

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

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

$$H g = v_0^2 \sin^2 \alpha$$

$$v_0 = \sqrt{\frac{2gH}{\sin^2 \alpha}} = \frac{\sqrt{2gH}}{\sin \alpha} =$$

$$= \frac{\sqrt{2 \cdot 10\text{m} \cdot 10 \frac{\text{m}}{\text{s}^2}}}{\frac{1}{\sqrt{2}}} = \frac{10 \cdot 2}{\sqrt{2}} = \frac{20}{\sqrt{2}} = \frac{20\sqrt{2}}{2} = 10\sqrt{2}$$

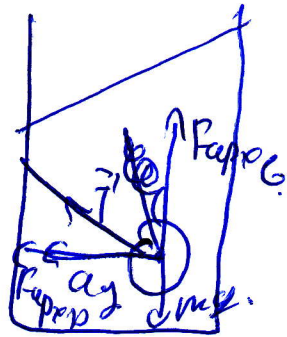
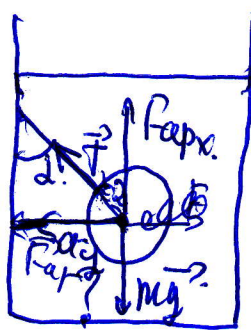
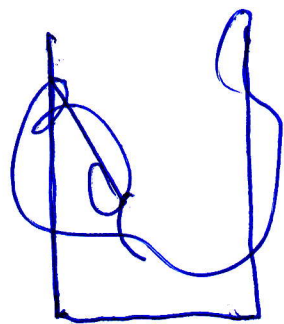
~~$$100 = (10\sqrt{2})^2 \cdot \left(\frac{\sqrt{2}}{2}\right)^2$$~~

$$v_0 = 10\sqrt{2} \approx 14.14 \frac{\text{m}}{\text{s}}$$

~~$$1000 = 100 \cdot 2 \cdot \frac{2}{4} = 100$$~~

2)

$v = \omega R$   
 $\omega$



$$a_y = \omega^2 R_2 = \frac{\omega^2}{R} R_2 = \frac{(R+l) \sin 60^\circ}{\cos 60^\circ} \sin 60^\circ$$

$$= 0,46 \frac{\omega^2}{2} = 0,08 \omega^2$$

$$F_{apx} = S_0 \cdot g \cdot V_T = \dots$$

Второй закон Ньютона.

$d = 60^\circ$

1)  $O_y: F_{apx} + T \cos d = mg$

$O_x: T \sin d + F_{apz} = m a_y$

~~$mg$~~   $sgV + T \cos d = mg$

$T = \frac{mg - sgV}{\cos d}$

~~$T$~~   $T \sin d + sgV = m a_y$

$T = \frac{c}{\omega}$

~~$T \sin d$~~   $T \sin d = a_y (m - S_0 V)$

$a_y = \frac{T \sin d}{m - S_0 V}$

$a_y = \frac{(mg - sgV) \tan d}{m - S_0 V} = g \cdot \tan d \quad d = 60^\circ$

$\omega^2 = \frac{a_y}{R_{cp}} \quad T_{cp} = \frac{2\pi}{\omega} = \frac{2\pi}{\frac{c}{\omega}} = \frac{2\pi}{\sqrt{\frac{a_y}{R_{cp}}}}$

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2).  $S_1 + S_2 = S.$

$S_1 = \frac{at^2}{2}$

$at = v_{max}$

$t = \frac{v_{max}}{a}$

$S_2 = \frac{v_{max} \cdot t}{2} = \frac{v_{max}^2}{2a}$

$S_1 = \frac{20}{2a}$

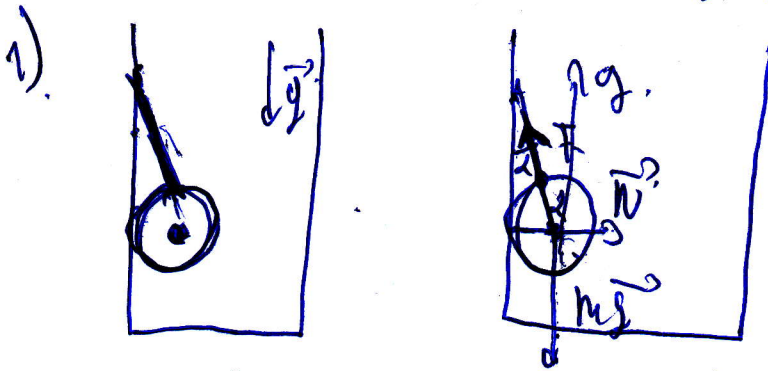
$a = 10 \cdot \frac{4}{25} - 10 \cdot 0,06 \cdot \frac{24}{25} =$

$= 2,224 \frac{4}{25}$

$S_1 = \frac{10}{2,224} \approx 4,496 \approx 4,5 \text{ m.}$

Poroga  $S_{obj} = 5 + 4,5 = 9,5 \text{ m.}$   
 us.

$R = 8 \text{ cm} = 0,08 \text{ m.} \quad l = 0,08 \text{ m.} \quad m = 5,2 \text{ m.}$



$\sin \alpha = \frac{R}{l+R} = \frac{0,08}{0,08+0,08} = \frac{1}{2}$   
 $\alpha = 30^\circ$

Obj:  $mg = T \cos \alpha. \quad T = \frac{mg}{\cos 30^\circ} = \frac{52}{\frac{\sqrt{3}}{2}} = \frac{104\sqrt{3}}{3}$

$$2) 10 \cdot \frac{7}{25} - 10 \cdot \frac{1}{2} = \frac{14}{25} = a$$

$a < 0$  и скорость  
замедляется.

