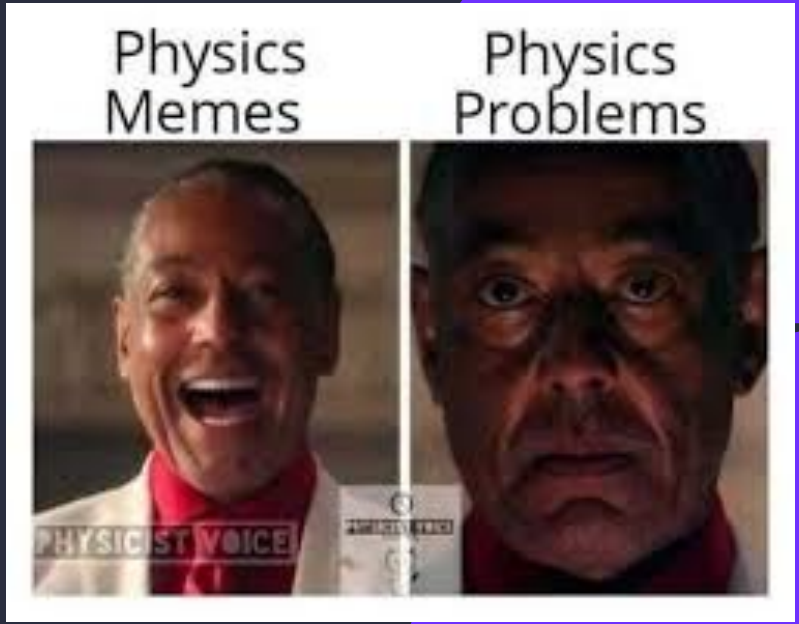
PHYS 211
Exam 1 Prep

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

SCAN ME

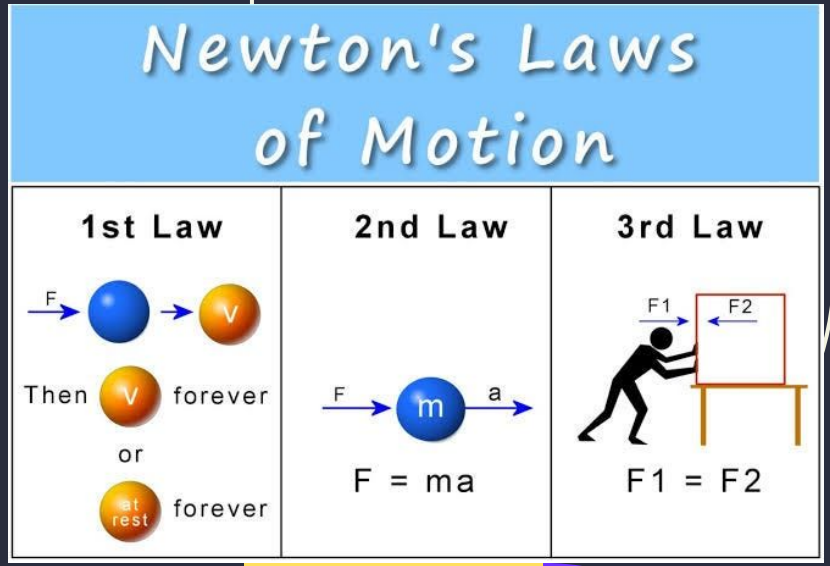
1. Overview

Quick Bits of info to know



Newton's Laws

- **1st Law:** Velocity of an object is constant if the sum of forces on the object is zero,
  $F=0 \Leftrightarrow dv/dt=0 \Leftrightarrow a=0$
- **2nd Law:** The net force on an object is equal to its mass times its acceleration,
  F=ma
- **3rd Law:** Any forces acting on an object will have an equal and opposite reaction,
  $\mathbf{F_{a,b} = -F_{b,a}}$

