Name _____ Section _____ Date _____

CONCEPTUAL PHYSICS | **Tech Lab**

Solids: Elasticity **Spring-Mass Simulation**

Spring to Another World

Purpose

To use a simulation of masses and springs to determine force constants, a mass value, and the gravitational acceleration of an unknown planet

Apparatus

computer additional sheet of writing paper

PhET simulation: "Masses and Springs" (available at http://phet.colorado.edu)

Discussion

Seventeenth-century English scientist Robert Hooke is credited with the discovery that the force exerted by a spring is directly proportional to the length it is stretched or compressed. This simulation has been programmed to obey Hooke's law. It will allow you to practice good lab technique to solve a few simple puzzles.

Procedure

Step 1: Turn on the computer and let it complete its start-up process.

Step 2: Open the PhET simulation, "Masses and Springs." If you're not sure how to do this, ask your instructor for assistance.

Step 3: When the simulation opens, the screen should resemble Figure 1 below.

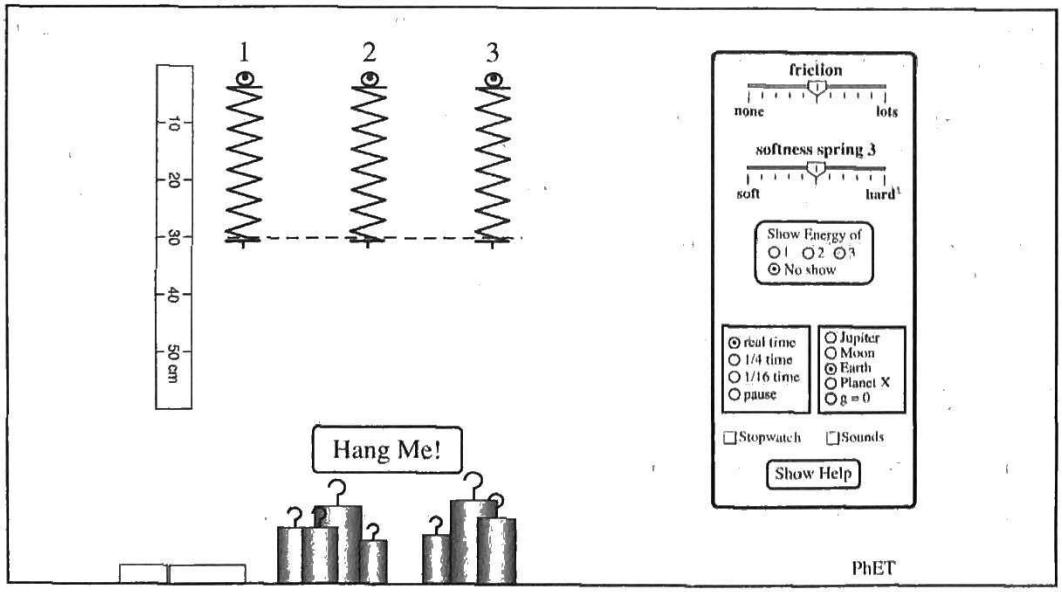

Figure 1. Masses and Springs

PART A: DETERMINATION OF A FORCE CONSTANT

Step 1: If it has not already been done, select Earth in the on-screen control panel.

Step 2: Click and drag to move the on-screen horizontal dashed line so that it is aligned with the bottom of the three springs.

Step 3: Click and drag to move the on-screen ruler so that its top (0 cm) is aligned with the dashed line.

Step 4: Click and drag to attach a 100-gram hooked mass to Spring 1. Determine the load force (F) of the 100-gram mass by converting grams to kilograms, then use $F = mg$.

Step 5: Carefully record the amount of stretch (x) that the spring experiences when loaded with the 100-gram mass.

Step 6: Rearrange Hooke's Law, $F = kx$, solving for k. Then determine the force constant (k) of Spring 1 using the force from Step 7 and the stretch from Step 8.

PART B: THE RED MATTER

Step 1: On a separate sheet of paper, describe a method to determine the mass of the red cylinder.

Step 2: Also on that sheet, record the data and any calculations needed to determine the mass of the red cylinder. Organize your data neatly and show calculations completely.

Step 3: Record the mass of the red cylinder here: $\boldsymbol{m}$ = _____.

PART C: GRAVITATIONAL ACCELERATION ON PLANET X

Suppose you were going to travel from Earth to Planet X. You can take Spring 1 and the gold cylinder with you on your voyage.

Step 1: On a separate sheet of paper, describe a method to determine the gravitational acceleration on Planet X using Spring 1 and the gold cylinder. You may conduct experiments on both worlds, and you may use knowledge gained in previous steps. But you may not use any other masses or springs.

Step 2: Also on that sheet, record the data and any calculations needed to determine the gravitational acceleration on Planet X. Organize your data neatly and show calculations completely.

Step 3: Record the gravitational acceleration of Planet X here: $\boldsymbol{g}$ = _____.

PART D: THE RANGE OF FORCE CONSTANTS FOR SPRING 3

Return to Earth (via the on-screen planet selection). Notice that there is an on-screen slide switch that can be used to adjust the force constant of Spring 3.

Step 1: On a separate sheet of paper, describe a method to determine the lowest and highest force constant values that Spring 3 can be set to.

Step 2: Also on that sheet, record the data and any calculations needed to determine the extreme force constant values of Spring 3. Organize your data neatly and show calculations completely.

Step 3: Record the ***lowest*** Spring 3 force constant value here: k_L = _____.

Step 4: Record the ***highest*** Spring 3 force constant value here: k_H = _____.