Phy 4A 10/31

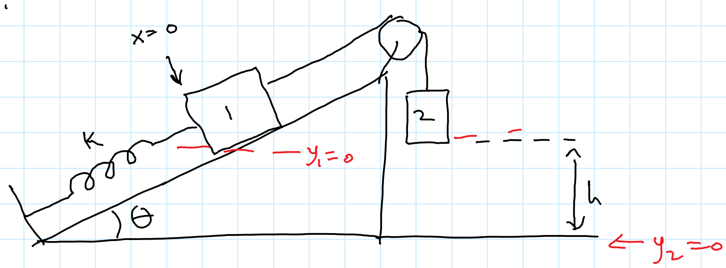
Thursday, October 27, 2016 12:36 PM

Goals for the Lecture:

1) Use Conservation of Energy to solve problems
2) Understand how defining your system can change external forces and potential energies

3) Understand why Power is useful in comparing motors
4) Understand what Momentum is and why it is special (how is it similar to and different from kinetic energy?)
5) Understand what Impulse is (how is it similar to and different from work?)
6) Be able to use the Impulse – Momentum Theorem to solve problems

Example:



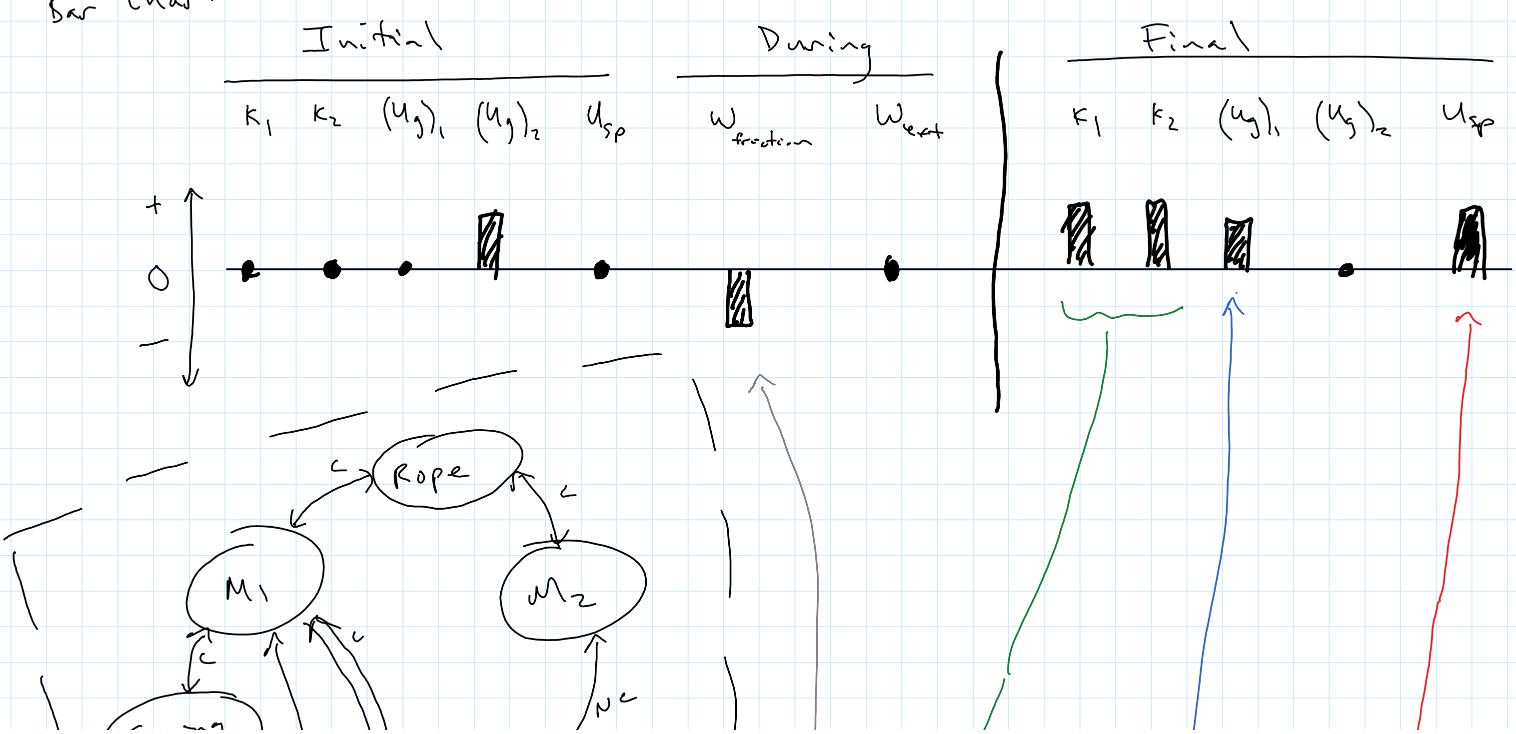
given: m_1, m_2, k, θ, h

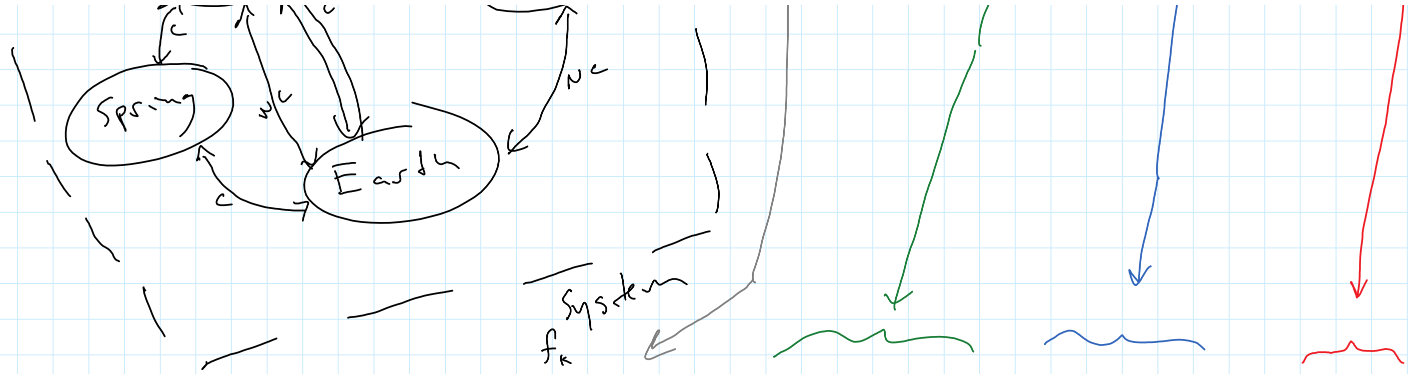
μ_s, μ_k

$v_i = 0$ at $x=0$ (equilibrium position of spring)

Find: velocity of m_2 just before it hits the ground

Bar Chart:





Equation: $m_2 g h - \overbrace{\mu_k N}^{f_k} h = \frac{1}{2}(m_1+m_2)v_f^2 + m_1 g \underbrace{h\sin\theta}_{\Delta y_1} + \frac{1}{2}k h^2$

Application of the Day:

Generating energy involves transfer from one type to another:

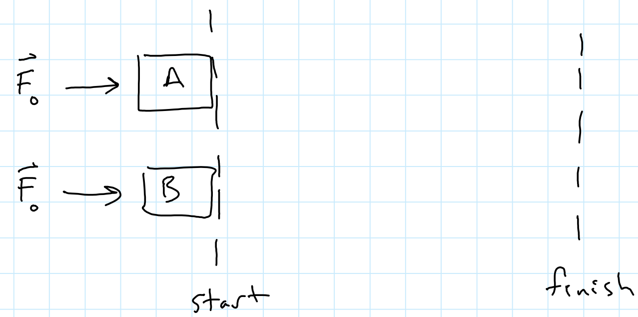
Solar / hydroelectric / etc

Runaway truck ramps (like on I-5 over the Grapevine) convert KE into other forms (PE, heat, etc)

Momentum

frictionless surface

worksheet p. 72



$m_B > m_A$

Start at rest

momentum: $\vec{p} = m\vec{v}$ $\quad kg\,\frac{m}{s}$

B) Cart B

c) $\Sigma F = ma$ $\quad \vec{a} = \frac{\Delta \vec{v}}{t}$

$\Sigma F = m\left(\frac{\Delta \vec{v}}{t}\right)$

1) $m_A|\Delta\vec{v}_A| \overset{?}{} \; m_B|\Delta\vec{v}_B|$

$(\Sigma F)_A t_A \; ? \; (\Sigma F)_B \, t_B$

$t_A < t_B$

B takes longer

$$\underbrace{\Sigma\vec{F}\, t}_{\text{Impulse}} = \underbrace{m\,\Delta\vec{v}}_{\Delta\vec{p}}$$