В конце пути корабль останавливается  
значит.  $v_k = 0$ .

Макс. скорость по условию с помощью  
веса определить

~~$$v_{max} + at = 0$$~~

$$v_{max} = at$$

$$a = \left| 10 \cdot \frac{7}{25} - 10 \cdot \frac{1}{2} \right| = \left| \frac{14}{25} - 5 \right| = 2 \frac{11}{25} \text{ м/с}^2$$

~~$$v_{max} = at$$~~

~~$$v_{max} = at$$~~

~~$$S = \frac{v_0^2}{2a}$$~~

$$S_2 = \frac{h}{\sin \alpha} = \frac{1,4}{\frac{7}{25}} = \frac{14 \cdot 25}{70} = 5 \text{ м}$$

~~$$S = \frac{v_0^2 - v_1^2}{2a} = \frac{-v_0^2}{-4} = \frac{v_0^2}{4}$$~~

~~$$v_{max} = \sqrt{2ah} = \sqrt{2 \cdot 5 \cdot \frac{14}{25}} = 2 \sqrt{7}$$~~

~~$$h = \frac{v_0^2}{2g} \quad v_0 = \sqrt{2hg} \quad H = \frac{gt^2}{2}$$~~

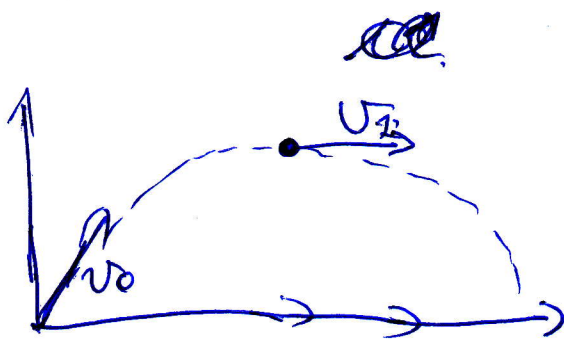
~~$$v_0 = gt$$~~

~~$$t = \sqrt{\frac{2H}{g}}$$~~

~~$$\sqrt{2hg} = g \cdot \sqrt{\frac{2H}{g}}$$~~

~~$$\sqrt{g} = \frac{g}{\sqrt{g}} \quad g = \frac{g^2}{g} = g$$~~





$$v_0 = v_1$$

$$v_y^2 + v_x^2 = v_1^2$$

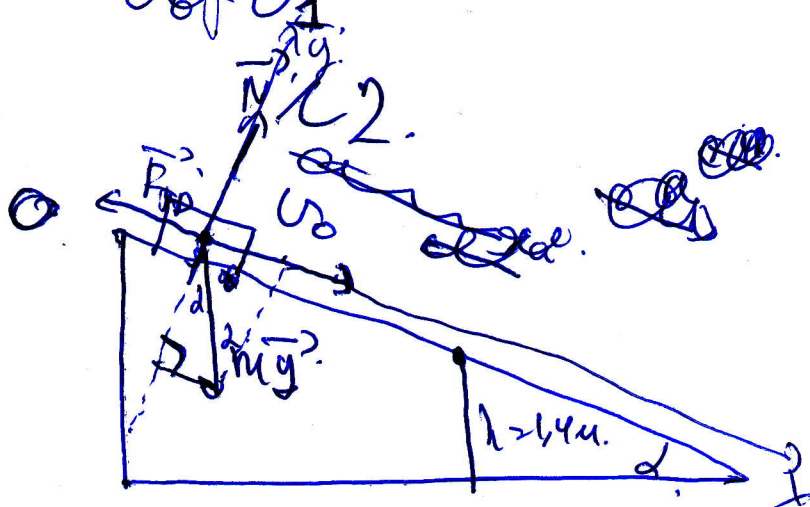
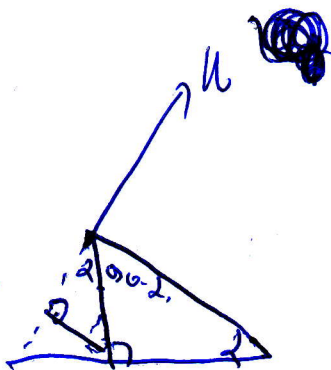
$$v_0^2 \sin^2 \alpha + v_0^2 \cos^2 \alpha = v_1^2$$

$$\frac{v_0^2}{2} + \frac{v_0^2}{2} = v_1^2$$

$$v_0^2 = v_1^2$$

$$v_0 = v_1$$

$$v_0 = v_1$$



$$\cos \alpha = \frac{24}{25}$$

$$\mu_1 = \frac{1}{2} = 0,5$$

$$\mu_2 = 0,06$$

$$v_k = 0$$

$$F_{fp} = \mu N$$

$$N = mg \cos \alpha$$

Q<sub>2</sub>!

$$N = mg \cos \alpha$$

$$F_{fp} = \mu mg \cos \alpha$$

$$mg \sin \alpha - F_{fp} = ma$$

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

$$1) \quad \cancel{mg} \sin \alpha - \cancel{mg} \cos \alpha = a$$

$$10 \cdot \frac{7}{25} - 10 \cdot 0,06 \cdot \frac{24}{25} = ma \quad a > 0 \text{ короче ускорения}$$

