Name: STANFORD Date:

NV College Physics Pquiz – Conservation of Energy

A young thug carries a 2-kg water balloon from street level up to the roof of his building. The roof top is 20m above the street below.

a) What is the change in the potential energy of the balloon?

$\Delta U = U - U_0$

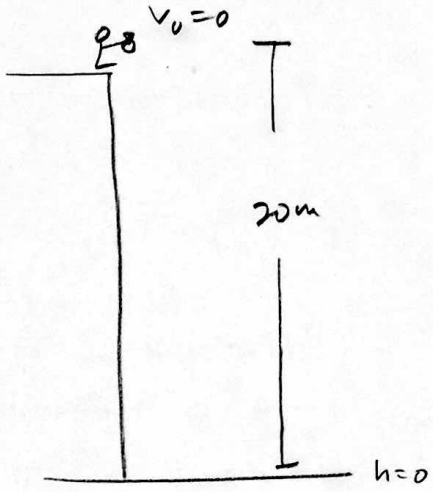
$= mgh - mgh_0$ ($h_0 = 0$)

$= (2)(9.8)(20) = \boxed{392\text{J}}$

b) If the balloon is released from rest on the rooftop, what is its kinetic energy when it reaches the ground?

$U_0 + K_0 = U + K$ ($U = 0$, $K_0 = 0$)

$U_0 = K = \boxed{392\text{J}}$



c) What is the speed of the balloon when it hits the ground?

$K = \frac{1}{2}mv^2 = 392\text{J}$

$\frac{1}{2}(2)v^2 = 392$

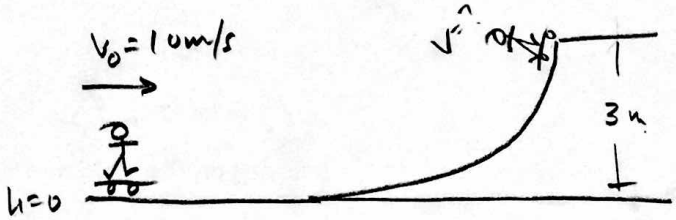
$\boxed{V = 19.8\text{ m/s}}$

2. A skateboarder with a mass of 60kg approaches the bottom of a ramp at a speed of 10m/s. The ramp is 3m high.

a) what is the kinetic energy of the skateboarder at the bottom of the ramp?

$K_0 = \frac{1}{2}mv^2 = \frac{1}{2}(60)(10)^2$

$= \boxed{3000\text{J}}$



b) what is their velocity at the top of the ramp?

$U_0 + K_0 = U + K$ ($U_0 = 0$)

$K_0 = mgh + \frac{1}{2}mv^2$

$3000 = (60)(9.8)(3) + \frac{1}{2}(60)v^2$

$30v^2 = 1236$

$\boxed{V = 6.42\text{ m/s}}$

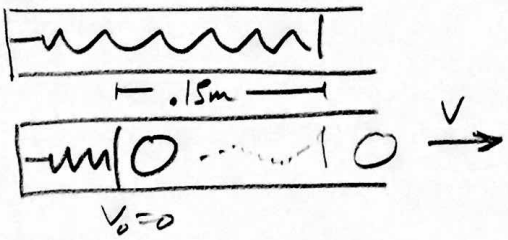
c) what maximum height above the ground can they reach if they are launched straight upwards from the end of the ramp?

$U_0 + K_0 = U + K$ ($K = 0$) at max height, $V = 0$

$\frac{1}{2}mv_0^2 = mgh$

$h = \frac{v_0^2}{2g} = \boxed{5.10\text{m}}$

3. A spring-loaded gun contains a spring with a constant of k = 240N/m. To load the gun, the spring is compressed a distance of 0.15m.



a) how much energy is stored in the spring when the gun is loaded?

$x = .15m$
$k = 240N/m$

$U_{sp} = \frac{1}{2}kx^2 = \frac{1}{2}(240)(.15)^2$

$\boxed{U_{sp} = 2.7\ J}$

b) what is the maximum speed that the gun can launch a projectile with a mass of .05kg?

$U_0 + K_0 = U + K$

$\frac{1}{2}kx^2 = \frac{1}{2}mv^2$

$2.7 = \frac{1}{2}(.05)v^2$

$\boxed{v = 10.4 m/s}$

c) How far would the spring need to be compressed to give the projectile a speed of 20m/s?

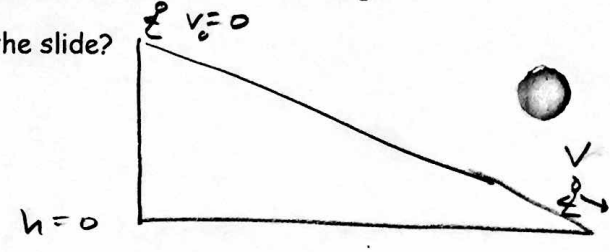
$U_0 + K_0 = U + K$

$\frac{1}{2}kx_0^2 = \frac{1}{2}mv^2$

$x_0 = \sqrt{\frac{mv^2}{k}} = \sqrt{\frac{(.05)(20)^2}{240}} = \boxed{.289m}$

4. A child with a mass of 20kg sits atop a slide at a height of 4m above the bottom. The slide is 12m long.

a) If there is no friction, what is the speed of the child at the bottom of the slide?



$U_0 + K_0 = U + K$

$mgh_0 = \frac{1}{2}mv^2$

$v = \sqrt{2gh} = \sqrt{2(9.8)(4)} =$

$= \boxed{8.85 m/s}$

b) If their speed at the bottom is actually 5 m/s, how much mechanical energy was lost to friction?

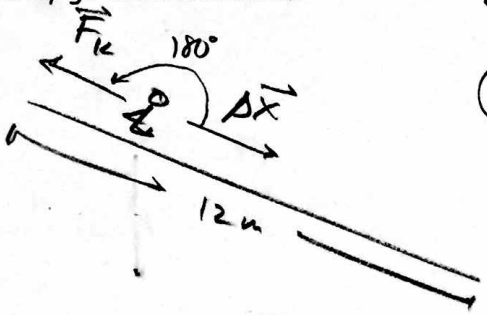
$U_0 + K_0 + W_{nc} = U + K$

$W_{nc} = K - U_0 = \frac{1}{2}mv^2 - mgh_0$

$= \frac{1}{2}(20)(5)^2 - (20)(9.8)(4) = 250 - 784 = -534\ J$

so $\boxed{534 J}$ are "lost" to friction (or converted to heat)

c) What is the force of friction acting on the child as they go down the slide?



$W_{nc} = |F_k||\Delta x|\cos\theta$

$W_{nc} = |F_k|(12)\cos 180^{-1}$

$-534 = |F_k|(-12)$

$|F_k| = \frac{534}{12} = \boxed{44.5N}$