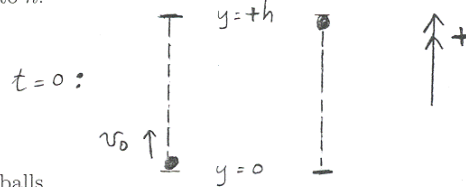


key

PHYSICS 161, Spring 2003
Discussion Quiz, Tuesday, Feb 11

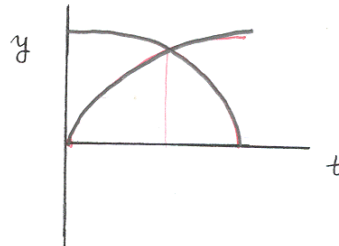
Q1). Fig 1. shows a ball being dropped from a height h and at the same instant a second ball being thrown vertically upwards with just the right velocity v_0 such that it reaches a maximum height exactly equal to h .

a). Draw a carefully labelled position versus time (y vs t) graph for each ball on the same plot.



b). Draw a velocity vs time graph for both balls on the same plot.

c). Draw an acceleration vs time graph for both balls on the same plot.



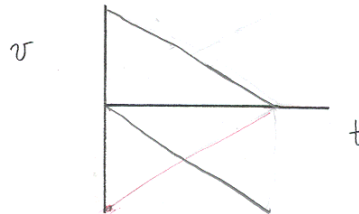
d). Write down the $y(t)$ equation for both balls. Label them $y_1(t)$ and $y_2(t)$.

You can use $y(t) = y_i(t) + v_i t + 1/2 a t^2$.

$$y_1 = h + \frac{1}{2} g t^2$$

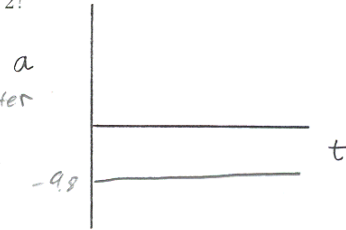
$$y_2 = 0 + v_0 t + \frac{1}{2} g t^2$$

$$g = -9.8$$



e). At the instant the balls pass each other are they at (i) $y = h/2$; (ii) $y < h/2$ or (iii) $y > h/2$? Why? Explain using a conceptual argument as well as using your graphs above.

$y > \frac{h}{2}$ both balls are moving faster at $y < \frac{h}{2}$ then at $y > \frac{h}{2}$ so they will cross at $y > \frac{h}{2}$



f). At the instant that the balls pass each other, how do their speeds compare?

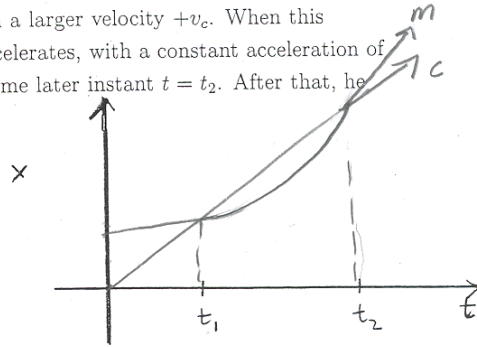
they are the same

Key

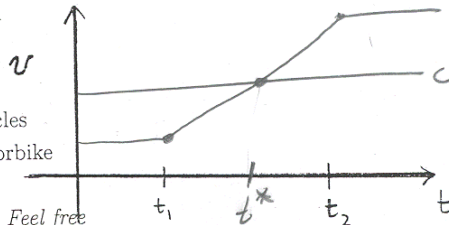
PHYSICS 161, Spring 2003
 Discussion Quiz, Thursday, Feb 12+1 = 13!

Q1). A motorcycle travels with a velocity $+v_m$ along a straight road. At some instant t_1 it is passed by a car traveling with a larger velocity $+v_c$. When this happens (i.e., at $t = t_1$), the motorcyclist accelerates, with a constant acceleration of magnitude $+a_m$ until he passes the car at some later instant $t = t_2$. After that, he again coasts with a constant velocity.

a). Draw a carefully labelled position versus time (x vs t) graph for each vehicle on the same plot.



b). Draw a velocity vs time graph for both vehicles on the same plot.



c). Draw an acceleration vs time graph for both vehicles on the same plot.

d). Write down the $x(t)$ equation for both vehicles valid over the time interval over which the motorbike is accelerating. Label them $x_c(t)$ and $x_m(t)$.

