Name _____

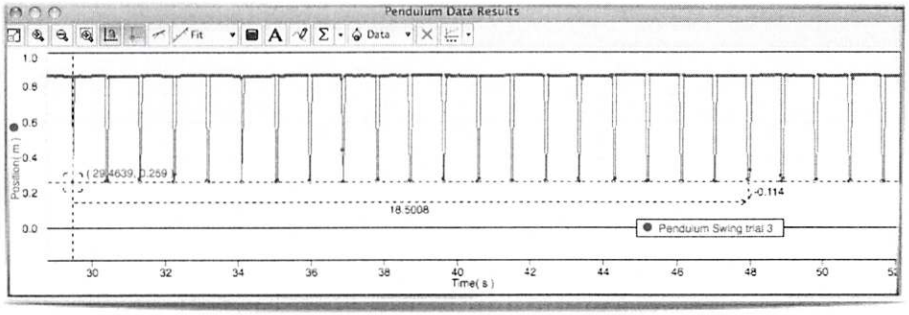
Pendulum Oscillations

A motion sensor is placed under the lowest point of a pendulum as it swings back and forth. A mass of 250g was placed on the string, and it was released from 12cm above the bottom. A student used the software to time 20 passes of the pendulum.

What was the length of the string?

$T = 2\pi\sqrt{\frac{L}{g}}$

Time for 20 passes	T (period)	f (frequency)	Length
18.5 s	$\frac{18.5}{20} = 0.925$ s	$\frac{1}{T} = 1.08$ Hz	$\left(\frac{.925}{2\pi}\right)^2(9.8) = 18.2$ cm



Fix the Lab: What should a student do (what would they change) if they need to **lower the frequency** of the pendulum?

LOWER THE FREQUENCY => INCREASE THE PERIOD

INCREASE L (OR LOWER GRAVITY)

You must show all work to get credit for each lab page. Complete the sample problem for each lab type. Turn in your original lab papers with this summation packet.

1. What is the period of the big pendulum at the Franklin Institute if it has a length of 26 meters?

$T = 2\pi\sqrt{\frac{26}{9.8}}$

$= 10.2$ s

2. A student finds that the period of a 2.0m pendulum is 2.90 seconds. What is the percent error for their estimation of gravity?

$2.90 = 2\pi\sqrt{\frac{2}{g}}$

$g = 9.39\ m/s^2$

$\frac{9.39 - 9.8}{9.8} = -4.2\%$

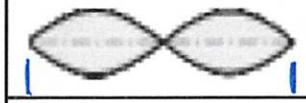
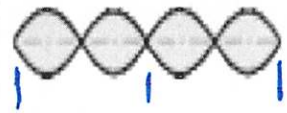
Harmonics Lab Summation

Name _____

Waves on a Spring

Students in a lab experiment were able to create the three waves shown below while sitting 2m apart. One group member used a stopwatch to find the time for 20 wave cycles.

Complete the table for the experiment.

Harmonic		Time (20)	Period	f	λ	v
	2	8.0	0.4 s	2.5 Hz	2 m	5 m/s
	3	5.4	0.27 s	3.7 Hz	1.33 m	4.94 m/s
	4	4.1	0.205 s	4.88 Hz	1 m	4.88 m/s
					Average Velocity	

Fix the Lab: What should a student do (what would they change) if they need to ***increase the velocity*** for another trial?

$V = \sqrt{\frac{T}{m/L}}$

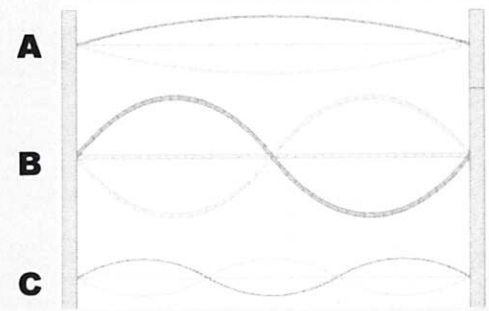
NOT INCREASE f

NOT INCREASE λ

NOT INCREASE A

EITHER INCREASE TENSION OR DECREASE THE DENSITY

You must show all work to get credit for each lab page. Complete the sample problem for each lab type. Turn in your original lab papers with this summation packet.



In the three diagrams created on the same string, explain which example shows the...

Longest wavelength?

A

Highest frequency?

C

Fewest nodes?

A

Greatest Amplitude?

B

Longest period?

A

Greatest Velocity?

