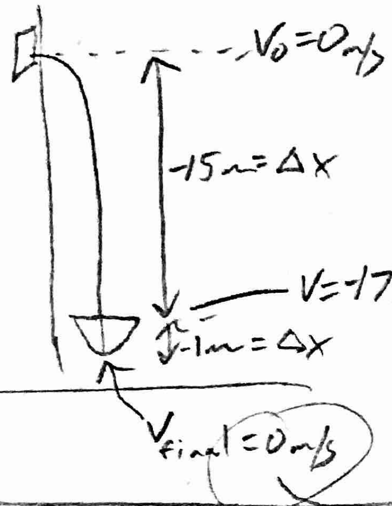
Physics 200

More Kinematics Problems

Name: ____________________

57. A person jumps from a fourth-story window 15.0 m above a firefighter's safety net. The survivor stretches the net 1.0 m before coming to rest. What was the average deceleration experienced by the survivor when she was slowed to rest by the net? (b) What would you do to make it "safer" (that is, to generate a smaller deceleration): would you stiffen or loosen the net? Explain.

Part A



Before hitting net ⟹ $V^2=V_0^2+2a\Delta x$

$V^2=(0m/s)^2+2(-9.8m/s^2)(-15m)$

$V=-17.1m/s$

While stretching net ⟹ $V^2=V_0^2+2a\Delta x$

Before hitting net

net stretch

$(0m/s)^2=(-17.1m/s)^2+2(a)(-1m)$

$\boxed{a=147m/s^2}$

Part B To decrease acceleration, loosen the net, so the acceleration distance increases.

58. The acceleration due to gravity on the Moon is about one-sixth what it is on Earth. If an object is thrown vertically upward on the Moon, how many times higher will it go than it would on Earth, assuming the same initial velocity?

The most concrete way to solve this is to make up a velocity and solve with -9.8 and $-\frac{9.8}{6}$.

Another way...

Consider the upward flight

$V^2=V_0^2+2a\Delta x$

$0=V_0^2+2a\Delta x$

V at top of flight path

$\Delta x=\frac{-V_0^2}{2a}$

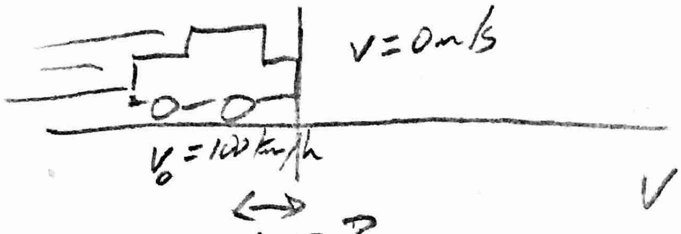
on Earth → $\Delta x=\frac{-V_0^2}{2(-9)}=\boxed{\frac{1}{2}\frac{V_0^2}{9}}$

on the moon → $\Delta x=\frac{-V_0^2}{2(-9/6)}=\boxed{\frac{3V_0^2}{9}}$

6X higher than

59. A person who is properly constrained by an over-the-shoulder seat belt has a good chance of surviving a car collision if the deceleration does not exceed about 30 "gs" $(1.0\,g = 9.8\,\text{m/s}^2)$ Assuming uniform deceleration of this value, calculate the distance over which the front end of the car must be designed to collapse if a crash brings the car to rest from $100\,\text{km/h}$.

$$a = 30g = 30(9.8\,m/s^2) = 294\,m/s^2$$



$a = -294\,m/s^2$

$$V_0 = \left(\frac{100km}{h}\right)\left(\frac{1hr}{3600s}\right)\left(\frac{1000m}{1km}\right)$$

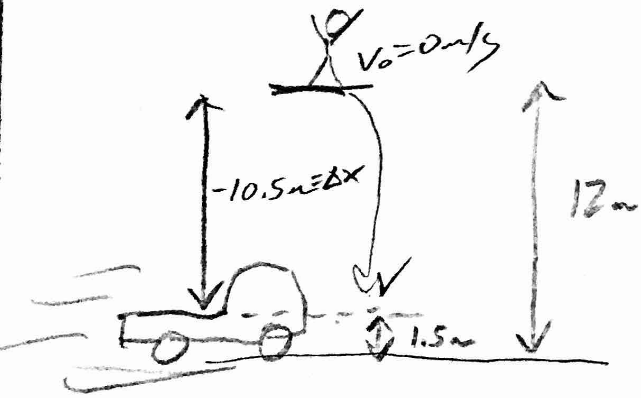
$V_0 = 27.8\,m/s$

$$V^2 = V_0^2 + 2a\Delta x$$

$$0^2 = (27.8\,m/s)^2 + 2(-294\,m/s^2)\Delta x$$

$$\boxed{\Delta x = 1.31\,m}$$

60. Agent Bond is standing on a bridge, 12 m above the road below, and his pursuers are getting too close for comfort. He spots a flatbed truck approaching at $25\,\text{m/s}$, which he measures by knowing that the telephone poles the truck is passing are 25 m apart in this country. The bed of the truck is 1.5 m above the road, and Bond quickly calculates how many poles away the truck should be when he jumps down from the bridge onto the truck to make his getaway. How many poles is it?



Find fall time

$$\Delta x = V_0 t + \tfrac{1}{2}at^2$$

$$-10.5m = 0m/s\,t + \tfrac{1}{2}(-9.8m/s^2)t^2$$

$$-10.5m = -4.9\,m/s^2\,t^2$$

$$2.14s^2 = t^2$$

$$\boxed{t = 1.46s}$$

fall time

Find Distance traveled by truck during fall

$$\bar{V} = \frac{\Delta x}{\Delta t} \qquad 25\,m/s = \frac{\Delta x}{1.46s}$$

$$\boxed{\Delta x = 36m}$$

Convert to poles

$$36m\left(\frac{1pole}{25m}\right) = \boxed{1.46\,poles}$$