08 FEB 12

• Day 91 •

- Warm-ups
- Related rates projects & Calculus Midterm MC
- Object of the Week: Ursa Major
- Center of Mass
- Physics midterm questions and review
- Homework Assignment: STUDY
  Read lab by Monday

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Warm-ups

1. A skydiver has been in the air long enough to be falling at a constant terminal speed of 50 meters per second. How much farther will the skydiver fall in the next 2.00 seconds?

(A) 19.6 m
(B) 50 m
(C) 98 m
(D) 100 m
(E) 120 m

$v = 50\ m/s$

$a = 0$

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

$= (50\ m/s)(2\ s)$

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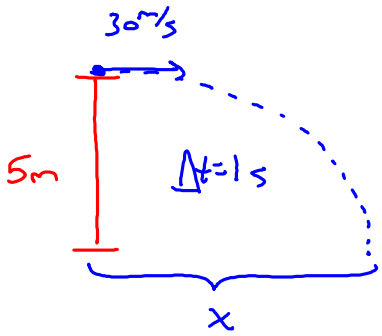
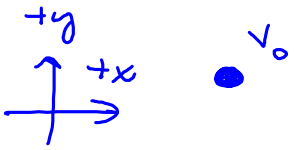
2. It takes about 1.0 second for an object to fall 5 meters vertically. If this same object is thrown horizontally with a speed of 30 meters per second from a roof-top 5 meters above ground, about how many meters from the base of the building will the object land?

(A) 30 m
(B) $30\sqrt{2}$ m
(C) $30\sqrt{3}$ m
(D) 60 m
(E) 90 m



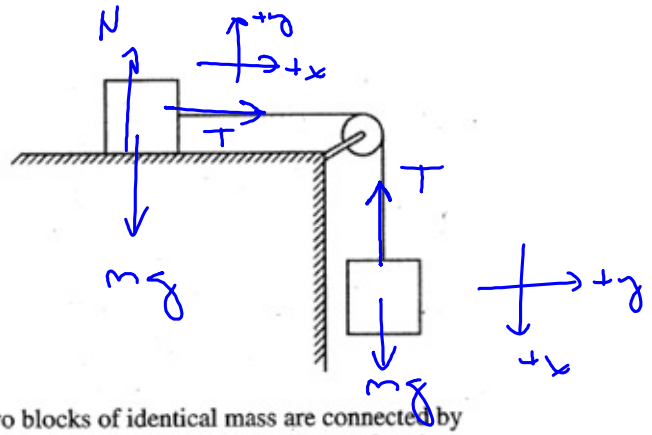


$a = \frac{v - v_0}{t}$

$y = \frac{v^2 - v_0^2}{2a}$

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

3



Two blocks of identical mass are connected by a light string as shown above. The surface is frictionless and the pulley is massless and frictionless. The acceleration of the two-block system is most nearly

(A) 20 m/s^2
(B) 15 m/s^2
(C) 10 m/s^2
(D) 5 m/s^2
(E) 2.5 m/s^2

$\Sigma F = T$ $\quad$ $\Sigma F = mg - T$

$ma = T$ $\quad$ $ma = mg - T$

$2ma = mg$

$a = \frac{g}{2}$

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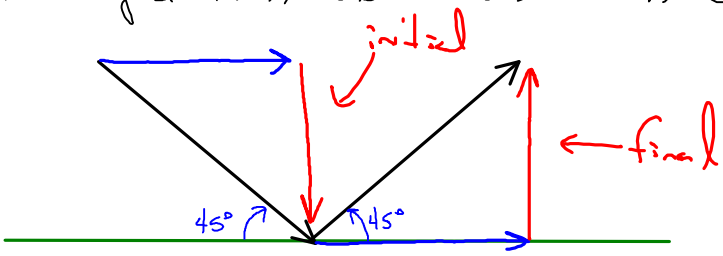
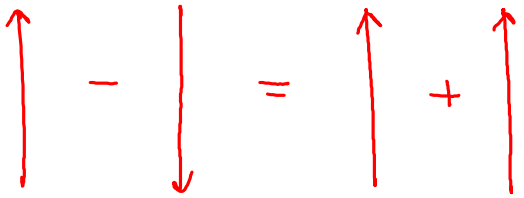
⇒ Vectors and $\Delta\vec{p}$

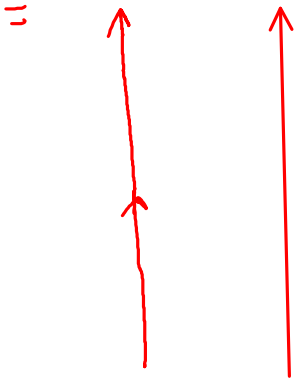
A ball collides elastically with a wall and "bounces off" as shown. Describe $\Delta\vec{p}$.



