

## Unit 7: Newtonian Mechanics – Oscillations

### OBJECTIVES

Big Idea 3: The interactions of an object with other objects can be described by forces.

Enduring Understanding 3.B: Classically, the acceleration of an object interacting with other objects can be predicted by using  $\vec{a} = \frac{\vec{F}}{m}$ .

Essential Knowledge 3.B.3: Restoring forces can result in oscillatory motion. When a linear restoring force is exerted on an object displaced from an equilibrium position, the object will undergo a special type of motion called simple harmonic motion. Examples should include gravitational force exerted by the Earth on a simple pendulum and mass-spring oscillator.

a. For a spring that exerts a linear restoring force, the period of a mass-spring oscillator increases with mass and decreases with spring stiffness.

b. For a simple pendulum, the period increases with the length of the pendulum and decreases with the magnitude of the gravitational field.

c. Minima, maxima, and zeros of position, velocity, and acceleration are features of harmonic motion. Students should be able to calculate force and acceleration for any given displacement for an object oscillating on a spring.

Learning Objective 3.B.3.1: The student is able to predict which properties determine the motion of a simple harmonic oscillator and what the dependence of the motion is on those properties.

Learning Objective 3.B.3.2: The student is able to **design a plan and collect data** in order to ascertain the characteristics of the motion of a system undergoing oscillatory motion caused by a restoring force.

Learning Objective 3.B.3.3: The student can analyze data to identify qualitative or quantitative relationships between given values and variables (i.e., force, displacement, acceleration, velocity, period of motion, frequency, spring constant, string length, mass) associated with objects in oscillatory motion to use that data to determine the value of an unknown.

Learning Objective 3.B.3.4: The student is able to construct a qualitative and/or a quantitative explanation of oscillatory behavior given evidence of a restoring force.

Enduring Understanding 3.C: At the macroscopic level, forces can be categorized as either long-range (action-at-a-distance) forces or contact forces.

Essential Knowledge 3.C.4: Contact forces result from the interaction of one object touching another object, and they arise from interatomic electrical forces. These forces include tension, friction, normal, spring, and buoyant.

### PROCEDURE:

All notes

Homework: Chapter 10 Conceptual Questions 1-14 and Problems 1, 3, 5, 24, 25, 28, 31, 39, 40, 41, 67, 69, 72 and Concepts & Calculations (Do both the conceptual questions and the problems...) 85 & 86

LABORATORY COMPONENT: Lab: Hooke's Law