PHYS211
Exam 2 Prep

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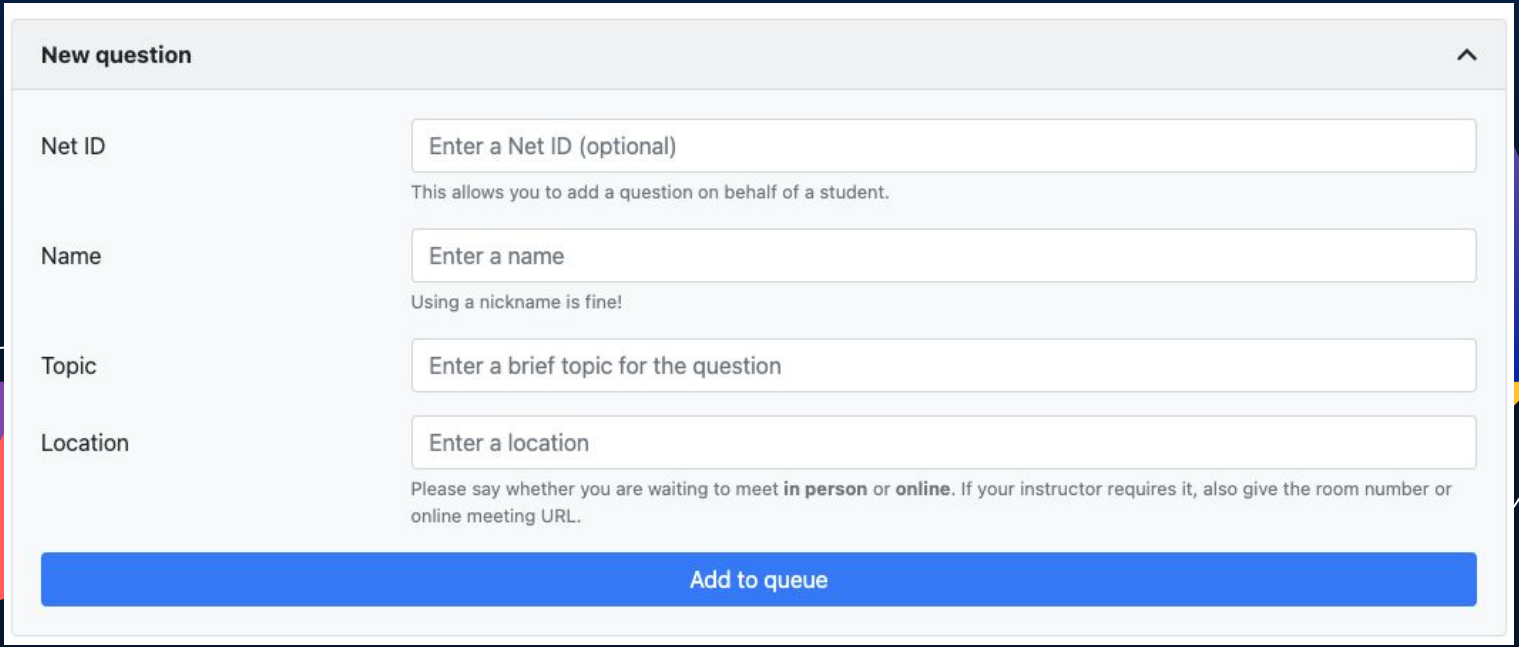
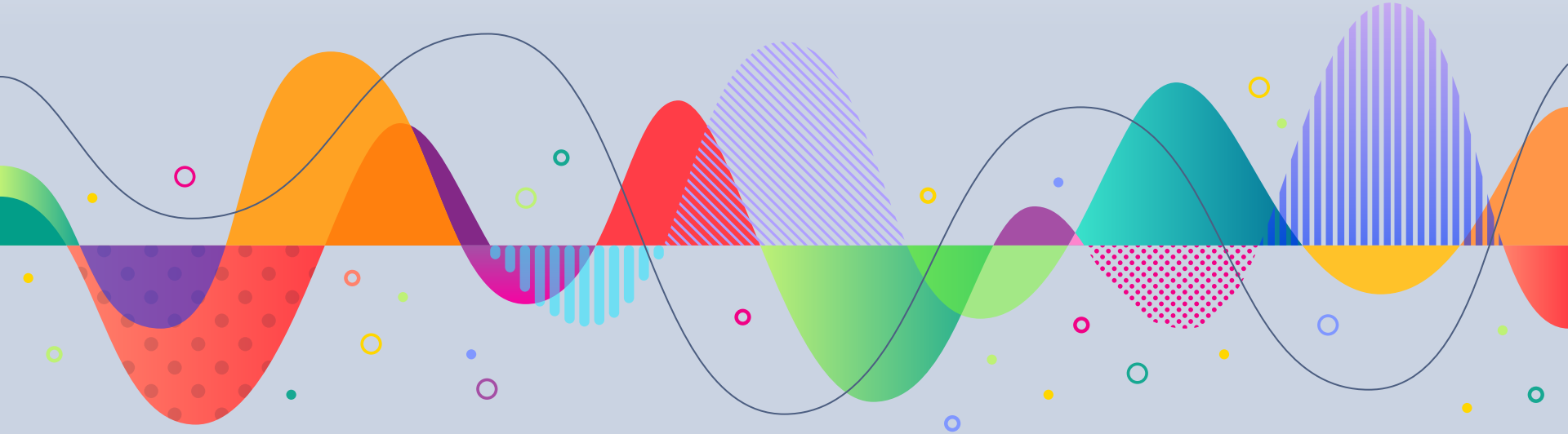
CARE / CARE PHYS 211 Exam Review



