Phys 2110-3 9/10/10

Note Title 9/10/2010

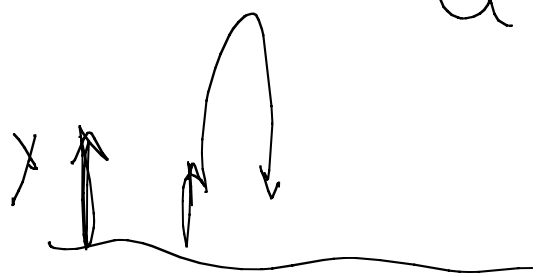
1D Motion, Const Accel.

$$v = v_0 + at$$

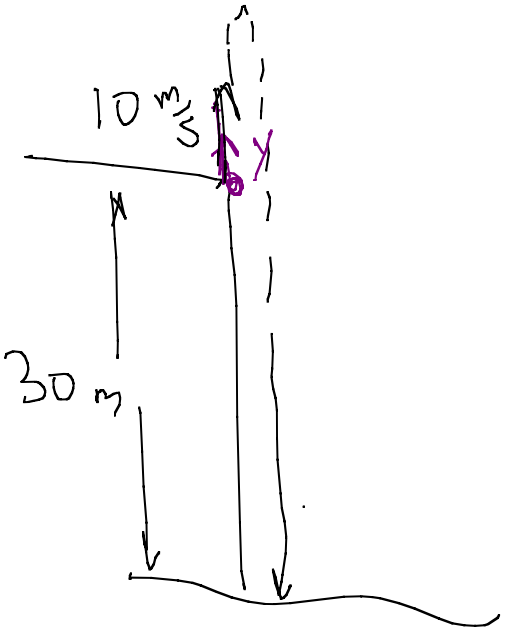
$$x = x_0 + v_0 t + \frac{1}{2} a t^2$$

Free-fall

$$a = -g = -9.8\ m/s^2$$



Prob: At edge of cliff throw rock up at $10\frac{m}{s}$. Fnd time & speed at which it hits ground below.




Find $t$ for which $y = -30\,m$

$$y = \left(10\tfrac{m}{s}\right)t + \tfrac{1}{2}\left(-9.8\tfrac{m}{s^2}\right)t^2 = -30\,m$$

$$\Longrightarrow \quad 4.9t^2 - 10t - 30 = 0$$

Solve quad. eqn

Another way: At ground, $v^2 = v_0^2 + 2a(y - y_0)$

$$v^2 = \left(10\tfrac{m}{s}\right)^2 + 2\left(-9.8\tfrac{m}{s^2}\right)(-30m)$$

$$v = -22.2\tfrac{m}{s} \Longleftarrow$$

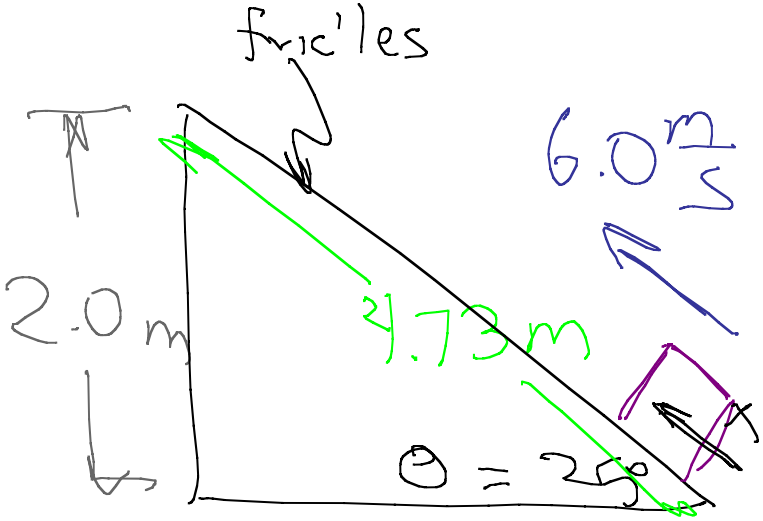
$$v = v_0 + at$$

$$-22.2\ \frac{m}{s} = 10\ \frac{m}{s} + \left(-9.8\ \frac{m}{s^2}\right) t$$

$$\Longrightarrow t = 3.29\ s$$

Problem

Does block get to top of slope?




Block slows down.

