Часть 1

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

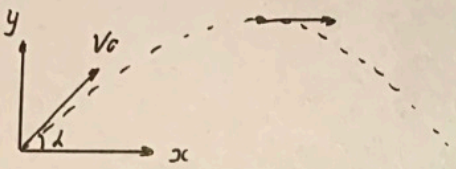
Шифр: **21204358**

ID профиля: **852805**

Вариант 4

Вариант

№ 1



1)

$H = V_0 \sin\alpha \cdot t - \frac{gt^2}{2}$

$V_y = V_0 \sin\alpha - gt = 0$

$V_0 \sin\alpha = gt$

$t = \frac{V_0 \sin\alpha}{g}$

$H_{max} = \frac{V_0^2 \sin^2\alpha}{g} - \frac{V_0^2 \sin^2\alpha}{2g} =$

$= \frac{V_0^2 \sin^2\alpha}{2g}$

$V_0^2 = \frac{H_{max} \cdot 2g}{\sin^2\alpha}$

$V_0 = \sqrt{\frac{H_{max} \cdot 2g}{\sin^2\alpha}} = \sqrt{\frac{10 \cdot 2 \cdot 10}{\sin^2 45}} =$

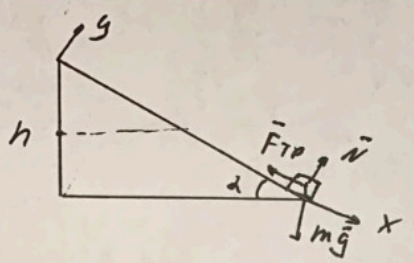
$= \sqrt{\frac{20^2}{\frac{1}{2}}} = \sqrt{400} = 20$ м/с

Ответ: 20 м/с.

2)

Чистовик

~2



②

1) максимальную скорость коробка набрала когда съехала до высоты $h = 1,4$ м, потом начала тормозить и остановилась

$F_x = mg\sin\alpha - \mu N = mg\sin\alpha - \mu mg\cos\alpha = mg(\sin\alpha - \cos\alpha\mu)$

$a = \frac{F}{m} = g(\sin\alpha - \mu\cos\alpha)$

$S = V_0 t - \frac{at^2}{2}$ $\quad S = \frac{h}{\sin\alpha}$ $\quad V_k = V_0 - at = 0$

$V_0 = at$

$t = \frac{V_0}{a}$

$S = \frac{V_0^2}{a} - a\frac{\frac{V_0^2}{a^2}}{2} = \frac{V_0^2}{2a}$

$V_0^2 = S \cdot 2a = \frac{h}{\sin\alpha} \cdot 2 \cdot g(\sin\alpha - \mu\cos\alpha)$

$V_0 = \sqrt{\frac{2hg(\sin\alpha - \mu\cos\alpha)}{\sin\alpha}} = \sqrt{\frac{2 \cdot 1,4 \cdot 10(0,28 - 0,5 \cdot \frac{24}{25})}{0,28}} =$

$= \sqrt{20} = 4,47$ м/с

2) $S_1 = V_{01}t + \frac{at^2}{2}$ $\quad V_{01} = 0$ $\quad a = g(\sin\alpha - \mu_1\cos\alpha)$

$S_1 = \frac{at^2}{2}$ $\quad V_k = at = V_0$

$t = \frac{V_0}{a}$

$S_1 = a\frac{\frac{V_0^2}{a^2}}{2} = \frac{V_0^2}{2a} = \frac{V_0^2}{2(g(\sin\alpha - \mu_1\cos\alpha))} = \frac{20}{2 \cdot 10 \cdot (0,28 - 0,06 \cdot \frac{24}{25})} =$

$\approx 4,5$ м

$S_2 = \frac{h}{\sin\alpha} = \frac{1,4}{0,28} = 5$

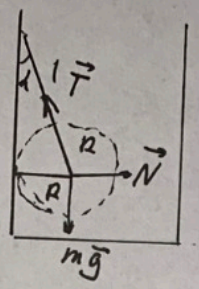
$S_0 = S_1 + S_2 = 5 + 4,5 = 9,5$ м

Ответ: $V_{max} = 4,47$ м/с; $S = 9,5$ м.