1.

Overview

Quick bits of info to know



Forces

- Conservative
  - Weight (gravity)
  - Spring Force: $F_s = -k \Delta x$
- Nonconservative
  - Normal: Perpendicular to an object's surface by below surface
  - Tension: points away from object
  - Friction: $f = \mu N$
- Equal & Opposite Forces
- X and Y components still apply, especially for ramp problems

Work

- Work-Energy Theorem: The work done on a system by the sum of forces acting on it is equal to the change of kinetic energy of the system, $\Delta KE = W_{tot} = \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2$
- $W=F*d$
- $W= -\Delta PE$ (for work done in a conservative field, such as dropping a ball with no air resistance)

$$W = \int \mathbf{F} \cdot d\mathbf{l}$$
$$W = \mathbf{F} \cdot \Delta\mathbf{r} = F\ \Delta r \cos\theta$$

Work and Mechanical Energy

- For ΔE, you can choose whichever two points you want for the initial and final energy ($E_f - E_i$)
- Don't mix up potential energy equations with work equations
  - i.e. $U_{spring} = kx^2/2$, but $W_{spring} = -k(x_f^2 - x_i^2)/2$
- Work and Energy are intimately related, using the theorems and conservation laws will help a lot!
- Total mechanical energy: $\Delta KE + \Delta PE = W_{NC}$

Momentum and Impulse

- $p=mv$
- $F_{net,\ external} = dp_{total}/dt$
  - When $F_{ext} = 0$, $dp/dt = 0$, momentum is conserved
- Is conserved in both the x and y direction
- Impulse : change in momentum
  - $I = F_{AVG}\Delta t = \Delta p$

- Inelastic
  - KE is not conserved
  - Perfectly Inelastic - Objects stick together
- Elastic
  - Momentum + KE is conserved
  - Objects bounce apart

Center of Mass + Frames

- For a system of objects, we treat them as point masses
- More massive object has more influence on center of mass

$$X_{CM} = \frac{\sum m_i x_i}{\sum m_i}$$

$$V_{CM} = \frac{\sum m_i v_i}{\sum m_i}$$

$$A_{CM} = \frac{\sum m_i a_i}{\sum m_i} = \frac{F_{Net,External}}{M_{Total}}$$

- Lab Reference Frame
  - Observe from outside system
- Center of Mass Reference Frame
  - Observing from inside system
  - $V^*_{obj,\,CM} = V_{obj,\,lab} - V_{CM,lab}$

