Test 2
Phys 111, Fall 2009, Section 1

You are designing the elevator in a hospital for patients with FLS (Fragile Leg Syndrome). If a FLS patient's apparent weight exceeds 1.6 times their actual weight, their legs will turn to dust. For technical reasons that are too complicated to discuss, the elevator can accelerate for only the first 3 meters of travel.

a) (18pts) Find an expression for the maximum allowed velocity of the elevator.

b) Calculate a numerical value for the acceleration.

Apparent weight is the normal force

actual weight is the normal force when you're not accelerating.

actual (stationary)	apparent (accelerating)
$N_{ac} - mg = 0$	$N_{ap} - mg = ma$
$N_{ac} = mg$	$N_{ap} = m(g+a)$

From the problem statement, if

$$N_{ap} > 1.6 N_{ac}$$

Your legs break. So, set $N_{ap} = 1.6 N_{ac}$ and solve for a. This will be maximum a.

$N_{ac} = mg$, $1.6 N_{ac} = m(g+a)$

→ divide ←

$$\frac{1.6 N_{ac}}{N_{ac}} = \frac{m(g+a)}{mg} \Rightarrow 1.6g = g + a$$

$$\Rightarrow \boxed{a = 0.6g}$$

continued ↓

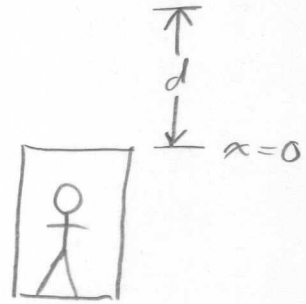
Now we need to use kinematics to find a in terms of the given info.

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

$d = 0 + 0 + \frac{1}{2} a t^2$

$v_f = v_0 + at$

$v_f = 0 + at$



After accelerating at $0.6g$ for d meters, the elevator will be travelling v_f m/s.

$$t = \left(\frac{2d}{a}\right)^{1/2} \Rightarrow v_f = a\left(\frac{2d}{a}\right)^{1/2}$$

$$\Rightarrow v_f = (2da)^{1/2}$$

$$\boxed{v_f = (2d(0.6)g)^{1/2}}$$

$$v_f = ((2)(3)(0.6)(9.8))^{1/2}$$

$$\boxed{= 5.9 \text{ m/s}}$$