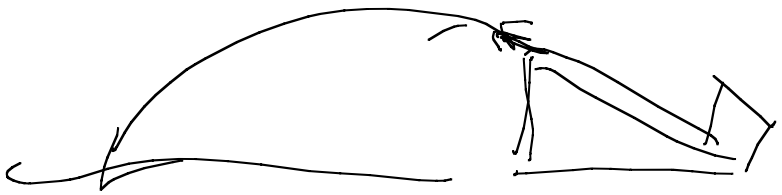
$$v^2 = v_0^2 + 2a(x - x_0)$$

$$a = -g\sin\theta$$
$$= -4.14\ \frac{m}{s^2}$$

At top (2)

$$0 = \left(6.0\ \frac{m}{s}\right)^2 + 2\left(-4.14\ \frac{m}{s^2}\right)(x - x_0) \qquad x_0 = 0$$

$x = 4.34\ m$ → No, doesn't get to top.



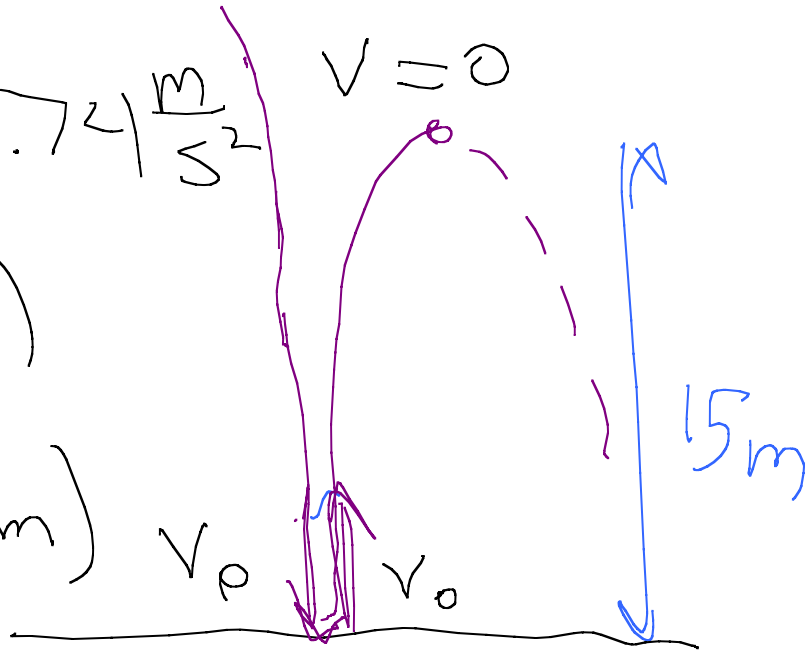
2.65 The Mars Spirit landed in 2004 bounced some 15 m vertically after impact. Assume no loss of speed at contact, what was impact speed?