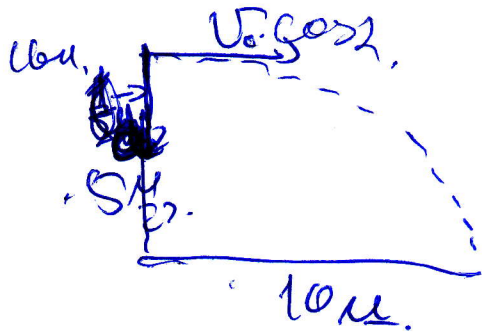
$$\sin \alpha = \frac{7}{25} \quad \sin \alpha = \sqrt{1 - \cos^2 \alpha} =$$

$$= 0,28 =$$

$$1 - \frac{576}{625} = \frac{49}{625}$$

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

# Упроблем.



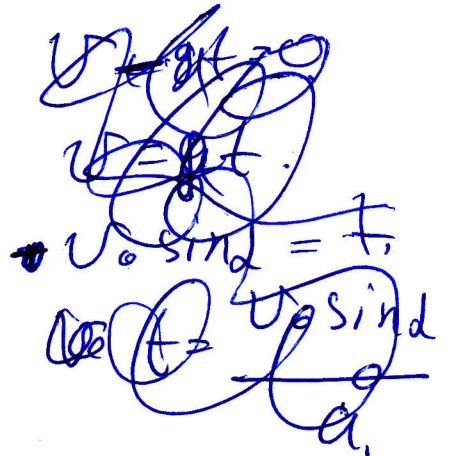
$v_0 = ?$

$$t = \sqrt{\frac{2H}{a}} = \sqrt{\frac{20}{5}} = 2c.$$

$$L = v_0 t$$

$$H = v_0 t - \frac{at^2}{2}$$

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



$$L = v_0 t$$

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

$v_0 = ?$

$$t = \sqrt{\frac{2H \cdot 20}{g \cdot 5}} = \sqrt{2} = 1.41c$$

$$v_0 \sin \alpha = gt$$

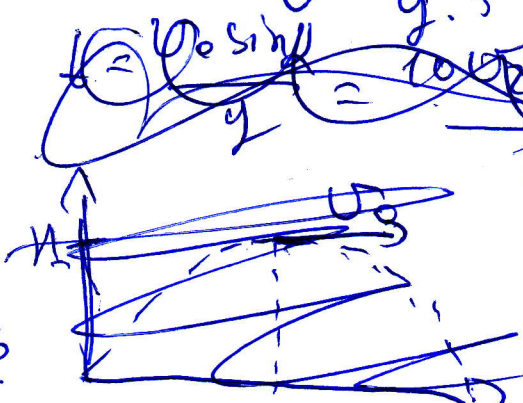
$$t = \frac{v_0 \sin \alpha}{g}$$

$$10 \sqrt{2} = \frac{v_0 \sin \alpha}{2} \cdot 2c$$

$$L = v_0 t$$

$$10 = \frac{v_0}{\sqrt{2}}$$

$$v_0 = 10\sqrt{2}$$



$$t = \sqrt{\frac{2H}{a}} = 2c$$

$$t = \frac{v_0 \sin \alpha}{g} = \frac{10 \cdot \frac{\sqrt{2}}{2}}{5}$$

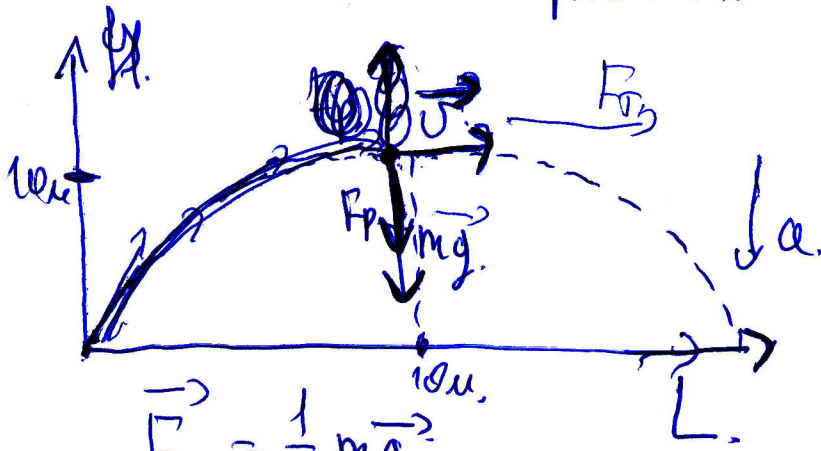
$$L = \frac{v_0^2 \sin 2\alpha}{a}$$

$$20 = \frac{v_0^2}{5} \cdot a \quad v_0 = 10 \frac{m}{c}$$

ответ:  $10 \frac{m}{c}$

10. 100 м/с.

Чепован.



$F_p$  бепро  
 Так лерк  
 у тент нет  
 чепован  
 бепро бепро  $x(L)$

$$\vec{F}_p = \frac{1}{2} m \vec{g}$$

$$v = \sqrt{v_y^2 + v_x^2}$$

$$v^2 = v_x^2 \text{ (бепуван)}$$

$$t_{\text{возв}} = 2t_0 = 2 \frac{v_0 \sin \alpha}{g}$$

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

$$= \frac{v_0^2 \sin 2\alpha}{g} = \frac{v_0^2 \sin 90^\circ}{g} = \frac{v_0}{g} = \frac{(10 \text{ м/с})^2}{10} = \frac{100 \text{ м}^2}{10} =$$

$$= 20 \text{ м.}$$

~~$$F_p = \frac{1}{2} mg$$~~

~~$$mg - F_p = ma$$~~

~~$$mg - \frac{1}{2} mg = ma$$~~

~~$$mg - F_p = ma$$~~

Чепован чеповане.

г.к

леть только бепро бепро  $H$ ,  $10$  го.

