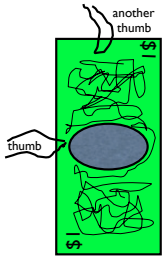
Prob. 2.69



Steps to doing a kinematic problem:

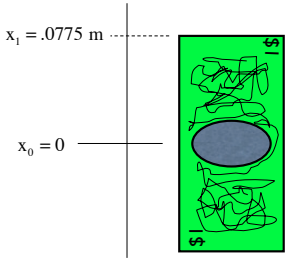
1.) Draw a picture, putting as much information into the sketch as you can.

2.) Set up a coordinate axis.

3.) Identify what you are trying to determine, try to find a kinematic equation that has what you are looking for along with what you know and solve that relationship for the unknown.

If you don't know what to do, start the process and see where it leads you.

Prob. 69

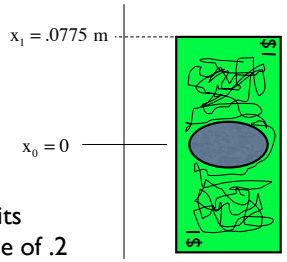


For amusement: How fast will the bill's top be going as it passes through the pinch point at x = 0 (that is, after falling .0775 meters)?

$$v_0^2 = v_1^2 + 2a\Delta x$$
$$\Rightarrow \quad v_0^2 = 0 + 2\left(-9.8 \text{ m/s}^2\right)(.0775 \text{ m})$$
$$\Rightarrow \quad v_0 = ?$$

Ack! Notice a problem?

Prob. 69



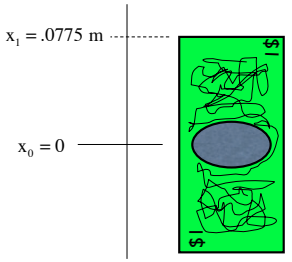
We don't really know what to do, so lets set up a coordinate axis and just start writing:

How far will top of bill fall while catcher sits immobilized (i.e., during reaction time lapse of .2 seconds)?

$$\Delta x = v_1 t + \frac{1}{2}at^2$$
$$\Rightarrow \quad \Delta x = .5\left(-9.8 \text{ m/s}^2\right)(.2 \text{ s})^2$$
$$\Rightarrow \quad \Delta x = -.196 \text{ m}$$

What is the measured distance between top and center of bill? (.0775 m)
So when fingers close, x-coordinate of top of bill will be .0775-.196=-.1185. In other words, the pinch-point will be .1185 m below the x=0 point! That means you will never get the bill.

Prob. 69



We need to write out the kinematic relationship for the top completely! That is:

$$v_0^2 = v_1^2 + 2a\left(x_o - x_1\right)$$
$$\Rightarrow \quad v_0^2 = 0 + 2\left(-9.8 \text{ m/s}^2\right)(0 - .0775 \text{ m})$$
$$\Rightarrow \quad |v_0| = 1.23 \text{ m/s}$$

(This negative-sign problem is why it is often better to work with coordinates instead of changes of position.) Delving deeper, how fast is the bill moving after .2 seconds?

$$v_0 = v_1 + a\Delta t$$
$$\Rightarrow \quad v_0 = 0 + \left(-9.8 \text{ m/s}^2\right)(.2 \text{ s})$$
$$\Rightarrow \quad v_0 = -1.96 \text{ m/s}$$

Conclusion? If it's going 1.96 m/s at the soonest it can be snagged, and it's only going 1.23 m/s when the top passes his thumb, the bill is obviously not going to be snagged!