Physics Revision Tutorial.

Kinematics, Dynamics, Forces, Work Energy Power.

1. (a) $s = ut + \frac{1}{2}at^2$

$\Rightarrow 100 = 0 + \frac{1}{2}(9.81)t^2$

$t = 4.52\,s$ //

(b) y-dirⁿ,

$V_y^2 = 2as$

$\Rightarrow V_y = \sqrt{2(9.81)(100)}$

$V = \sqrt{V_y^2 + V_x^2}$

$= \sqrt{2(9.81)(100) + 30^2}$

$= 53.5\ ms^{-1}$ //

(c) $\sqrt{2(9.81)(100) + 30^2} = \sqrt{2(9.81)h + 50^2}$

$\Rightarrow h = 18.5\,m$ //

(d) Horizontal dist $= V_x t = 135.6\,m$ //

2 (a) $\frac{1}{2}m_\alpha V_\alpha^2 = 2.93 \times 10^{-13}$

$V_\alpha = 9.37 \times 10^6\ ms^{-1}$ //

(b) $M_d V_d = M_\alpha V_\alpha$

$\Rightarrow (2.41 \times 10^{-25} - 6.68 \times 10^{-27}) V_d = (6.68 \times 10^{-27})(9.37 \times 10^6)$

$\Rightarrow V_d = 2.67 \times 10^5\ ms^{-1}$

(c) $KE = \frac{1}{2}m_d V_d^2 = 8.36 \times 10^{-15}\,J$ //

(d) $\frac{KE_d}{KE_T} = \frac{8.36 \times 10^{-15}}{8.36 \times 10^{-15} + 2.93 \times 10^{-13}} = 0.0277$ //

3 (a) $N_1 = m_1 g$

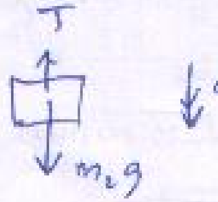
$= (20)(9.81) = 196.2\,N$ //

(b) $(m_1 + m_2)a = m_2 g$

$\Rightarrow (30)a = (10)(9.81)$

$\Rightarrow a = 3.27\,ms^{-2}$ //

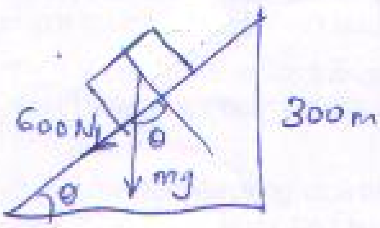
(c) $m_2 g - T = m_2 a$



$\Rightarrow T = m_2 g - m_2 a$

$= 65.4\,N$ //

4 (a)



$\sin\theta = \frac{300}{2100}$

$\theta = 8.21^\circ$

Average force parallel to slope $= 600 + mg\sin\theta$

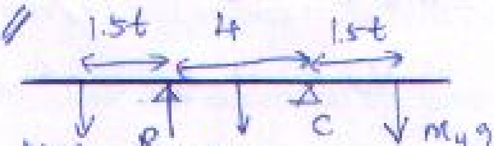
$= 2000\,N$ //

(b) $Fv = (2000)\left(\frac{50\times10^3}{60\times60}\right) = 2.78\times10^4\,W$ //

(c) $N = mg\cos\theta$

$= 9.71\times10^3\,N$ //

(d) $f = mg\sin\theta = 1400\,N$ //



5. Taking moments abt C,

Clockwise = Anticlockwise

$1.5t \times m_y = (1.5t + 4)m_x + 4R_B + 2m_p$ ($R_B = 0$ when plank starts to overturn.)

$\Rightarrow 75t = 30t + 80 + 40$

$\Rightarrow t = 2.67s$ //

6(a) $(M+m)a_1 = \sout{Mg} \sout{(M \; a)} \; (M-m)g$

(b) $\sout{(M+m)(a_1+a) = Mg}$ $(M+m)a_2 = \sout{M(g+a)} \; (M-m)(g+a)$

$a_2 = \sout{\frac{M(g+a)}{(M+m)}} \; \frac{(M-m)}{(M+m)}(g+a)$

(c) $S = ut + \frac{1}{2}at^2$

$l = \frac{1}{2}(a_1+a)t^2$

$t = \sqrt{\frac{2l}{(a_1+a)}} = \sqrt{\frac{2l}{a_2}}$ //

(d) $\sout{a_2 = \frac{M(g+a)}{M+m} = \frac{2m(9.81+2.0)}{3m} =}$

$a_2 = \frac{(M-m)(g+a)}{(M+m)}$

$= \frac{m}{3m}(9.81+2.0)$

$= 3.94 \, ms^{-2}$ //

$t = \sqrt{\frac{2l}{a_2}}$

$= \sqrt{\frac{2(0.50)}{3.94}} = 0.50 s$ //

7(a) $4uv = -4uv_\alpha + 197uv_{Au}$

$4v = 197v_{Au} - 4v_\alpha$ — ①

$v = v_\alpha + v_{Au}$ — ②

Subst. ② into ①, $v_\alpha = v - v_{Au}$

$\Rightarrow 4v = 197V_{Au} - 4V + 4V_{Au}$

$8V = 201 V_{Au}$

$\sout{V_{Au}}/V = 0.040$ //

$\sout{4v_\alpha + 4v_{Au} = 197v_{Au} - 4v_\alpha}$

$\sout{\Rightarrow 8v_\alpha = 201 v_{Au}}$ 193

$\sout{\Rightarrow v_{Au}/v_\alpha = 8/201 = 0.040}$ 0.041, 193

(b) $\frac{\frac{1}{2}m_\alpha v_\alpha^2}{\frac{1}{2}m_{Au}v_{Au}^2} = \frac{4}{197}\left(\frac{201}{8}\right)^2 = 12.82$

% of Au $= \frac{1}{1+12.82} = 0.07 \simeq 8\%$