~~Чепован~~ бепро бепро чеповане с чеповане. г.к

$$ma = \frac{1}{2} mg \quad a = \frac{1}{2} g$$

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

# Часть 2

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

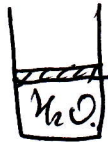
Шифр: **21205083**

ID профиля: **831623**

Вариант 4

# Микро бук (1)

У  
Семена:



Дано:  
 $m = 0,01 \text{ кг}$   
 $t_0 = 20^\circ \text{C}$   
 $P_0 = 10^5 \text{ Па}$   
 $Q = 33 \text{ Дж}$   
 $r = 2,26 \cdot 10^6$   
 $c = 4180$   
 $c_p = 2200$

$Q_1 = ?$   
 $V_k = ?$

$$Q_1 = mc \Delta t = 0,01 \cdot 4180 \cdot (100 - 20) = 3344 \text{ Дж}$$

$$Q_2 \hat{=} mc \Delta t + r m = 3344 + 2,26 \cdot 10^6 \cdot 0,01 = 25944 \text{ Дж} \text{ (для воды испарения)}$$

$$Q_3 = 33000 - 25944 = 7056 \text{ Дж} \text{ (Энергия на нагрев пара)}$$

$$t_k = \frac{Q_3}{m \cdot c_p} = \frac{7056}{0,01 \cdot 2200} = \frac{7056}{22} = 320,72 \text{ К}$$

$$pV = \frac{m}{M} RT \quad V = \frac{m}{M} \frac{RT}{p} = \frac{0,01}{18 \cdot 10^{-3}} \cdot 8,31 \cdot 623,72 = \frac{31,19}{10^5} =$$

$$= 0,03119 \text{ м}^3 = 31,19 \text{ см}^3$$

Ответ:  $Q_1 = 3344 \text{ Дж}$      $V = 31,19 \text{ см}^3$

Условие (2).

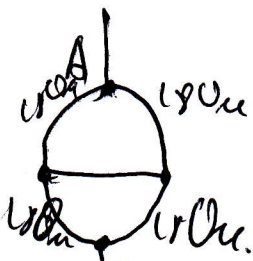
и т.д.

Решение:

Дано:  
 $R_{экв} = 12 \text{ Ом}$   
 $U = 24 \text{ В}$

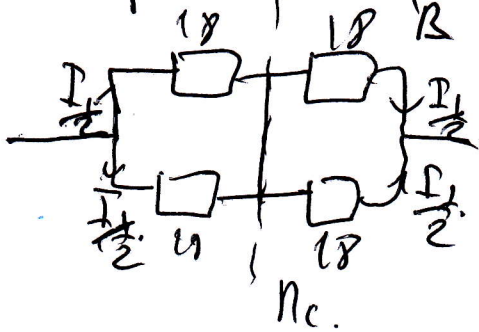
р-1

1)



$$\frac{U}{2} = 18$$

Цепочка из коротких  
 Плохой симметрии,  
 ток в перемычке  
 отсутствует.



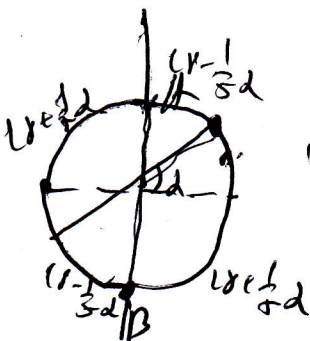
$$18 \cdot \frac{I}{2} + 18 \cdot \frac{I}{2} = U$$

$$18I = 4$$

$$I = \frac{24}{18} = 1 \frac{1}{3} \text{ А}$$

$$P = U \cdot I = 24 \cdot 1 \frac{1}{3} = 32 \text{ Вт}$$

2)

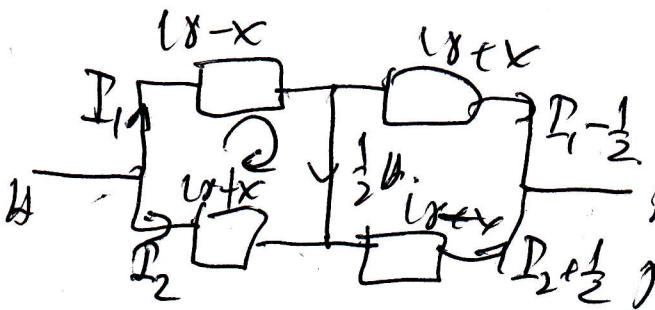


в цепочке окруж.  $R = 18 \text{ Ом}$ .

Тогда от А до перемычки

$$R = 18 - 18 \cdot \frac{d}{50} = 18 - \frac{1}{5}d$$

$$\text{или } \frac{1}{5}d = x$$



~~Р-1~~

По правилу контурных токов.

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

$$I_2 = \frac{18-x}{18+x} I_1$$

методом (3)  
15 (прогонка)

$$(18-x)I_1 + (18+x)(I_1 - \frac{1}{2}) = 24$$

$$36I_1 - \frac{1}{2}x = 33 \quad I_1 = \frac{33 + 0,5x}{36}$$

$$(18+x)I_2 + (18-x)(I_2 + \frac{1}{2}) = 24$$

$$(18+x) \frac{18-x}{18+x} I_1 + (18-x) \left( \frac{18-x}{18+x} I_1 + \frac{1}{2} \right) = 24$$

$$(18-x) \frac{33 + 0,5x}{36} + \frac{(18-x)^2}{18+x} \cdot \frac{33 + 0,5x}{36} - \frac{1}{2}x = 15 \left( \frac{18-x}{18+x} \right) \frac{33 + 0,5x}{36}$$

