Часть 1

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

Шифр: **21206092**

ID профиля: **315288**

Вариант 1

↑v $\quad v - gt = v_к \quad t = \frac{v}{g}$

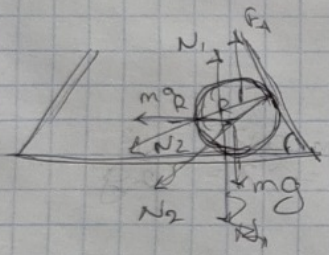
$H = \frac{gt^2}{2} = \frac{v^2}{2g}$

↓gt $\quad v - gt = v_к \quad t = \frac{H}{v}$

↑v-gt

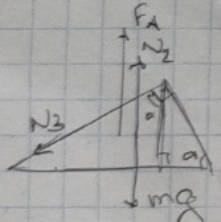
$vt - \frac{gt^2}{2} = H \qquad H - \frac{gt^2}{2} = h = H -$

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



$N_1 = mg - F_A = 3\rho Vg - \rho Vg = 2\rho Vg =$

$= \frac{8}{3}\rho\pi R^3 g$



$N_3 \cdot \cos\alpha + mg = N_2 + F_A$

$N_3 \cdot \sin\alpha = ma$

$ctg\alpha = \frac{N_2 + F_A - mg}{ma}$

$N_2 = ma \cdot ctg\alpha + mg - F_A$

$N_2 = 3\rho V \cdot \omega^2 R \cdot ctg\alpha + 3\rho Vg - \rho Vg =$

$= \rho Vg(3\omega R \cdot ctg\alpha + 2) =$

$= \frac{4}{3}\pi R^3 g(3\omega R \cdot \frac{1}{2} + 2) =$

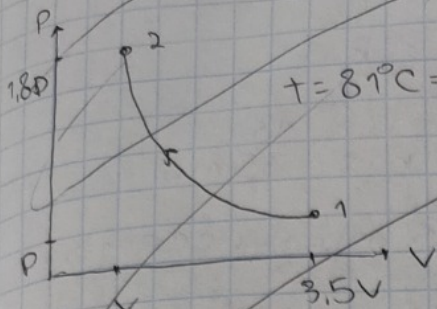
$= \frac{4}{2}\pi R^4 \omega g + \frac{8}{3}\pi R^3 g$

$2\pi R^4 \omega^2 g \quad \rho V(3\omega^2 R \cdot ctg\alpha + 2g)$

$2\rho\pi R^4 \omega^2 + \frac{8}{3}\pi R^3 g\rho$

$\frac{кг \cdot м}{с^2} \quad \frac{м^4 кг}{с^2 м^3} \quad \frac{м^3 \cdot кг \cdot м}{м^3 \cdot с^2}$

3 Задача



$T = 81°C = const$

(1) $3,5pV = \frac{m_1}{M} RT$

(2) $1,8pV = \frac{m_2}{M} RT$

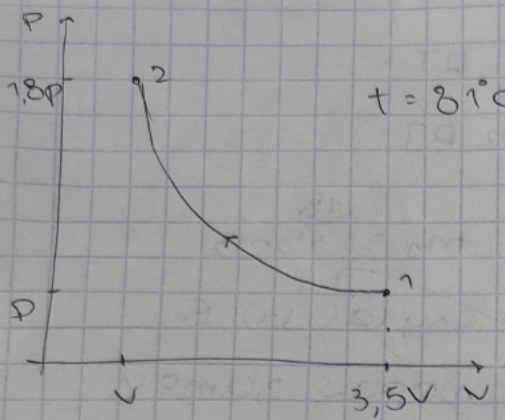
$\frac{(1)}{(2)}$ $\frac{3,5}{1,8} = \frac{m_2}{m_1}$ $m_1 = \frac{18}{35} m_2$

1) $m_1 < m_2$ => В случае (1) в сосуде также была вода, которая затем перешла в пар в процессе 1→2 => случай (1) - насыщенный пар => $p_{нач} = 0,5 \cdot 10^5$ Па