Чистовик

№ 3

③

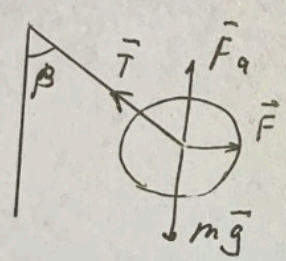


1) $T \cdot \cos\alpha = mg$ $\quad T = \frac{mg}{\cos\alpha}$ $\quad \sin\alpha = \frac{R}{l+R} = \frac{1}{2}$ $\quad \alpha = 30°$

$T = \frac{10 \cdot 5,2}{\frac{\sqrt{3}}{2}} = \frac{2 \cdot 10 \cdot 5,2}{\sqrt{3}} \approx 60$ Н

2)

$\beta = 60°$



$T\cos\beta = mg - F_a$

$F_a = \rho V g$

$T = \frac{mg - \rho V g}{\cos\beta}$

$V = \frac{3}{4}\pi R^3$ $\quad T = \frac{mg - \rho \cdot \frac{3}{4}\pi R^3 g}{\cos\beta} = \frac{5,2 \cdot 10 - 1 \cdot \frac{3}{4} \cdot 3,14 \cdot 8 \cdot 10^3}{\cos 60°} =$

$= \frac{5,2 \cdot 10 - 1000 \cdot \frac{3}{4} \cdot 3,14 \cdot 0,08^3 10}{\cos\beta} \approx 80$ Н

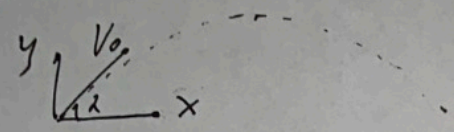
$F = T \sin\beta = 80 \cdot \frac{\sqrt{3}}{2} \approx 69$ Н

$F = ma$ $\quad a = \frac{F}{m} = \frac{69}{5,2} = 13,3$

$a = \omega^2 R_1$ $\quad R_1 = (l+R)\sin\alpha = 0,16 \cdot \frac{\sqrt{3}}{2} = 0,14$

$\omega = \sqrt{\frac{a}{R_1}} = \sqrt{\frac{13,3}{0,14}} = 9,7$ $\quad T = \frac{2\pi}{\omega} = \frac{2 \cdot 3,14}{9,7} = 0,64$ с

Ответ: $T = 60$ Н ; $T = 0,64$ с.



$V_0 \cos\alpha$

$S = V_0 \sin\alpha \cdot t - \frac{gt^2}{2}$

$V_y = V_0 \sin\alpha - gt = 0$

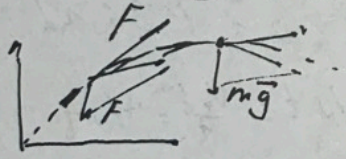
$V_0 \sin\alpha = gt$

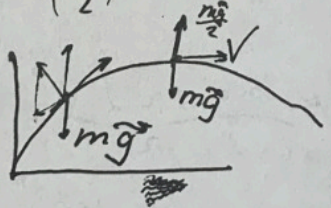
$t = \frac{V_0 \sin\alpha}{g}$

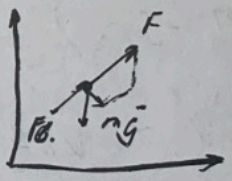
$S = \frac{V_0 \sin\alpha \cdot V_0 \sin\alpha}{g} - g \cdot \frac{V_0^2 \sin^2\alpha}{g^2} = \frac{V_0^2 \sin^2\alpha}{g} - \frac{V_0^2 \sin^2\alpha}{2g} = \frac{V_0^2 \sin^2\alpha}{2g}$