Δp_x : $mv_{fx} - mv_{ix} = m(v_{fx} - v_{ix})$

Δp_y :





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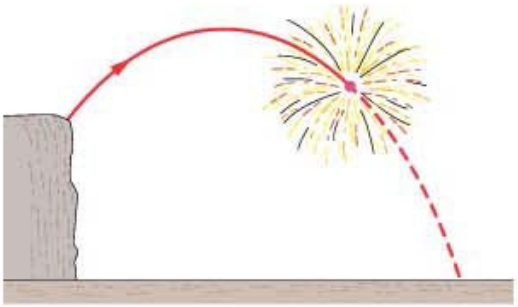
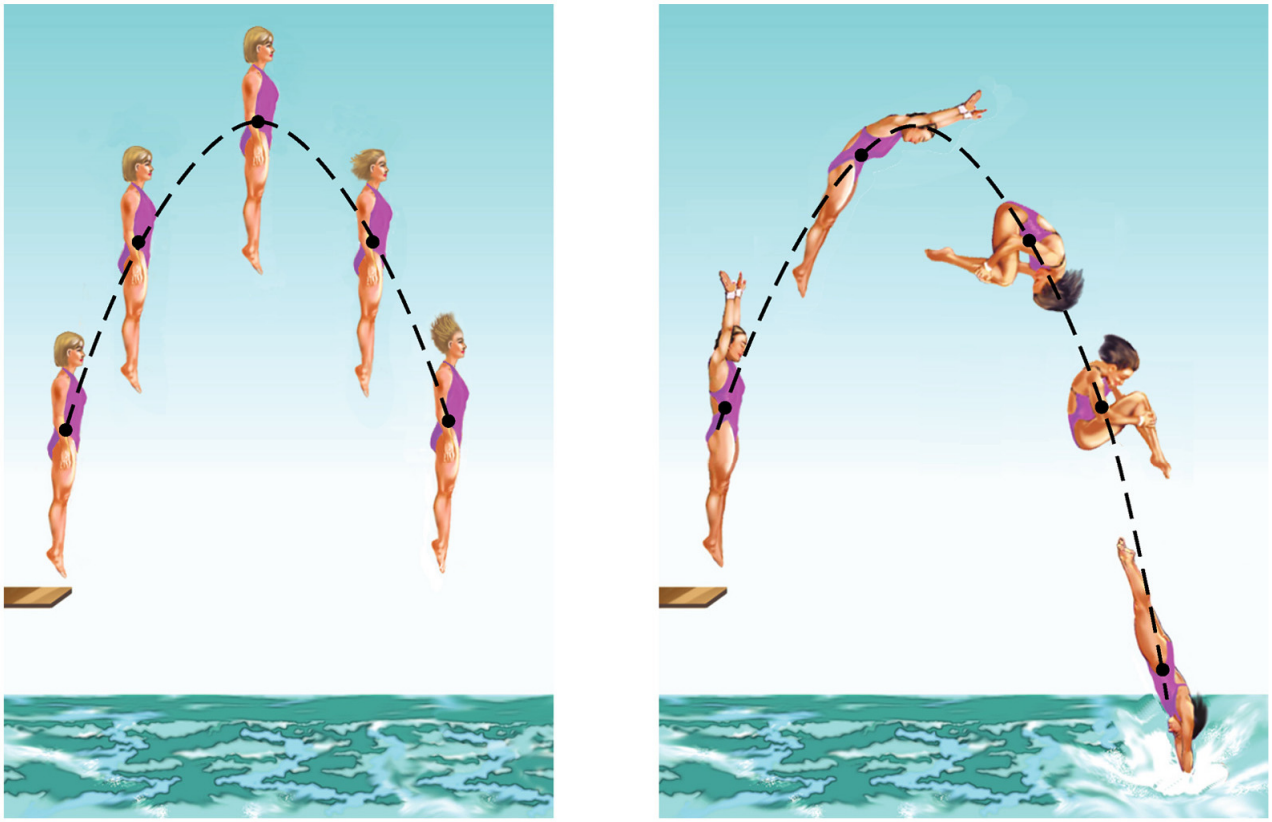



