THE UNIVERSITY OF BRITISH COLUMBIA

FACULTY OF SCIENCE UNDERGRADUATE PEER MENTORING PROGRAM

NEXT PROGRAM WORKSHOP:
JANUARY 20TH
5:15PM-7:15PM

PROGRAM BENEFITS:

- Meet New People
- Build Academic Resilience
- Learn Mentorship Skills
- Add to Your Resume
- Social Belonging

WANT TO PARTICIPATE?

Sign up through the QR code or contact Sarah Craven at sarah.craven@ubc.ca

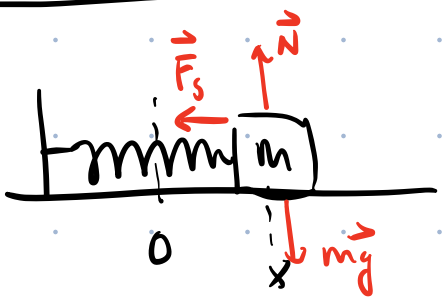
Principle Investigator: Dr. Bowen Hui (bowen.hui@ubc.ca)
Study number: H24-01151; Version date: July 19, 2024

PHYS 121 Jan. 10, 2025

To do:
- complete survey by Jan. 13 @ 23:59 (link in Canvas)
- complete HW1 on PL by Jan. 15 @ 23:59 (link in Canvas)
- complete HW2 on PL by Jan. 17 @ 23:59

Last Time:

Mass on a Spring

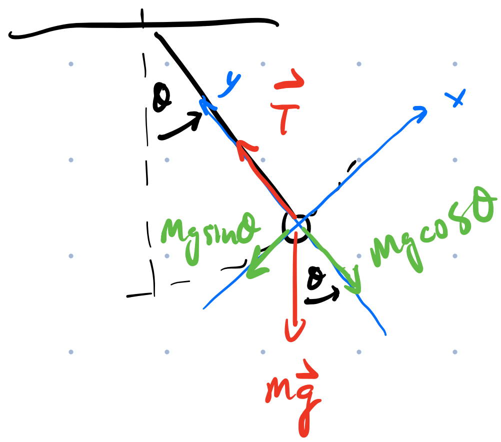


$$\frac{dx^2}{dt^2} = -\frac{k}{m}x$$

$$x = A\cos(\omega t)$$

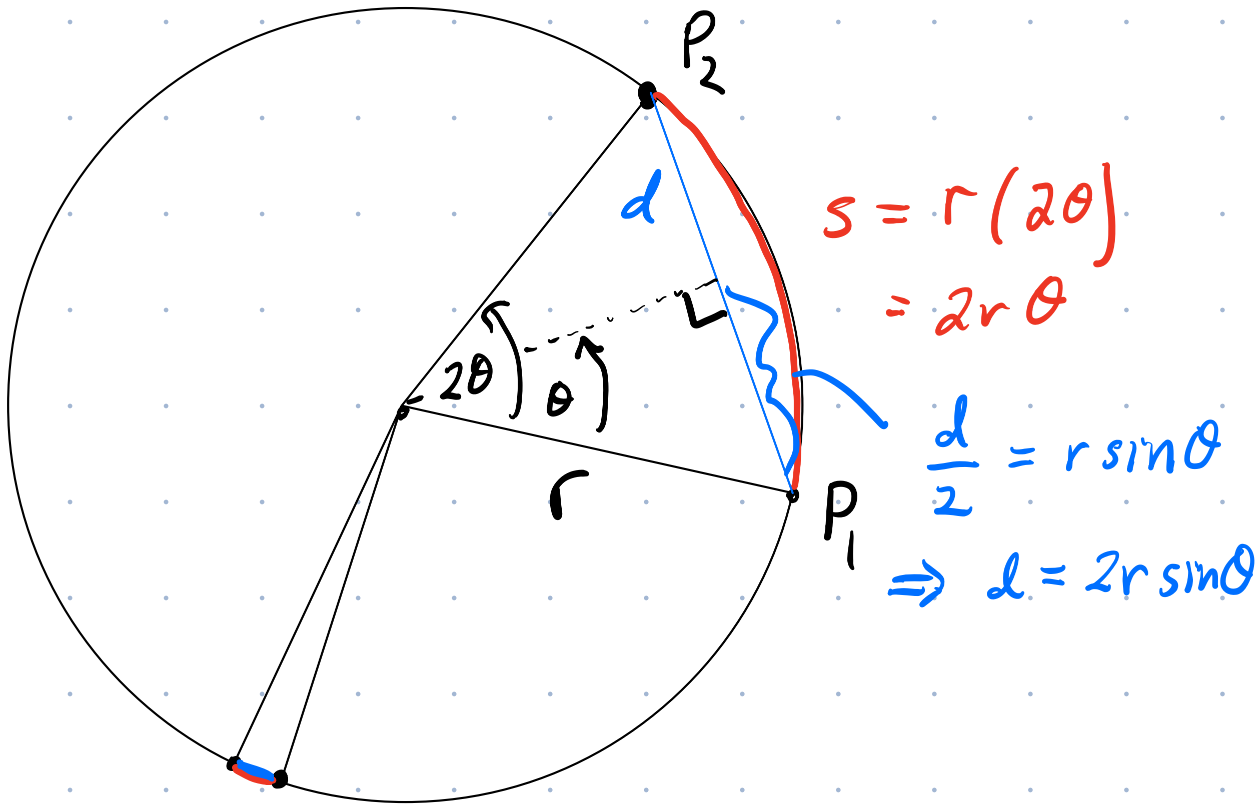
$$\omega = \sqrt{\frac{k}{m}} \quad , \quad T = 2\pi\sqrt{\frac{m}{k}}$$

