Часть 1

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

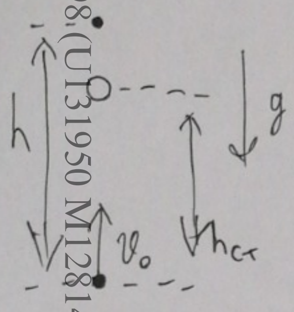
Шифр: **21204798**

ID профиля: **131950**

Вариант 2

Чистовик

№1



Перейдём в СО, падающую с ускорением g, тогда один из камней будет стоять, а другой двигаться к нему с v_0.

$$\boxed{t = \frac{h}{v_0} = \frac{v_0}{2g}}$$

• ЗСЭ для 1 камня:

$$\frac{mv_0^2}{2} = mgh$$

$$h = \frac{v_0^2}{2g}$$

Т.к камень в верхней точке траектории:

$$t_{взл} = \frac{v_0}{g}$$

$$t_1 = t_{взл} + t = \frac{3}{2}\frac{v_0}{g}$$

$$t_2 = t = \frac{1}{2}\frac{v_0}{g}$$

$$\Downarrow$$

$$\boxed{\frac{t_1}{t_2} = 3}$$

$$h_{ст} = v_0 \cdot t - \frac{gt^2}{2} =$$

$$= \frac{v_0^2}{2g} - \frac{v_0^2 \cdot \cancel{g}}{4g^{\cancel{2}} \cdot 2} = \frac{v_0^2}{g}\left(\frac{1}{2} - \frac{1}{8}\right)$$

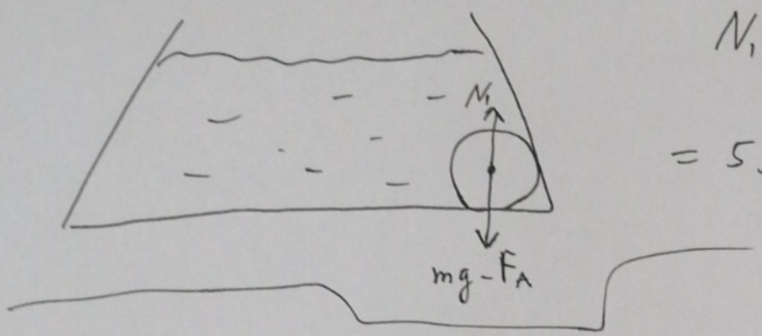
$$\boxed{h_{ст} = \frac{3}{8} \cdot \frac{v_0^2}{g}}$$

Ответы: 1) $\frac{v_0}{2g}$; 2) 3; 3) $\frac{3}{8} \cdot \frac{v_0^2}{g}$

Чистовик

лист 3

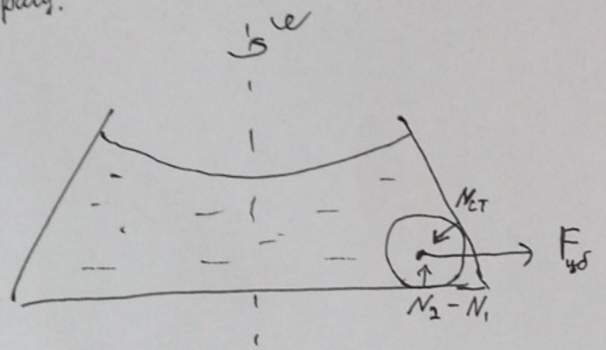
№ 2



$$N_1 = mg - F_A = 6\rho V g - \rho V g =$$

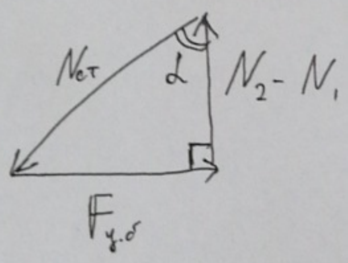
$$= 5\rho V g = \frac{4}{3}\pi R^3 \cdot 5\rho g = \boxed{\frac{20}{3}\pi R^3 \cdot \rho \cdot g}$$

Во вращ. СО:



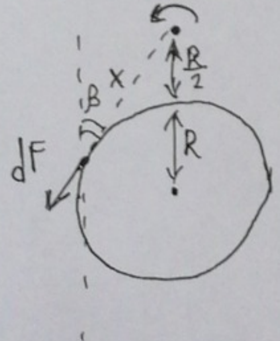
$$\operatorname{tg}\alpha = \frac{F_{ц.б}}{N_2 - N_1} = \frac{3}{2}$$

$$N_2 = N_1 + \frac{2}{3} F_{ц.б}$$



В $F_{ц.б}$ содержатся центробежная сила на шар и проекция силы архимеда на горизонтальную ось

Вид сверху:



$$dF = \omega^2 \cdot x \cdot dm$$

$$dF_{ц.б} = \omega^2 \cdot x \cdot dm \cdot \cos\beta$$

Это сложный интеграл

Но шар - очень хорошая фигура, поэтому

$$F_{ц.б} = 5\rho V \cdot 1{,}5\,\omega^2 R$$

$$N_2 = \frac{20}{3}\pi R^3 \rho \left(g + \omega^2 R\right)$$

Ответ: 1) $\frac{20}{3}\pi R^3 \rho g$; 2) $\frac{20}{3}\pi R^3 \cdot \rho \left(g + \omega^2 R\right)$

Чистовик

лист 2

№ 3

$T = const = 81^\circ C$

$p_0 V_0 = \nu R T$

$\frac{V_0}{7} = 1,7$ л

$3,6\, p_0 \cdot \frac{V_0}{7} = \nu' R T$

$V_0 = 11,9$ л $= 0,0119$ м^3

Как мы видим, $\nu \neq \nu'$, значит часть пара сконденсировалась, значит $3,6\, p_0 = p_{насыщ}$

$$\boxed{p_0 = \frac{0,5 \cdot 10^5}{3,6} \text{ Па}}$$

$\nu = \frac{m}{\mu}$

$p_0 V_0 = \frac{m}{\mu} \cdot R T$

$m = \frac{p_0 V_0 \cdot \mu}{R T} = \boxed{1,01 \text{ г}}$

Ответы: 1) 13888 Па ; 2) 1,01 г

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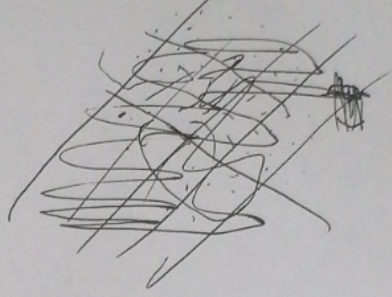
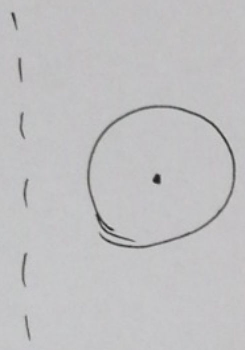
$$N_2 \cdot \cos\alpha = N_1 - \cancel{}\ 5\rho V g$$

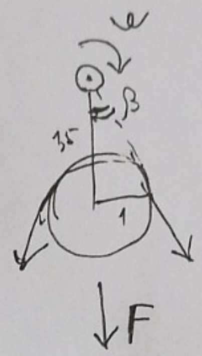


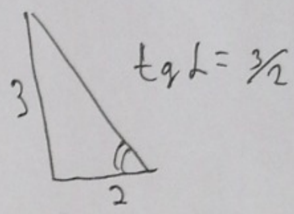
$$\frac{F}{N_1 - 5\rho V g} = tg\,\alpha = \frac{3}{2}$$

$$F = 1{,}5\left(N_1 - 5\rho V g\right)$$

$$N_1 = \frac{2}{3}F + 5\rho V g$$





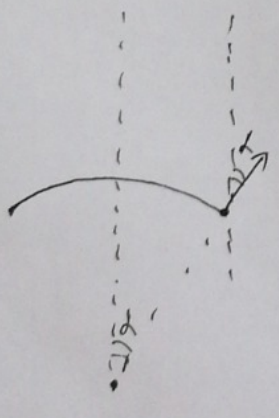


$$tg\,\beta = \frac{2}{3}$$

$$a = \omega^2 \cdot x$$

$$\cancel{dF = dm \cdot \omega^2 \cdot x \cdot \cos\beta}$$

$$dF = dm \cdot a \qquad dm = d\alpha \cdot \sigma$$



$$dF \cdot \cos\alpha = dF_x$$

$$F_x = \int_{-\alpha}^{\alpha} \cos\alpha \cdot ma = \left(\sin\alpha - (-\sin\alpha)\right) ma =$$