2) Из (2)

$$V = \frac{MRT}{1,8mp} = \frac{28 \cdot 10^{-3} \frac{кг}{моль} \cdot 8,31 \frac{Дж}{моль \cdot К} \cdot 354 К}{1,8 \cdot 3 г \cdot Па \cdot 10^5}$$

3 Задача Чистовик



$t = 81°C$

(1) $3{,}5pV = \frac{m_1}{\mu} \cdot R \cdot T$

(2) $1{,}8pV = \frac{m_2}{\mu} \cdot R \cdot T$

(1) $\frac{35}{18} = \frac{m_1}{m_2}$ $m_2 = \frac{18}{35} m_1$

1) $m_1 > m_2 \Rightarrow$ в процессе 1→2 часть водяного пара сконденсировалась $\Rightarrow$ случай 2 - насыщенный пар

$1{,}8p = p_0$ $p = \frac{p_0}{1{,}8} = 0{,}28 \cdot 10^5$ Па

2) из (2)

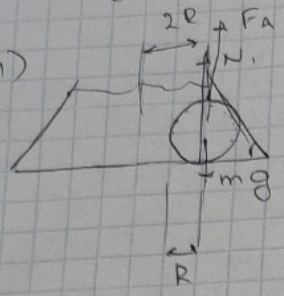
$$V = \frac{\frac{18}{35} m_1 \cdot R \cdot T}{\mu \cdot 1{,}8p} = \frac{\frac{18 \cdot 3}{35} \cdot 8{,}31 \cdot \frac{Дж}{моль \cdot К} \cdot 354К}{18 \frac{г}{моль} \cdot 0{,}5 \cdot 10^5 Па} = 504 \cdot 10^{-5} м^3$$

$V = 5{,}04 \cdot 10^{-3} м^3$

Ответ: 1) $0{,}28 \cdot 10^5$ Па 2) $5{,}04 \cdot 10^{-3} м^3$

Чистовик

2 задача

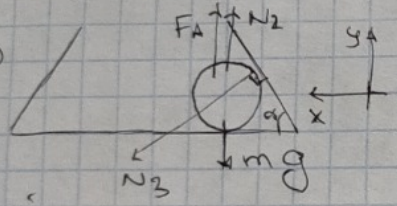
1) 

Шар покоится, значит действие сил скомпенсировано. F_A, N_1, mg действуют по вертикальной оси, значит если есть взаимодействие с боковой стенкой должна быть сила, которая ее скомпенсирует, но такой силы нет => нет взаимодействия с боковой стенкой

2й закон Ньютона на вертикальную ось:

$F_A + N_1 - mg = 0$

$N_1 = mg - F_A = 3\rho Vg - \rho Vg = 2\rho Vg = \frac{8}{3}\pi R^3 \rho g$

2) 

2й закон Ньютона на Oy:

$N_2 + F_A - mg - N_3 \cdot \cos\alpha = 0$

(1) ~~$N_3 \cdot \sin\alpha$~~ $N_2 = N_3 \cos\alpha + mg - F_A$

2й закон Ньютона на Ox:

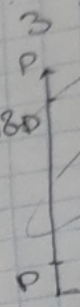
(2) $N_3 \cdot \sin\alpha = ma = m\omega^2 \cdot 2R$

Подставив (2) в (1) получаем

$N_2 = m\omega^2 \cdot 2R \cdot \operatorname{ctg}\alpha + mg - F_A = 4\pi R^3 \rho \omega^2 2R \cdot \frac{1}{2} + \frac{8}{3}\pi R^3 \rho g =$

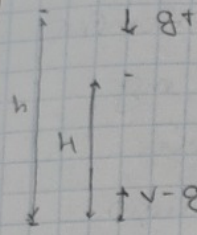
$= 4\pi R^4 \omega^2 \rho + \frac{8}{3}\pi R^3 \rho g$