Pendulum



$$\boxed{\frac{d^2\theta}{dt^2} = -\frac{g}{L}\sin\theta} \quad (*)$$

Today: Start w/ the "Small angle approximation"



clearly $s > d$.

$$\cancel{2r}\theta > \cancel{2r}\sin\theta$$

$$\theta > \sin\theta$$

For small angles the red arc & blue straight get more & more similar.

For sufficiently small θ, $\sin\theta \approx \theta$ when θ is expressed in radians

small angle approximation

Let's apply the small-angle approx. to our pendulum analysis. In this case, Eq. ⊛ becomes

$$\frac{d^2\theta}{dt^2} = -\frac{g}{L}\underbrace{\sin\theta}_{\approx\theta} \Rightarrow \frac{d^2\theta}{dt^2} \approx -\frac{g}{L}\theta$$

This is mathematically identical to the eq'n of motion for a mass on a spring.

$$\frac{d^2x}{dt^2} = -\frac{k}{m}x \Rightarrow x = A\cos\omega t$$

$$\omega = \sqrt{\frac{k}{m}} \qquad T = 2\pi\sqrt{\frac{m}{k}}$$

∴ For small angles, it must be the case that the pendulum position is given by:

$$\theta = A\cos\omega t \qquad \omega = \sqrt{\frac{g}{L}} \qquad T = 2\pi\sqrt{\frac{L}{g}}$$

Note that the period of the pend. osc. is indep. of both the mass of the pendulum bob & the initial amplitude of the oscs.