$$= 2\sin\alpha \cdot ma$$

$$dF_x = \cos\alpha \cdot d\alpha \cdot a \cdot \sigma \qquad \sigma = \frac{m}{2\alpha}$$

$$F_x = 2\sin\alpha \cdot a \cdot \sigma$$

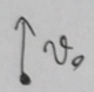
$$\omega^2 \cdot 1{,}5R \cdot 5\rho V = F_y \cdot \delta$$

$$\omega^2 \cdot R \cdot 5\rho V + 5\rho V g = 5\rho V (g + \omega^2 R)$$

$$\frac{20}{3} \pi R^3 \cdot \rho (g + \omega^2 R)$$

$$mgh = \frac{m v_0^2}{2} \qquad t = \frac{h}{v_0} = \frac{v_0}{2g}$$

$$v_0 = \sqrt{2gh} \qquad t_1 = t_{взл} + t = \frac{3}{2}\frac{v_0}{g}$$

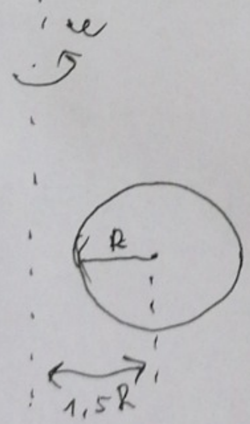


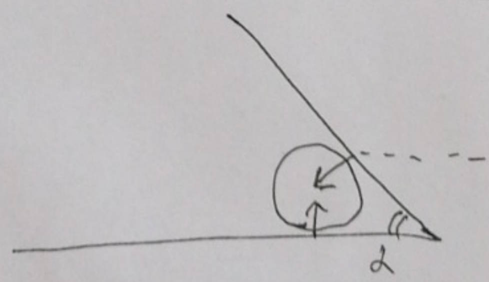
$$h = \frac{v_0^2}{2g} \qquad t_2 = t = \frac{1}{2}\frac{v_0}{g}$$

$$t_{взл} = \frac{v_0}{g} \qquad \frac{t_1}{t_2} = \frac{t_{взл}}{t} + 1 = 3$$

$$h = v_0 \cdot t - \frac{g t^2}{2} = \frac{v_0^2}{2g} - \frac{v_0^2 \cdot \cancel{g}}{4g^{\cancel{2}} \cdot 2} = \frac{v_0^2}{g}\left(\frac{1}{2} - \frac{1}{8}\right) =$$