Ответ: 1) $\frac{8}{3}\pi R^3 \rho g$ 2) $4\pi R^4 \omega^2 \rho + \frac{8}{3}\pi R^3 \rho g$



Чистовик 1/3

1 задача



$v_{сбл}(t) = gt + v - gt = v$

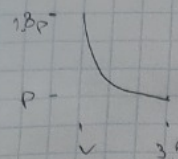
$t = \frac{2h}{v_{сбл}} = \frac{h}{v} = \frac{\frac{v^2}{2g}}{v} = \frac{v}{2g}$

$H = vt - \frac{gt^2}{2} = \frac{v^2}{2g} - \frac{v^2}{8g} = \frac{3}{8}\frac{v^2}{g}$

$v = \sqrt{\frac{8}{3}gH} \quad t = \frac{v}{2g} = \sqrt{\frac{2}{3}\frac{H}{g}}$

$S = 2h - H = 2 \cdot \frac{v^2}{2g} - H = \frac{8}{3}\frac{gH}{g} - H = \frac{8}{3}H - H = \frac{5}{3}H$

Ответ: 1) $\sqrt{\frac{2}{3}\frac{H}{g}}$ 2) $\sqrt{\frac{8}{3}gH}$ 3) $\frac{5}{3}H$



$3{,}5pV = \frac{M}{m_1}RT$

$1{,}8pV = \frac{M}{m_2}RT$

$\frac{m_2}{m_1} = \frac{35}{18}$ $\quad m_1 = \frac{18}{35}m_2$

$p = 0{,}5$

$8 \cdot 10^5 V = \frac{18}{8} \cdot 8{,}31 \cdot 8T$

$V = 448{,}74 \cdot 10^{-3}\ м^3$

$V = 4{,}489 \cdot 10^{-3}\ м^3$

$8 \cdot 10^5 V = \frac{18}{8} \cdot 8{,}31 \cdot 354$

$V =$

$\frac{m_1}{M}$

$\frac{35}{18} = \frac{m_1}{m_2}$ $\quad m_2 = \frac{18}{35}m_1$

(2) - Н.Л.

$3{,}5 \cdot 0{,}28 \cdot 10^{-5} V = \frac{3}{18} \cdot 8{,}31 \cdot$

$3{,}5 \cdot$ $\frac{354}{59}$

$1{,}8pV = \frac{\frac{18}{35}m_1}{M} \cdot RT$

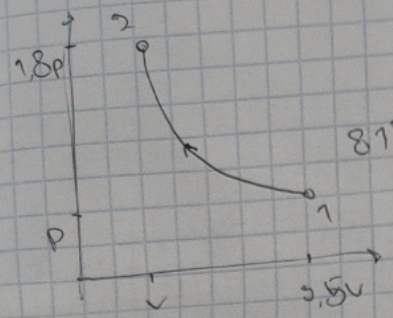
$0{,}5 \cdot 10^{-5} \cdot V = \frac{m_1}{35} \cdot 8{,}31 \cdot 354$

$p = \frac{0{,}5}{1{,}8} \cdot 10^5\ Па = 0{,}28\ Па$

$0{,}5 \cdot 10^5\ Па\ V = \frac{\frac{18}{35}m_1}{18} \cdot 8{,}31 \cdot 354$

$V = \frac{2 \cdot 8{,}31 \cdot 354}{35} \cdot 10^{-5}$

$1{,}68 \cdot 10^{-3}\ м^3$



$A = -\Delta U$

$3,5pV = 1,8pV$

$\frac{3,5}{1,8}pV = \frac{M}{m}RT$

$1,8pV = \frac{M}{m - m_{кон}}RT$

$\frac{m - m_{конд}}{m} = \frac{35}{18}$

$18m - 18m_{конд} = 35m$

$17m = 18m_{конд}$

$m_{конд} = \frac{17}{18}m$

$3,5pV = \frac{M}{\frac{1}{18}m}RT$

$1,8pV = \frac{M}{m}RT$

$V = \frac{3,5\nu RT}{1,8mp}$

$V = \frac{\nu RT}{m\,3,5p}$

$p_x = \frac{\nu RT}{\frac{18}{35}\cdot 1,8V}$

$\frac{0,5\cdot 10^5}{1,8} = 0,28\cdot 10^5$ Па

$V = \frac{\nu RT\,1,8}{3,5\,pm} = \frac{81\cdot 18\cdot 8,31\cdot 1,8}{3,5\cdot 0,28\cdot 10^5\cdot 3}$

