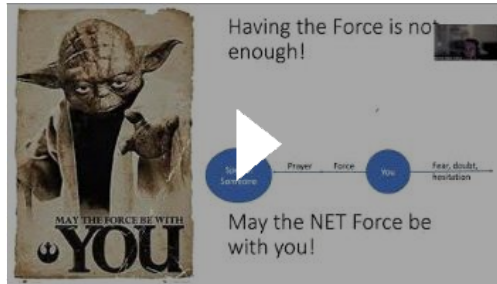


Lecture 9

Thursday, February 9, 2023 9:28 AM

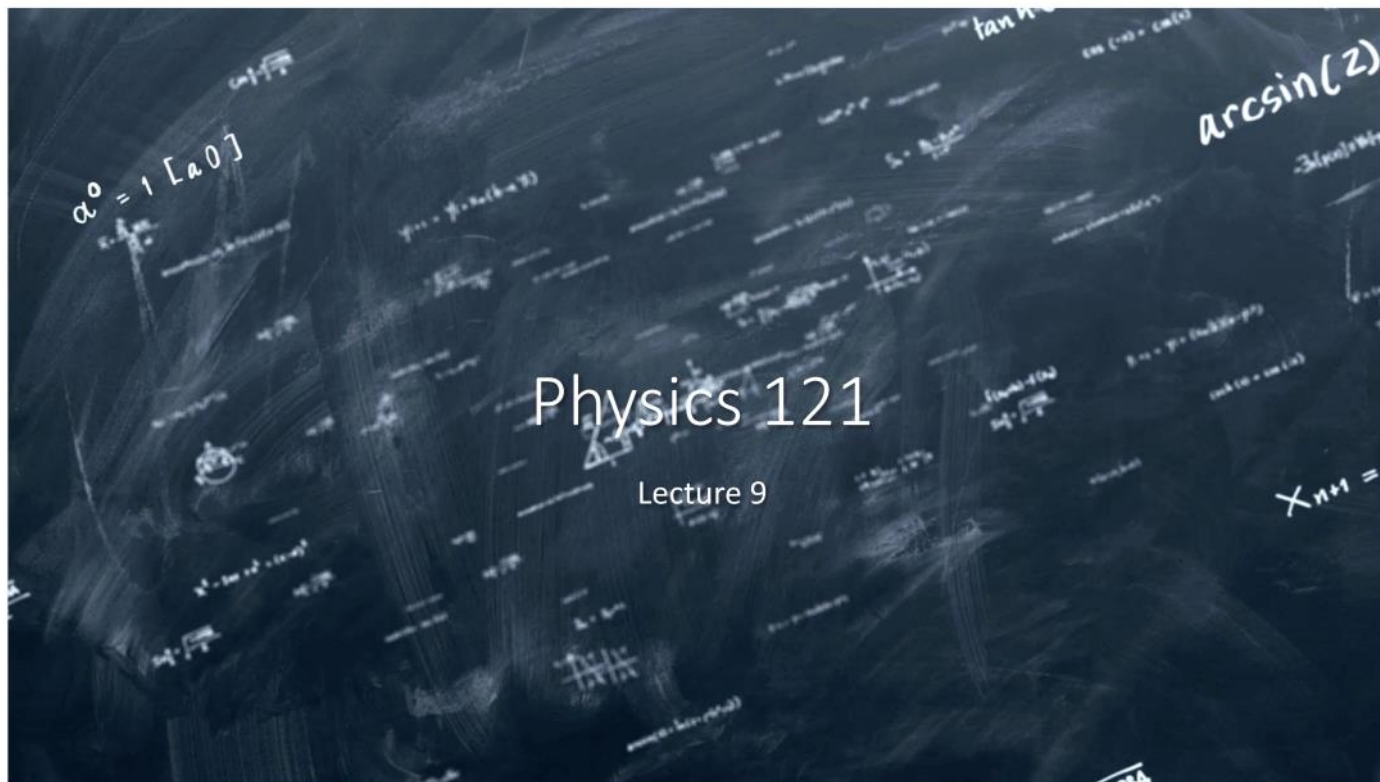
[Physics 121 - WS2023 Lecture 9](#)



Don't feel forced to watch this...