Path of head
Path of center of mass



(a) (b)

⇒ Center of Mass (com or cm)

- Demo: Exploration of Physics Vol. I
  Center of Mass

- "Donald Duck Magic Book" meter stick demo

- PhysSlat I 8.7 ; P 8.14

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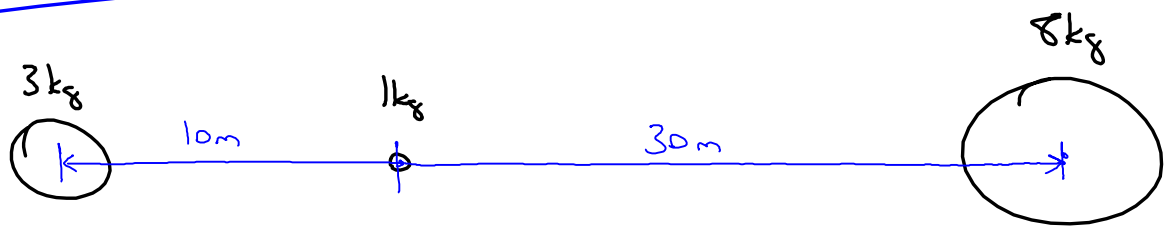
⇒ Center of Mass Calculation



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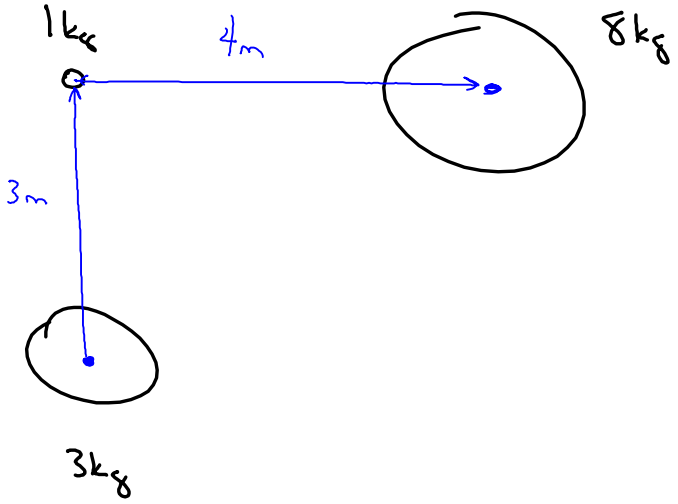

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• 2 kg

$U(x) = 8x^2 + 2x^4$ $\quad v = 5\ m/s \quad x = 1$

$F = -\frac{dU}{dx} = -(16x + 8x^3)$

speed at $x = 0$

KE @ $x = 1$: $\frac{1}{2} m v^2 = \frac{1}{2}(0.2\ kg)(5\ m/s)^2$

$= 2.5\ J$

$U(1) = 8(1)^2 + 2(1)^4 = 10\ J$

$E_{mech,tot} = K + U = 2.5\ J + 10\ J$

$= 12.5\ J$

@ $x = 0$: $U(0) = 0\ J$

$K = 12.5\ J$

$\frac{1}{2} m v^2 = 12.5\ J$

$v = 11.180\ m/s$

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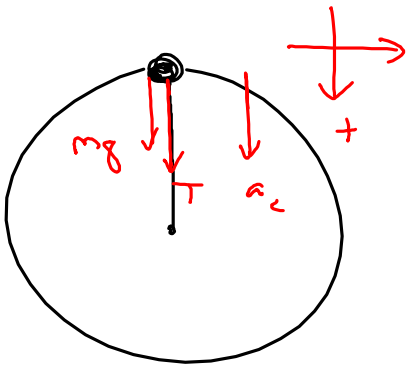


