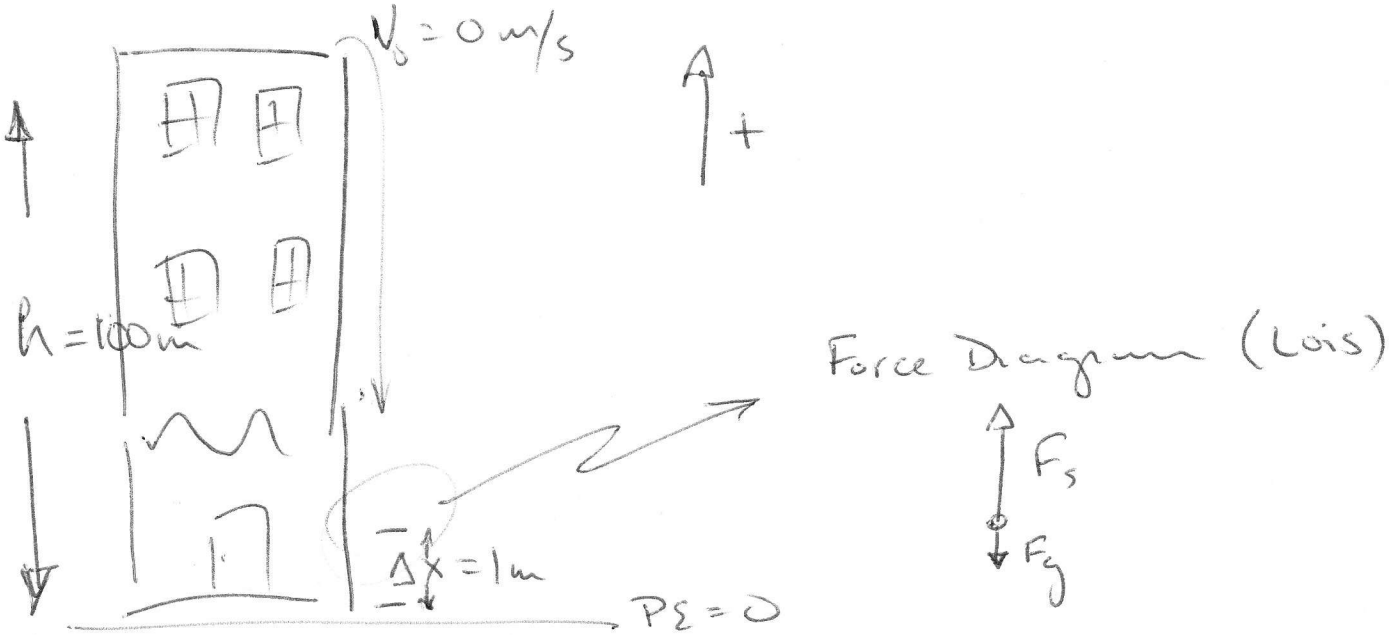
Generic Problem Solving Guide

- Focus
  - Draw a picture
  - What is the question?
  - List known quantities and unknown quantities
  - List assumptions
- Physics
  - Determine approach – What physics principles will you use?
  - Pick a coordinate system
  - Simplify picture to a schematic (if needed)
- Plan
  - Divide problem into sub-problems
  - Modify schematic and coordinate system if needed
  - Write general equations
- Execute
  - Write equations with variables
  - Simplify and solve
- Evaluate
  - Check units
  - Is answer reasonable? Check limiting cases!



How much time does it take Superman to stop Lois?

How much force is applied to Lois? (How many g's?)

Approach

$E_i = E_f$ $\quad W = \int \vec{F} \cdot d\vec{x}$

$\int \vec{F} dt = \Delta \vec{p}$

☐ Find velocity of Lois when she has fallen 99m.
(right before Superman catches her)

$E_i = E_f$

$mgh_0 = \frac{1}{2}mv^2 + mgx$ $\quad v = [2g(h-x)]^{1/2}$

$v = \left(2 \cdot 9.8 \frac{m}{s^2} \cdot 99m\right)^{1/2} \simeq 44 \, m/s$

[Direction from diagram]

☐ Find force from work needed to stop Lois

$W = -\int F_{net} \cdot dx = \Delta E$

$-F_{net} \Delta x = E_f - E_i = 0 - \frac{1}{2}mv^2 - mg\Delta x$

$F_{net} = \frac{mv_0^2}{2\Delta x} + mg$ $\quad F_s = F_{net} + mg$

$= 54{,}360 \, N$

☐ Find time from impulse

$\int F_{net} \cdot dt = \Delta p$ $\quad$ Since F_{net} is const.

$\frac{v_0}{\frac{v_0^2}{2\Delta x} + g} = \Delta t = \frac{\Delta p}{F_{net}} = \frac{mv_0}{\frac{mv_0^2}{2\Delta x} + mg} = \frac{v_0}{\frac{v_0^2}{2\Delta x} + g}$

$a = \frac{F_s}{m} = 988 \, m/s^2 \simeq 100g$

safe to say Lois is "squashed" [NOT SAFE]

$\Delta t = \frac{2429 Ns}{53820 N}$

$= 4.5 \times 10^{-2} s \; (45 \, ms)$ ← Not enough time to portray.

✓ units ✓
$N = \frac{kg \, m/s^2}{m} + kg \, m/s^2$

$h \uparrow \; v \uparrow$ and $\Delta t \downarrow$ ✓
$x \uparrow \; \Delta t \uparrow$ ✓
mass independent

reasonable ✓