<https://www.youtube.com/watch?v=GmIMV7bA0TM>



Physics 121

Lecture 9


What is the difference between Zone Conferences and our classes at BYU?

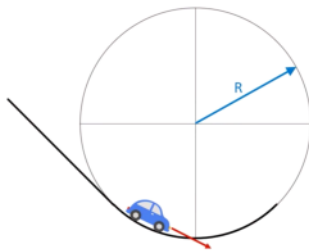


9 And Moses made a serpent of brass, and put it upon a pole, and it came to pass, that if a serpent had bitten any man, when he beheld the serpent of brass, he lived.

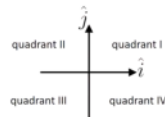
Review

- We can now express x,v,a in 1D as functions of time.
- We explored projectile motion in 2D
- Learned the special case of circular motion

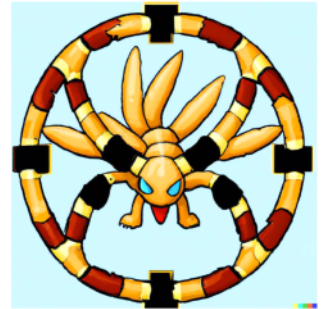
Circular motion $a = \frac{v^2}{r}$ $\vec{a} \perp \vec{v}$ 



Q1: At the moment shown, in what direction does the acceleration vector point?
 A. Towards quadrant I
 B. Towards quadrant II
 C. Towards quadrant III
 D. Towards quadrant IV



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



Center – Seeking
Centripetal

Does the Word of Wisdom make Wise?

Why study STEM?

Humanities teach the laws of men. STEM teaches the laws of God. - Dr. Jeff Silk



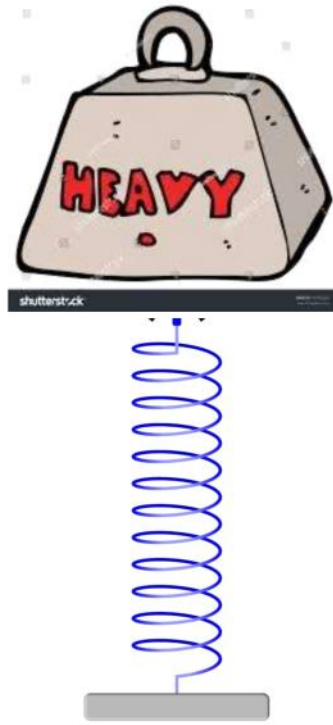
<https://www.youtube.com/watch?v=btxMd5mbPeM>



Introduction of Forces

- Throwing the ball. Why does it change velocity?
- GRAVITY!
- But why does it not change velocity when resting on a table?

Experiment



Enter the world of Dynamics!

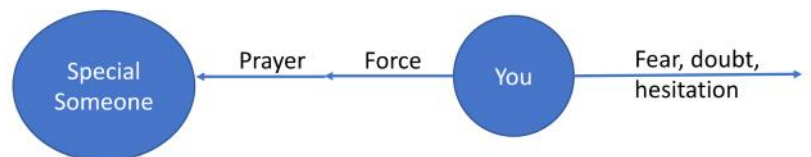
- Kinematics – how objects move
- Dynamics – how forces affect motion

Principle: Any unbalanced force causes motion!