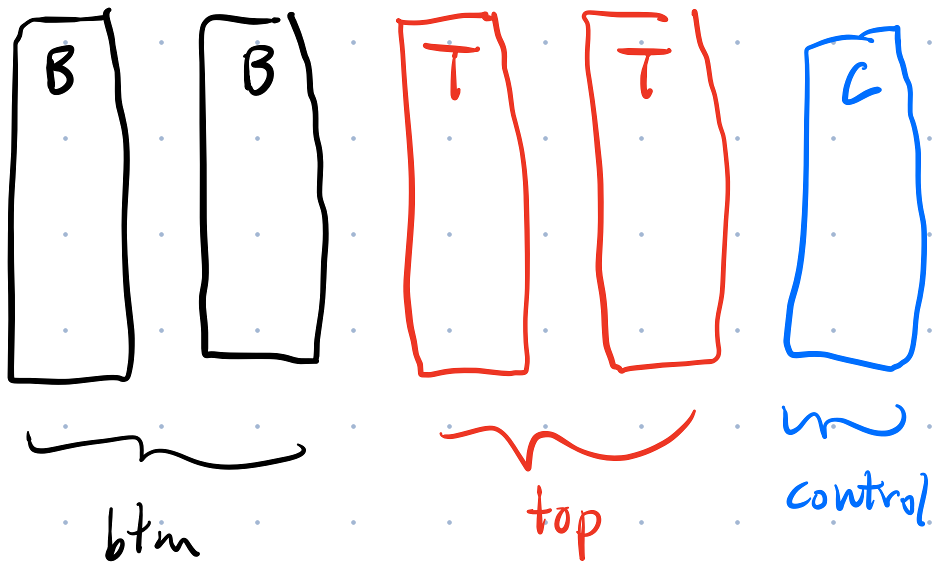
In Experiment #1 & 2 you will test the independence on the osc. amplitude.

Chapter 5 secs. 1 & 2 in OSUPv2.

Electric Charge.

Imagine the following exp't.

- Take two pieces of cellophane tape stuck to one another (sticky side to non-sticky side)
- Pull the pieces apart
- Repeat w/ two more pieces of tape
- Take a fifth piece of tape that has not had any treatment → control.



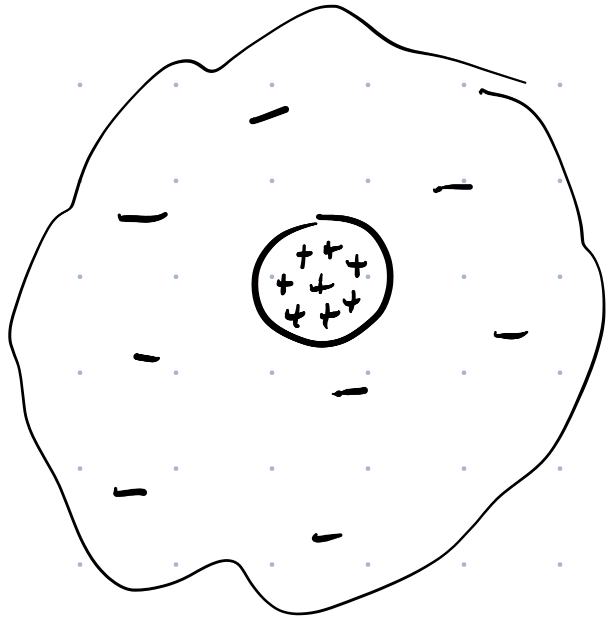
Observations:

- The B pieces of tape strongly repel one another
  " T " " " " " " "

- The T & B pieces strongly attract one another

- The control tape C weakly attracts both T & B pieces.

Model of atoms that form all materials



- have a neucleus w/ neutral neutrons & positive protons.

- surrounding the dense nucleus is a cloud of negative electrons.

- overall the atom in neutral.

Proton/neutron mass

1.67×10^{-27} kg

electron mass is

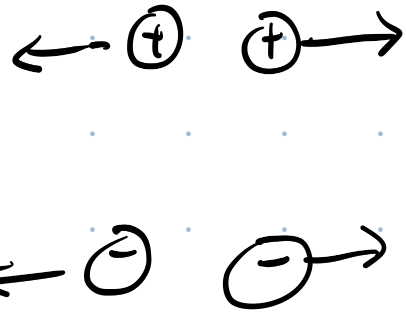
9.11×10^{-31} kg

Because electrons are light w.t. protons, they can be displaced/moved relatively easily through friction.

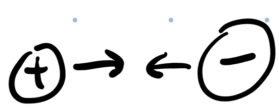
When the two pieces of tape are pulled apart, some electrons from one are transferred to the other. Tape that gains e^- becomes negatively charged & the tape that lost e^- becomes positively charged.