$\frac{0,28}{0,35}V_1 = \frac{18}{\frac{18}{35}\cdot 3}\quad 8,31\cdot 81 = \frac{35\cdot 27\cdot 8,31\cdot 5}{10^5\cdot 4}$

$= V = 0,098\ м^3$

$\sqrt{\frac{м^2}{с^2}} = \frac{м}{с}\qquad \sqrt{\frac{м}{м\,с^2}} = \sqrt{с^2} = с$

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

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

$h = \frac{v^2}{2g}$

$vt - h = 0 \quad t = \frac{h}{v} = \frac{v}{2g}$

$H = vt - \frac{v^2}{2g}$

$v = \sqrt{2gH}$

$\frac{mv_H^2}{2} = mgh$

$v_H = \sqrt{2gh}$

$\frac{v^2}{g} - H = \frac{2gH}{g} - H = H$

$v - gt = 0 \quad t = \frac{v}{g}$

$h_{max} = \frac{gt^2}{2} = \frac{v^2}{2g}$

$2h_{max} - H = \frac{2gH}{2g} - H$

$h_{max} = \frac{v^2}{2g}$

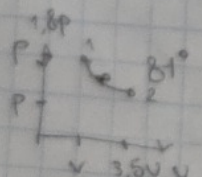
$\frac{mv^2}{2} = mgH \quad h = H = \frac{v^2}{2g}$

$v_{con}(t) = gt + v - gt = v = const$

$t = \frac{h_{max}}{v} = \frac{\frac{v^2}{2g}}{v} = \frac{v}{2g}$

$H = vt - \frac{gt^2}{2} = \frac{v^2}{2g} - \frac{v^2}{8g} = \frac{3v^2}{8g}$

$\frac{gv^2}{2 \cdot 4g}$



$v = \sqrt{\frac{8}{3}gH}$

$h_{max} = \frac{gt^2}{2}$

$t = \frac{\sqrt{\frac{8}{3}gH}}{2g} = \sqrt{\frac{8}{3}\frac{H}{g}}$

$2h_{max} - H = \frac{2 \cdot \frac{8}{3}gH}{2g} - H =$

$= \frac{8}{3}H - H = \frac{5}{3}H$

Часть 2

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

Шифр: **21206092**

ID профиля: **315288**

Вариант 1

5 Задача

Чистовик

1/2

1) $pV = \nu RT_1$

$1{,}02 \cdot 0{,}99\, pV = \nu RT_2$ $\Rightarrow \frac{T_2}{T_1} = 1{,}02 \cdot 0{,}99$

$T_2 = 1{,}0098 T_1$ – увеличилась на 0,98%

2) $Q = A + \Delta U$

$Q = A + \frac{3}{2} \nu R \Delta T$

$Q = A$ (т.к. $\Delta T \ll 1$ из 1))

$\frac{Q}{A} = 1$

Ответ: 1) увеличилась на 0,98%

2) 1

5 Задача Чистовик 1/2

1) $pV = \nu RT_1$ $\Rightarrow \frac{T_2}{T_1} = 1{,}02 \cdot 0{,}99$

$1{,}02 \cdot 0{,}99 pV = \nu R T_2$

$T_2 = 1{,}0098 T_1$ – увеличилась на 0,98%

2) $Q = A + \Delta U$

$Q = A + \frac{3}{2} \nu R \Delta T$

$Q = A$ (т.к. $\Delta T \ll 1$ из 1))