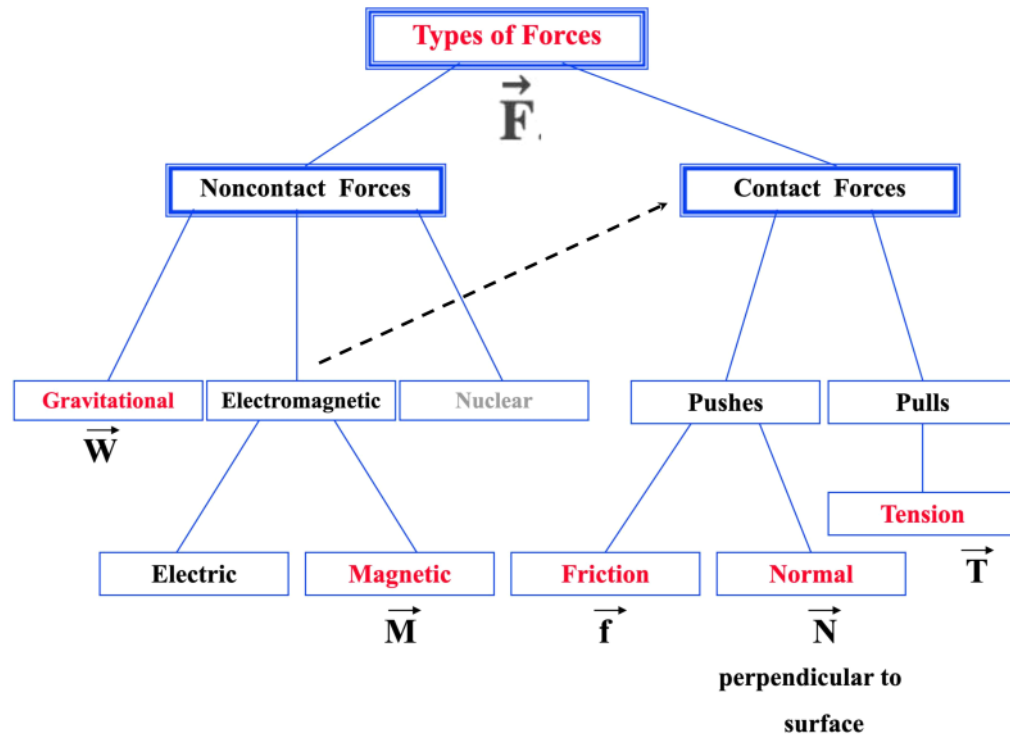
- Free body diagrams (free body = object as dot), only external forces



Having the Force is not enough!



May the NET Force be with you!



Newton's first law – The law of inertia

A body at rest remains at rest or, if in motion, remains in motion at constant velocity unless acted on by a net external force.



This was very hard to believe!

Experiment – Frictionless motion



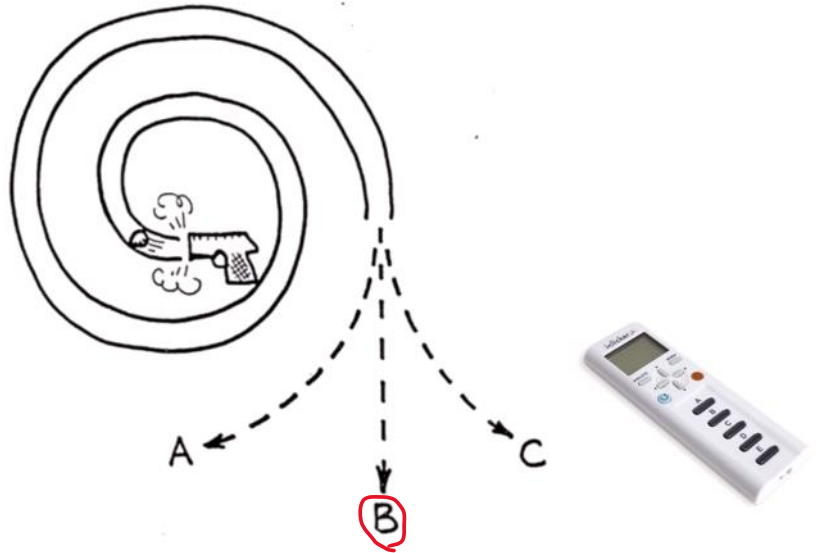
Discussion – Asteroid Problem

Some scientists are worried that an asteroid might collide with Earth someday, with serious consequences. (This happened 66 million years ago when an asteroid splashed down in the Yucatan Peninsula in Mexico and caused the extinction of the dinosaurs as well as 75% of all living things.) Knowing what you know about how things move in a frictionless environment like space, how might you divert such an asteroid (assuming you could find it)?