$S = \frac{V_0^2 \sin^2\alpha}{2g}$ $\quad 2gS = V_0^2 \sin^2\alpha$

$V_0 = \sqrt{\frac{2gS}{\sin^2\alpha}} = \sqrt{\frac{2 \cdot 10 \cdot 10}{\left(\frac{\sqrt{2}}{2}\right)^2}} = \sqrt{\frac{200}{\frac{2}{4}}} = \sqrt{400} = 20$

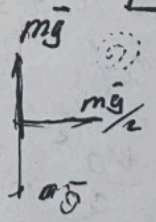


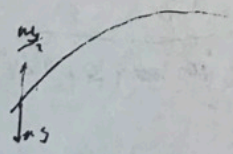


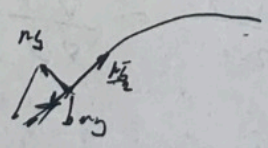


$F = mg \sin\alpha$

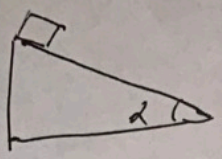
$V_x = \text{const}$

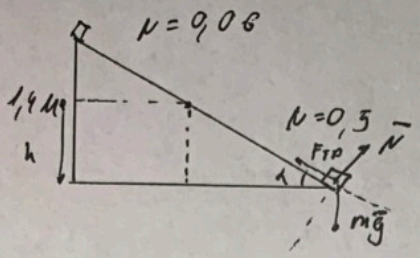


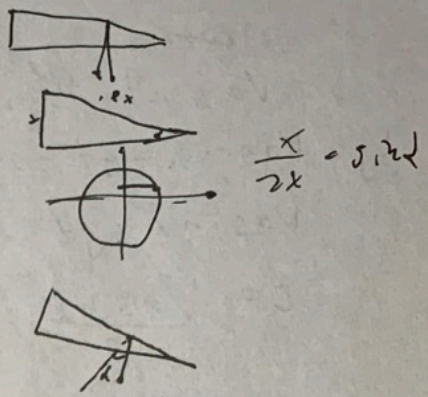




Чертёж







$\frac{x}{2x} = \sin\alpha$

$V_{max} = V_0 + at \qquad V_0 = 0$

$a = mg\cos\alpha - F_{тр}$

$F_{тр} = \mu N = \mu \cdot mg\sin\alpha$

$a = mg\cos\alpha - \mu mg\sin\alpha = mg(\cos\alpha - \mu\sin\alpha)$

$\sin\alpha = \sqrt{1-\cos^2\alpha} = \sqrt{0,784} = 0,28$

$F_{тр2} = \mu N = \mu mg\sin\alpha$

$S = V_0 t - \frac{at^2}{2} = V_0 t - \frac{\mu mg\sin\alpha\, t^2}{2}$

$F = ma$

$S = h \cdot \sin\alpha$

$f = \mu mg\sin\alpha$

$a = \mu g\sin\alpha$

$h\cdot\sin\alpha = V_0 t - \frac{\mu mg\sin\alpha\, t^2}{2}$

$V_0 t - \frac{V_0 t}{2} = V_0 t$

$V = V_0 - at = 0$

$a = \frac{V_0}{t}$

$V_0 = at \qquad t = \frac{V_0}{a}$

$h\sin\alpha = \frac{V_0^2}{a} - \frac{V_0^2}{2a} = \frac{V_0^2}{2a} = \frac{V_0^2}{\mu mg\sin\alpha}$

$V_0^2 = h\sin\alpha\,\mu g\sin\alpha = h\mu g\sin^2\alpha$

$V_0 = \sqrt{h\mu g\sin^2\alpha} = \sqrt{1,4\cdot 0,5\cdot 10\cdot 0,28^2} = \sqrt{0,5488} =$

$= 0,74$ м/с

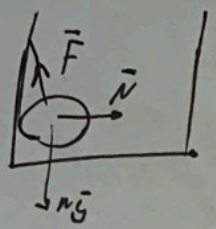
$\frac{h}{\sin\alpha} = \frac{V_0^2}{\mu g\sin\alpha}$

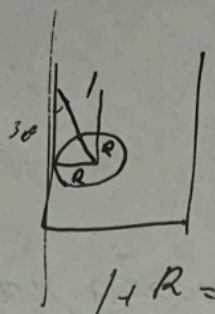
$h = \frac{V_0^2}{\mu g} \qquad V_0^2 = h\mu g$

$V_0 = \sqrt{h\mu g} = \sqrt{7}$

$= 2,65$ м/с

Задача.