EQUAL (SAME STRING)

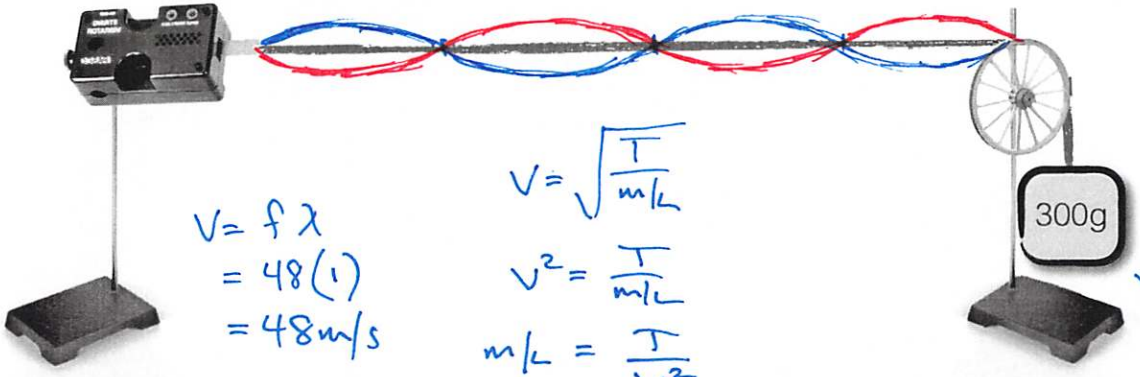
Harmonics Lab Summation

Name _____

Waves on a String

Another demonstration uses a speaker-like device to create wave patterns in a string. A 2.0m long string supports a mass of 300 g. A frequency of 48 Hz causes the string to demonstrate a standing wave with 4 antinodes.

Draw the wave and complete the table



$V = f\lambda$
$= 48(1)$
$= 48 m/s$

$V = \sqrt{\frac{T}{m/L}}$

$V^2 = \frac{T}{m/L}$

$m/L = \frac{T}{V^2}$

$W = 2.94N$

λ	f	v	T	m/l	m
1 m	48 Hz	48 m/s	2.94 N	0.0013 kg/m	2.55 g

Fix the Lab: What would it look like if the student used the same string and the same hanging weight, but ***lowered the frequency*** to 36 Hz?

$V = 48 m/s$
$f = 36 Hz$

$\lambda = 1.33m$
or .67m/ANTINODE

You must show all work to get credit for each lab page. Complete the sample problem for each lab type. Turn in your original lab papers with this summation packet.

1. A wave generator produces 16.0 pulses in 4.00 s.

a. What is its period?

$\frac{4s}{16 CYCLES} = .25 s$

b. What is its frequency?

$f = T^{-1} = 4 Hz$

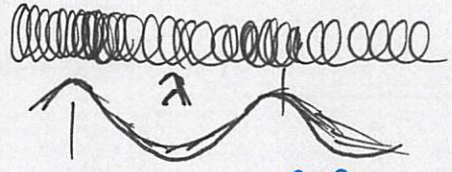
2. A periodic wave disturbance that has a frequency of 2.50 Hz and a wavelength of 0.600 m?

What is the speed of the wave?

$V = f\lambda$
$= 2.5(0.6) = 1.5 m/s$

3. A longitudinal wave that has a frequency of 20.0 Hz travels along a coil spring. The distance between each compression is 0.400 m.

What is the speed of the wave?



$V = f\lambda = 20(.4) = 8 m/s$

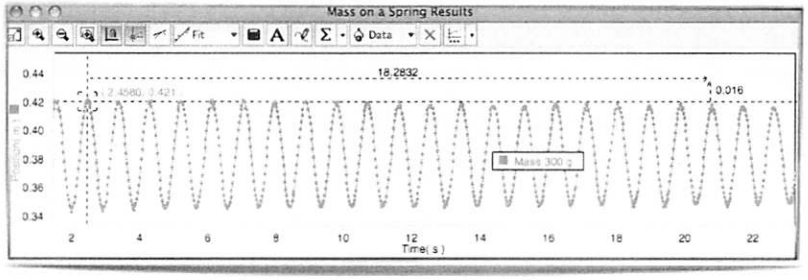
Name _____

Spring Oscillations

A computer watches as a spring bounces up and down in the lab room. The Y axis shows the height of the spring (cm), the X axis shows the time as the spring moves (s). As instructed by the teacher, the student counted 20 crests on the wave shown by the computer.

Find the spring constant for this experiment.

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



mass	(20) T	Period	frequency	spring constant
300 g	18.28 s	$\frac{18.28}{20}$ 0.914 s	$\frac{1}{T} = 1.09$ Hz	14.2 $\frac{N}{m}$

Fix the Lab: What would change if the student used the same spring but put 4 times (1.2 kg) on the hanger? (be specific)

WITH 4 TIMES THE MASS, THE PERIOD INCREASES BY $\sqrt{4}$, OR TWICE. (1.83s)

You must show all work to get credit for each lab page. Complete the sample problem for each lab type. Turn in your original lab papers with this summation packet.

1. A student uses a spring for this lab with a constant of 2.6 N/m. What would the period be for a 250g mass hanging from the spring?

$T = 2\pi\sqrt{\frac{.25}{2.6}}$

$T = 1.95$ s

2. They want to use the spring to help them time a slow moving class. How much mass should they add to the bottom to create a period of exactly 4 seconds?

$4 = 2\pi\sqrt{\frac{m}{2.6}}$

$m = 1.054$ kg