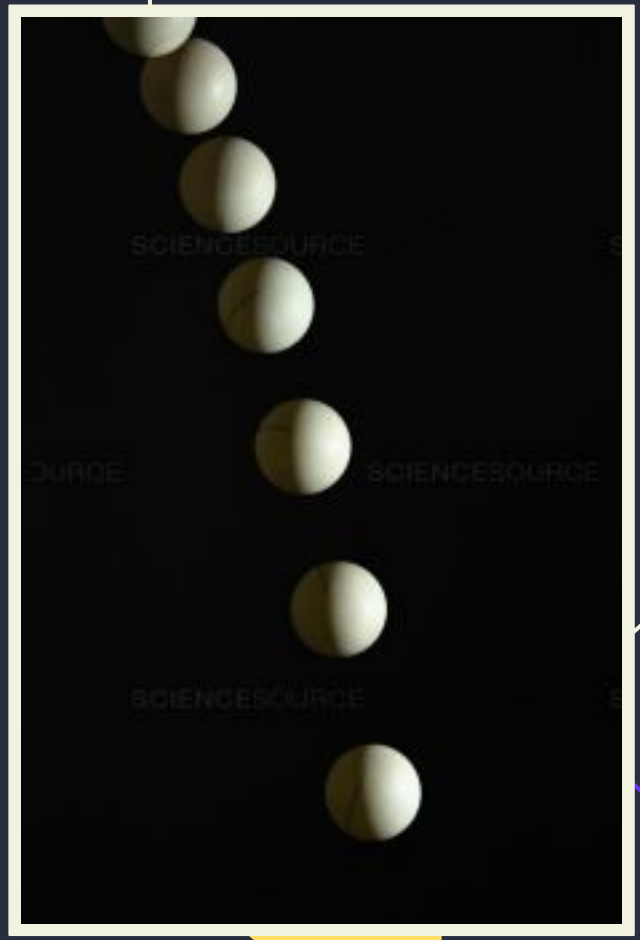


*These equations are true for all interactions in Phys 211! Note that the forces and acceleration are vectors; direction matters

1-D, 2-D Kinematics:

Equations associated with Kinematics:

- ★ $v = v_o + at$
- ★ $r = r_o + v_o t + \frac{1}{2} at^2$
  - ○ r is the position in x or y (at time t)
- ★ $v^2 = v_o^2 + 2a(x-x_o)$



Kinematics Assumptions

Projectile Motion:

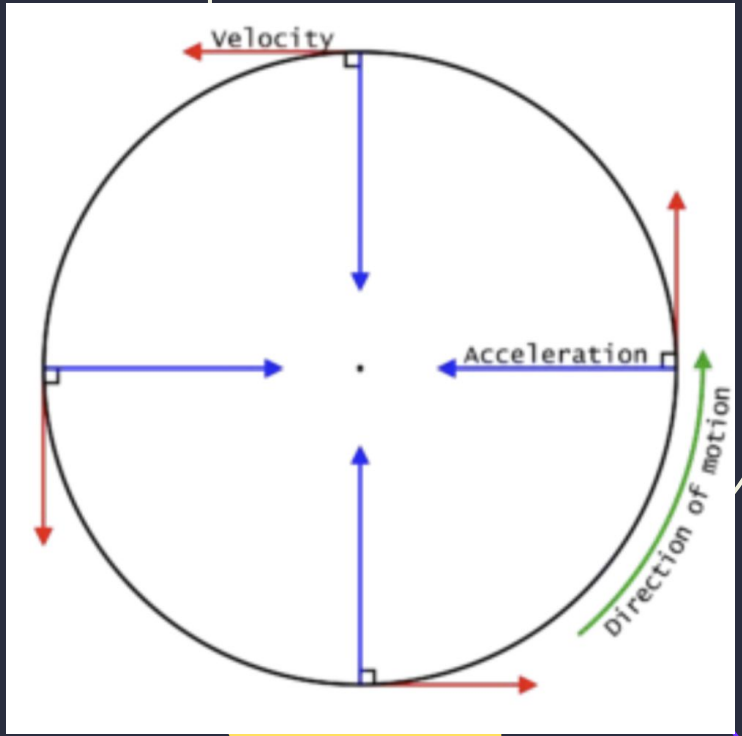
- X-direction: v is constant; a=0
- Y-direction: v at top = 0; a = g
- Remember, time is the same in both x and y
- Break up velocity components if needed