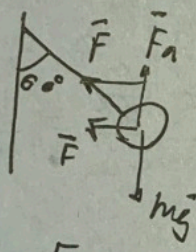
$F = \sqrt{mg^2 + N^2}$

$l + R = 16$ $\quad \sin\alpha = \frac{1}{2}$

$R = 8$ $\quad \alpha = 30°$

~~$\bar{F} = mg$~~ $\quad F \cdot \cos\alpha = mg$

$F = \frac{mg}{\cos\alpha} = \frac{10 \cdot 5{,}2}{\frac{\sqrt{3}}{2}} = \frac{52 \cdot 2}{\sqrt{3}} = \frac{104}{\sqrt{3}}$



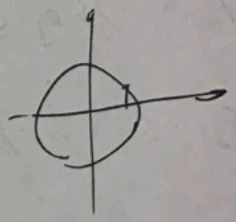
$\bar{F}_A = \rho V g$

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

$F = \frac{mg - F_A}{\cos\alpha}$ $\quad F_2 = F \sin\alpha = \frac{mg - F_A}{\cos\alpha} \sin\alpha$

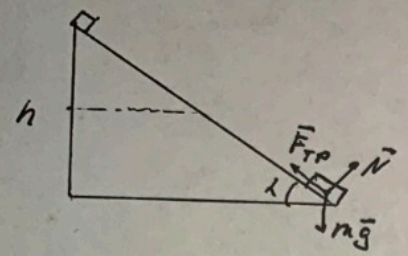
$a = \frac{F}{m} =$ $\quad a = \omega^2 R$ $\quad \omega = \sqrt{\frac{a}{R}}$

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



~~Контрольная~~ работа

№ 2



а) Максимальную скорость кубика нашли когда съехала до высоты h=1,4 м, потом начала тормозить и остановилась.

$F_{тр} = \mu N = \mu mg\cos\alpha$ $\quad a = \frac{F}{m} = \mu g\cos\alpha$

$S = V_0 t - \frac{at^2}{2}$ $\quad S = \frac{h}{\sin\alpha}$

$V_k = V_0 - at = 0$

$V_0 = at$

$t = \frac{V_0}{a}$

$S = \frac{V_0^2}{a} - a\frac{\frac{V_0^2}{a^2}}{2} = \frac{V_0^2}{a} - \frac{V_0^2}{2a} = \frac{V_0^2}{2a}$

$\frac{h}{\sin\alpha} = \frac{V_0^2}{2\mu g\cos\alpha}$

$V_0^2 = \frac{2hg\mu\cos\alpha}{\sin\alpha}$ $\quad V_0 = \sqrt{\frac{2hg\mu\cos\alpha}{\sin\alpha}} = \sqrt{\frac{2\cdot 1{,}4\cdot 10\cdot 0{,}5\cdot \frac{24}{25}}{0{,}28}} =$

$= 6{,}92$ м/с

б) $F = mg\sin\alpha - \mu N = mg\sin\alpha - \mu mg\cos\alpha = mg(\sin\alpha - \mu\cos\alpha)$

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

$S = V_0 t + \frac{at^2}{2}$ $\quad V_0 = 0$

$S = \frac{at^2}{2} = \frac{V_0 t}{2}$ $\quad V_k = V_0 = at$

$t = \frac{V_0}{a}$

$a\frac{\frac{V_0^2}{a^2}}{a} = \frac{V_0^2}{2a} = \frac{V_0^2}{2\cdot(\sin\alpha - \mu\cos\alpha)} = S$