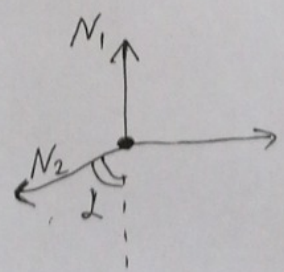
$$= \frac{3}{8} \cdot \frac{v_0^2}{g}$$





$mV = 6\rho$

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



$$N_2 \cdot \cos\alpha = N_1$$

$$N_2 \cdot \sin\alpha = F$$

$$= \cancel{V(\rho_s - \rho) g}$$

$$= \cancel{\frac{20}{3}\pi R^3 g}$$

$$\frac{F}{N_1} = \cancel{A}\ tg\,\alpha = \frac{3}{2}$$

$$F = 1{,}5\, N_1 \qquad \boxed{N_1 = \frac{2}{3}F}$$

$p_0 V_0 = \nu R T$

$V_0 = 11{,}9$ л

$\cancel{p_0 /7}$

$3{,}6\, p_0 = 3{,}5 \cdot 10^5$ Па

$$\boxed{p_0 = \frac{3{,}5 \cdot 10^5}{3{,}6}}$$

$$\frac{\cancel{V_0}}{7} \cdot 3{,}6\, \cancel{p_0} = \nu' R T$$

1 м$^3 = 1000$ л

$V_0 = 0{,}0119$ м^3

$$\frac{3{,}5 \cdot 10^5}{3{,}6} \cdot 0{,}0119 = \nu \cdot 8{,}31 \cdot 354$$

$+\begin{array}{r} 273 \\ 81 \\ \hline 354 \end{array}$

$$\nu = \frac{3{,}5 \cdot 10^5 \cdot 0{,}0119}{3{,}6 \cdot 8{,}31 \cdot 354}$$

$\nu = \frac{m}{\mu}$

$m = \nu \cdot \mu$

$m = \nu \cdot \mu = 1{,}01$ г

Часть 2

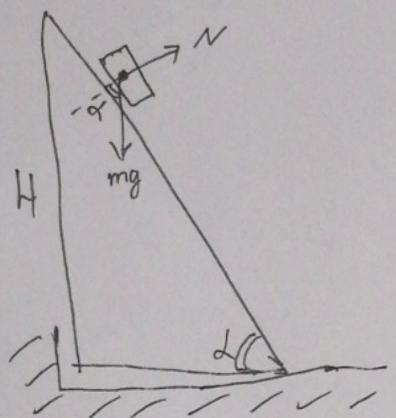
Олимпиада: **Физика, 10 класс (2 часть)**

Шифр: **21204798**

ID профиля: **131950**

Вариант 2

№4



$$ma_{бр} = mg \cdot \sin\alpha$$

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

$$L = \frac{a_{бр} \cdot t_1^2}{2}$$

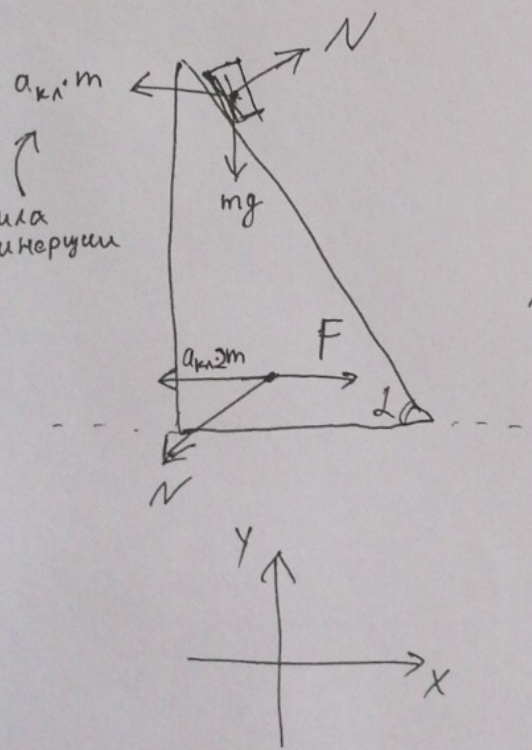
$$\frac{H}{\sin\alpha} = \frac{g \cdot \sin\alpha \cdot t_1^2}{2}$$

$$\cos\alpha = \frac{3}{5}$$

$$\sin\alpha = \frac{4}{5}$$

$$t_1 = \sqrt{\frac{2H}{g \cdot \sin^2\alpha}} = \boxed{\sqrt{\frac{25H}{8g}}}$$

Перейдём в СО клина:



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

$$N = m\left(g \cdot \frac{3}{5} + a_{кл} \cdot \frac{4}{5}\right)$$

в проекции на ось X

$$N \cdot \sin\alpha + 2m\, a_{кл} = F = mg$$

$$2a_{кл} + g \cdot \frac{12}{25} + a_{кл} \cdot \frac{16}{25} = g$$

$$a_{кл} \cdot \frac{50+16}{25} = g\,\frac{25-12}{25}$$

$$a_{кл} \cdot 66 = 13g$$

$$\boxed{a_{кл} = \frac{13}{66} g}$$

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Чистовик   страница 2

$$m \cdot a_y = mg - N \cdot \cos\alpha = mg - m\left(g \cdot \frac{9}{25} + a_{кл} \cdot \frac{12}{25}\right)$$

$$a_y = g - \frac{9}{25}g - \frac{13}{66} \cdot \frac{12}{25}g = \frac{16 \cdot 66 - 13 \cdot 12}{66 \cdot 25}g = \frac{900}{25 \cdot 66}g =$$

$$= \frac{36}{66}g = \frac{6}{11}g$$

$$H = \frac{a_y \cdot t_2^2}{2}$$

$$t_2 = \sqrt{\frac{2H}{a_y}} = \sqrt{\frac{11H}{3g}}$$

Ответы: 1) $\sqrt{\frac{25H}{8g}}$; 2) $\frac{13}{66}g$; 3) $\sqrt{\frac{11H}{3g}}$