$$\underbrace{\Sigma F}_{ma_c} = T + mg$$

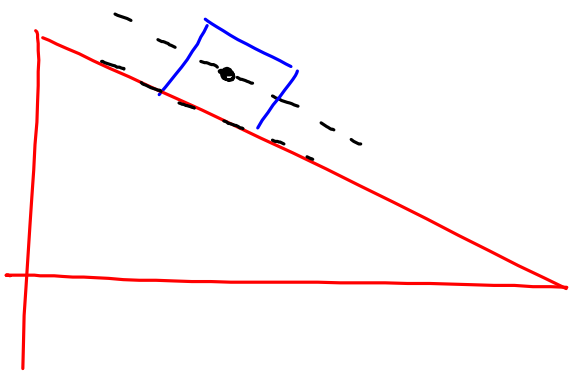
$$ma_c = \cancel{T}^{0} + mg$$

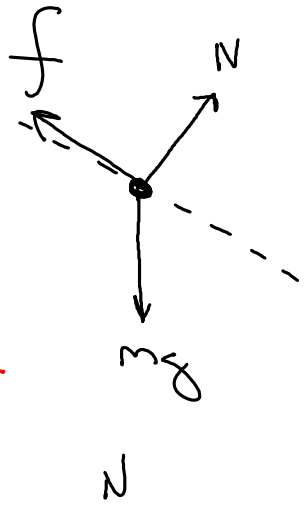
$$\cancel{m}a_c = \cancel{m}g$$

$$\frac{v^2}{r} = g$$

$$v^2 = gr$$

speed: $v = \sqrt{gr}$





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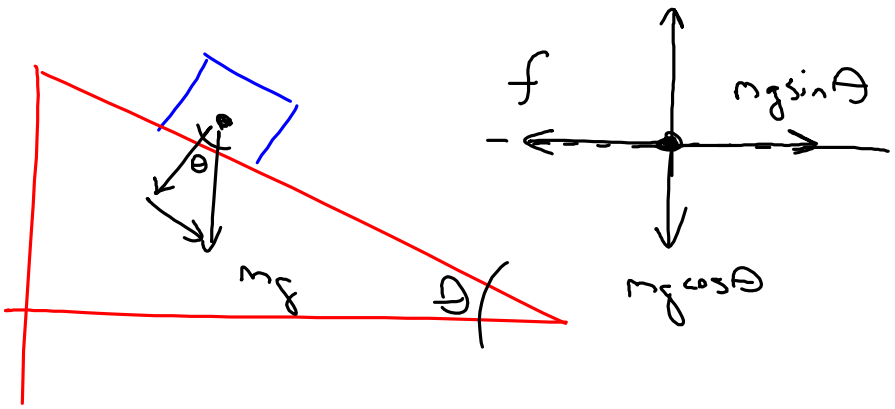
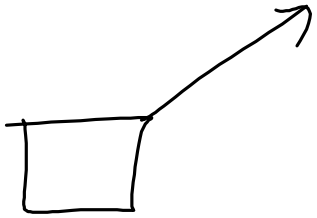
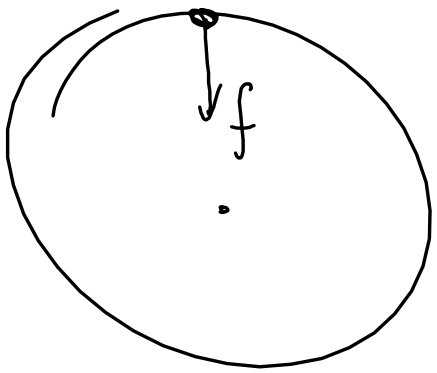

f
mgsinθ
θ
mg
θ
mgcosθ





$$\underbrace{\Sigma F} = f$$

$$ma_c = \mu N$$

$$\cancel{m}a_c = \mu \cancel{m} g$$

$$\frac{v^2}{r} = \mu g$$

$$v = \sqrt{\mu g r}$$

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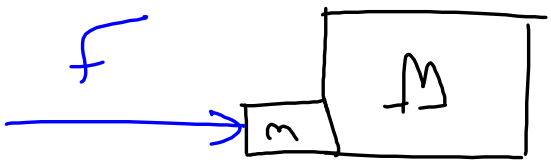

