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Course: PHYS-1111-01

Lab: Lab 3

Grade: ______ (Filled in by grader)

1. **Objective**:

a. In this lab, students will use Interactive Physics (IP) software to simulate various kinds of two-dimensional motion and compare the results to their written calculations.

2. **Theory**:

a. Variables:
   i. Δx – Displacement
   ii. t – Time interval
   iii. v_o – Initial Velocity
   iv. v_f – Final Velocity
   v. a – Constant Acceleration

b. Kinematic Equations:
   i. $v = v_o + at$
   ii. $\Delta x = v_0 t + (1/2\ at^2)$
   iii. $v^2 = v_0^2 + 2a\Delta x$

c. Gravity Constant: $a_y = -9.8\ \text{m/s}^2$

d. Part 1: Create one circle and give it an initial velocity in the y-direction. Then, at a different height, create another circle and calculate the necessary initial y-velocity so that both circles hit the floor at the same time.

e. Part 2: Design an experiment where a projectile collides with a freely falling object.

3. **Procedure**:

a. Part 1: Using the Interactive Physics (IP) software, create a scenario where two circles (at different heights and velocities) collide with the anchored floor at the same time. Calculate the initial velocity for the second circle on paper and compare the accuracy of your computations to the simulation. Track the simulation at various times to verify your work.

b. Part 2: Anchor a floor in IP and create one circle at an initial height with no velocity so that it is in free-fall. Then, create another circle that has both an x and y component velocity that will collide with the circle in free fall. Track the simulation to verify that the two circles collide.