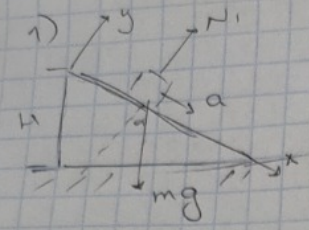
$\frac{Q}{A} = 1$

Ответ: 1) увеличилась на 0,98%

2) 1

Чистовик

4 задача

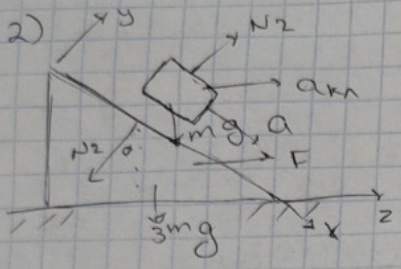
1) 

2й закон Ньютона

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

$a = g\sin\alpha = g\sqrt{1-\cos^2\alpha} = \frac{3}{5}g$

$\frac{at^2}{2} = H/\sin\alpha \Rightarrow t = \sqrt{\frac{2H}{a\sin\alpha}} = \frac{5}{3}\sqrt{\frac{2H}{g}}$

2) 

2й закон Ньютона

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

Oy (майда) $N_2 - mg\cdot\cos\alpha = m a_{кл}\cdot\sin\alpha$

Oz (клин) $-N_2\cdot\sin\alpha + F = 3m a_{кл}$

$N_2 = m a_{кл}\cdot\sin\alpha + mg\cdot\cos\alpha$

$F - N_2\cdot\sin\alpha = F - m a_{кл}\sin^2\alpha + mg\sin\alpha\cdot\cos\alpha = 3m a_{кл}$

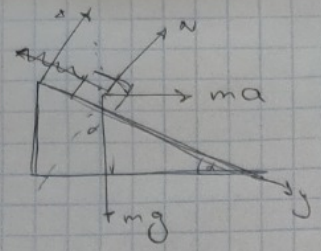
$2g + g\cdot\sin\alpha\cdot\cos\alpha = 3a_{кл} - a_{кл}\sin^2\alpha$

$a_{кл} = g\frac{2-\sin\alpha\cdot\cos\alpha}{3-\sin^2\alpha} = \frac{13}{66}g$

3) $a_x = a_{кл}\cdot\cos\alpha + a = \frac{13}{66}\cdot\frac{4}{5}g + \frac{3}{5}g = \frac{50}{66}g$

$\frac{a_x t^2}{2} = \frac{H}{\sin\alpha} \quad t = \sqrt{\frac{2H}{a_x\cdot\sin\alpha}} = \sqrt{\frac{44H}{10g}} = \sqrt{\frac{22H}{5g}}$

Ответ: 1) $\frac{5}{3}\sqrt{\frac{2H}{g}}$ 2) ~~$\sqrt{\frac{22H}{5g}}$~~ $\frac{13}{66}g$ 3) $\sqrt{\frac{22H}{5g}}$