---

p. 73

Impulse: $\vec{I} = \vec{F}_{net}\,\Delta t = m\,\Delta\vec{v} = \Delta\vec{p}$

Momentum: $\vec{p} = m\vec{v}$

Work - KE Theorem

$W = \Delta K$

Impulse - momentum Theorem

$\vec{I} = \Delta\vec{p}$

$$|\vec{I}_B| > |\vec{I}_A|$$

4) $(\vec{P}_B)_f > (\vec{P}_A)_f$

D) $W_A = W_B$

$KE_A = KE_B$

student 1: okay

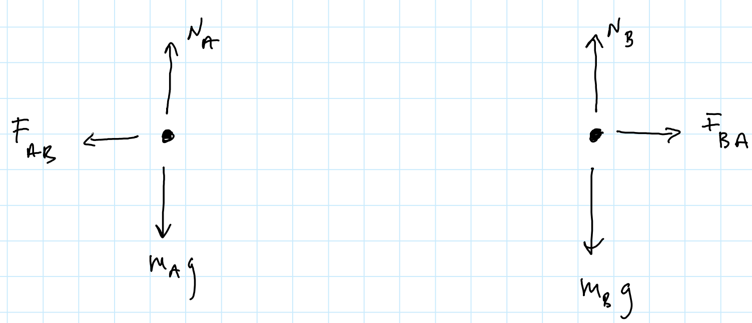
2: wrong $\quad \vec{P}_B > \vec{P}_A$

3: wrong $\quad KE_A = KE_B$

---

p. 74 $\quad$ B)

A $\qquad\qquad$ B



1) $(\vec{F}_{Net})_A = -(\vec{F}_{Net})_M$

p. 75

2) $|(\vec{F}_{Net})_A| \Delta t = |(\vec{F}_{Net})_M| \Delta t$ $\quad$ same

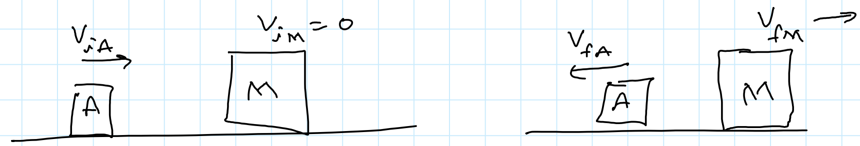
direction is opposite

$\vec{I}_A = -\vec{I}_M$

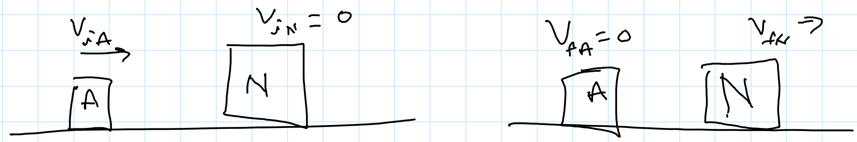
$\Delta\vec{P}_A = -\Delta\vec{P}_M$

V_{iA} $\quad V_{iM} = 0$ $\quad V_{fA}$ $\quad V_{fM} \rightarrow$

c) case 1:



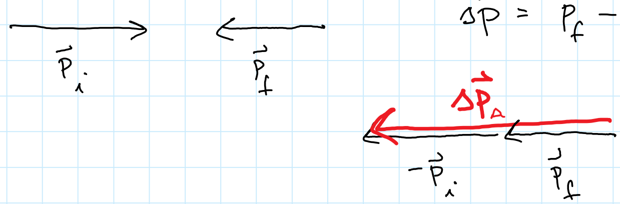
case 2:



case 1

cart A)

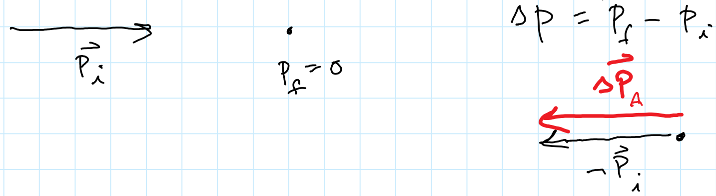
$$\Delta\vec{p} = \vec{p}_f - \vec{p}_i$$



case 2

cart A)

$$\Delta\vec{p} = \vec{p}_f - \vec{p}_i$$



$$\left|\left(\Delta\vec{p}_A\right)_1\right| > \left|\left(\Delta\vec{p}_A\right)_2\right|$$

So,

$$\left|\Delta\vec{p}_M\right| > \left|\Delta\vec{p}_N\right|$$

since, $\Delta\vec{p}_A = -\Delta\vec{p}_M$

So,

$$V_{mf} > V_{Nf}$$