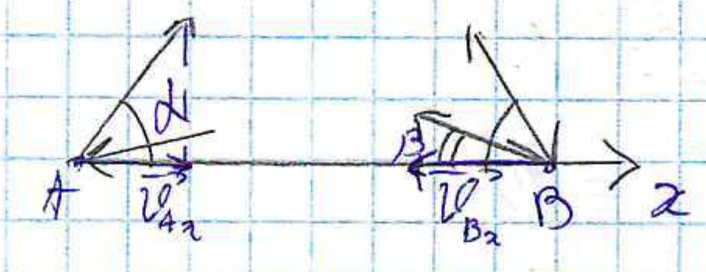
11 - 945

1

Дано: $AB = S$

$\frac{t_{AB}}{t_{BA}} = \sqrt{3}$

$\alpha - ?$



$v_{Ax} = v\cos\alpha$; $v_{Bx} = -v\cos\beta$

$t_{AB} = \frac{S}{v\cos\alpha}$; $t_{BA} = \frac{S}{v\cos\beta}$

$\frac{t_{AB}}{t_{BA}} = \frac{S \cdot v \cdot \cos\beta}{S \cdot v \cdot \cos\alpha} = \frac{\cos\beta}{\cos\alpha} = \sqrt{3}$

$\cos\beta = \sqrt{3}\cos\alpha$. ($\alpha > \beta$), то если $\alpha = 60°$: $\cos\alpha = \frac{1}{2}$,

$\cos\beta = \frac{1}{2} \cdot \sqrt{3}$;

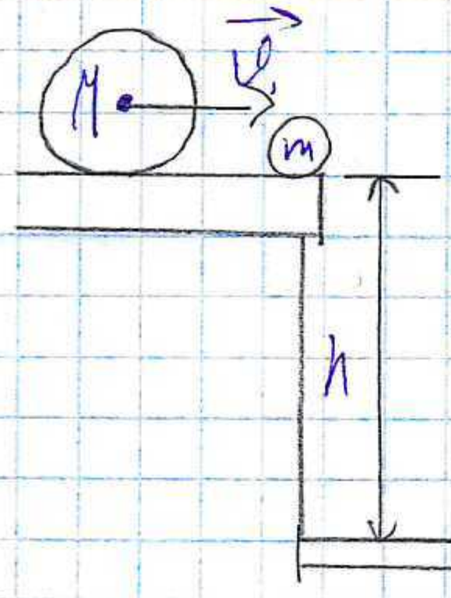
$\beta = \arccos\frac{\sqrt{3}}{2} = 30°$.

Ответ: 60°.

2.

Дано:
$h = 0{,}8$ м
$M \gg m$
$v_1 = 10$ м/с

$S - ?$



$Mv_1 = mv$

$v = v_x = \frac{Mv_1}{m}$;

$h = \frac{gt^2}{2}$; $S = v_x t$;

$t = \sqrt{\frac{2h}{g}}$; $S = v_x\sqrt{\frac{2h}{g}}$

$S = v_x\sqrt{\frac{2 \cdot 0{,}8\text{м}}{10\text{м/с}^2}} = 0{,}4\, v_x = 0{,}4 \cdot \frac{Mv_1}{m} = 4\frac{M}{m}$

Ответ: $4\frac{M}{m}$

3.

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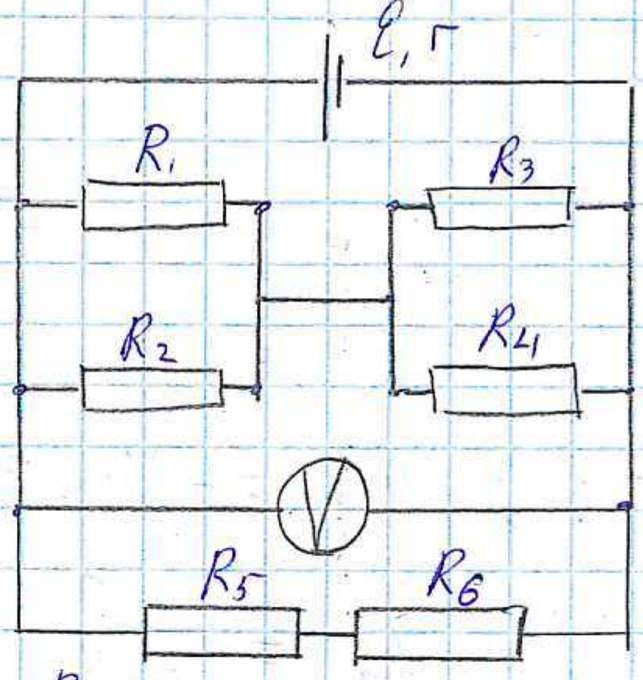
Дано:

$\mathcal{E} = 6 В$

$r = \frac{2}{3} Ом$

$R = 2 Ом$

$U - ?$



$R_{12} = \frac{R}{2}$; $R_{34} = \frac{R}{2}$

$R_{14} = R$; $R_{56} = 2R$

$\frac{1}{R_{16}} = \frac{1}{R_{14}} + \frac{1}{R_{56}} = \frac{R_{56} + R_{14}}{R_{56} R_{14}}$;

$R_{16} = \frac{R_{56} R_{14}}{R_{56} + R_{14}} = \frac{2R \cdot R}{2R + R} = \frac{2R^2}{3R} = \frac{2}{3} R$

$\nu = \frac{\mathcal{E}}{R_{16} + r} = \frac{6 В}{\frac{2}{3} R + r} = \frac{6 В}{\frac{4}{3} Ом + \frac{2}{3} Ом} = 3 А$

$U = \nu R_{16} = 3 А \cdot \frac{2}{3} \cdot 2 Ом \approx 4 В$

Ответ: 4 В.