You can use $x(t) = x_i(t) + v_i t + 1/2 a t^2$. Note: Feel free to relabel any instant of time to be $t = 0$ for your convenience.

$t_1 = 0$

$$x_c = x_{0c} + v_{0c}t + \frac{1}{2}at^2 \quad x_m = x_{0m} + v_{0m}t + \frac{1}{2}at^2$$

$$x_c = 0 + v_c t + 0 \quad x_m = 0 + v_m t + \frac{1}{2}a_m t^2$$

$$x_c = v_c t \quad x_m = v_m t + \frac{1}{2}a_m t^2$$

e). Over the time interval over which the motorbike is accelerating, what is its average velocity? Hint: Try to deduce the answer straight from the graph.

The average slope of a curve between 2 points is the line connecting them. In part a the line connecting t_1 and t_2 has a slope of $v_c \Rightarrow \bar{v} = v_c$

f). Are there any instants of time when the car and the motorbike have the same velocity? If so mark that instant on your plot, give it a name and report it below.

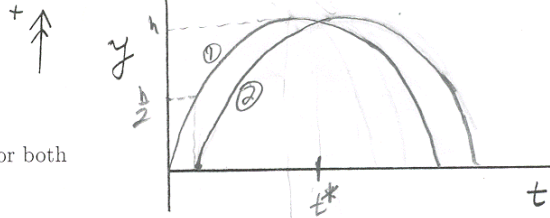
$t = t^*$

key

PHYSICS 161, Spring 2003
Discussion Quiz, Friday, Feb 14

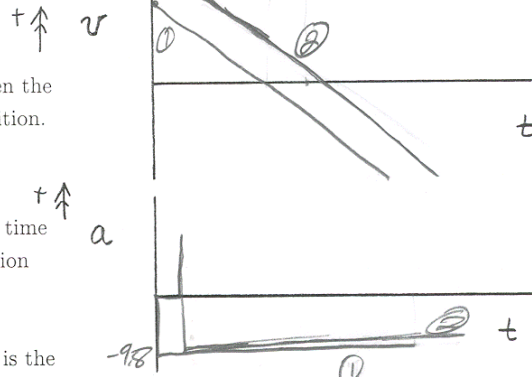
Q1). A ball (#1) is thrown upwards with velocity $+v_0$. When the ball reaches half its maximum height $h_{1/2} \equiv h_{max}/2$, a second ball (#2) is thrown upwards with the same velocity $+v_0$. In the following, we will consider the motion of the balls for the entire time until both have made it back to their respective thrower's hands.

a). Draw a carefully labelled position versus time (y vs t) graph for each ball on the same plot.



b). Draw a velocity vs time graph for both balls on the same plot.

c). Draw an acceleration vs time graph for both balls on the same plot.



d). On your plots, mark the time when the two balls are at the same vertical position. Call this time t^* . At this instant, which ball has the higher speed?

e). Suppose I ask you to solve for the time $t = t^*$ by writing down the $y(t)$ equation for each ball and then setting $y_1(t) = y_2(t)$. To do that, you must first carefully consider which instant is the most convenient to be labelled $t = 0$: when the first ball is thrown up or when the second ball is thrown up. **Will you need to first solve for some other quantity? If so, which? Give it a name for use below.**

Their speed is the same
 $|\vec{v}_1| = |\vec{v}_2|$
 $\vec{v}_2 = -\vec{v}_1$

set $t=0$ when the second ball is thrown up, then you have to solve for the velocity of ball 1 at $\frac{h}{2}$

f). Let's simply assume that you have solved for the needed quantity above. Write down the $y(t)$ equations for each ball. Label them $y_1(t)$ and $y_2(t)$.

You can use $y(t) = y_i(t) + v_{iy}t + \frac{1}{2}at^2$.

$$y_1 = \frac{h}{2} + v_{\frac{h}{2}}t + \frac{1}{2}gt^2$$

$$y_2 = v_0t + \frac{1}{2}gt^2$$

$$g = -9.8$$