4. **Data**: *(See attached copy of work)*

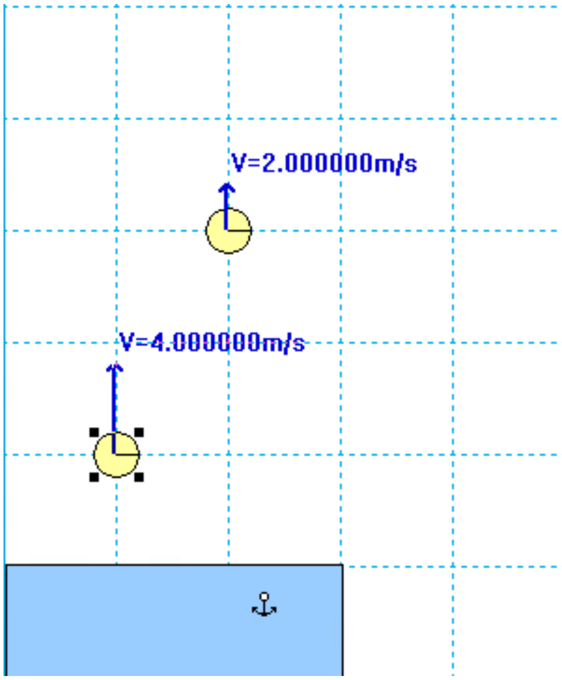

Figure 1: Initial Conditions

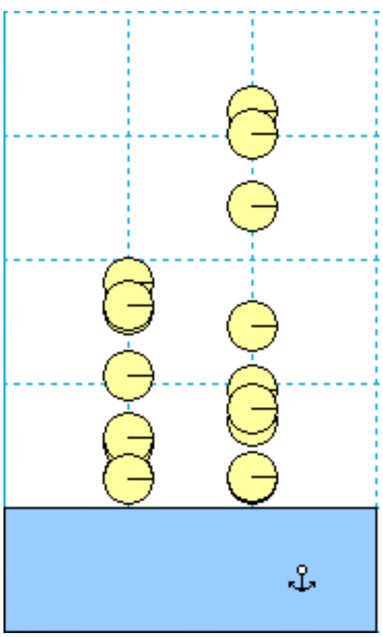

Figure 2: 1-D Motion

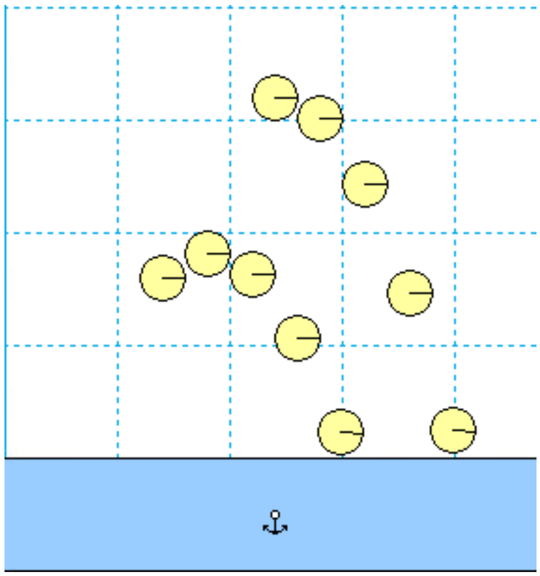

Figure 3: Projectile Motion

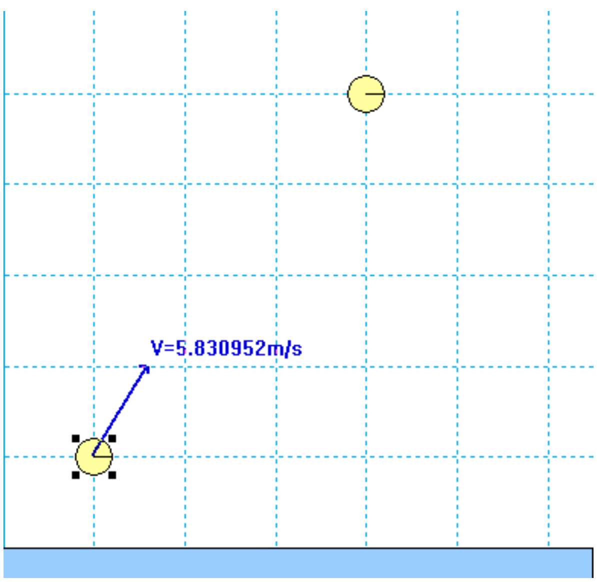

Figure 4: Part 2 Initial Conditions

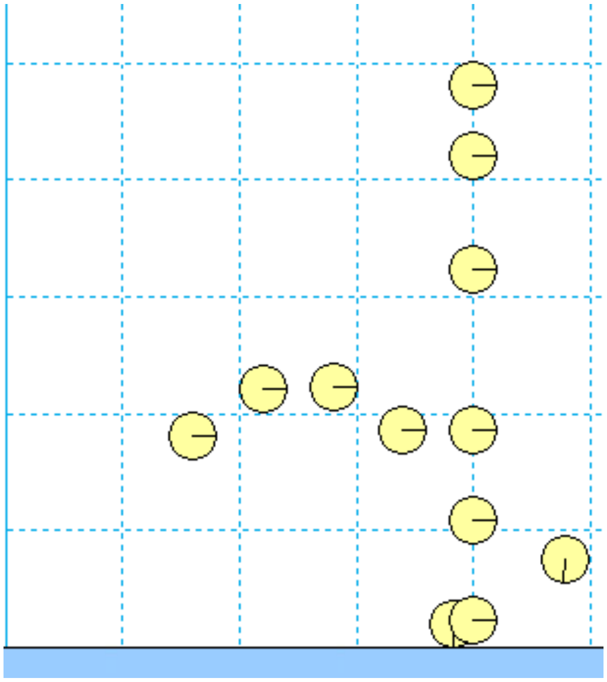

Figure 5: Part 2 Final Result

5. Calculations: *(See attached copy of work)*

CIRCLE 1

$V_i = 2.00\ m/s$

$y_i = 4.00\ m$

$y_f = 1.18\ m$

$V_f = 0.00\ m/s$

$a = -9.8\ m/s^2$

$t = 1s$

CIRCLE 2

$V_i = ?$

$y_i = 2.00\ m$

$y_f = 1.18\ m$

$V_f = 0.00\ m/s$

$a = -9.8\ m/s^2$

$t = 1s$

$$V^2 = V_0^2 + 2a\Delta x$$

$$0 = V_0^2 + 2(-9.8(1.18-2))$$

$$0 = V_0^2 + 16$$

$$|-16| = |V_0^2|$$

$$\sqrt{16} = V_0$$

$$[4 = V_0 \text{ of CIRCLE 2}]$$

6. Results:

a. Part 1:

i. Circle 1 initial velocity: 2.00 m/s

ii. Circle 2 initial velocity: 4.00 m/s

iii. Time to impact: 1 second

b. Part 2:

i. Free-fall Circle initial height: 6.00 m

ii. Circle 2 Velocity: 5.83 m/s

7. Analysis:

a. In conclusion, I was able to accurately calculate the initial velocity for Circle 2 in Part 1 so that it collided with the anchored floor at the same time as Circle 1 (1 second). In Part 2, I was able to successfully demonstrate an experiment where a circle with a given velocity purposefully collided with another circle in free-fall.

8. Comments:

a. This lab helped me to understand how kinematics can be used to predict velocities with the use of helpful diagrams and experimentation.