$$(324 - x^2)(33 + 0,5x) + (18 - x^2)(33 + 0,5x) - \frac{1}{2}x(18+x) = 540$$

$$324 \cdot 33 - 33x^2 + \frac{1}{2}x^3 + 162x + 594 - 33x^2 - \frac{1}{2}x^3 + 9x - 324x + 18x^2 = 540 \cdot 18 + 18x^2$$

$$18x^2 - 693x - 10314 = 0$$

$$x = \frac{693 \pm \sqrt{693^2 + 4 \cdot 18 \cdot 10314}}{36}$$

$$\frac{1}{5}d = \frac{693 \pm \sqrt{693^2 + 4 \cdot 18 \cdot 10314}}{36}$$

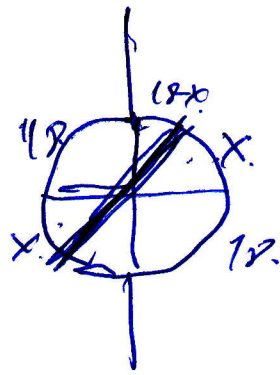
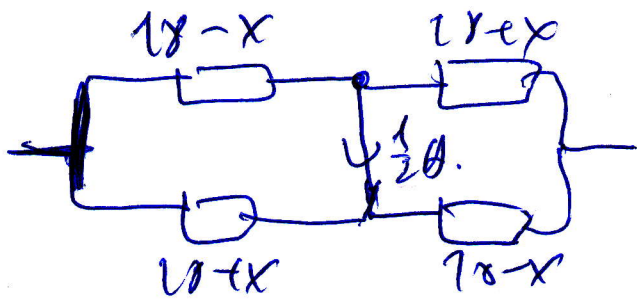
$$d = 5 \cdot \left( \frac{693 \pm \sqrt{693^2 + 4 \cdot 18 \cdot 10314}}{36} \right)$$

~~Решение~~

$$R_{\text{отн}} = \frac{1}{(18-x) + (18+x)} + \frac{1}{(18+x) + (18-x)} = \frac{2}{36}$$

$$P = \frac{4^2}{R} = \frac{24^2}{\frac{2}{36}} = 324 \text{ Вт}$$

Ответ:  $d = 5 \cdot \left( \frac{693 \pm \sqrt{693^2 + 4 \cdot 18 \cdot 10314}}{36} \right)$   $P = 324 \text{ Вт}$



$$(18-x)I_1 + (18+x)\left(I_1 - \frac{1}{2}\right) = 24$$

$$18I_1 - xI_1 + 18I_1 + xI_1 - 9 - \frac{1}{2}x = 24$$

$$36I_1 - \frac{1}{2}x = 33$$

~~$$x = 33 - 36I_1$$~~

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

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

$$I_1 = \frac{18+x}{18-x} I_2$$

$$I_2 = \frac{18-x}{18+x} I_1$$

~~$$(18+x) \frac{18-x}{18+x} I_1 + (18-x) \left( \frac{18-x}{18+x} I_1 + \frac{1}{2} \right) = 24$$~~

$$(18-x)I_1 + \frac{(18-x)^2}{18+x} I_1 + 9 - \frac{1}{2}x = 24$$

~~1200~~

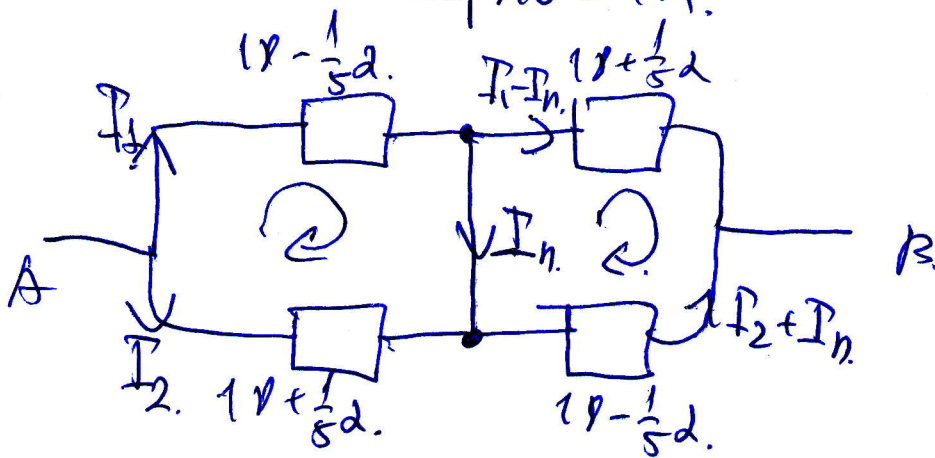
$$(18-x) \frac{33 + 0,5x}{36} + \frac{(18-x)^2}{18+x} \cdot \frac{33 + 0,5x}{36} - \frac{1}{2}x = 15 \cdot \left| \frac{33}{36} \right.$$

$$(18-x)(33 + 0,5x) + \frac{(18-x)^2}{18+x} \cdot (33 + 0,5x) - \frac{1}{2}x = 540$$

1.11000



Черновик.



$$I_n = \frac{1}{2} \text{ A.}$$

По правому контурным токам.