Q3: Which path?

Let's suppose you fire a pellet into a frictionless tube that is curved like the one shown below. When the pellet emerges from the tube, which path will it take?



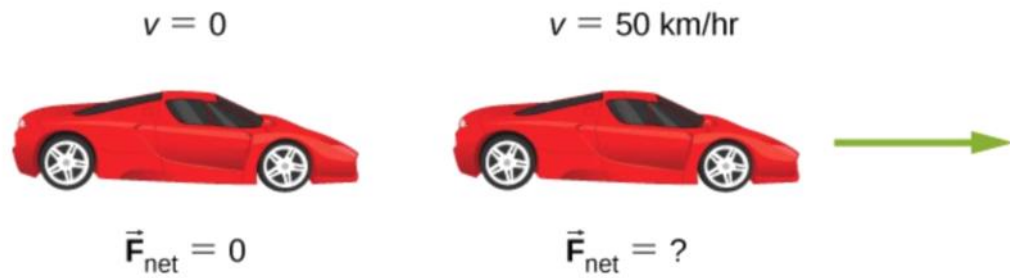
Bookkeeping on Terms

- Mass
→ How much matter is in an object
- Gravitation / Weight / Gravitational Force
→ How much do two masses attract each other
- Inertia
→ How much does a mass resist change



Reading Quiz

Which Car Experiences a Net Force?



- A) Left Car
- B) Right Car
- C) Both Cars
- D) No Car
- E) Who Car's?

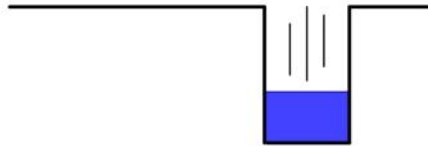


Example #1

It snowed overnight. From your 2nd story window, you drop a crate into a large snowdrift. The crate enters the snow and slows down and eventually stops. While the crate is slowing down,

...what is true about the forces on the crate?

- A. The force of the snow on the crate is greater than the weight of the crate.
- B. The force of the snow on the crate is smaller than the weight of the crate.
- C. The force of the snow on the crate equals the weight of the crate.



Let's work on a table together

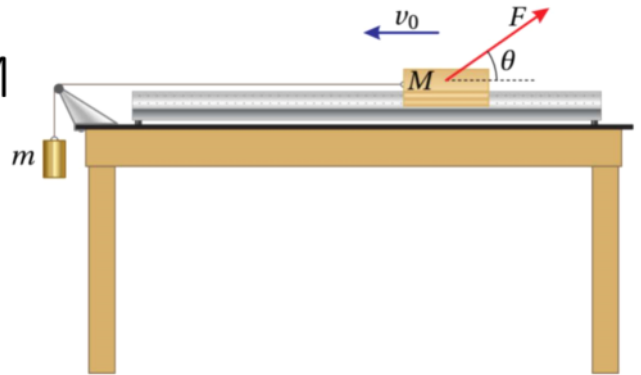
We can think about a ball on a flat surface without friction.

MOTION	VELOCITY	ACCELERATION	Force causing acceleration
At rest			
Uniform motion to the right			
Moving to the right but speeding up			
Moving to the right but slowing down			

How-To: Drawing Free-Body Diagrams

1. Draw the object under consideration as a point at the origin of coordinate system.
2. Include all forces that **act on** the object as force vectors. However, do not include the net force on the object or the forces that the object exerts on its environment.
3. Resolve all force vectors into x - and y -components.
4. Draw a separate free-body diagram for each object in the problem.