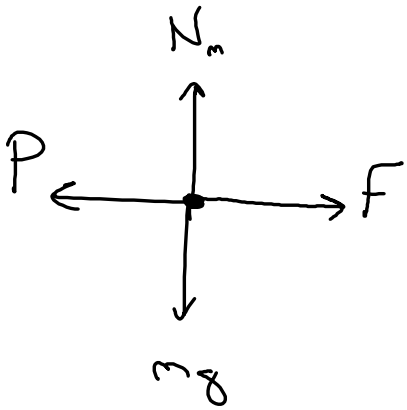

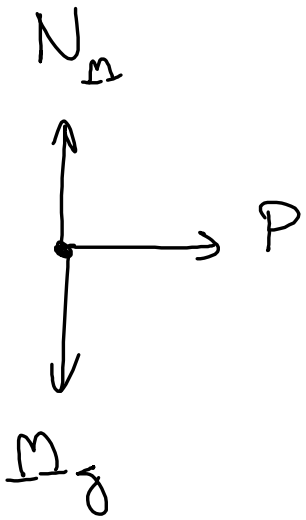

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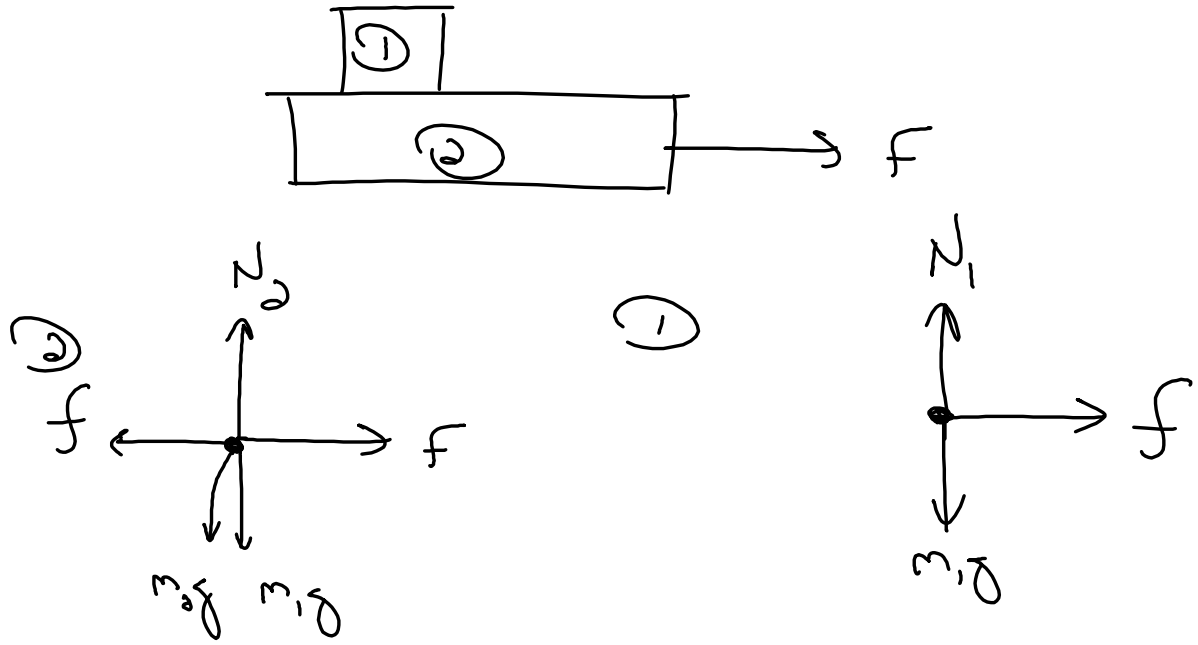