$$1) \quad I_1 \cdot (18 - \frac{1}{5}d) + I_2 \cdot 0 + (18 + \frac{1}{5}d)I_1 = 0$$

$$(18 - \frac{1}{5}d)I_1 = (18 + \frac{1}{5}d)I_2$$

$$2) \quad I_1(18 + \frac{1}{5}d) - (18 + \frac{1}{5}d)I_n = (18 - \frac{1}{5}d)I_2 + (18 - \frac{1}{5}d)I_2$$

$$18I_1 + \frac{1}{5}dI_1 - 18I_n + \frac{1}{5}dI_n = 18I_2 - \frac{1}{5}dI_2 + 18I_2 - \frac{1}{5}dI_2$$

$$18I_1 + \frac{1}{5}dI_1 = 18I_2 - \frac{1}{5}dI_2 + 36I_n - \frac{2}{5}dI_n$$

$$(18 + \frac{1}{5}d)I_1 - (18 + \frac{1}{5}d)I_2 + (18 - \frac{1}{5}d)I_n = 24I_n$$

$$36I_2 + 18 \cdot 0,5 \text{ A} - \frac{1}{10}d = 24I_n$$

$$36I_2 - \frac{1}{10}d = 15 \text{ B.}$$

$$18I_2 - \frac{1}{20}d = 7,5$$

$$18I_1 + \frac{1}{5}dI_1 = 18I_2 - \frac{1}{10}d + 18 - \frac{1}{5}d$$

$$18I_1 + \frac{1}{5}dI_1 = 18I_2 + \frac{1}{20}d + \frac{1}{20}d = 18 + \frac{1}{5}d.$$

$$= 18I_2 - \frac{1}{5}dI_2.$$

$$(18 - \frac{1}{5}d)I_1 = (18 + \frac{1}{5}d)I_2.$$

$$I_1 = \frac{18 + \frac{1}{5}d}{18 - \frac{1}{5}d} I_2.$$

Ngeryo  $I_1 = y$   
 $I_2 = x.$

CP. 18-

$$18y - \frac{1}{5}d y + 18y + \frac{1}{5}d y - 18 \cdot \frac{1}{2} - \frac{1}{5} \cdot \frac{1}{2}d = 24.$$

$$36y - \frac{1}{5}d y - y - \frac{1}{10}d = 24.$$

$$36y - \frac{1}{10}d = 33.$$

$$18x + \frac{1}{5}d x + 18x - \frac{1}{5}d x + 18 \cdot \frac{1}{2} - \frac{1}{5} \cdot \frac{1}{2}d = 24.$$

$$36x + y - \frac{1}{10}d = 24.$$

$$36y - \frac{1}{10}d = 33.$$

$$36x - \frac{1}{10}d = 15.$$

$$y = \frac{18 + \frac{1}{5}d}{18 - \frac{1}{5}d} x.$$

$$36y - 36x = 18.$$

$$2y - 2x = 1.$$

$$y = \frac{2x + 1}{2}.$$

$$d^2 + 145d + 4875 = 0$$

$$D = 15225 = (39,05)^2$$

$$d_1 = \frac{-145 \pm 39,05}{2} = -52,975$$

$$d_2 = -53,025$$

$$97,05 \approx 53,025$$

$$18I_1 = 17 + \frac{1}{5}d$$

$$18 - \frac{1}{5} \cdot 92 =$$

$$I_1 = 1,25A$$

$$18 - 18,4 < 0$$

$$18 + 18,4$$

$$-0,4$$

$$36,4$$

$$18 + 18,4$$

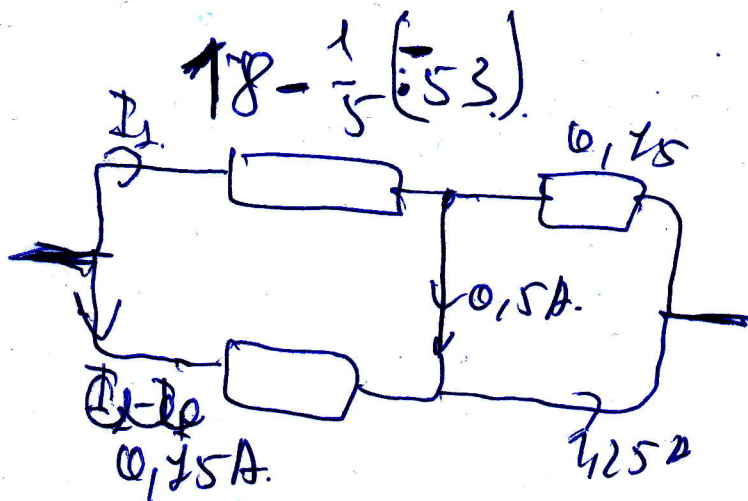
$$18 - 18,4$$

$$< 0$$

$$53,0$$

$$9,15A$$

$$18 - \frac{1}{5}(-53)$$

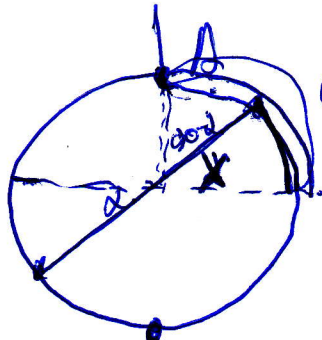


Чертеж

$$P = U \cdot I = 24 \cdot 1\frac{1}{3} = 24 \cdot \frac{4}{3} = 8 \cdot 4 = 32 \text{ Вт.}$$

$$P = \frac{U^2}{R} = \frac{24 \cdot 24}{18} =$$

2)