Чистовик

№5

$k_p = 0,99$ | $\Rightarrow$ т.к изменения малые $k_T \approx \frac{k_p + k_V}{2} = 1,01$

$k_V = 1,02$

$$\Delta Q = p'V' - pV = (k_p \cdot k_V - 1)\, pV$$

$$\Delta E = \frac{3}{2} R \cdot \nu \cdot (T' - T) = \frac{3}{2} R \cdot \nu \cdot (k_T - 1)\, T$$

$$pV = \nu R T$$

$$\frac{\Delta E}{\Delta Q} = \frac{\frac{3}{2} \cancel{\nu R T}\,(k_T - 1)}{(k_p \cdot k_V - 1) \cdot \cancel{pV}} = \frac{1,5 \cdot 1\%}{1\%} = \boxed{1,5}$$

Ответ: 1) выросла на 1% ; 2) 1,5

$$m a_y = mg - N \cdot \cos\alpha = mg - \frac{13}{15} \cdot \frac{3}{5} mg$$

$$a_y = \frac{75 - 39}{75} g = \frac{36}{75} g$$

$$4 : 3$$

$$\frac{36}{75} : \frac{28}{75}$$

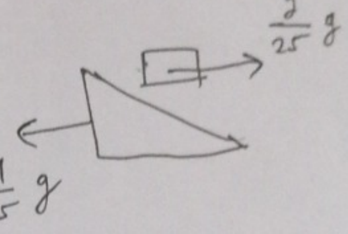
$$\frac{a_y t^2}{2} = H$$

$$t = \sqrt{\frac{2H}{a_y}} = \sqrt{\frac{150 H}{36 g}}$$

$$\frac{4}{5} \cdot \frac{13}{15} mg - \frac{mg}{3} = a_x \cdot m$$

$$\frac{52 - 25}{75} g = a_x$$

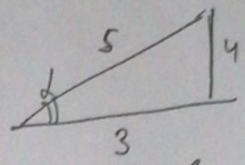
$$a_x = \frac{27}{75} g = \frac{9}{25} g$$

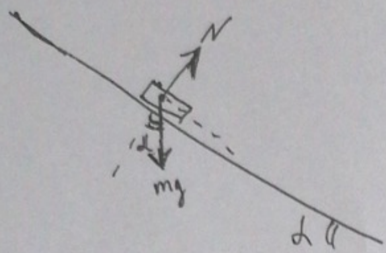


$$\cancel{m \cdot a_{кл} = }$$

$$m \cdot a_x = N \cdot \sin\alpha - m a_{кл} = mg - 2 m a_{кл}$$

$$a_x = g - 2 \cdot \frac{13}{41} g = \frac{15}{41} g$$





$$a = mg \cdot \sin\alpha$$

$$S = \frac{H}{\sin\alpha}$$

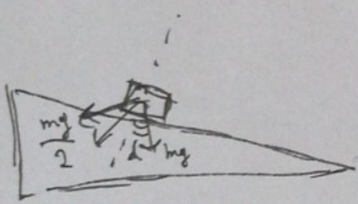
$$\cos\alpha = \frac{3}{5}$$

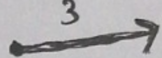
$$\sin\alpha = \frac{4}{5}$$

$$S = \frac{at^2}{2} \qquad \frac{2H}{\sin\alpha} = mg \cdot \sin\alpha \cdot t^2$$

$$t^2 = \frac{2H}{\cancel{m}g \cdot \sin^2\alpha} \qquad t = \sqrt{\frac{2H}{g \cdot \sin^2\alpha}}$$

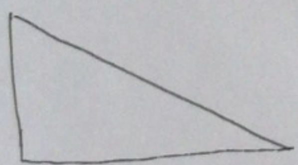
$$\alpha < 45^\circ \Rightarrow F \cdot \leftarrow$$