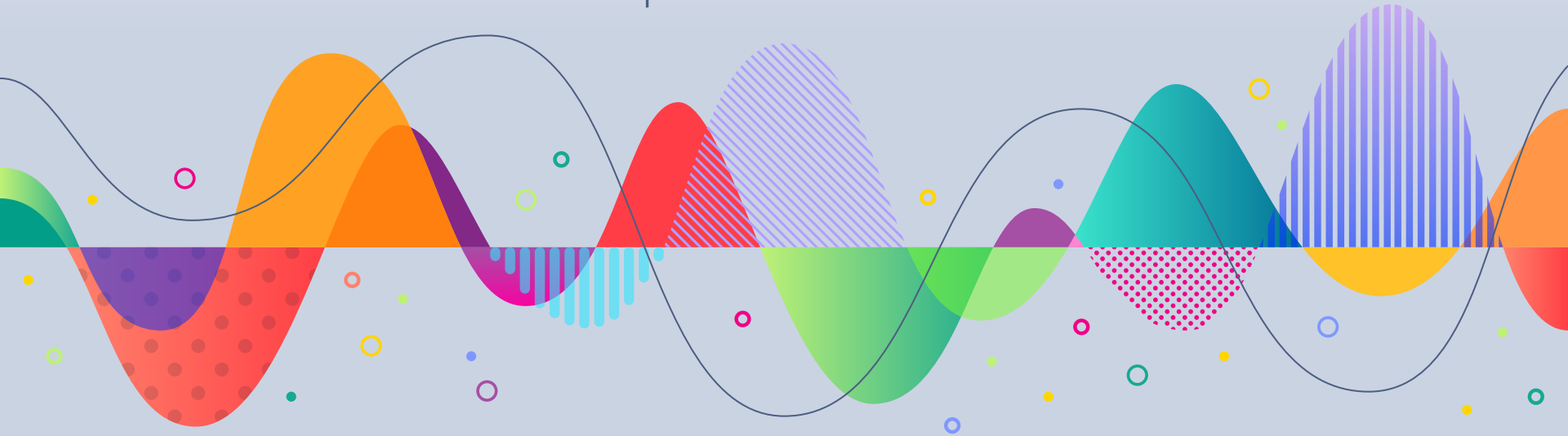
Transformation to the CM Frame

$$\vec{v}_{object,B} - \vec{v}_{CM,B} = \vec{v}_{object,CM}$$

2.

Problem Solving

Some Steps to Follow If You're Lost



Momentum

How to Identify:

- Collisions
- Explosions
- Impulse

Momentum

- List given variables
  - **In both x and y directions if necessary**
- Identify if momentum is conserved (no external forces)
- List all initial momentums and all final momentums
- Solve for missing variable
- *You will almost never need to use Kinematics, think of **Energy**, **Work, or Momentum** instead*
- Impulse:
  - Use F <u>average</u>

CoM + Frames

How to Identify:

- “In _ ref frame”
- Canoe/Plank
- Usually says “center of mass”

Center of Mass + Frames

- Center of Mass
- Identify X_{CM}, V_{CM} if necessary
  - Pay attention to x and y direction

$$V_i^* = V_i - V_{CM}$$
$$V_i^* = -V_f^*$$
$$V_f = V_f^* + V_{CM}$$

- Think Reference Frames
- List variables and their frames
  - $V_{lab,}$ $V_{cm,}$ etc.
- Solve for the variable you're looking for

Work/Energy

How to Identify:

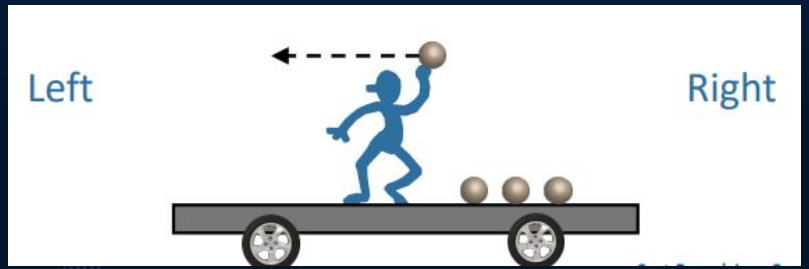
- Change in Height
- Starts & ends at rest
- Kinematics/Force eqns look too complicated

Work/Energy

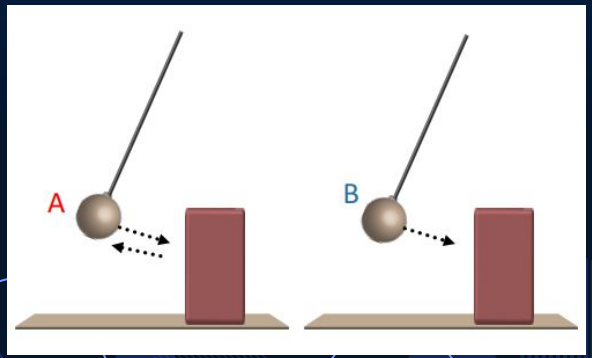
- Conservation of Energy: $E_i = E_f$
- Work-KE Theorem: $W_{NET} = W_C + W_{NC} = \Delta KE$
- Conservation of Mechanical E: $W_{NC} = \Delta E = \Delta K + \Delta U$
  - Nonconservative Forces: Friction, Normal, Tension
- Choose one of the above paths and plug in your variables
- Make sure you have the right SIGN for work!
  - Remember, opposing Force and Distance → -W

Momentum Concept Question

How will the carts position change?



