Kinematics in Two Dimensions:
Answer Key

Name:_____

Date:_____

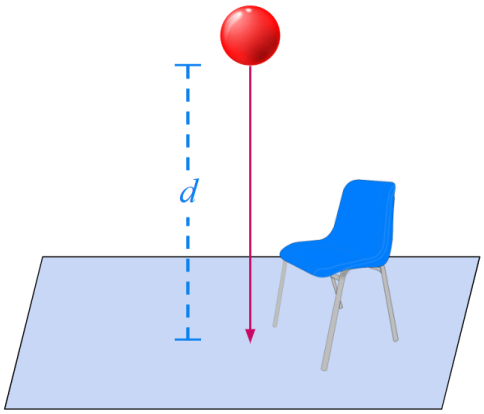
Vocabulary

Velocity - The speed of an object in a specific direction.
Acceleration - The rate at which an object's speed changes (speeds up or slows down).
Gravity - A force that pulls objects towards the center of a mass.

Activity 1

For this activity, you will conduct an experiment to find the gravitational constant, which describes the strength of gravity. To do this, you will drop a ball and take some measurements, which will allow you to calculate the gravitational constant.

- ☐ Get a ball, Ari, and a stopwatch from your teacher.
- ☐ Your teacher will give instructions on how to conduct the experiment and from where the ball should be dropped. Make sure that you are following all instructions and safety procedures throughout the experiment.
- ☐ When you know the height from which you'll be dropping the ball, hold the ball up at that point. Use Ari to measure the **displacement** between the ball and the floor. Record the value in your table.



- ☐ Convert displacement into meters and add it to the table.
- ☐ Another person from the group will be in charge of the stopwatch. You will need to start the stopwatch when the ball is released and stop it as soon as it hits the floor.
- ☐ Release the ball and record how long it takes for it to hit the floor.
- ☐ Repeat the experiment 2 more times and calculate the average time.

Displacement (cm)	Displacement (m)	Time (trial 3)	Time (trial 2)	Time (trial 3)	Time (average)
600 cm	6 m	1.06 s	1.13 s	1.01 s	1.07 s

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- [ ] The displacement equation is:

$$d = \frac{v_i + v_f}{2} \times t$$

- [ ] Rearrange the displacement equation to solve for v_f.
- [ ] Plug in the values from your table and calculate v_f.

$$v_f = 11.2 \text{ m/s}$$

Activity 2

Now that you have velocity and time you can calculate the acceleration due to gravity and compare it to the actual value.

- [ ] Calculate the experimental acceleration using the acceleration equation.

$$a = \frac{v_f - v_i}{t}$$

$$a = 10.5 \text{ m/s}^2$$

- [ ] The gravitational constant is 9.81 m/s^2. Calculate the percent error of your experimental value.

Percentage Error

$$\left| \frac{\text{Measured} - \text{True}}{\text{True}} \right| \times 100$$

Percent Error = 7.03 %

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Exit Ticket

Please answer the following prompts.
Do not forget to include your **name** and **date** on this paper!

Equations

$$d = v_i t + \frac{1}{2} a t^2 \qquad v_f = v_i + at$$

$$d = \frac{v_i + v_f}{2} \times t \qquad v_f^2 = v_i^2 + 2ad$$

1. An object is traveling at 80 m/s when it hits a wall. If the object traveled for 5 seconds with an acceleration of 12.5 m/s^2, what was the initial velocity of the object?

$$v_f = v_i + at$$

$$v_i = v_f - at$$

$$v_i = 80\ m/s - 12.5\ m/s^2\ (5\ s) = 17.5\ m/s$$

2. An object is dropped and travels for 10 seconds before hitting the floor with an acceleration of 9.81 m/s^2. How far did the object fall before hitting the ground?

$$d = v_i t + \frac{1}{2} a t^2$$

$$d = 0\ m/s\ (10\ s) + \frac{1}{2}(9.81\ m/s^2)(10\ s)^2 = 490.5\ m$$