Часть 2

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

Шифр: **21204358**

ID профиля: **852805**

Вариант 4

Источник Вар. 10-04 часть 2

№ 4

(1)

1) $Q_1 = cm\Delta t = 4180 \cdot 0{,}01 \cdot 80 = 3344$ Дж

2) $Q_2 = \lambda m = 2{,}26 \cdot 10^6 \cdot 0{,}01 = 22600$ Дж

$Q_1 + Q_2 = 22600 + 3344 = 25944$ Дж

$Q - Q_1 - Q_2 = 33000 - 25944 = 7056$ Дж

$Q_3 = cm\Delta t \qquad \Delta t = \frac{Q_3}{cm} = \frac{7056}{2200 \cdot 0{,}01} = 320^\circ$

$T_к = 100^\circ + 320^\circ = 420^\circ$

$pV = \upsilon RT$

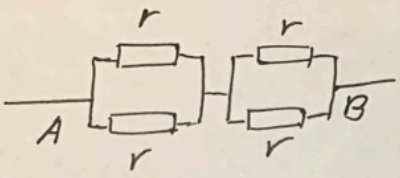
$V = \frac{\upsilon RT}{p} \qquad \upsilon = \frac{m}{M} = \frac{10}{1 \cdot 2 + 16} = \frac{10}{18}$

$V = \frac{\frac{m}{M} \cdot R \cdot T}{p} = \frac{\frac{10}{18} \cdot 8{,}3 \cdot (420 + 273)}{10^5} \approx 0{,}032$ м^3

Ответ: $Q_1 = 3344$ Дж ; $V = 32$ л.

Чистовик

№ 5



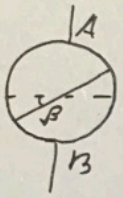
(2)

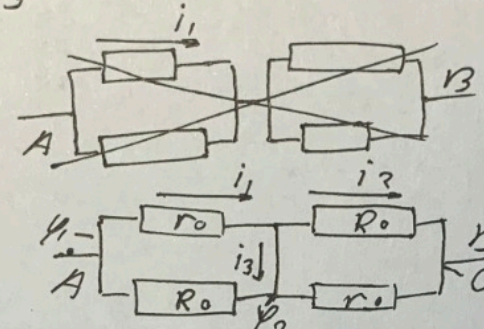
1) $r+r+r+r=72\,Ом$ $\quad r=\frac{72}{4}=18\,Ом$

$R=2\cdot\frac{r\cdot r}{r+r}=2\cdot 9=18\,Ом$

$I=\frac{U}{R}=\frac{24}{18}=\frac{4}{3}\,А$ $\quad P=UI=\frac{24\cdot 4}{3}=32\,Вт$

2)





$r_0+R_0=36\,Ом$

$\varphi_1=24\,В$

$\varphi_2=12\,В$

$R_1=\frac{r_0\cdot R_0}{r_0+R_0}=\frac{r_0R_0}{36}$

$U=IR$

$24=I\cdot 2R_1$

$\varphi_2=I\cdot R_1=12\,В$

$i_1=\frac{U}{R}=\frac{12}{r_0}$ $\quad i_2=\frac{12}{R_0}=\frac{12}{36-r_0}$ $\quad i_1=i_2+i_3;\ i_3=0{,}5\,А$