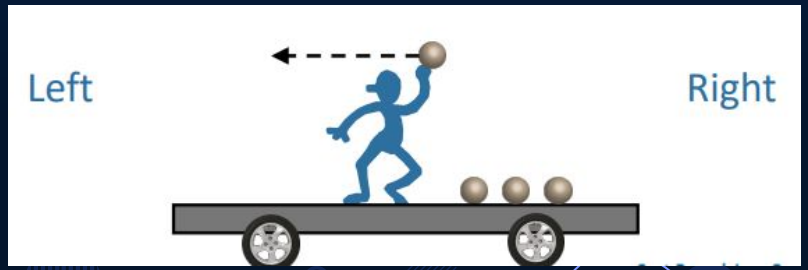
Which brick will fall over and why?



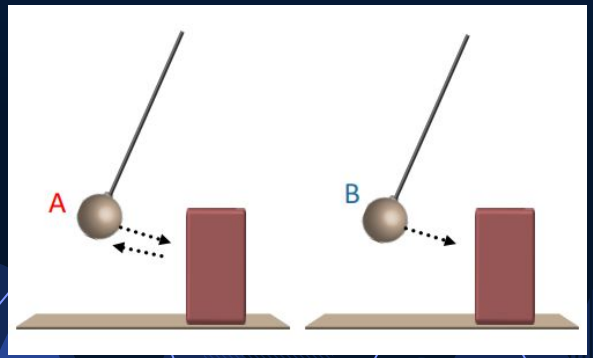
SOLUTION: Momentum Concept Question

How will the carts position change?

Will move to the **right**

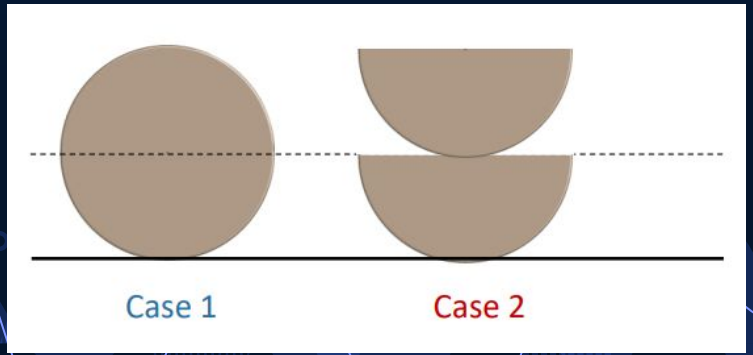


Which brick will fall over and why? **A**, it has a larger impulse moment

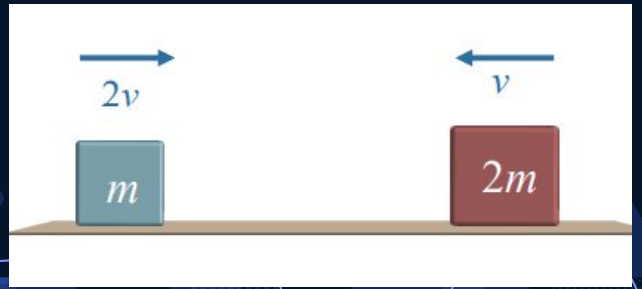


CoM and Reference Frames Concept Question

Which case has the higher center of mass?

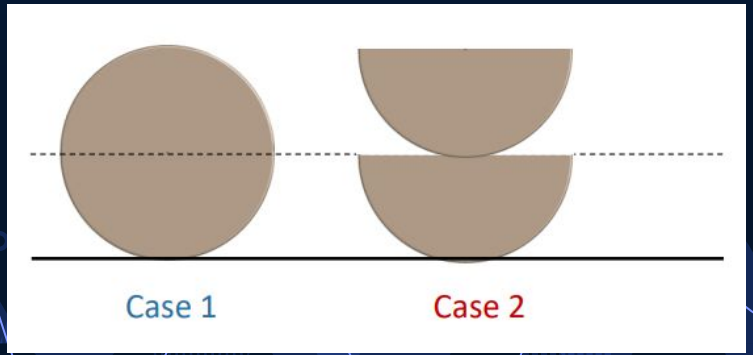


What is the momentum in the center of mass frame?