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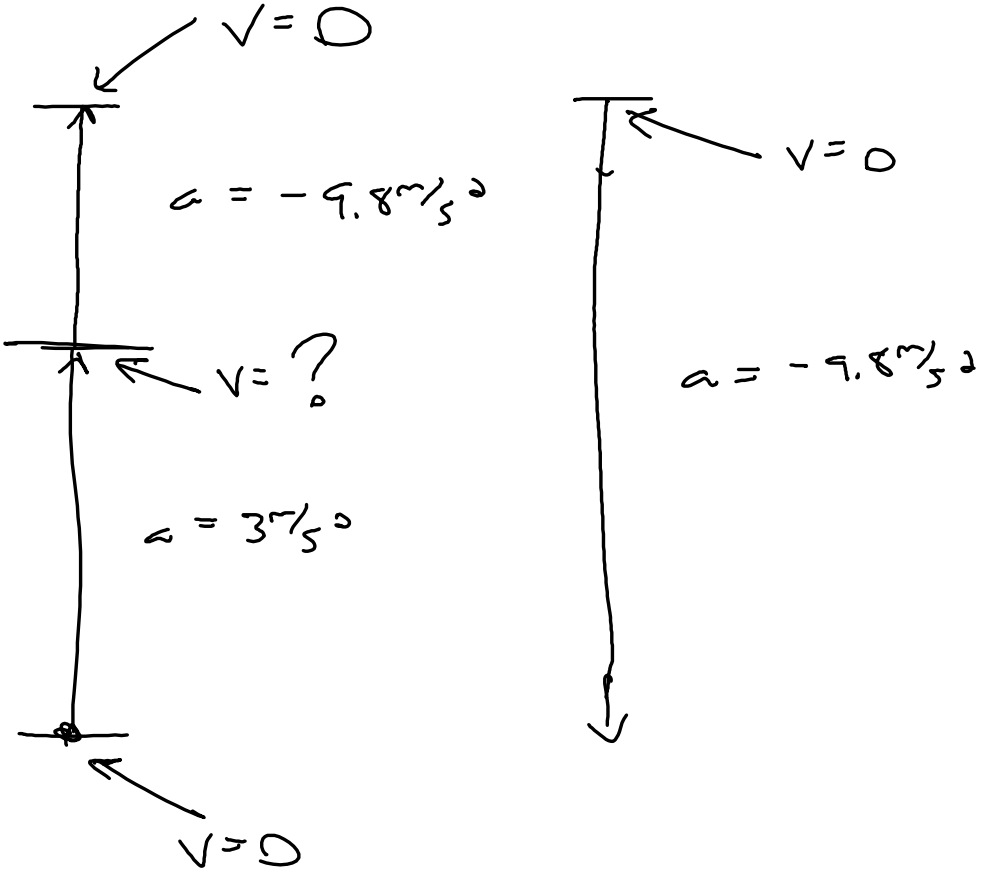

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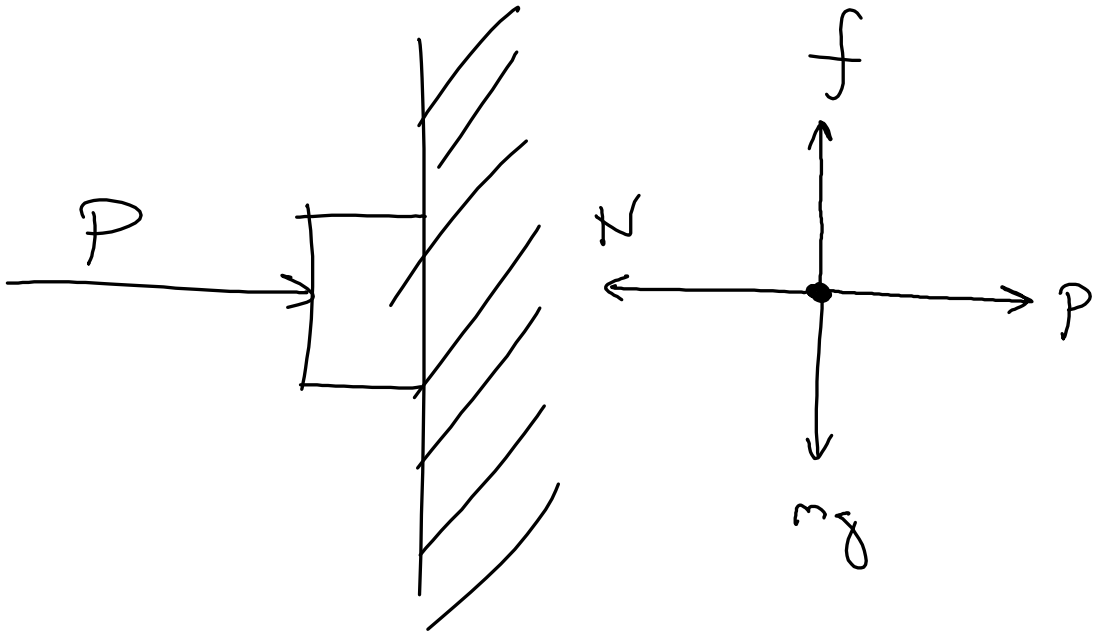

$$f = mg$$

$$\mu N = mg$$

$$\mu P = mg \Rightarrow P = \frac{mg}{\mu}$$

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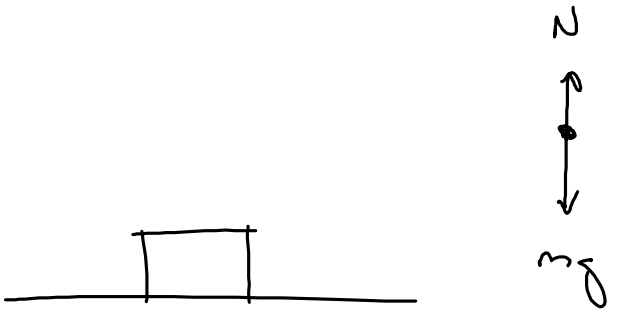

