Falling by Numbers

Use motion data to find gravitational acceleration.

P.1.b "Analyze free fall motion using one-dimensional kinematics to determine the acceleration due to gravity (g)."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Circle every time, speed, and distance value in the passage and table, and underline the two rules that let you calculate g from those values.

A Ball in the Atrium

1. In a tall indoor atrium, a student releases a steel ball beside a marked wall. A camera records its motion at equal time steps. The ball starts from rest, and downward is chosen as the positive direction. The table gives its downward speed from an idealized run that ignores air resistance. Time starts when the ball is released.

BALL RELEASED FROM REST

Time (s)	Downward velocity (m/s)
0.0	0.0
0.5	4.9
1.0	9.8
1.5	14.7

2. Acceleration tells how much velocity changes each second. For constant acceleration, divide a change in velocity by the time interval. In free fall near Earth's surface, this acceleration is called g. With downward positive, g has a positive value. The calculation works across any pair of times in the table, not just from release.

3. Distance offers another check: a ball released from rest falls a distance of one half times g times time squared. In this model, the ball falls 4.9 meters in 1.0 second. In another trial, a ball starts downward at 2.0 meters per second and reaches 11.8 meters per second after 1.0 second.

2 ANSWER WITH EVIDENCE

Use the passage

1. Use the table to find g from 0.0 to 0.5 second. Show your calculation.

2. Use the table to find g from 0.5 to 1.5 seconds. Does it match your first result?

3. The ball falls 4.9 meters in 1.0 second from rest. Use the distance rule to find g.

4. In the other trial, use the two speeds and the elapsed time to find g. Does the starting speed change g?

3 YOUR TURN

Your own words

Create a different falling object's two velocity readings, 2.0 seconds apart, starting at a nonzero downward velocity and showing an acceleration of 9.8 m/s^2. In two sentences, give the times and velocities, then calculate g from your readings.

Falling by Numbers

PART 1 · READ AND MARK

Circle every time, speed, and distance value in the passage and table, and underline the two rules that let you calculate g from those values. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Use the table to find g from 0.0 to 0.5 second. Show your calculation.	**g = (4.9 − 0.0) ÷ 0.5 = 9.8 m/s² downward.**
2	Use the table to find g from 0.5 to 1.5 seconds. Does it match your first result?	**g = (14.7 − 4.9) ÷ (1.5 − 0.5) = 9.8 m/s² downward. Yes, it matches.**
3	The ball falls 4.9 meters in 1.0 second from rest. Use the distance rule to find g.	**4.9 = ½ × g × (1.0)², so g = 9.8 m/s² downward.**
4	In the other trial, use the two speeds and the elapsed time to find g. Does the starting speed change g?	**g = (11.8 − 2.0) ÷ 1.0 = 9.8 m/s² downward. The nonzero starting speed does not change g in this model.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

At 0.0 s, my object has a downward velocity of 3.0 m/s; at 2.0 s, it has a downward velocity of 22.6 m/s. Its acceleration is (22.6 − 3.0) ÷ 2.0 = 9.8 m/s² downward.

Accept any two readings 2.0 seconds apart with a nonzero starting downward velocity and a velocity increase of 19.6 m/s. The calculation must use the change in velocity, not just the final velocity.