$$a = -g_{Mars} = -3.74 \frac{m}{s^2}$$

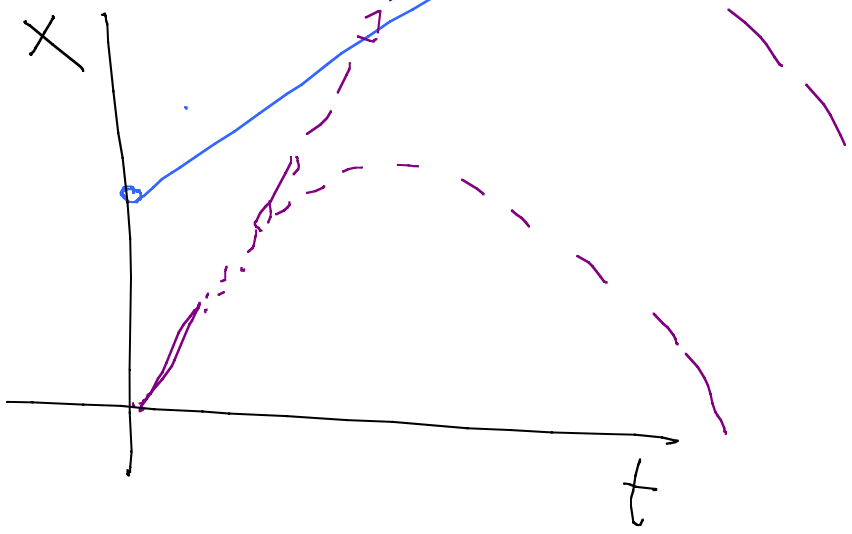
$$v^2 = v_0^2 + 2a(y - y_0)$$

$$0 = v_0^2 + 2\left(-3.74 \frac{m}{s^2}\right)(15 m)$$

$$v_0 = 10.6 \frac{m}{s}$$

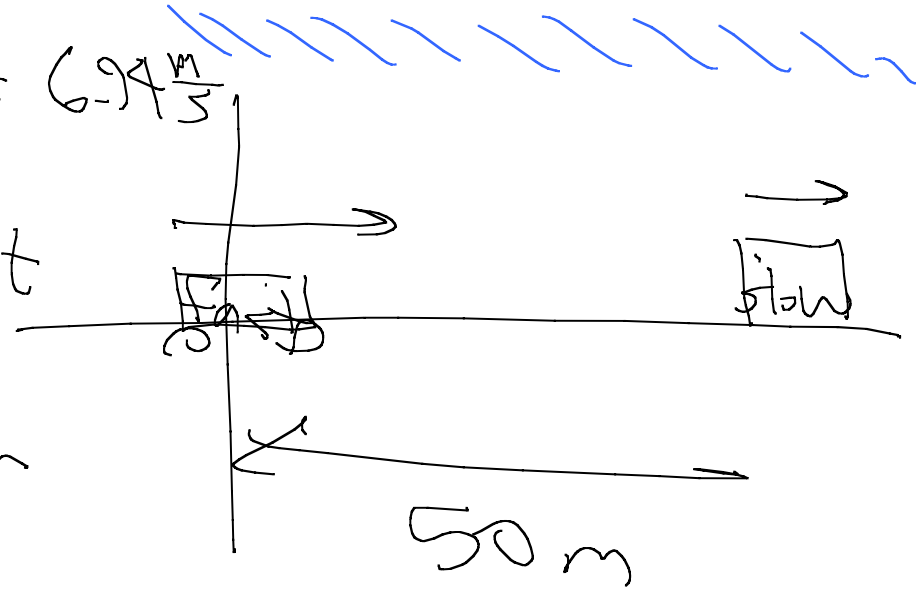


2.73 Subway train travels at 80 $\frac{km}{h}$ approaches slower train 50 m ahead traveling in same dir at 25 $\frac{km}{hr}$ Fast train begins decel. at 2.1 $\frac{m}{s^2}$ while slower train continues at const. speed. How soon and at what rel. speed do they collide



Fast $x_1 = 22.\frac{m}{s}\,t - \frac{1}{2}\left(2.1\frac{m}{s^2}\right)t^2$

$80\frac{km}{hr} = 22.2\frac{m}{s}$ $\quad 25\frac{km}{hr} = 6.94\frac{m}{s}$




$x_2 = 50\,m + 6.94\frac{m}{s}\,t$

Is there a $t$ for which $x_1 = x_2$

$50 + 6.94t = 22.2t - \frac{1}{2}(2.1)t^2$

$t = \frac{15.3 \pm \sqrt{(15.3)^2 - 4(1.05)(50)}}{2.10} = \begin{cases} 4.95\ s \\ 9.62\ s \end{cases}$

