

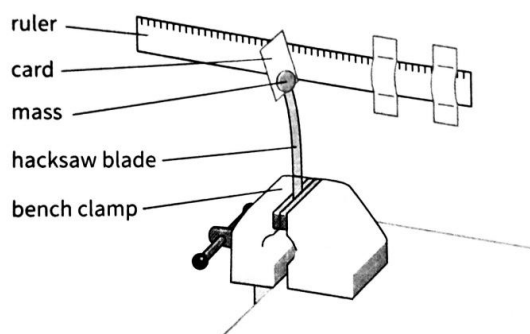
Enrichment – Oscillations

Instructions

Complete the following questions on a separate sheet of paper.

Experiment

You can investigate the exponential decrease in the amplitude of oscillations using a simple laboratory arrangement (as shown in the figure). A hacksaw blade or other springy metal strip can be clamped (vertically or horizontally) to a bench. A mass is attached to the free end. This will oscillate freely if you displace it to one side. For the first experiment, do not place a card on the end of the mass.



Displace the mass and allow it to oscillate, recording the mass's displacement over time.

Analysis

1. Plot a graph of the displacement of the mass. Your graph should be roughly sinusoidal.
2. Determine the frequency and angular frequency of the oscillation.
3. Create the equation that describes the **displacement** of the oscillating mass.
4. Create the equation that describes the **velocity** of the oscillating mass.
5. On your original graph, draw the graph of the velocity of the mass as it changes over time.
6. On your graph, label where the mass reaches its maximum speed.
7. Calculate the maximum speed of the oscillation.
8. Calculate the maximum acceleration of the mass. Label where this happens on your graph.
9. Create a quantitative graph of acceleration vs displacement x for the oscillator.
 - a. Explain why this graph does or does not show that this experiment is an example of simple harmonic motion.
10. Draw a diagram of the experiment, labeling locations of maximum oscillation on either side (label as A and B) and of the equilibrium position (label as E).
 - a. Draw a graph of how the kinetic energy, potential energy, and total energy change over time.
 - i. On your graph, label where A, B, and E align with how the energy changes.
 - b. Draw a graph of how the kinetic energy, potential energy, and total energy change vs displacement.
 - i. On your graph, label where A, B, and E align with how the energy changes.
11. Repeat step 1 with a card attached to the mass (as shown in the diagram above).
12. Repeat step 11 with at least 2 other sized cards.
13. Explain how this shows an example of damping.