$mg \cdot \cos\alpha = N$

$mg \cdot \sin\alpha = ma$

$mg \cdot$

$a = g \cdot \sin\alpha = \frac{3}{5}g$

$\frac{at^2}{2} = l = \frac{H}{\sin\alpha}$

~~$mg \cdot \sin$~~

$g \cdot \sin^2\alpha$

~~$\frac{2H}{g \cdot \sin^2\alpha} = \frac{9}{5}\sqrt{\frac{2H}{g}}$~~

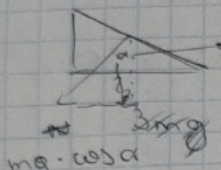
$N \cdot \cos\alpha = mg$

$N \cdot \sin\alpha = ma$

$mg \cdot \sin\alpha \, t^2 = 2H/\sin\alpha$

$t = \frac{5}{3}\sqrt{\frac{2H}{g}}$

$ma = mg \cdot tg\alpha = \frac{3}{4}g$

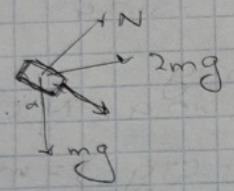


$2mg + mg \cdot \cos\alpha \cdot \sin\alpha = ma$

$g(2 + \frac{12}{25}) = \frac{62}{25}g$

$\frac{50}{12}$ $\frac{38}{38}$

$\frac{50}{66} \cdot \frac{5}{38}$ $\frac{10}{22}$

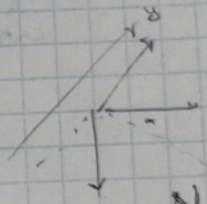


$-mg \cdot \cos\alpha \cdot \sin\alpha + 2mg = 3ma$

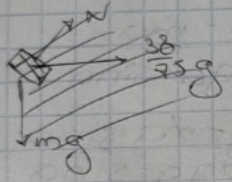
$(2 - \frac{12}{25})g = 3a$

$\frac{38}{75}g = a$

$\cdot 10$
75
9
66

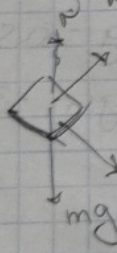


×66



$2 - \frac{12}{25} = \frac{13}{25}$ → $3 - \frac{9}{25} = \frac{13}{66}$ (a)

$N = mg \cdot \sin\alpha$



$pV = \nu RT_1$

$1{,}02 \cdot 0{,}99 = \nu RT_2$

$1{,}02 \cdot 0{,}99 \, pV =$

198 $T_2 = 1{,}0098 \, T_1$

↑ na 0,98%

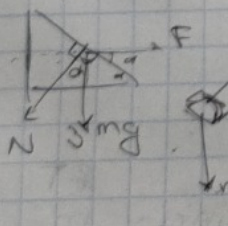
$N - mg\cos\alpha = ma \cdot \sin\alpha$

$N = mg \cdot \cos\alpha$

$-ma\sin\alpha$

250

$\frac{10}{22}$

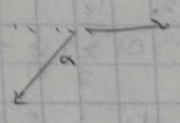


$Q = \Delta U + A = \frac{3}{2}\nu R\Delta T +$ $+\frac{45}{38}$ $\frac{50}{9}$

$-U = A$

$\vec{N} + m\vec{g} = m\vec{a}$

$N = mg \cdot \cos\alpha$



$3m\vec{g} + \vec{N} + \vec{F} = m\vec{a}_2$

$F = 2mg$

$2mg - mg \cdot \sin\alpha\cos\alpha + ma\sin^2\alpha = ma$

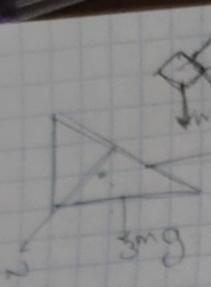
$F - N \cdot \sin\alpha = 3ma$

$tg\alpha$

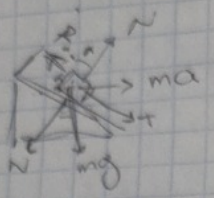
$2g - g\sin\alpha \cdot \cos\alpha = 3a$

$ma \cdot \cos^2\alpha = gf$

$a = g \frac{38}{75} \frac{5}{12}g$



$F - N\cdot\sin\alpha = 3ma$



$$\begin{cases} N\cdot\sin\alpha - T\cdot\cos\alpha = ma \\ T\cdot\sin\alpha + N\cdot\cos\alpha = mg \\ F - N\cdot\sin\alpha = 3ma \end{cases}$$

