3A Pre-Lab Assignment

Submit the answers to questions Slide 7,8 and 9 on Gradescope before Mon/Tue lab.

Simple harmonic motion (SHM) review

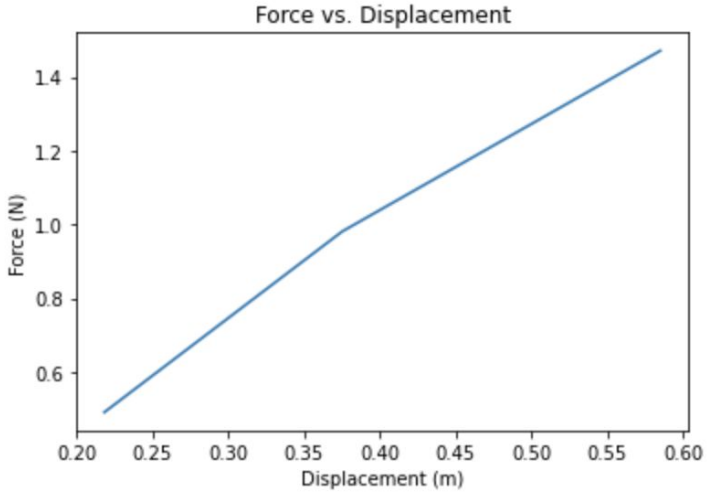
- **Use the following link to review simple harmonic motion :**
  https://openstax.org/books/university-physics-volume-1/pages/15-1-simple-harmonic-motion

Hooke's law

Identify the spring constant if you have the following information about a hanging mass and spring displacement. Check your units. Plot these values and use polyfit to find the spring constant with units of N/m (with error).

Mass (g)	Displacement (m)
50	0.218
100	0.375
150	0.585

```
k = 2.6545704342354917 N/m ± 0.3245556833828281 N/m
```



Python notebook

- Run the following notebook to process data for finding the best fit sine function that fits data. Use the sample data set.
- Print the final numbers you get:
  - Amplitude: 0.09m
  - Period: 1.19s
  - Frequency: 0.84Hz

Derivatives in SHM

What is the first derivative w.r.t t of $y(t)=A\sin(\omega t)$?

$y'(t) = A\omega\cos(\omega t)$

What is the second derivative w.r.t t of $y(t)=A\sin(\omega t)$?

$y''(t) = -A\omega^2\sin(\omega t)$

What quantities do these derivatives represent?

$y'(t)$ = S.H.O. Velocity $y''(t)$ = S.H.O. Acceleration

Between-Labs Assignment
(due by Wed/Thu Lab)

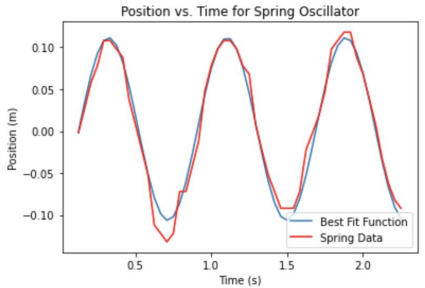
Submit the answers to questions Slide 27 and 30 on Gradescope before Wed/Thu lab.

Python plot of position data and best fit

- Plot the position data obtained from Tracker on Python along with the plot of the best fit sine function to the position data in the same window.
- What is the value of spring constant from the best fit function? Compare this value to the spring constant obtained from Hooke's law. (You know the mass is 50 g)

$$\omega = \sqrt{\frac{k}{m}}$$

- $k_{theoretical}$ = 2.65 N/m
- k_{actual} = 2.35 N/m

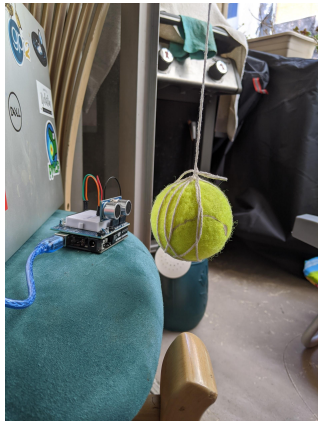


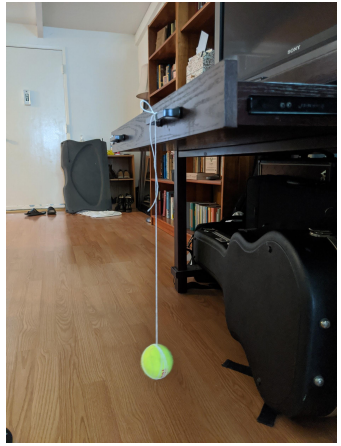
Simple pendulum review

- **Review simple pendulums here :**
  https://openstax.org/books/university-physics-volume-1/pages/15-4-pendulums

Pendulum measurements

- Hang a pendulum somewhere in your house. You can hang anything with a handle with no air resistance (mug, small bag, etc)
- If you don't have string, you can try using shoelaces, wires, cables, strips of fabric.
- Design the experiment so that you can collect both ultrasound data and you can collect video for Tracker.





Pendulum measurements

- Measure the length of string and calculate the theoretical frequency and period: (L = 0.444 m)
  - Period (seconds): 1.34 s
  - Frequency (Hz): 0.748 Hz
- Using a timer, measure the amount of time elapsed for 20 oscillations of the pendulum. What is the period you derive from this measurement?
  - Period (seconds): 1.465 s
  - Frequency (Hz): 0.683 Hz

You will be using video and ultrasound data of the pendulum in future lab sessions/assignments.

Damped oscillations Review

- **Review damped oscillations :**
  https://openstax.org/books/university-physics-volume-1/pages/15-5-damped-oscillations