The first two observations imply:

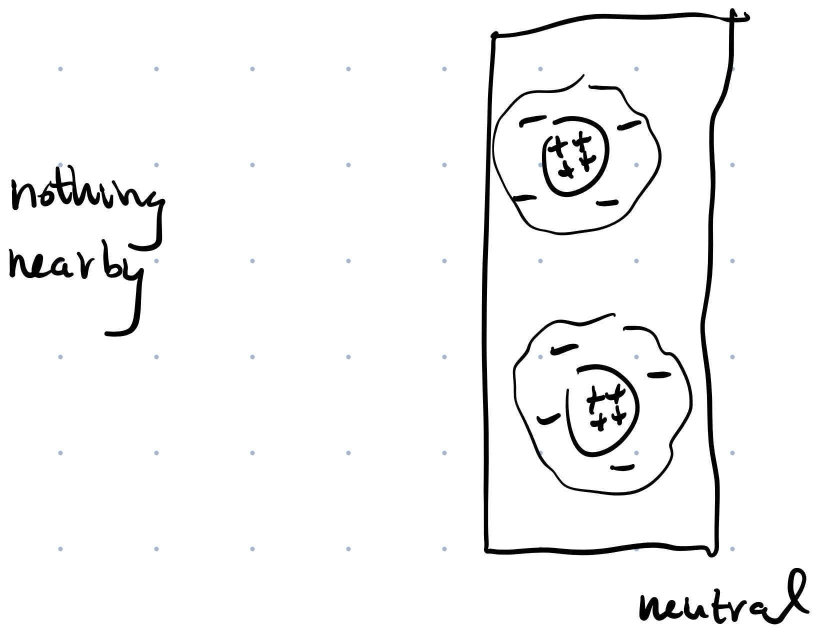
Like charges repel

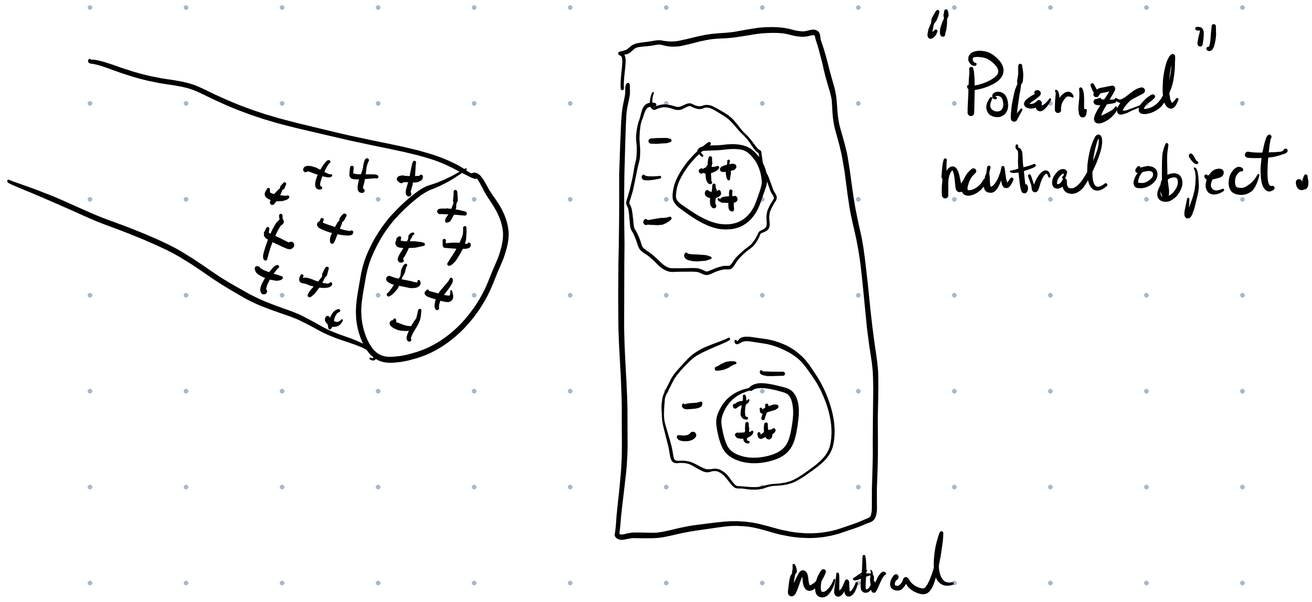


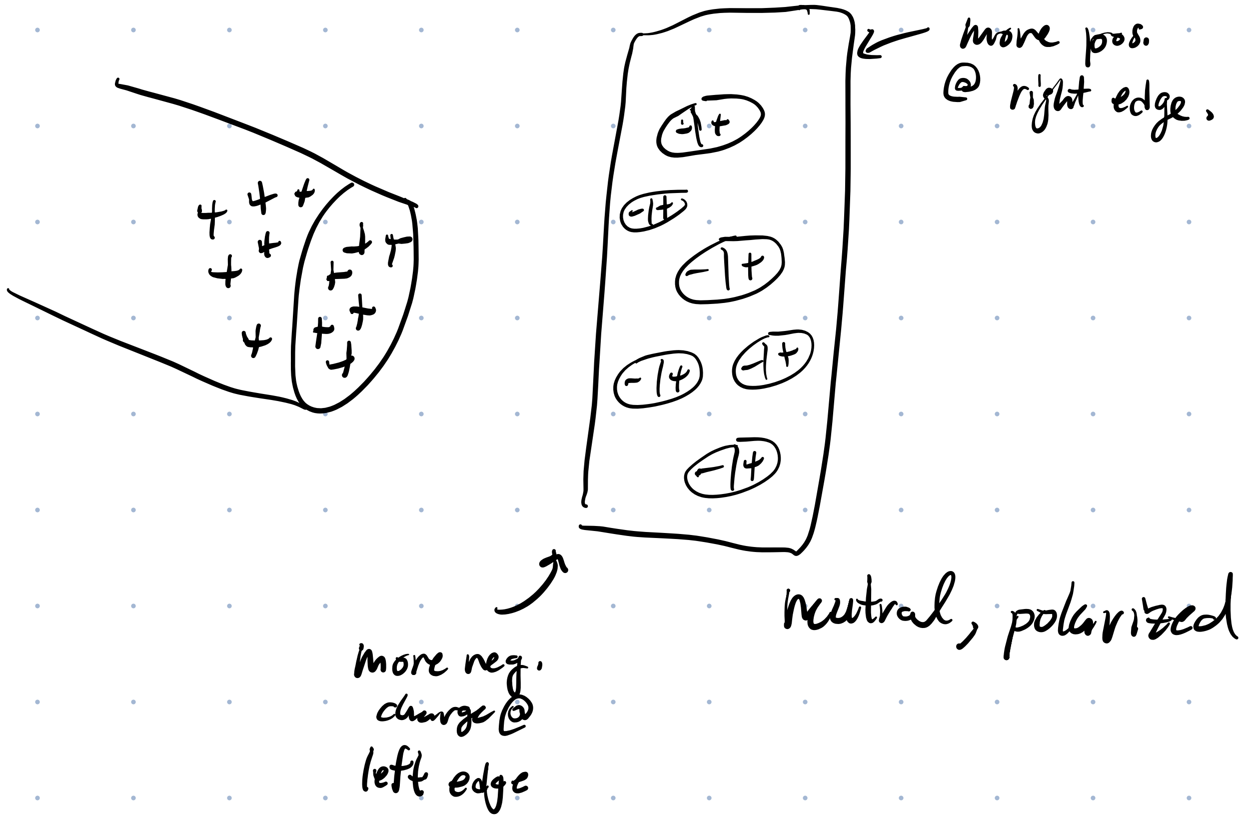
Opposite charges attract



When a charged object is brought close to, but not touching, a neutral object, the atoms in the neutral object become "polarized".







Negative left edge is more strongly attracted to rod that the positive right edge is repelled by the rod. This happens because the force of attraction/repulsion is inversely prop. to distance, and the negative edge is closer to the rod than the positive edge.