# Ramp Motion Lab

Use position measurements to investigate changing velocity

**PHS.5.2** "Design and conduct an investigation to study the motion of an object using properties such as displacement, time of motion, velocity, and acceleration."

NAME _____ DATE _____

## 1 READ AND MARK

Read it twice

**YOUR JOB** Underline how the team measures position, circle the origin and positive direction, and number the two steps used to test whether the cart's velocity changes.

### A Cart on a Ramp

1. At the start of a lab, a cart rests at the top of a smooth, shallow ramp. A team tapes a meterstick beside the ramp and calls the release point zero centimeters. They choose downhill as the positive direction. Their question is whether the cart gains speed as it rolls downhill.

2. One student releases the cart without pushing it. A second student films the cart beside the meterstick at 30 frames per second. They read its position at whole seconds and record the measurements below. Repeating the release helps them see whether an odd reading came from a timing or position mistake.

**CART POSITION DURING ONE RUN**

| Time after release (s) | Position (cm) |
|---|---|
| 0 | 0 |
| 1 | 10 |
| 2 | 40 |
| 3 | 90 |

3. Position alone does not give the cart's speed at every instant. For each one-second interval, divide the change in position by one second to estimate average velocity. Compare the interval velocities to test whether the cart speeds up. A rise of the same size in velocity each second supports roughly constant acceleration, but more trials would strengthen that conclusion.

## 2 ANSWER WITH EVIDENCE

Use the passage

1. From 1 second to 3 seconds, what are the cart's displacement and the time of motion?

2. Calculate the cart's average velocity from 0 to 1 second. Show the position change you used.

3. Calculate the average velocities from 1 to 2 seconds and from 2 to 3 seconds. What acceleration do those velocities suggest?

4. Which part of the team's procedure helps check whether its measurements are reliable? What readings should the team compare?

## 3 YOUR TURN

Your own words

Design a test to find out whether a battery-powered toy car's velocity changes during its first three seconds on a flat floor. State your origin and positive direction, what you will measure and when, how you will use displacement and interval velocities to judge acceleration, and one way to check reliability.

ANSWER KEY

# Ramp Motion Lab

HIGH SCHOOL · PHS.5.2

## PART 1 · READ AND MARK

Underline how the team measures position, circle the origin and positive direction, and number the two steps used to test whether the cart's velocity changes. Accept any marking that follows this job and points at the right text.

## PART 2 · ANSWERS

| # | QUESTION | ANSWER |
|---|---|---|
| 1 | From 1 second to 3 seconds, what are the cart's displacement and the time of motion? | **The displacement is +80 cm, and the time of motion is 2 s.** |
| 2 | Calculate the cart's average velocity from 0 to 1 second. Show the position change you used. | **The position changes by +10 cm in 1 s, so average velocity is +10 cm/s.** |
| 3 | Calculate the average velocities from 1 to 2 seconds and from 2 to 3 seconds. What acceleration do those velocities suggest? | **The average velocities are +30 cm/s and +50 cm/s. They increase by 20 cm/s over 1 s, suggesting an acceleration of about +20 cm/s$^2$.** |
| 4 | Which part of the team's procedure helps check whether its measurements are reliable? What readings should the team compare? | **Repeat the release and compare the cart's positions at the same times across runs.** |

## PART 3 · YOUR TURN (SAMPLE ANSWER)

I will mark the car's starting point as zero and define forward as positive. I will film the car beside a meterstick and record its position at 0, 1, 2, and 3 seconds. I will subtract each interval's starting position from its ending position to find displacement, then divide by one second to find interval velocity. I will compare those velocities to judge whether the car accelerates. I will repeat the test three times and compare positions at matching times.

Accept equivalent units and methods that use changes in position over measured time intervals. For the open task, accept any clear, repeatable plan that defines direction and uses interval velocities to assess acceleration.