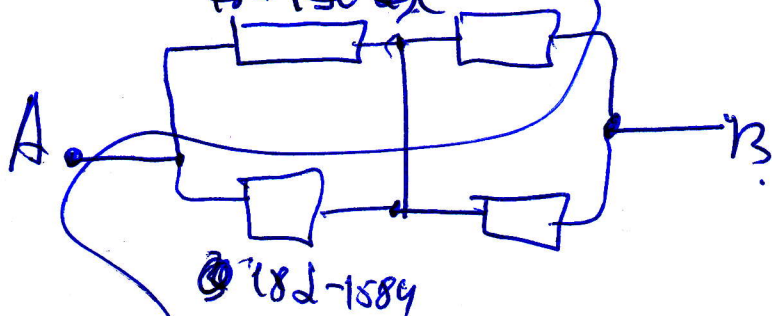
18 Ом.  $d = ?$   $P_{\text{ен}} = 0,5 \text{ Вт.}$

$$18 \cdot \frac{d}{5} = 90 \cdot 36 - 18 \cdot (90 - d) =$$

$$= \frac{1}{5} d$$

$$1620 - 18d = 1584 - 18d$$

$$18(2 - 88)$$

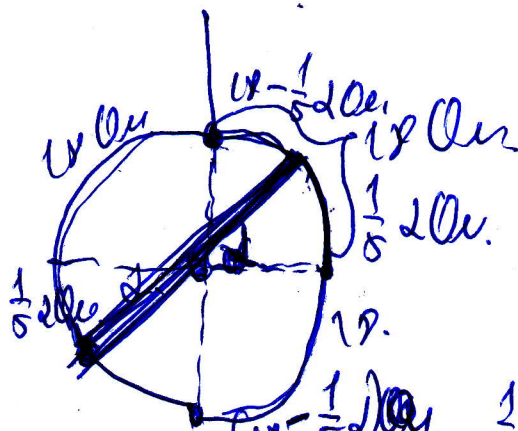


$$1620 - 18d + X = 36.$$

$$X = 18d - 1584.$$

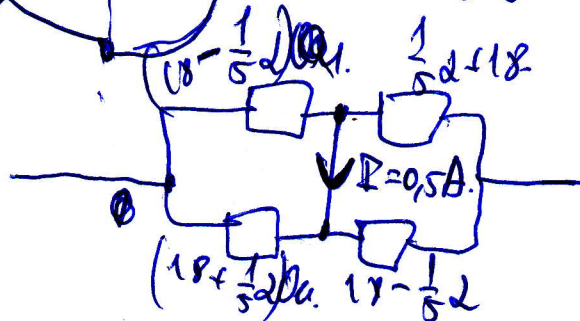
X - длина окружности  
на которую нужно  
переместить перемычку

с правой стороны  
в левую.



$$18 \cdot \frac{d}{5} = \frac{1}{5} d \text{ Ом.}$$

$$36 - \frac{1}{5} d$$



непроблем.

$$M(H_2O) = 2 + 16 = 18 \frac{g}{mol}$$

$$= 18 \cdot 10^{-3} \frac{kg}{mol}$$

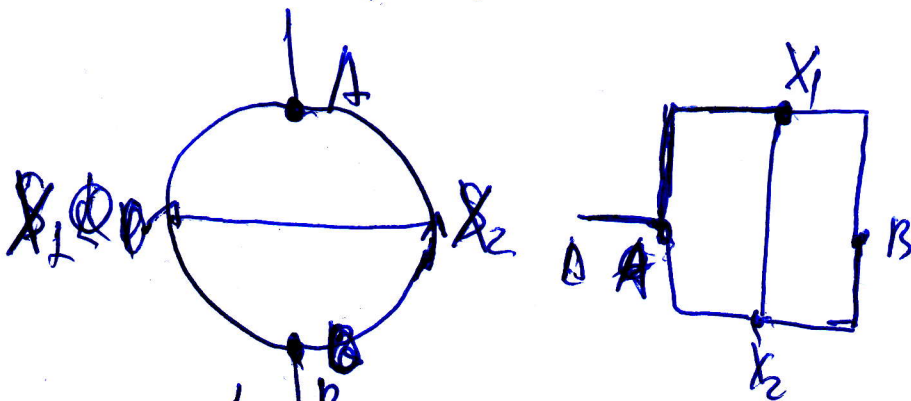
$$pV = \nu RT$$

$$V = \frac{\nu RT}{p} = \frac{\frac{m}{M} RT}{p} = \frac{0,01}{18 \cdot 10^{-3}} \cdot 8,31 \cdot 673,72 = 31,1 \text{ л}$$

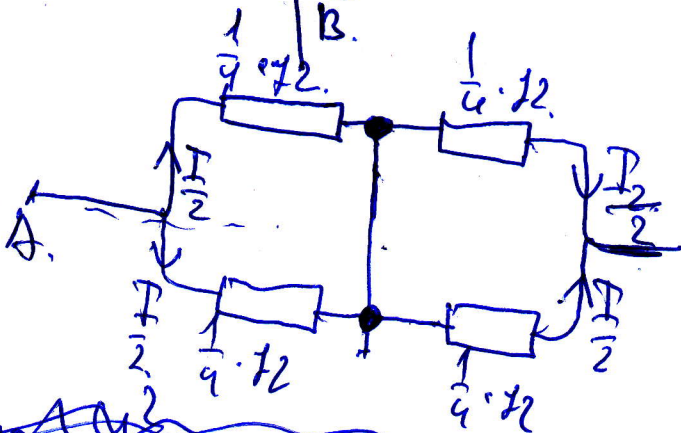
$$\varphi = \frac{10 \cdot 8,31 \cdot 673,72}{18 \cdot 10^5} = \frac{8,31 \cdot 673,72}{18 \cdot 10^4} = 0,0311 \text{ ат} = 31,1 \text{ гн}^3$$

н.с.

$$R = 72 \text{ Ом. } U = 24 \text{ В}$$

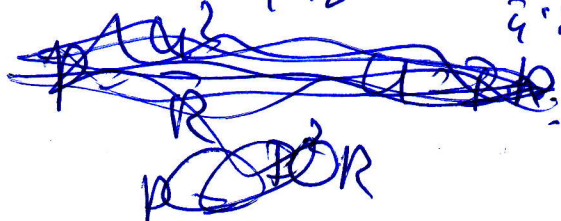


$$\frac{72}{9} = 18$$



I-сон.