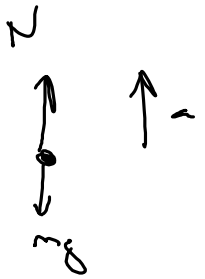

$$\underbrace{\Sigma F} = N - mg$$

$$ma = N - mg \Rightarrow N = m(a+g)$$

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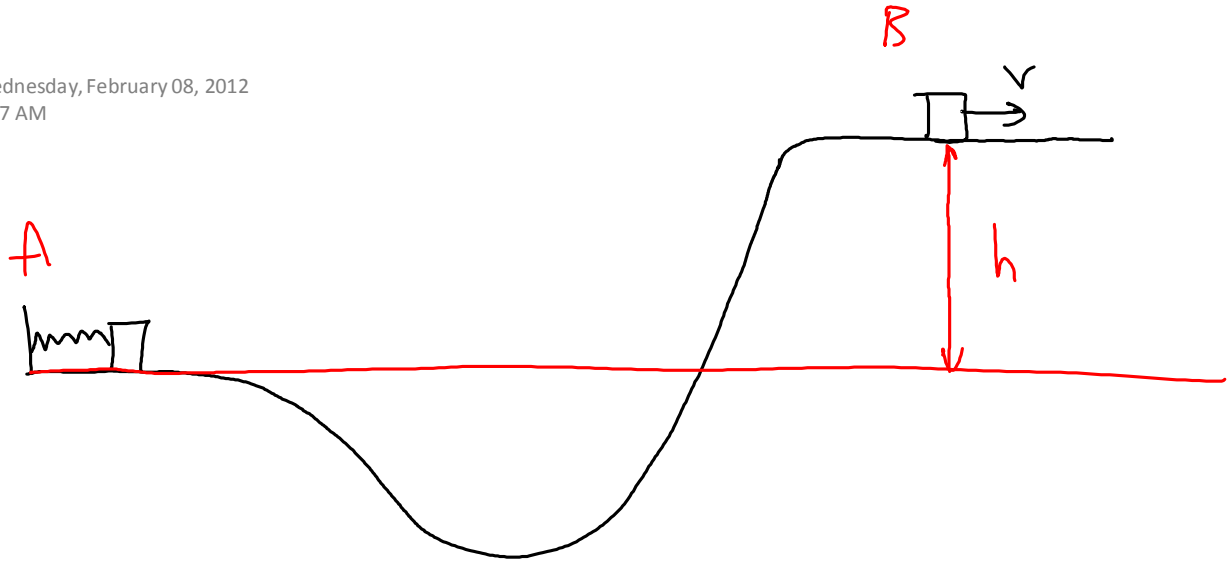
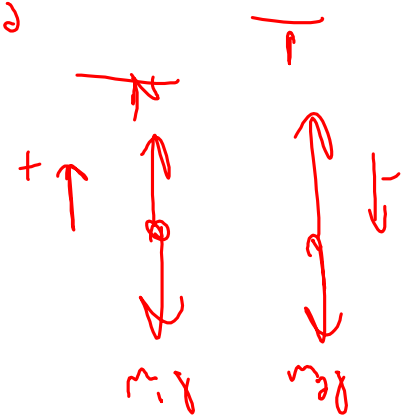
Wednesday, February 08, 2012
9:07 AM



$$\tfrac{1}{2}kx^2 = mgh + \tfrac{1}{2}mv^2$$

$$kx^2 = 2mgh + mv^2$$

$$\frac{mv^2}{m} = \frac{kx^2}{m} - \frac{2mgh}{m}$$



$$v^2 = \frac{kx^2}{m} - 2gh$$

$$v = \sqrt{\frac{kx^2}{m} - 2gh}$$

★Homework Assignment★

- Study
- Read lab for Monday

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