$$F - T\cdot\cos\alpha - ma = 3ma$$

$mg\cdot\cos\alpha$

$\vec{a_1} + \vec{a_2} = \vec{a_3}$

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

$N_1 + N_2$

$\vec{a_4} + \vec{a_5} = \vec{a_6}$

$$N\sin\alpha - \frac{mg}{\sin\alpha} - N\cdot ctg\alpha = 3ma$$

$$N(\sin\alpha - ctg\alpha) = ma - \frac{mg}{\sin\alpha}$$

$$N = \frac{\frac{mg}{\sin\alpha} - ma}{ctg\alpha - \sin\alpha}$$

$$2mg - \frac{mg - ma\cdot\sin\alpha}{ctg\alpha - \sin\alpha} = 3ma$$

$\frac{8}{3} - \frac{6}{5} \cdot 1$

$\frac{40}{15} - \frac{32}{15} = \frac{8}{15}\ 4\ 3$

$$2g(ctg\alpha - \sin\alpha) - g - a\sin\alpha = 3a\cdot ctg\alpha - 3a\sin\alpha$$

$\frac{72}{3}\ 4 - \frac{6}{5}$

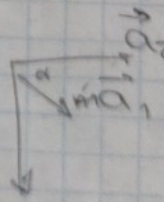
$$g\frac{(2ctg\alpha - 2\sin\alpha - 1)}{3ctg\alpha - 2\sin\alpha}$$

$\frac{24}{3}\ 7$

$\frac{4}{21}\ 8$

$\frac{9}{210}$

$\frac{4}{3}$



$$a\sin\alpha - g\sin\alpha - a\frac{\sin^2\alpha}{\cos^2\alpha} \quad \frac{ma\sin\alpha + F}{m} = a\cdot\sin\alpha + \frac{T}{m}$$

$\frac{3}{5}a\ \frac{4}{21}g - \frac{3}{5}g - \frac{9}{20}a$

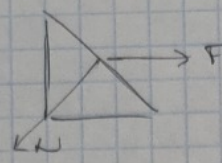
$\frac{4}{35} - \frac{21}{35}$

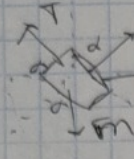
$$N = \frac{ma + T\cdot\cos\alpha}{\sin\alpha}$$

$$T\sin\alpha + ma\cdot tg\alpha + T\frac{\cos^2}{\sin} = mg$$

$$T\left(\sin + \frac{\cos^2}{\sin}\right) = mg - ma\cdot tg\alpha$$

$$T = mg\sin\alpha - ma\cdot\frac{\sin^2\alpha}{\cos\alpha}$$





$$\begin{cases} N\cdot\sin\alpha - T\cdot\cos\alpha = ma \\ T\cdot\sin\alpha + mg\cdot\cos\alpha = mg \\ F - N\cdot\sin\alpha = 3ma \end{cases}$$

$N = ma - T\cdot\cos\alpha$

$T\cdot\sin\alpha - ma\cos\alpha - T\cdot\cos^2\alpha = mg$

$T = \dfrac{mg + ma\cdot\cos\alpha}{\sin\alpha - \cos^2\alpha}$

$F - ma\cdot\sin\alpha - T\cdot\sin\alpha\cdot\cos\alpha = 3ma$

$ma(3+\sin\alpha) = F + 2mg - T\cdot\sin\alpha\cdot\cos\alpha$

$a = 2g - \dfrac{g\cdot\sin\alpha\cos\alpha - g\cdot\cos^2\alpha\sin\alpha}{\sin\alpha - \cos^2\alpha}$

$3 + \sin\alpha$

$a = g\,\dfrac{I}{mg}$

$F - ma - \dfrac{mg\sin\alpha\cos\alpha + ma\cdot\sin\alpha\cdot\cos^2\alpha}{\sin\alpha - \cos^2\alpha} = 3ma$

$2mg(\sin\alpha\cdot\cos\alpha) - ma\sin^2\alpha + ma\sin\alpha\cos^2\alpha$

$- mg\sin\alpha\cdot\cos\alpha + ma\cdot\sin\alpha\cdot\cos^2\alpha = 3ma\sin\alpha -$

$3ma\cdot\cos^2\alpha$

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

$= a(3\sin\alpha - 3\cos^2\alpha + a\sin^2\alpha + a\cdot\sin\alpha\cdot\cos\alpha +$

$a\sin\alpha\cdot\cos^2\alpha$