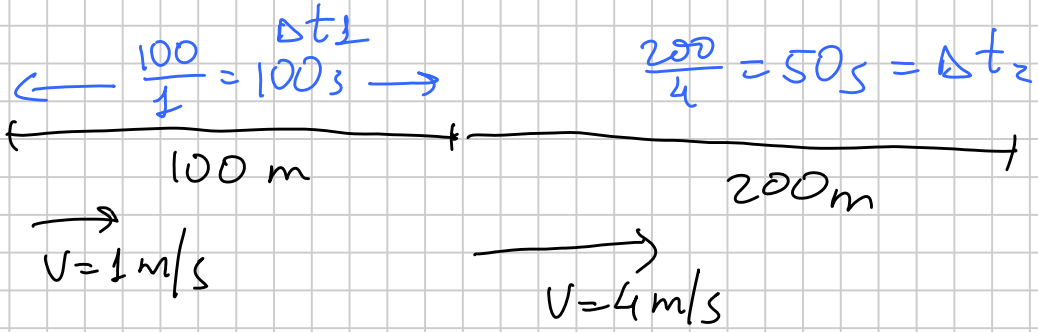
Midterm solutions

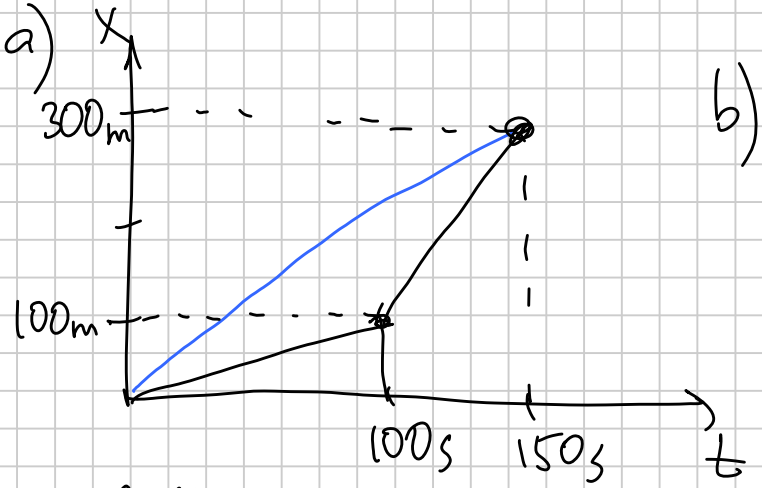
Note Title 10/5/2011

1. Read & imagine processes
2. Diagram. Identify forces, accel., vel., etc
3. Think
4. Formulate
5. Solve
6. Makes sense?

1

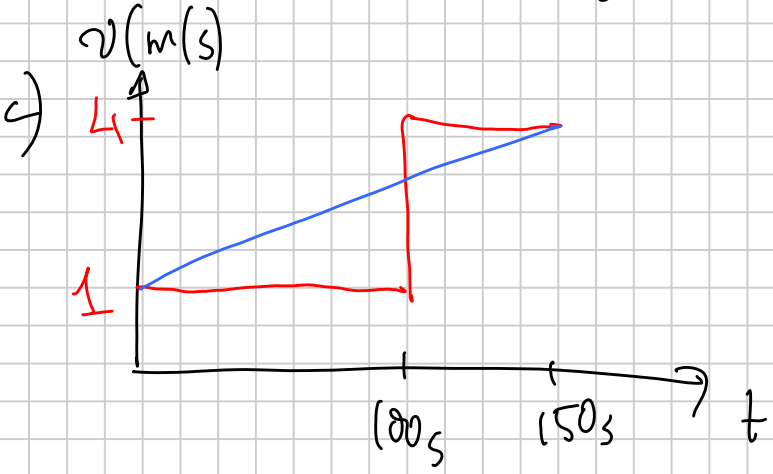


a)



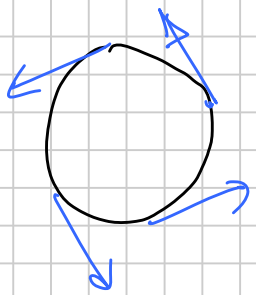
b) $v_{avg} = \frac{\Delta X}{\Delta t} = \frac{300m}{150s} = 2\ m/s$

c)