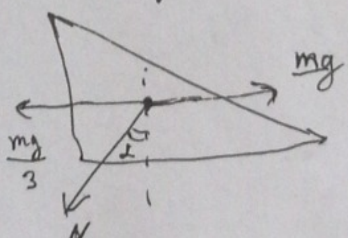




$$N = mg \cdot \cos\alpha + \frac{mg}{3} \cdot \sin\alpha$$

$$N = \frac{3}{5} mg + \frac{4}{5 \cdot 3} mg$$



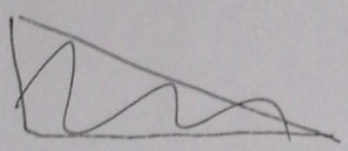


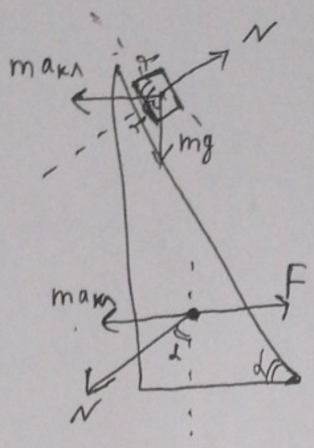
$$N = \frac{9+4}{15} = \frac{13}{15} mg$$

$$2ma_{кл} = mg - \frac{mg}{3} - \sin\alpha \cdot N = \frac{2}{3} mg - \frac{4 \cdot 13}{75} mg$$

$$2a_{кл} = \frac{50-52}{75} g$$

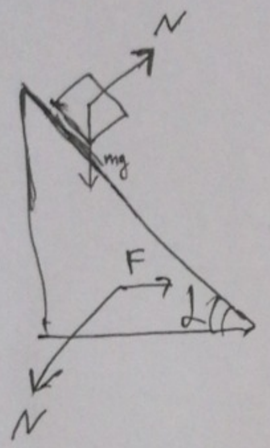
$$a_{кл} = \frac{1}{75} g$$ в СО у.м





$$N = mg\cdot\cos\alpha +$$

$$+\ ma_{кл}\cdot\sin\alpha$$



$$N = m\left(g\cdot\frac{3}{5} + a_{кл}\cdot\frac{4}{5}\right)$$

$$N\cdot\sin\alpha + m a_{кл} = F = mg$$

$$\cancel{m} a_{кл} + \cancel{m}\left(g\cdot\frac{12}{25} + a_{кл}\cdot\frac{16}{25}\right) = \cancel{m} g$$

$$a_{кл}\frac{16+25}{25} = g\,\frac{25-12}{25}$$

$$a_{кл}\cdot 41 = 13g$$

$$a_{кл} = \frac{13}{41}g$$

$$ma_y = mg - N\cdot\cos\alpha = mg - m\left(g\cdot\frac{9}{25} + a_{кл}\cdot\frac{12}{25}\right)$$

$$a_y = g - g\cdot\frac{9}{25} - \frac{13}{41}\cdot\frac{12}{25}g = 0{,}488\,g = 4{,}79\ м/с^2 = \boxed{\frac{20}{41}g}$$

$$H = \frac{a_y\cdot t^2}{2}$$

$$t = \sqrt{\frac{2H}{a_y}} = \sqrt{\frac{2H}{0{,}488g}}$$

$$\frac{16 - \frac{13\cdot 12}{41}}{25}$$

$$\frac{500}{41\cdot 25} = \frac{20}{41}$$

$pV = \nu RT$

$c_v = \frac{3}{2}R$

$\Delta E = \Delta \nu$

$T \uparrow 1\%$

$\cancel{\Delta Q = \Delta p + \Delta V}$

$\Delta E = \frac{3}{2} R \cdot \nu \cdot (T' - T) =$

$\Delta Q = p'V' - pV =$

$= \frac{3}{2} R \cdot \nu \cdot (k_T - 1) T$

$= (k_p \cdot k_v - 1)\, pV$

$$\frac{\frac{3}{2} \cancel{R \cdot \nu} \cdot (k_T - 1) \cdot \cancel{T}}{(k_p \cdot k_v - 1) \cdot \cancel{\nu R T}} = \frac{1{,}5 \cdot 1\%}{1\%} = 1{,}5$$

$k_p = 0{,}99$

$k_v = 1{,}02$

$k_T = 1{,}01$