Circular Motion

- Acceleration always points inward
- v = ωr (and is tangential to the path)
- Direction of individual forces can be different in different positions of the circle

Relative, Circular Motion

- The Centripetal force is a fictitious force, meaning that it is a result of other forces acting on a system to make it go in circular motion
- Centripetal acceleration, for circular motion, is always radially inwards and the velocity is tangential to the path



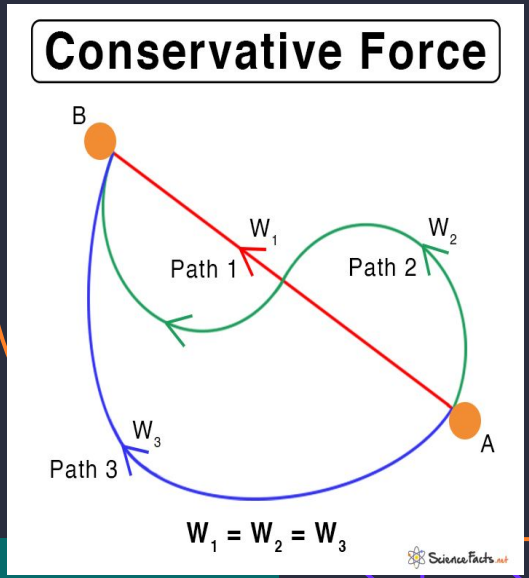
Forces

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**: $f = \mu N$, opposes motion



Forces

- Equal and Opposite Forces
- X and Y components still apply, especially for ramp problems
- Free Body Diagrams:
  - The net force is NOT drawn on the free body diagram
  - Only draw external forces acting on the object