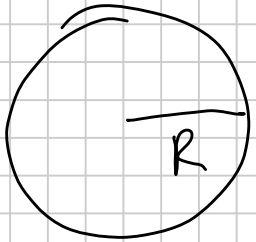


d) $a_{avg} = \frac{\Delta v}{\Delta t} = \frac{3\ m/s}{150s} = 0{,}02\ m/s^2$

e)



$\vec{v}_{avg} = \frac{\Delta \vec{x}}{\Delta t} = 0$



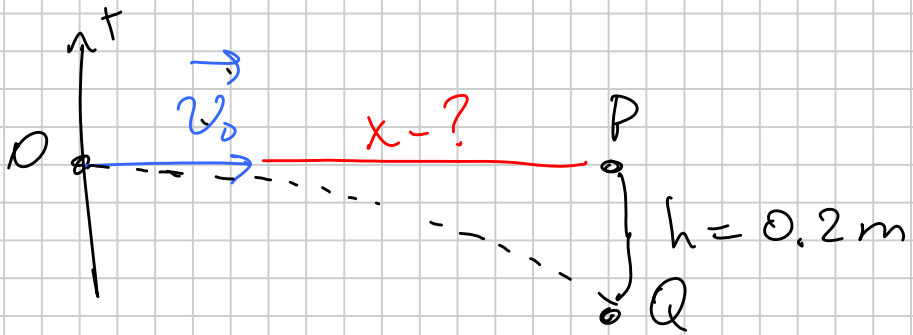
$R = 20\,km = 20{,}000\,m$

$T = 2\,s$

$$a_c = \frac{v^2}{R} \qquad v = \frac{2\pi R}{T}$$

$$a_c = \frac{(2\pi R)^2}{T^2 R} = \frac{4\pi^2 R}{T^2} = \frac{4 \cdot \pi^2 \cdot 2 \cdot 10^4}{4} = 2\pi^2 \cdot 10^4 \approx 2 \cdot 10^5\ m/s^2$$

3



$v_0 = 10\ m/s$

$x = \cancel{x_0}^{0} + v_{0x}t + \frac{1}{2}\cancel{a_x}^{0}t^2 = v_0$

$y = \cancel{y_0}^{0} + \cancel{v_{0y}}^{0}t + \frac{1}{2}a_y t^2$

$a_y = -g$

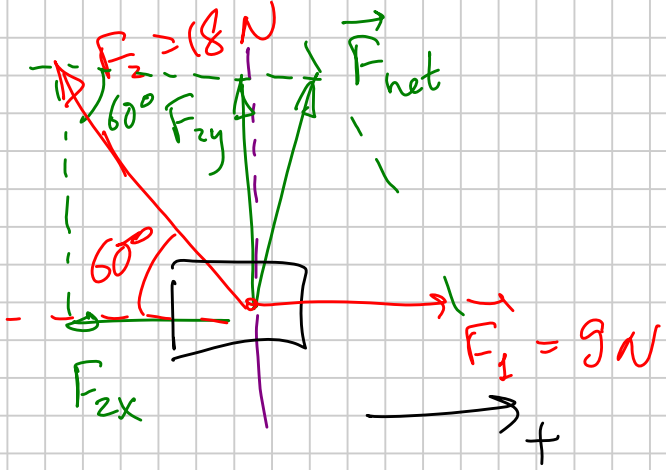
$x = v_0 t$

$y = -\frac{1}{2}gt^2$

$-h = -\frac{1}{2}gt^2 \Rightarrow t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2 \cdot 0,2}{10}} = \sqrt{0,04} = 0,2\ s$