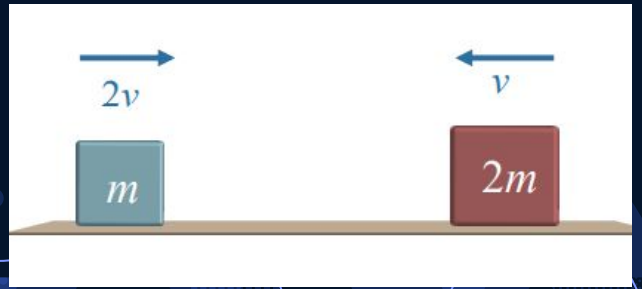


SOLUTION: CoM and Reference Frames Concept Question

Which case has the higher center of mass? **Case 2**

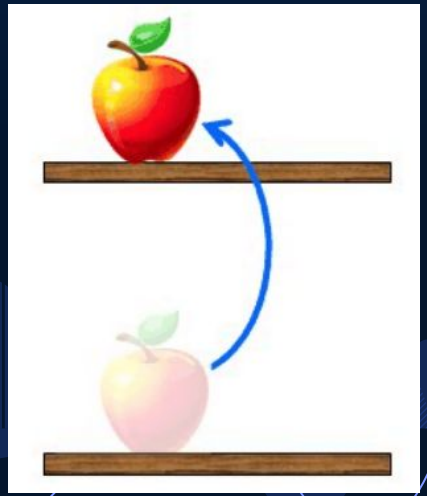


What is the momentum in the center of mass frame? **Zero!**

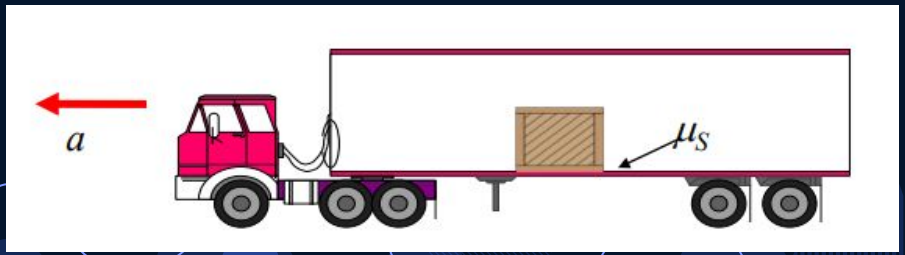


Work and Energy Concept Questions

What is the net work done on the apple?



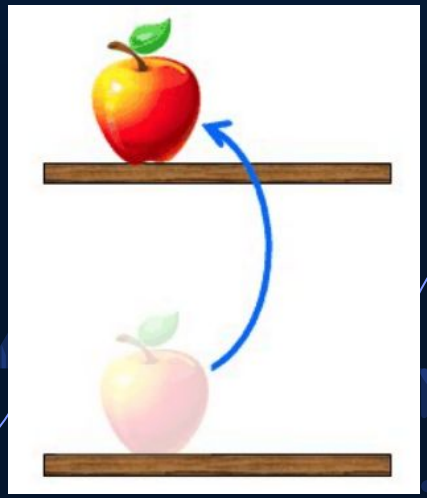
In what direction does the work due to static friction point?



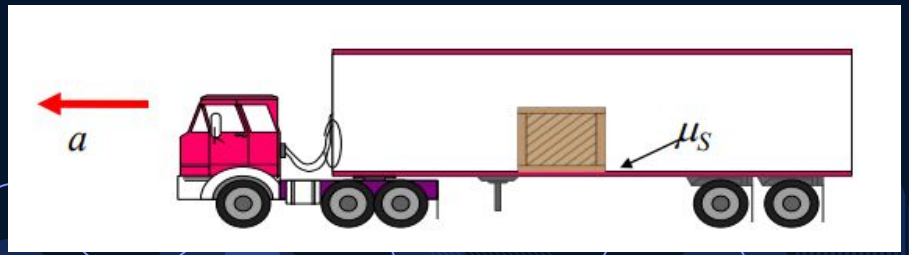
SOLUTION: Work and Energy Concept Questions

What is the net work done on the apple?

Zero, no change in KE



In what direction does the force due to static friction point? **To the left**



Worksheet Time!

Enter Queue with your name and net ID:

By entering the queue, you help us:

-Reserve a big enough space at the next review session

-Assign enough tutors for everyone to have access to help

Thank you!