$i_1-i_2=0{,}5$

$\frac{12}{r_0}-\frac{12}{36-r_0}=0{,}5$

$\frac{432-12r_0-12r_0}{r_0(36-r_0)}=0{,}5$

$432-24r_0=0{,}5r_0(36-r_0)$

$-0{,}5r_0^2+42r_0-432=0$

$D=42^2-2\cdot 432=900$

$r_0=\frac{-42\pm 30}{-1}=42\pm 30$

$r_0=42-30=12\,Ом$

$r_0=42+30=72$

не подходит

$r_0+R_0=36$

$r_0=12\,Ом$ $\quad R_0=36-12=24\,Ом$

$\frac{x}{180}=\frac{24}{36}$ $\quad x=120^\circ$

$\beta=120^\circ-90^\circ=30^\circ$

3) $R_2=2\cdot\frac{r_0\cdot R_0}{r_0+R_0}=\frac{12\cdot 24\cdot 2}{36}=16\,Ом$

$I=\frac{U}{R_2}=\frac{24}{16}=\frac{3}{2}\,А$

$P_2=IU=\frac{24\cdot 3}{2}=36\,Вт$

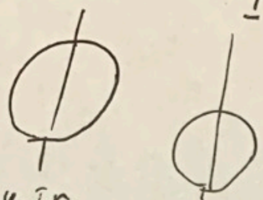
Ответ: $P=32\,Вт$;

$\beta=30^\circ$;

$P_2=36\,Вт$.

черновик

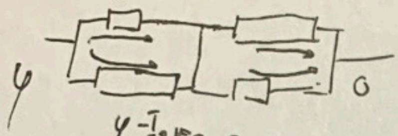
$I = \frac{U}{R \to 0}$



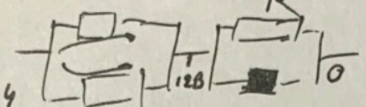
$U_2 = I = \frac{U}{R} = \frac{R}{4,9} = 0,7A$

4,5 Ом

4 − I·r



4 − I_2 8 − r



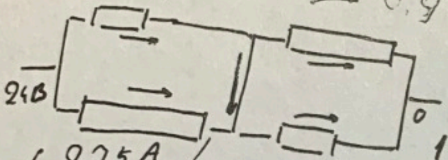
$\frac{8,5}{9,5} = \frac{I_1}{I_2}$

$I_1 + I_2 = 7,7$

$8,5 I_2 = 9,5 I_1$

1,4 A   1,275

24 − ir



1,275 A

24 − i R

$R = \frac{r \cdot R}{r + R}$ $I = \frac{U}{R}$

$I_r = I_2 R$ $I_1 = \frac{8,5}{9,5} I_2$

$\frac{I_r}{I_R} = \frac{r}{R}$

$U = I r$ $\frac{I}{I_2} = \frac{R}{r}$

$U = I_2 R$

$\frac{8,5}{9,5} I_2 + I_2 =$

$\frac{1 \cdot 17}{1 + 17} = \frac{17}{18}$

$\frac{18}{9,5} I_2 = 7,7$

$\frac{i}{I_{r}} = \frac{R}{r}$ $IR = ir$

IR

18 10 8

ir = 12

$i = \frac{12}{r}$

$I = \frac{12}{10} = 1,2$

$I = \frac{12}{R}$ $I_2 = \frac{8}{10} = 0,8$

$I = \frac{ir}{R}$ $I = \frac{U}{R} = \frac{U}{\frac{r \cdot R}{r + R}} = \frac{U(r + R)}{rR}$

$I_2 = \frac{7,7 \cdot 9,5}{18}$

$R = (18 - r)$ $I = \frac{12}{r} - \frac{12}{18 - r} =$

$\frac{12}{r} - \frac{12}{R}$ $\frac{12}{r} - \frac{12}{18 - r} = \frac{216 - 12r - 12r}{18r - r^2}$ 4,1

$\frac{216 - 24r}{r(18 - r)}$

$\frac{12}{R} - \frac{12}{r} = \frac{12}{18 - r} - \frac{12}{r} = \frac{12r - 12 \cdot 18 + 12r}{r(18 - r)} = \frac{24r - 216}{r(18 - r)}$