На перемычке нет тока



$$U = \frac{I}{2} \cdot 18 + \frac{I}{2} \cdot 18 =$$

$$= 18I$$

$$I = 1 \frac{1}{3}$$

$$R = 24 = 18$$

$$I = 4 \text{ А.}$$

$$\frac{1}{R_{\text{экв}}} = \frac{1}{36} + \frac{1}{36}$$

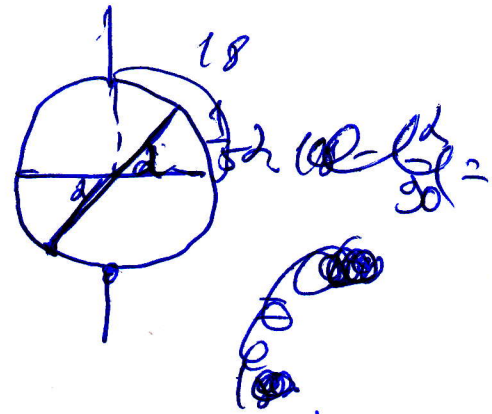
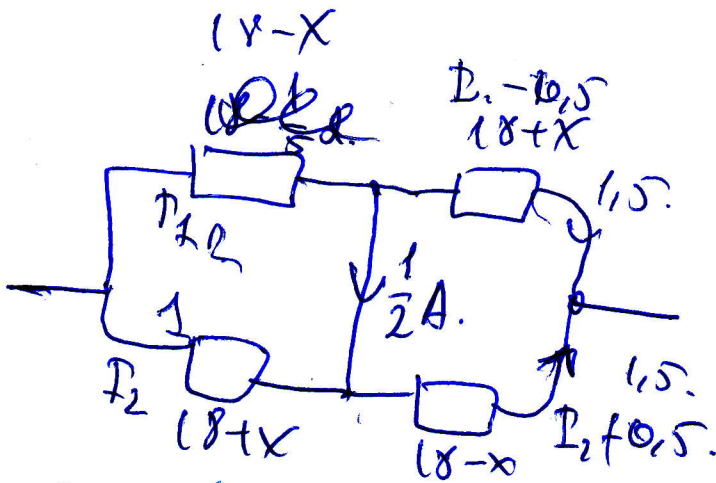
$$\frac{1}{R_{\text{экв}}} = \frac{2}{36}$$

$$U = I \cdot R = 4 \cdot 18 = 72$$

$$R_{\text{экв}} = 18.$$

Упрелен.

$$\frac{1}{5}d = X$$



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

$$18 = \frac{d}{90} = \frac{1}{5}d$$

$$I_1 = I_2 + 0,5$$

~~$I_1 = I_2 + \frac{1}{2}A$~~

~~$$(18+x)(I_1 - \frac{1}{2}) = (18-x)(I_2 + \frac{1}{2})$$~~

~~$$18I_1 + xI_1 - 9 - \frac{1}{2}x = 18I_2 - xI_2 + 9 - \frac{1}{2}x$$~~

~~$$18I_1 - 18I_2 + xI_1 - xI_2 = 18$$~~

~~$$18(I_1 - I_2) + x(I_1 - I_2) = 18$$~~

~~$$(18+x)(I_1 - I_2) = 18$$~~

~~$$I_1 - I_2 = \frac{18}{18+x}$$~~

~~$$I_1 - \frac{18+x}{18-x} I_2 = \frac{18}{18+x}$$~~

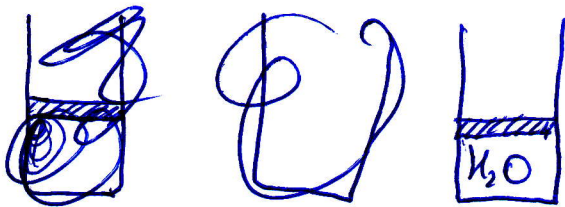
~~$$\frac{18-x}{18+x} = \frac{18-x}{18-x} = \frac{2x}{x-18}$$~~

~~$$I_1 =$$~~

Упроблн  
№4.

$$m = 0,01 \text{ кг} \quad t_0 = 20^\circ\text{C} \quad p = 10^5 \text{ Па} \quad t_1 = 100^\circ\text{C}$$

$$Q = 33 \text{ кДж}$$



$$c = 4180 \frac{\text{Дж}}{\text{кг} \cdot \text{K}}$$

$$\rho = 2,26 \cdot 10^6$$

$$p_0 = 10^5 \text{ Па}$$

$$C_p = 2200 \text{ Дж}/(\text{кг} \cdot \text{K})$$

$$Q_1 = mc \Delta t = 0,01 \cdot 4180 \cdot 80 =$$

$$= 0,418 \cdot 8 \cdot 100 \cdot 0,01 = 418 \cdot 8 = 3344 \text{ Дж}$$

$$Q_2 = \rho m = 0,01 \cdot 2,26 \cdot 10^6 = 2,26 \cdot 10^4 =$$
$$= 226 \cdot 10^2 = 22600$$

$Q_3 = 25944$  — необходимое тепло до кипения.  
и полностью испарения воды.

$$Q_4 = 33000 - 25944 = 7056 \text{ Дж}$$

$$Q_4 = m \cdot C_p \cdot \Delta t$$

$$\Delta t = \frac{Q_4}{m \cdot C_p} = \frac{7056}{0,01 \cdot 2200} = \frac{7056}{22} = 320,72 \text{ К}$$

конечная температура пара =

$$= 273 + 100 + 320,72 = 693,72 \text{ К} \approx 694 \text{ К}$$