Friction

- Friction is a force that opposes the direction of motion

Kinetic Friction

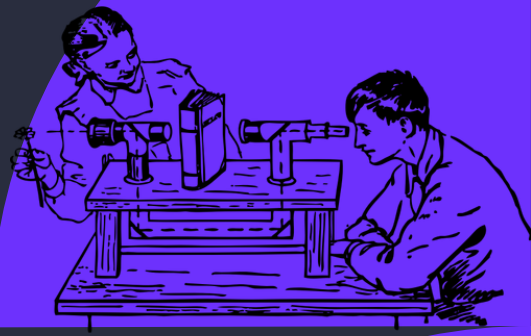
$$f_k = \mu_k N$$

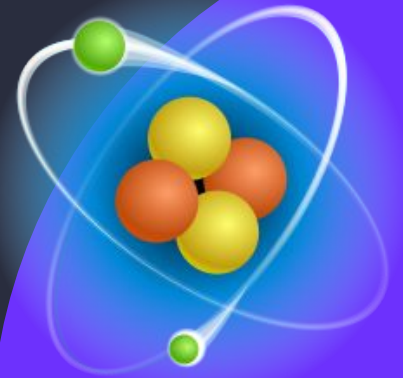
Static Friction

$$f_s \leq \mu_s N$$

2. Problem Solving

Some Steps to Follow If You Are Lost

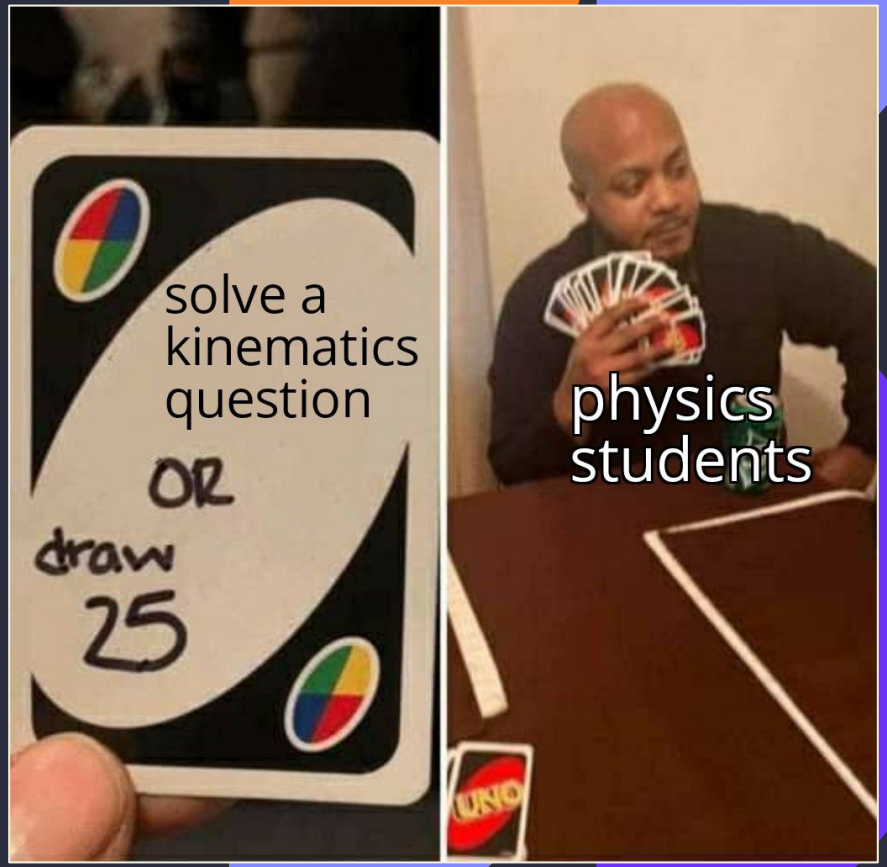




Kinematics

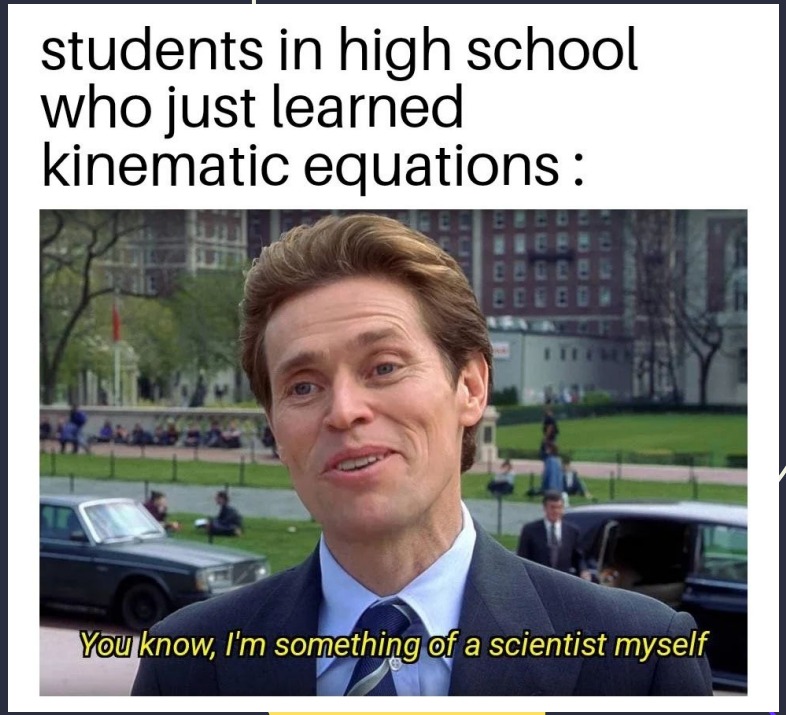
How to Identify:

- Projectile Motion
- Given x/v/a
- Relative Motion



Kinematics

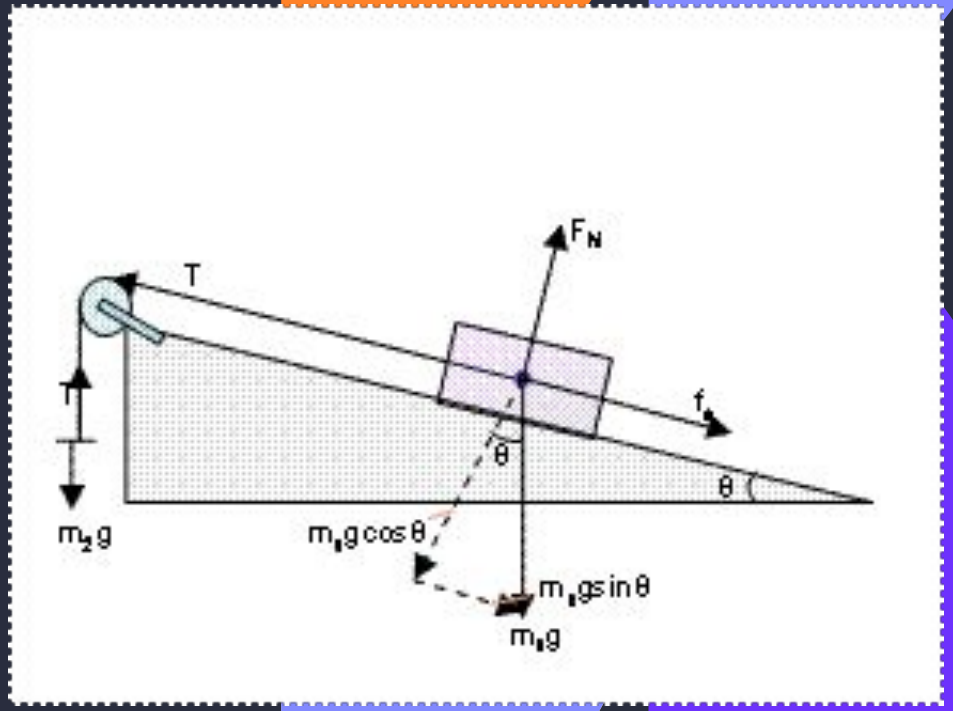
- List given variables
  - In both x and y directions
- Match up to kinematics equations on equation sheet
- Remember to watch out for Relative Motion



Forces

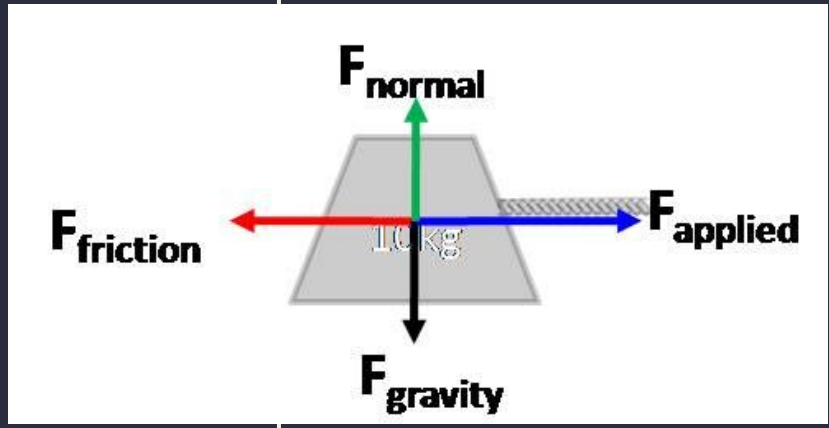
How to Identify:

- Springs
- Mass Slidings
- Ramps
- Strings



Forces

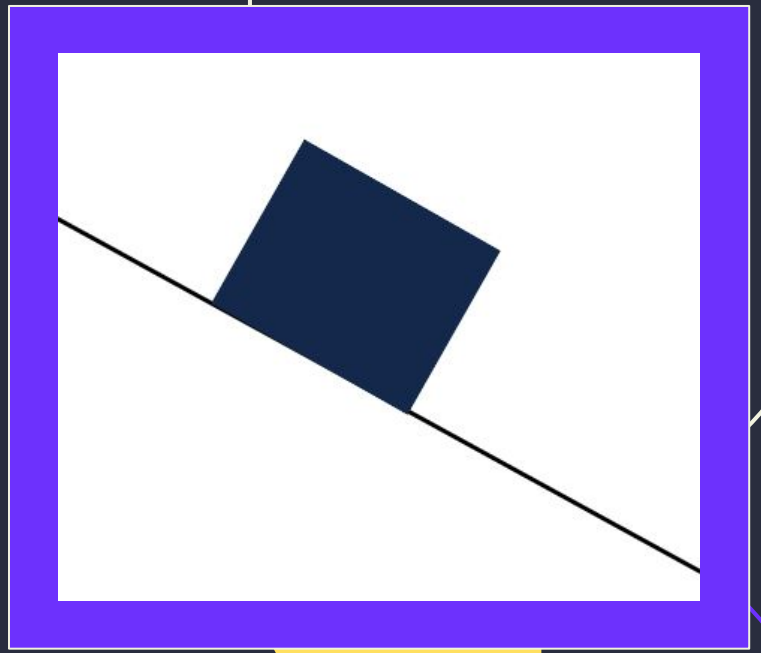
- ALWAYS start with Free Body Diagrams
- Write F=ma equations
  - In both x and y directions
  - Pay close attention to the SIGNS of your variables!
- Solve for the unknown variable(s) in the problem