$216 - 24r = 0,5 \cdot (18r - r^2)$ $\frac{216 - 24r}{r(18 - r)} = 0,5$

r = 9,5 Ом   R = 18 − 9,5 Ом = 8,5 Ом

$216 - 24r = 9r - 0,5r^2$ $216 - 24r = 0,5r(18 - r)$

$-0,5r^2 + 33r - 216 = 0$ $532 - 48r = 18r - r^2$

$\frac{9,5 \cdot 8,5}{18} = 4,49$

$D = 1089 - 432 = 657$ $-r^2 + 66r - 532 = 0$

18 − 7,4 = 10,6   4,5 Ом

$D = 66^2 - 4 \cdot 532$

$\frac{4356}{2128}$ $I = \frac{12}{10,6}$

$r = \frac{-33 \pm \sqrt{657}}{-1} = 33 \pm \sqrt{657} = 33 - 25,6$ 7,4 Ом

2228 $I = \frac{12}{7,4} - \frac{12}{10,6}$

=

$r = \frac{-66 \pm \sqrt{D}}{-2} = \frac{66 \pm \sqrt{D}}{2} = \frac{66 + 47}{2} = 56,5$

0,5

9,5

Условия

1 р 10^5 Па

20°
102

$432 - 12r_0 - 12r_0 = (36r_0 - r_0^2)0{,}2$

$432 - 24r_0 = 18r_0 - 0{,}5r_0^2$

$-0{,}5r_0^2 + 42r_0 - 432 = 0$

$D = 42^2 - 2432 - 900 = 30^2$

$r = \frac{-42-30}{-1} = -72$

$r = \frac{-42+30}{-1} = 12$

$Q = cm\Delta t = 4180 \cdot 0{,}01 \cdot 80$

3 344

30 кДж

$Q = \lambda m = 0{,}01 \cdot 2{,}26 \cdot 10^6$ 22,6

22 600 Дж
+ 3344
25944

7056 Дж

1
102
1002
1,000 м

пар

$Q = cm\Delta t$ $\Delta t = \frac{Q}{cm} = \frac{3050}{2200 \cdot 0{,}1}$ 32

$\frac{12}{r_0} - \frac{12}{36-r_0}$ 132°

$PV = \nu RT$

$V = \frac{\nu RT}{P} = \frac{(132+273) \cdot 8{,}3 \cdot \frac{m}{M}}{10^3}$

$\nu = \frac{m}{M} = \frac{0{,}18}{18} = \frac{5}{9}$

$D = 1764 - 2 \cdot 432 = 900$

$10 \cdot 10 \cdot 10 = 1000$

$r_0 = \frac{24-30}{2}$

$24 + 30 =$

$\frac{12}{54} -$

$\frac{12}{r_0} - \frac{12}{36-r_0} = 0{,}5$

$432 - 12r - 12r = 0{,}5(r_0(36-r_0))$

$432 - 24r_0 = 18r_0 - 0{,}5r_0^2$

$-0{,}5r_0^2 + 42r_0 - 432 = 0$

(7,37)

