Lesson 3.2: Conservation of Energy

Unit 3: Momentum and Energy

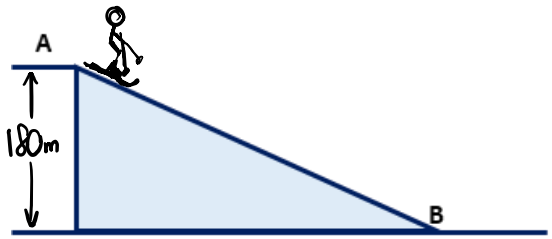
Law of Conservation of Energy:

$$E_{Ti} = E_{Tf}$$

$$E_{pi} + E_{ki} = E_{pf} + E_{kf}$$

Energy is neither created nor destroyed. Energy can be transformed from one kind to another, but the total amount of energy remains constant.

Example 1 – A basic conservation problem: A skier travels from A to B. If his velocity at A is 6.0 m/s, find velocity at B (ignore friction).



* Slope angle is irrelevant!
* mass of the skier is also irrelevant!

$$E_{pA} + E_{kA} = E_{pB} + E_{kB}$$

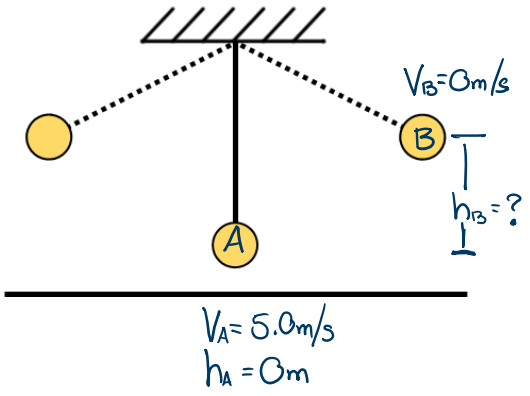
$$mgh_A + \frac{1}{2}mv_A^2 = mgh_B + \frac{1}{2}mv_B^2$$

$$(9.8)(180) + \frac{1}{2}(6)^2 = (9.8)(0) + \frac{1}{2}v_B^2$$

$$v_B = \sqrt{3564\ m^2/s^2}$$

$$\boxed{v_B = 59.7\ m/s}$$

Example 2 – A pendulum problem: A pendulum passes through its lowest point with a velocity of 5.0 m/s. How high (vertically) will it rise?



$$E_{pA} + E_{kA} = E_{pB} + E_{kB}$$

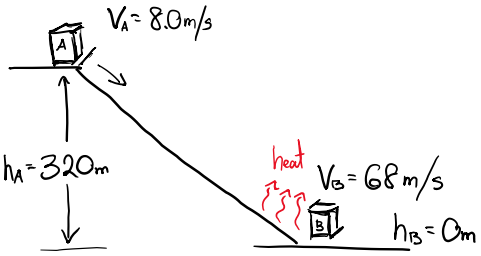
$$\frac{1}{2}mv_A^2 = mgh_B$$

$$h_B = \frac{v_A^2}{2g}$$

$$h_B = \frac{(5)^2}{2(9.8)}$$

$$\boxed{h_B = 1.3m}$$

Example 3 – When energy of the system is lost to heat or sound: A box of mass 62 kg skids down a slope from a height of 320m with an initial velocity of 8.0 m/s. At the bottom the velocity is 68 m/s. how much energy was transformed to heat?



$E_{pA} + E_{KA} = E_{pB} + E_{KB} + E_H$ ← Energy converted to heat + sound.

$mgh_A + \frac{1}{2}mv_A^2 = \frac{1}{2}mv_B^2 + E_H$

$(62)(9.8)(320) + \frac{1}{2}(62)(8)^2 = \frac{1}{2}(62)(68)^2 + E_H$

$E_H = 530000J$

$= 5.3 \times 10^4 J$ or $53kJ$

$E_H = m\left(gh_A + \frac{V_A^2 - V_B^2}{2}\right)$

$= 62\left(9.8(320) + \frac{8^2 - 68^2}{2}\right)$

$= 53072J$ or $5.3 \times 10^4 J$

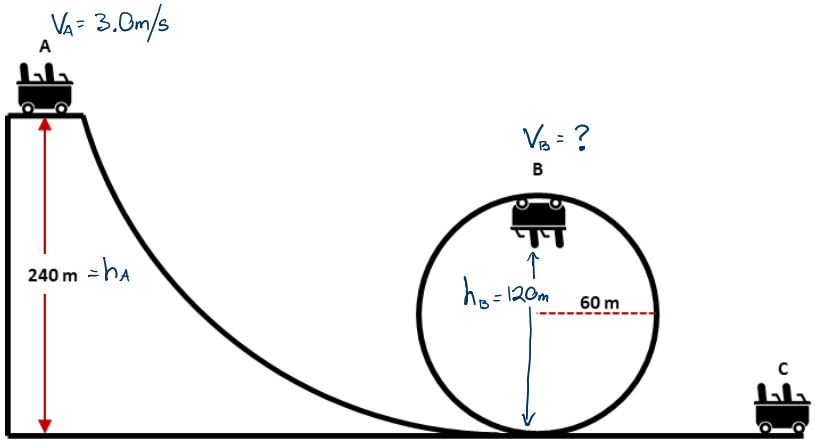
Example 4: When energy is conserved in two non-zero heights: Find the speed of the rolling cart at B when initial velocity is 3.0 m/s.

$E_{pA} + E_{KA} = E_{pB} + E_{KB}$

$mgh_A + \frac{1}{2}mv_A^2 = mgh_B + \frac{1}{2}mv_B^2$

$(9.8)(240) + \frac{1}{2}(3)^2 = (9.8)(120) + \frac{1}{2}V_B^2$

$V_B = 49 m/s$



$\frac{1}{2}V_B^2 = gh_A - gh_B + \frac{1}{2}V_A^2$

$V_B = \sqrt{2g(h_A - h_B) + V_A^2}$

$V_B = \sqrt{2(9.8)(240-120) + (3.0)^2}$

$V_B = 49m/s$

Assignment: Sander-Gore Pgs. 91-92 # 2-7 | Extra Practice: Pg 90 #1-3