$x = 10\ m/s \cdot 0,2\ s = \underline{2\ m}$

4



$\vec{a} - ?$ $\quad m = 3$ kg

$\vec{F}_{net} = m\vec{a}$

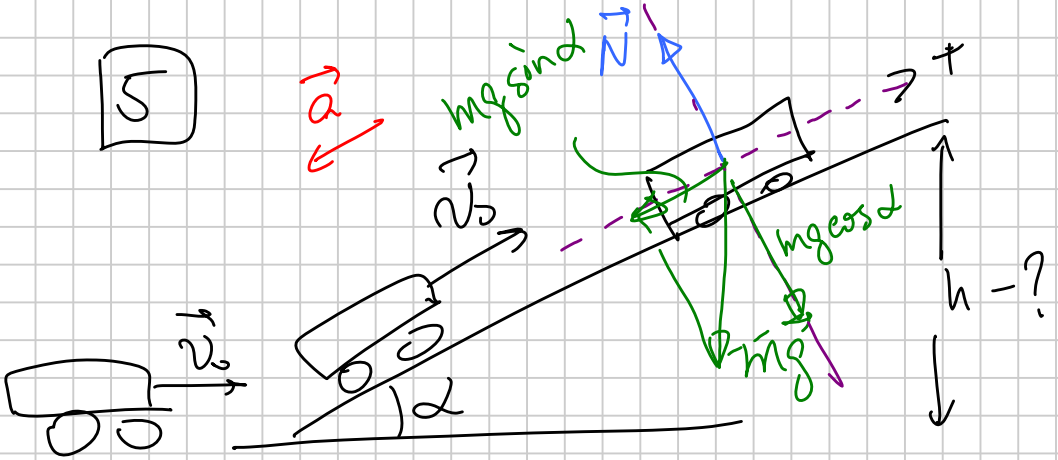
x: $F_{1x} = 9$ N $\quad F_{2x} = -18 \cdot \cos 60° = -9$ N

y: $F_{1y} = 0$ $\quad F_{2y} = 18 \sin 60° = 18 \frac{\sqrt{3}}{2} = 9\sqrt{3}$

$$F_{net} = \sqrt{F_{net_x}^2 + F_{net_y}^2} = 9\sqrt{3} \text{ N}$$

$$a = \frac{F_{net}}{m} = \frac{9\sqrt{3}}{3} = 3\sqrt{3} \simeq 5.2 \text{ m/s}^2$$

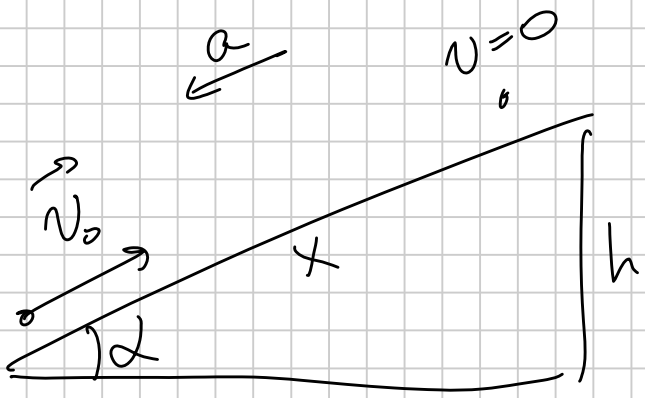
5



$\alpha = 30^\circ$

$v_0 = 2\ m/s$

$v = v_0 - at = 0$



$x: -mg\sin\alpha = -ma$

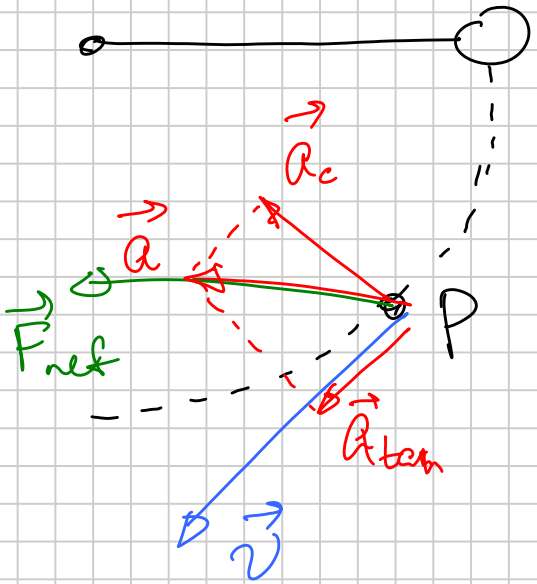
$a = g\sin\alpha = 10 \cdot \frac{1}{2} = 5\ m/s^2$

$h = x\sin\alpha$

$$\begin{cases} x = v_0 t - \frac{1}{2}at^2 \\ 0 = v_0 - at \Rightarrow t = \frac{v_0}{a} = \frac{2}{5} = 0{,}4\ s \end{cases}$$

$x = 2 \cdot 0{,}4 - \frac{1}{2} \cdot 5 \cdot 0{,}4^2 = 0{,}8 - 0{,}4 = 0{,}4\ m$

$h = 0{,}4 \cdot \sin 30^\circ = \underline{0{,}2\ m}$



$$\vec{F}_{net} = m\vec{a}$$