$$v_2 = 6.94 \frac{m}{s}$$

$$v_1 = 22.2 \frac{m}{s} - (2.1)t$$

$$= 11. \frac{m}{s}$$

$t = 4.95$ s

Rel. speed

$= \Delta v$

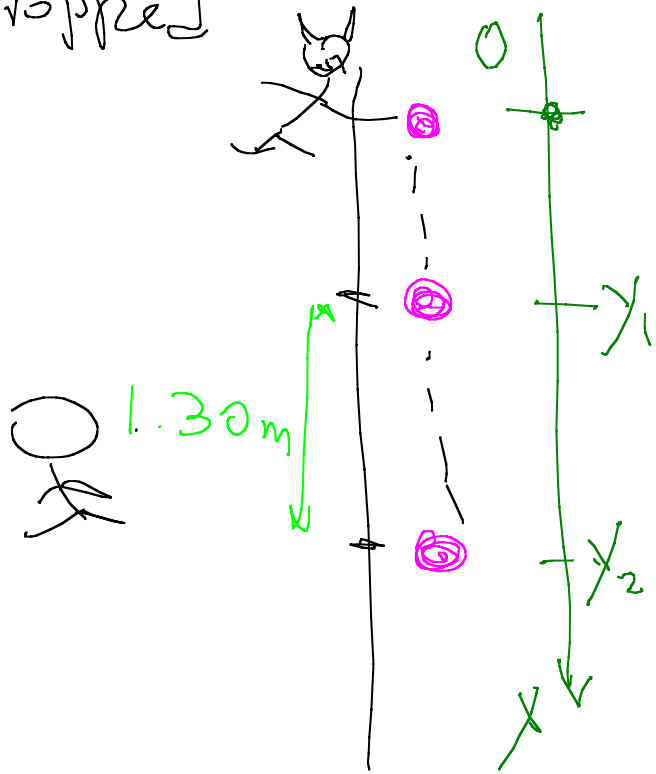
$= -4.86 \frac{m}{s}$

2.78 Student stares idly out window sees water balloon fall past. If balloon takes 0.22s to cross 130 cm window from what height above window was it dropped

$\Delta t = 0.22s$

$y = \frac{1}{2} g t^2$

$y_2 - y_1 = 1.30\,m$



$$t_2 - t_1 = 0.22\,s$$

$$y_1 = \frac{1}{2} g t_1^2 \qquad y_2 = \frac{1}{2} g t_2^2$$


$$y_2 - y_1 = 1.30\,m = \frac{1}{2} g (t_2^2 - t_1^2)$$

The rest is math:

$$0.22\,s = t_2 - t_1$$

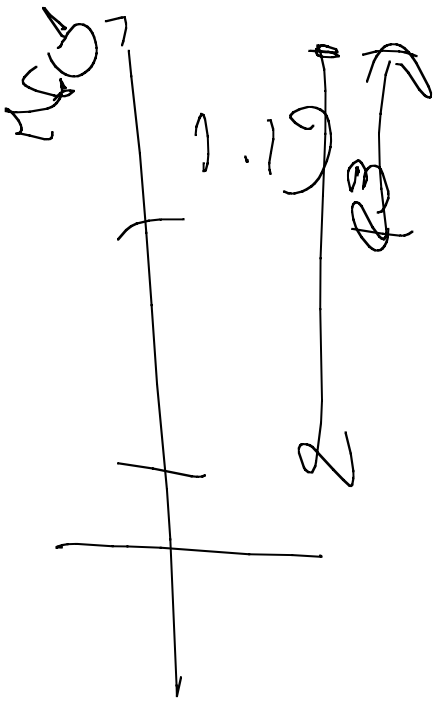
$$1.30\,m = \frac{1}{2} g (t_2 - t_1)(t_2 + t_1)$$