10,63

$\frac{7{,}37}{18} = \frac{x}{180}$

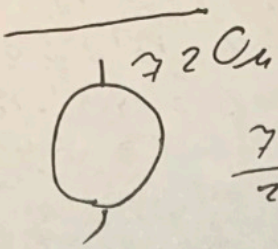
$x = 73{,}7°$

$\frac{10{,}63}{18} = \frac{x}{180}$

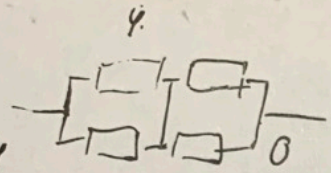
360м

черновик

№5

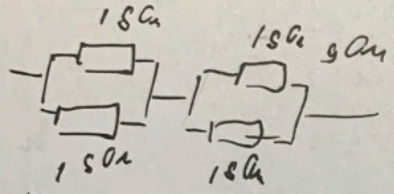


$\frac{72}{2} = 36$ Ом



$\frac{36 \cdot 36}{36+36} = 18$ Ом

$P = UI$

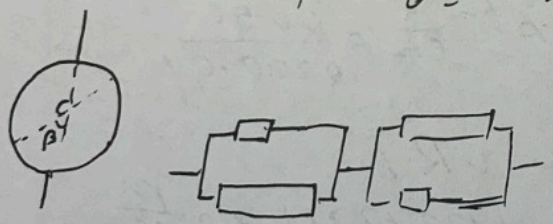


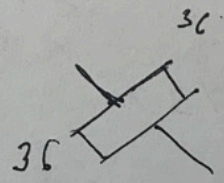
$R = \frac{18 \cdot 18}{18+18} = 9$ Ом

$I = \frac{U}{R} = \frac{24}{18} = \frac{12}{9} = \frac{4}{3}$ А

$R_0 = 18$ Ом

$P = UI = 24 \cdot \frac{4}{3} = 8 \cdot 4 = 32$ Вт





18

$R = 2\frac{r \cdot R}{r+R}$

$R + r = 18$

$r = R\,18 - R$

$R_0 = 2 \cdot \frac{(18-R)R}{(18-R)+R} = \frac{2 \cdot (18R - R^2)}{18} = \frac{18R - R^2}{9}$

$I = \frac{U}{R}$ — $R = \frac{U}{I} = \frac{24}{0,5} = 48$ Ом

$I = \frac{U}{R} = \frac{24}{48} = 0,5$

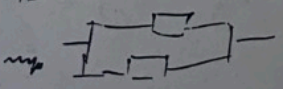
$18R - R^2 = 9 \cdot 48$

$-R^2 + 18R - 9 \cdot 48 = 0$

$-R^2 + 18R - 432 = 0$

$D = 324 - 4 \cdot 432$?

48 В

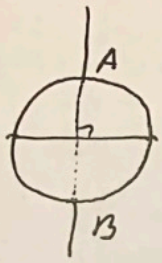


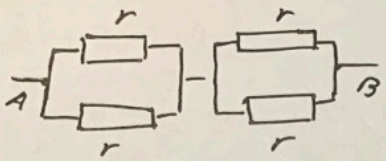
$\frac{R \cdot R}{R+R} = 48$

$R = 96$

~~Шпаргалка~~ Черновик.

№ 5





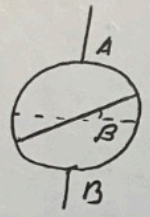
1) $r+r+r+r=72$ Ом $\quad r=\frac{72}{4}=18$ Ом

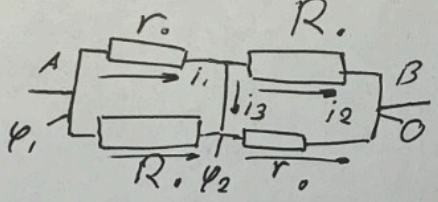
$R=2\cdot\frac{r\cdot r}{2r+r}=2\cdot 9=18$ Ом

$I=\frac{U}{R}=\frac{24}{18}=\frac{4}{3}$ А

$P=UI=\frac{24\cdot 4}{3}=32$ Вт

2)





$r_0+R_0=18$ Ом $\quad R_1=\frac{r_0\cdot R_0}{r_0+R_0}=\frac{r_0 R_0}{18}$

$\varphi_1=24$ В

$\varphi_2=12$ В

$U=IR$

$24=I\cdot 2R_1$

$\varphi_2=I\cdot R_1=12$ В

$i_1=\frac{U}{R}=\frac{12}{r_0}$ $\quad i_2=\frac{12}{R_0}=\frac{12}{18-r_0}$

$i_1=i_2+i_3$ $\quad i_3=0{,}5$ А $\quad i_1-i_2=0{,}5$

$\frac{12}{r_0}-\frac{12}{18-r_0}=0{,}5$

$\frac{216-12r_0-12r_0}{r_0(18-r_0)}=0{,}5$

$216-24r_0=0{,}5r_0(18-r_0)$

$-0{,}5r_0^2+33r_0-216=0$

$D=33^2-2\cdot 216=657$

$r_0=\frac{-33\pm\sqrt{657}}{-1}=33\pm\sqrt{657}$

$r_0=33-\sqrt{657}\approx 7{,}37$ Ом

$r_0=33+\sqrt{657}$ - слишком большое