5

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Дано:

$V_1 = 5л$

$V_2 = 10л$

$V_3 = 15л$

$p_1 = 3{,}17 \cdot 10^5$ Па

$p_3 = 0{,}51 \cdot 10^5$ Па

$\eta - ?$

СИ:	
$0{,}005м^3$	
$0{,}01м^3$	
$0{,}015м^3$	
—	
—	
—	
...%	

12: $p = p_1 = const$;

$\Delta V_{12} = V_2 - V_1 = 0{,}005м^3$

$T_1 = T$; $T_2 = \frac{V_2}{V_1} T = 2T$; $\Delta T_{12} = T$

$\Delta U_{12} = Q_{12} + A'_{12} = \frac{3}{2} \nu R \Delta T_{12}$

$A'_{12} = \Delta V_{12} \cdot p_1 = 3{,}17 \cdot 10^5 Па \cdot 0{,}005м^3 =$

$= 1{,}585 \cdot 10^3$ Дж.

$Q_{12} = \frac{3}{2} \nu R T + A'_{12}$;

23: $V = V_2 = const \Rightarrow A' = 0$; $\Delta U_{23} = Q_{23}$

$T_2 = 2T$; $T_3 = \frac{p_3}{p_1} T_2 = \frac{0{,}51 \cdot 10^5 Па}{3{,}17 \cdot 10^5 Па} \cdot 2T = 0{,}32T$

$\Delta T_{23} = -1{,}68T$; $\Delta U_{23} = \frac{3}{2} \nu R \Delta T_{23} = -\frac{3}{2} \nu R \cdot 1{,}68T = Q_{23}$

34: $p = p_3 = const$

$\Delta V_{34} = V_4 - V_2 = 0{,}005м^3$

$T_3 = 0{,}32T$; $T_4 = \frac{V_4}{V_2} T_3 = \frac{0{,}005м^3}{0{,}01м^3} \cdot 0{,}32T = 0{,}48T$

$\Delta T_{34} = 0{,}16T$; $\Delta U_{34} = Q_{34} - A'_{34} = \frac{3}{2} \nu R \Delta T_{34}$

$A'_{34} = \Delta V_{34} \cdot p_3 = 0{,}005м^3 \cdot 0{,}51 \cdot 10^5 Па = 0{,}255 \cdot 10^3$ Дж.

41: $Q_{41} = 0$ $Q_{34} = \frac{3}{2} \nu R \Delta T_{34} + A'_{34}$;

$\Delta U_{41} = A'_{41}$

$A'_{41} = S = -\int_{V_1}^{V_4} \left(\frac{\nu R T}{V}\right) dV = (\nu R T \ln V)\Big|_{V_1}^{V_4} =$

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$= \ln 0{,}015 \cdot \nu R T - \ln 0{,}005 \cdot \nu R T = \nu R T \ln 3 \approx \nu R T =$

$= \frac{\nu R \cdot 1{,}585 \cdot 10^3}{\nu R} = 1{,}585 \cdot 10^3 \text{ Дж}.$

$p_1 V_1 = \nu R T, \quad T = \frac{p_1 V_1}{\nu R} = \frac{3{,}17 \cdot 10^5 \text{ Па} \cdot 0{,}005 \text{ м}^3}{\nu R} = \frac{1{,}585 \cdot 10^3}{\nu R};$

$\eta = \frac{A}{Q} = \frac{A_{12}' + A_{23}' + A_{34}' + A_{41}'}{Q_{12} + Q_{23} + Q_{34} + Q_{41}} = \frac{A_{12}' + A_{34}' + A_{41}'}{\frac{3}{2}\nu R T + A_{12}' - \frac{3}{2}\nu R 1{,}68 T + \frac{3}{2}\nu R 0{,}16 T + A_{34}'}$

$= \frac{A_{12}' + A_{34}' + A_{41}'}{-0{,}52 \cdot \frac{3}{2}\nu R T + A_{12}' + A_{34}'} = \frac{(1{,}585 \cdot 10^3 + 0{,}255 \cdot 10^3 + 1{,}585 \cdot 10^3) \text{ Дж}}{-0{,}52 \cdot \frac{3}{2}\nu R T + 1{,}59 \cdot 10^3 \text{ Дж} + 0{,}255 \cdot 10^3 \text{ Дж}} =$

$= \frac{0{,}255 \cdot 10^3 \text{ Дж}}{-0{,}52 \cdot \frac{3\nu R \cdot 1{,}585 \cdot 10^3}{2\nu R} + 1{,}84 \cdot 10^3 \text{ Дж}} = \frac{255 \text{ Дж}}{1840 \text{ Дж} - 1236{,}7 \text{ Дж}} = \frac{255 \text{ Дж}}{603{,}7 \text{ Дж}} =$

$= 0{,}42 = 42\%$

Ответ: 42%