Box on a slanted ramp

Which direction does the normal force point?

1. Straight up
2. Up and right
3. Straight down
4. Down and right



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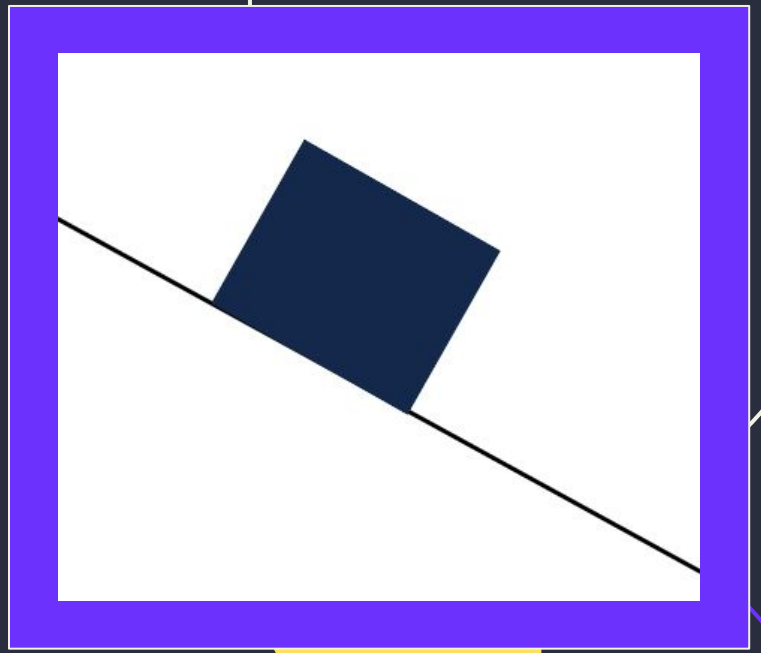
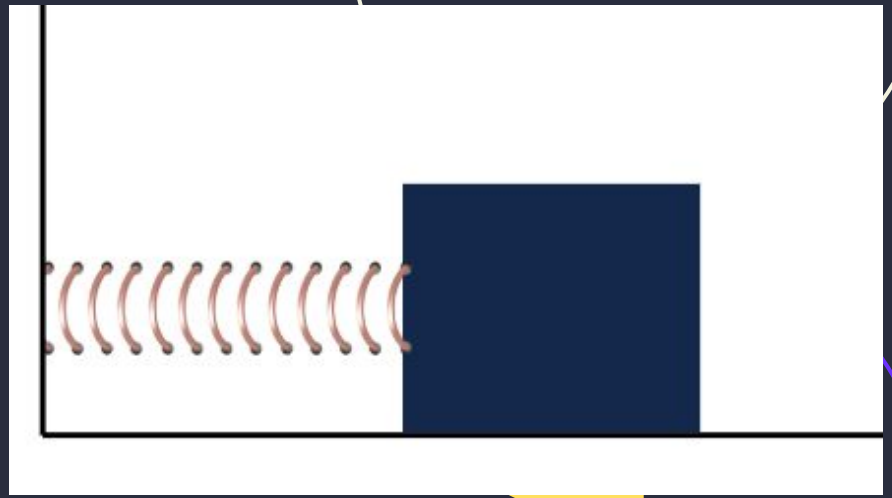


Box on a spring in compression

Which direction does the spring force point on the box?