$$t_2 + t_1 = 1.21\ s$$

$$t_2 - t_1 = 0.22\ s$$

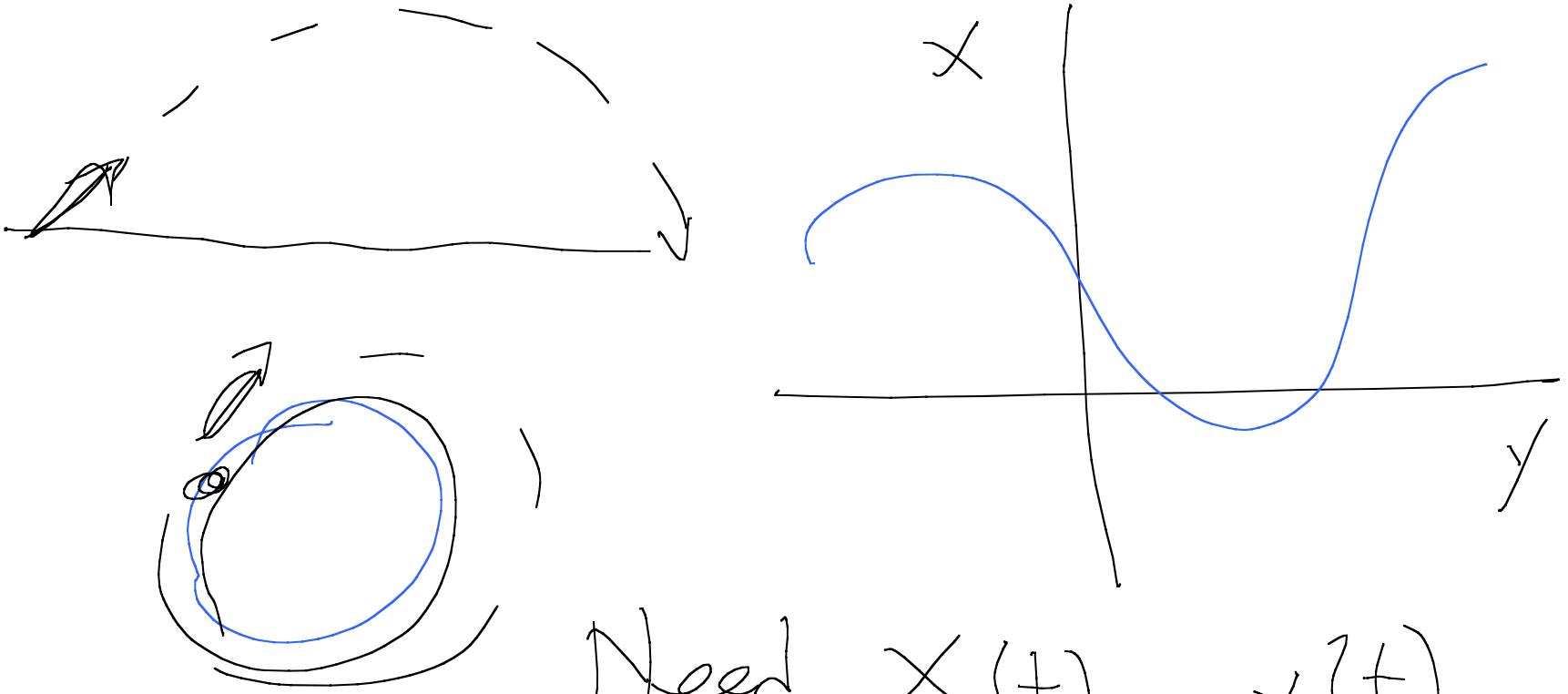
$$t_1 = 0.49\ s \qquad t_2 = 0.71\ s$$

$$y_1 = \frac{1}{2} g t_1^2 = 1.19\ m$$




Movin' on ~~~

# Chap 3 Two-Dimensional Motion



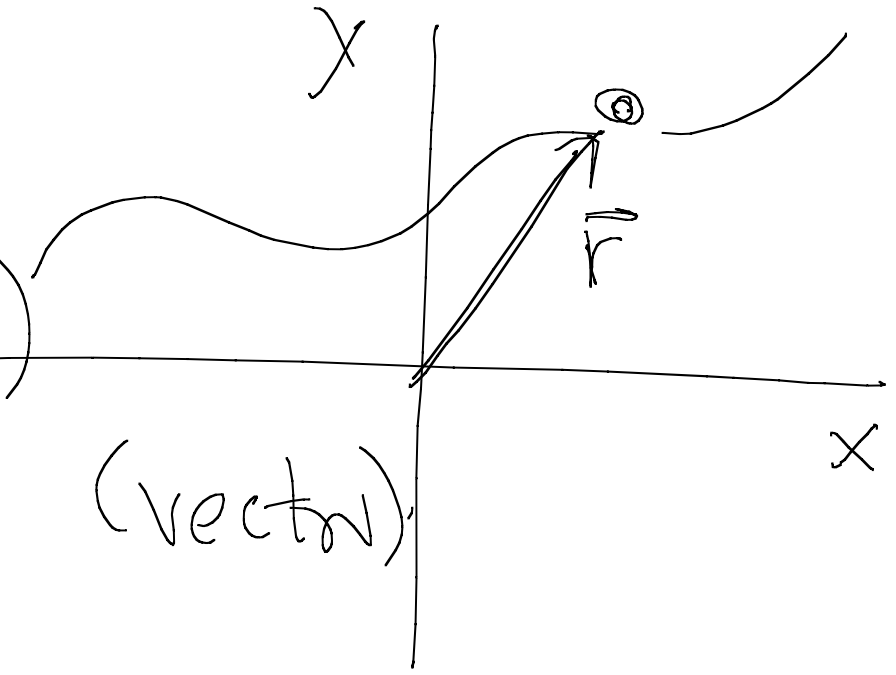

Need $x(t)$, $y(t)$

(trajectory)

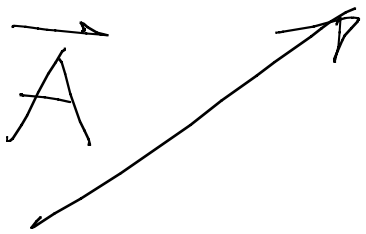
Vectors are used

Location (displacement)

rep'd by arrow. (vector)




Vector is given magnitude and direction.




Mag & dir are specified

Doesn't matter where you draw

You can add arrow