LESSON MAKER PRO

Motion in Motion

Calculate how far objects travel in one and two dimensions.

HIGH SCHOOL · P.1.d

P.1.d "Use mathematics and computational thinking to solve problems, using kinematics equations in both one- and two-dimensional motion."

NAME _____ DATE _____

USE THE SAME TIME

With constant acceleration, displacement is $\Delta x = v_0 t + (1/2)at^2$, and final velocity is $v = v_0 + at$. For two-dimensional motion, calculate horizontal and vertical motion separately using the same time. Ignore air resistance, and use 10 m/s^2 for downward acceleration due to gravity.

WORKED EXAMPLE

A cart starts at 7 m/s and accelerates at 6 m/s^2 for 5 s. How far does it travel, and what is its final speed?

1. Substitute into the displacement equation: $\Delta x = 7(5) + (1/2)(6)(5^2)$.
2. Calculate displacement: $\Delta x = 35 + 75 = 110$ m.
3. Calculate final speed: $v = 7 + 6(5) = 37$ m/s.

Answer: The cart travels 110 m and reaches 37 m/s.

PRACTICE 6 problems

1 A runner moves at 8 m/s, then accelerates at 2 m/s^2 for 3 s. What is the runner's final speed?

ANSWER _____

2 A cart starts at 2 m/s and accelerates at 4 m/s^2 for 2 s. How far does it travel?

ANSWER _____

3 A bicycle moves at 18 m/s, then slows at a constant acceleration of -3 m/s^2 for 2 s. How far does it travel during those 2 s?

ANSWER _____

4 A ball is dropped from rest. How far does it fall in 2 s?

ANSWER _____

5 A ball rolls off a level platform at 9 m/s. How far does it move horizontally in 3 s?

ANSWER _____

6 A ball rolls off a level platform at 12 m/s. In 2 s, how far does it move horizontally, and how far does it fall?

ANSWER _____

APPLY IT Show your work

1 An electric go-kart enters a straight section at 4 m/s and accelerates at 2 m/s^2 for 3 s. How far does it travel, and what is its final speed?

WORK SPACE

ANSWER _____

2 A camera drone flies horizontally at 9 m/s, 20 m above the ground. It releases a foam marker that keeps its horizontal speed. How long does the marker take to land, and how far does it travel horizontally?

WORK SPACE

ANSWER _____

CHALLENGE One step up

In a video game, a ball launches from the ground at 8 m/s horizontally and 20 m/s upward. It lands at the same height. How long is it in the air, and how far does it travel horizontally? Show how you find the nonzero time.

WORK SPACE AND ANSWER

Motion in Motion

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	A runner moves at 8 m/s, then accelerates at 2 m/s^2 for 3 s. What is the runner's final speed?	**14 m/s**
2	A cart starts at 2 m/s and accelerates at 4 m/s^2 for 2 s. How far does it travel?	**12 m**
3	A bicycle moves at 18 m/s, then slows at a constant acceleration of -3 m/s^2 for 2 s. How far does it travel during those 2 s?	**30 m**
4	A ball is dropped from rest. How far does it fall in 2 s?	**20 m**
5	A ball rolls off a level platform at 9 m/s. How far does it move horizontally in 3 s?	**27 m**
6	A ball rolls off a level platform at 12 m/s. In 2 s, how far does it move horizontally, and how far does it fall?	**24 m horizontally and 20 m downward**

PART 2 · APPLY IT

1. **21 m and 10 m/s** Displacement is $4(3) + (1/2)(2)(3^2) = 21$ m. Final speed is $4 + 2(3) = 10$ m/s.
2. **2 s and 18 m** The vertical drop gives $20 = (1/2)(10)t^2$, so $t = 2$ s. The horizontal distance is $9(2) = 18$ m.

CHALLENGE

Vertical displacement is $0 = 20t - 5t^2 = t(20 - 5t)$, so the nonzero time is 4 s. Horizontal distance is $8(4) = 32$ m.

Accept equivalent equations and correctly labeled units. For the challenge, students must use the nonzero time when the ball returns to its launch height.