Let's Practice!
Draw the free body for M



1. Draw the object under consideration as a point at the origin of coordinate system.
2. Include all forces that **act on** the object as force vectors. However, do not include the net force on the object or the forces that the object exerts on its environment.
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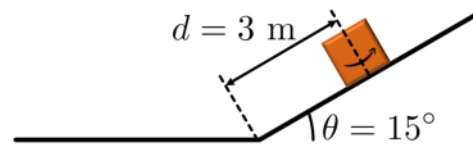
NEWTON'S SECOND LAW OF MOTION

The acceleration of a system is directly proportional to and in the same direction as the net external force acting on the system and is inversely proportional to its mass.

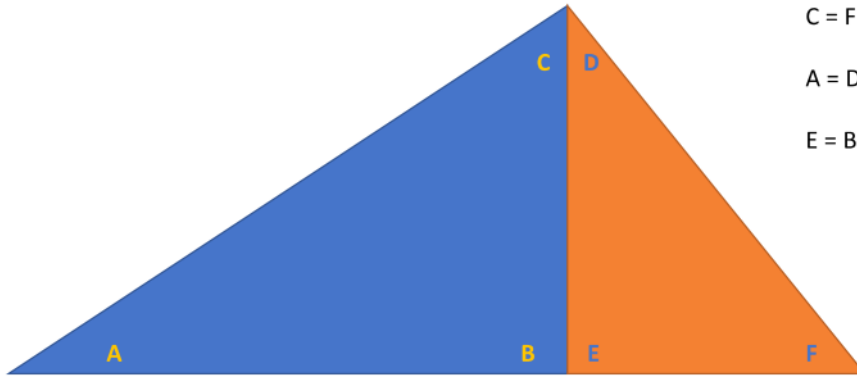
$$\vec{\mathbf{F}}_{\text{net}} = \sum \vec{\mathbf{F}} = m\vec{\mathbf{a}}.$$

A very typical problem to solve

A box starts from rest and slides 3 meters down an inclined ramp before moving onto a flat surface. How fast is it going at the bottom of the ramp? Neglect friction



Some Geometry Review



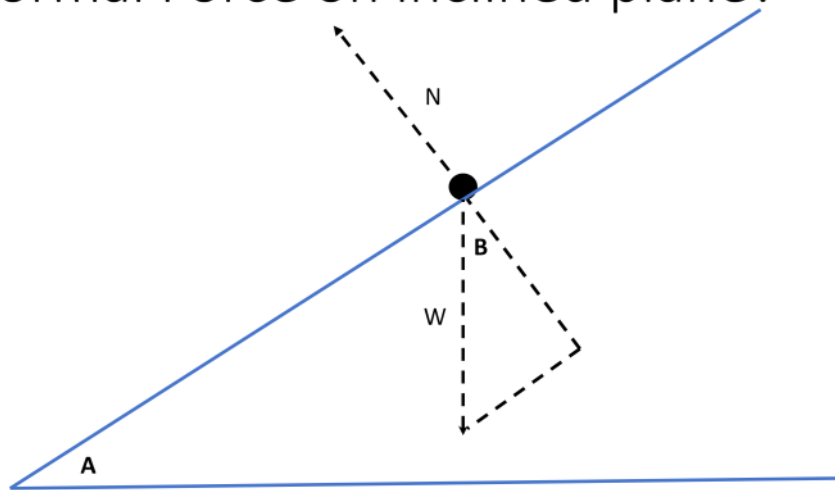
If $C + D = 90$ degrees:

$$C = F$$

$$A = D$$

$$E = B$$

Quiz: What is the angle between Weight and Normal Force on inclined plane?



- A) 90 degrees
- B) 180 degrees
- C) $180 - A$ degrees
- D) $90 + A$ degrees
- E) A degrees



Turn to your neighbor and state in one sentence: What is a Force?



<https://www.youtube.com/watch?v=GmIMV7bA0TM>

An influence tending to change the motion of a body or produce motion or stress in a stationary body.

So, are midterms forces?

Exit Poll

- Please provide a letter grade for todays lecture:

- A. A
- B. B
- C. C
- D. D
- E. Fail

