Name: Section Date

FACTORS AFFECTING THE FREQUENCY OF A SIMPLE HARMONIC OSCILLATOR

OBJECTIVE: To investigate the dependence of the frequency of oscillation on the following physical quantities: amplitude, spring constant and mass.

MATERIALS masses-and-springs-en.html, spreadsheet

ONLINE RESOURCES Masses and Springs PhET simulation: https://phet.colorado.edu/sims/html/masses-and-springs/latest/masses-and-springs_en.html

PROCEDURE

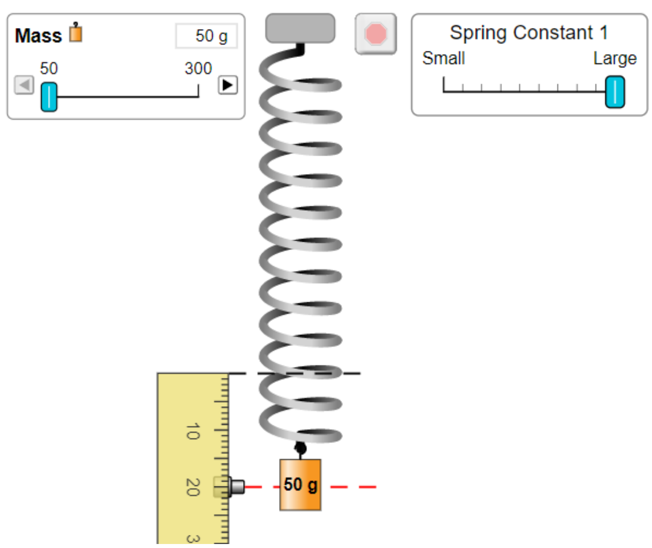
Frequency and Amplitude of Oscillation

1. Open the Masses and Springs PhET simulation. Select LAB.

2. Set the following parameters:

Simulation	PAUSED
Mass	50 g
Spring Constant	"Large"
Mass Equilibrium	Enabled
Movable Line	Enabled
Gravity	Earth
Damping	None
Simulation Speed	Slow

3. Hook the 50-g mass and adjust the position of the movable line tracer 20 cm below the equilibrium line. This will be the starting position of the 50-g mass.



4. Start the simulation by clicking on the Pause/Play button. Using the built-in stopwatch, determine the time it takes the 50-g mass to make 10 complete oscillations. Make two trials.

5. Adjust the starting position to 40 cm and repeat procedure no. 4. Record your measurements and calculations in Data Table I.

Data Table I

Starting Position	Time for 10 complete oscillations (s)			Frequency (Hz)
	Trial 1	Trial 2	Ave.	
20 cm				
40 cm				

QUESTIONS:

- What does the starting/initial position of the 50-g mass represent?
- What happens to the length of the path travelled by the 50-g mass when the starting position is increased from 20 cm to 40 cm? What happens to its speed?
- Does the starting position of the object affect the frequency of the object-spring system? Explain.

Frequency and Spring Constant

1. Set the following parameters:

Simulation	PAUSED
Mass	50 g
Spring Constant 1	1 unit from "Small"
Mass Equilibrium	Enabled
Movable Line	Enabled
Gravity	Earth
Damping	None
Simulation Speed	Slow
Starting position from equilibrium line	30 cm

2. Run the simulation by clicking on the Start/Stop button. Determine the frequency of oscillation of the 50-g mass.

3. Using the same parameters in (1), make several trials, each time, increasing the spring constant by 2 units from "Small" until the spring constant = 9 units. In each trial, make sure that the starting position is always kept at 30 cm below the equilibrium line. Summarize your measurements in Data Table 2.

Data Table 2

Spring constant k	Frequency of Oscillation
1	
3	
5	

4. Using a spreadsheet, plot the values of the frequency against the values of the spring constant. Describe the graph formed.

5. Plot the values of f^2 against the values of k. Describe the graph formed.

QUESTIONS:

- What happens to the frequency of oscillation of the mass-spring system as the spring constant increases?
- What does the graph of f^2 against k suggest about the relationship between the frequency and the spring constant? Explain

Frequency and Mass

1. Set the following parameters:

Simulation	PAUSED
Mass	50 g
Spring Constant 1	LARGE
Mass Equilibrium	Enabled
Movable Line	Enabled
Gravity	Earth
Damping	None
Simulation Speed	Slow
Starting position from equilibrium line	30 cm

2. Run the simulation. Determine the frequency of oscillation of the 50-g mass.

3. Using the parameters in (1), make several trials, in each time increasing the mass of the object by 50 g until the mass equals 300 g. For each trial, make sure to set the starting position from the equilibrium line to 30 cm. Enter your measurements in Data Table 3

Data Table 3

Mass (g)	Frequency of Oscillation (Hz)
50	
100	
150	
200	
250	
300	

4. Plot the values of the frequency against the values of the mass. Describe the graph formed.

5. Plot the values of f^2 against the values of 1/m. What is the shape of the graph?

QUESTIONS:

- What happens to the frequency of oscillation as the mass of the oscillator increases?

- What does the graph of f^2 against 1/m suggest about the relationship between f and m? Explain.

CONCLUSION(S)

GOING FURTHER

In the simulation, the mass of the blue and the red weights are not known. Develop a procedure on how you will determine the masses of these objects.