1. Up
2. Down
3. Left
4. Right



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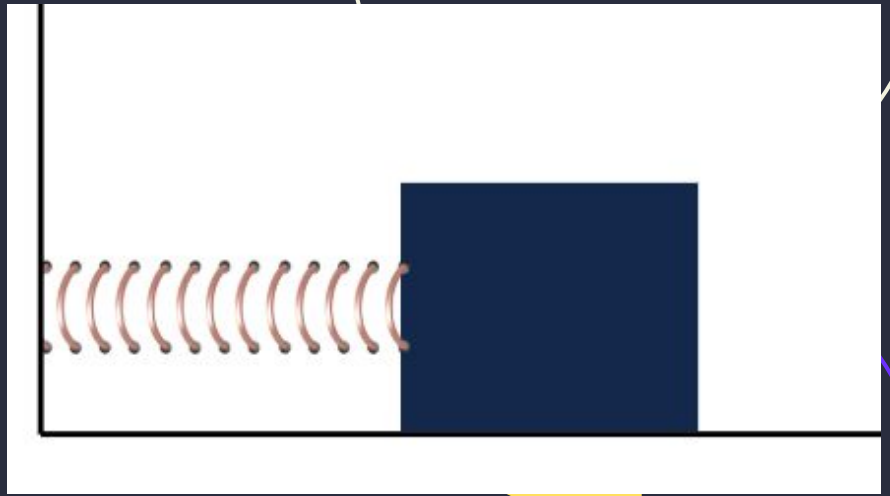
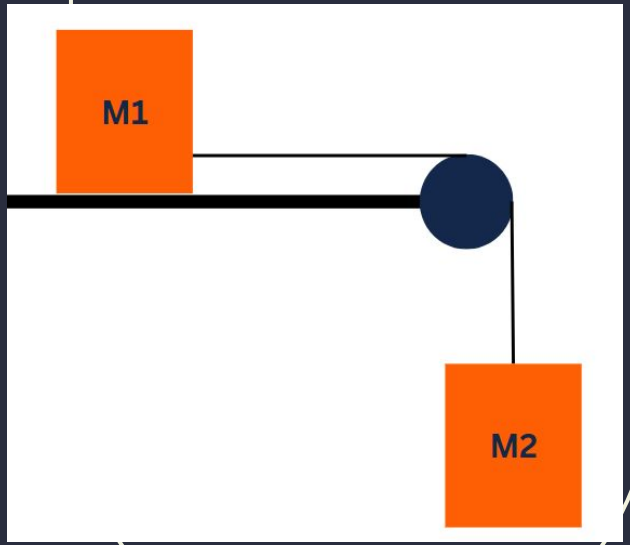


Two boxes connected with a rope

Which direction does the tension force point on M2?

1. Up
2. Down
3. Left
4. Right



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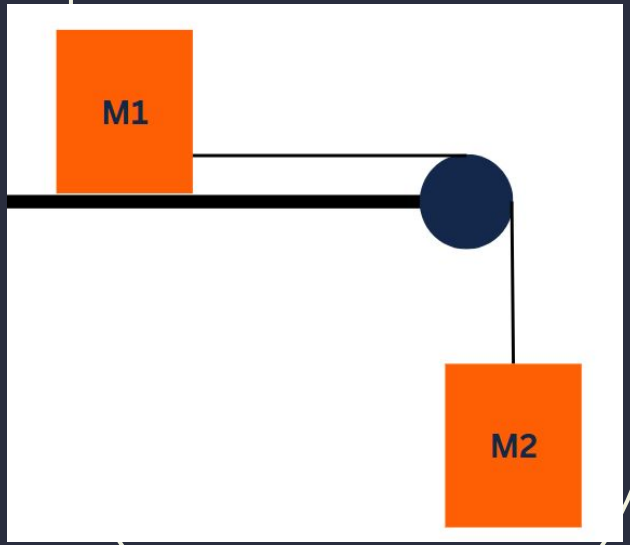

Worksheet Time!

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!