LESSON MAKER PRO

# Motion in Motion

*Find how far objects travel when their speed changes.*

**HIGH SCHOOL · PHY.1.3**

**PHY.1.3** "Use mathematical and computational analysis to solve problems using kinematic equations."

NAME _____ DATE _____

## CONSTANT ACCELERATION

When acceleration is constant, use $\Delta x = v_i t + (1/2)at^2$ to find displacement. Use $v_f = v_i + at$ to find final velocity. If an object slows down while moving forward, its acceleration is negative.

## WORKED EXAMPLE

A cart moves at 9 m/s and accelerates at 4 m/s² for 5 s. How far does it travel?

1. Substitute: $\Delta x = (9)(5) + (1/2)(4)(5^2)$.
2. Calculate each term: $\Delta x = 45 + 50$.
3. Add: $\Delta x = 95$ m.

**Answer: 95 m**

## PRACTICE 6 problems

**1** A cart starts from rest and accelerates at 2 m/s$^2$ for 10 s. How far does it travel?

**ANSWER** _____

**2** A cart moves at 11 m/s and accelerates at 1 m/s$^2$ for 8 s. How far does it travel?

**ANSWER** _____

**3** A cart moves at 18 m/s and then accelerates at -2 m/s$^2$ for 6 s. How far does it travel in that time?

**ANSWER** _____

**4** A cart moves at 14 m/s and accelerates at 3 m/s$^2$ for 6 s. What is its final velocity?

**ANSWER** _____

**5** A cart slows from 30 m/s to 10 m/s in 10 s. What is its acceleration?

**ANSWER** _____

**6** A cart starts from rest and accelerates at 2 m/s$^2$. How long does it take to travel 121 m?

**ANSWER** _____

## APPLY IT Show your work

**1** An electric scooter begins a straight test run at 2 m/s and accelerates at 1 $m/s^2$ for 6 s. How far does it travel during those 6 s?

WORK SPACE

**ANSWER** _____

**2** A cyclist riding toward a crosswalk at 12 m/s brakes with a constant acceleration of -2 $m/s^2$. The crosswalk is 40 m away. How far does the cyclist travel before stopping, and how much space remains before the crosswalk?

WORK SPACE

**ANSWER** _____

## CHALLENGE One step up

A go-kart starts from rest and accelerates at 2 $m/s^2$ for 8 s. It then continues at its new speed for 10 s. How far does it travel in total? Show how you find the distance for each part of the trip.

WORK SPACE AND ANSWER

# Motion in Motion



## PART 1 · PRACTICE

| # | PROBLEM | ANSWER |
|---|---|---|
| 1 | A cart starts from rest and accelerates at 2 $m/s^2$ for 10 s. How far does it travel? | **100 m** |
| 2 | A cart moves at 11 m/s and accelerates at 1 $m/s^2$ for 8 s. How far does it travel? | **120 m** |
| 3 | A cart moves at 18 m/s and then accelerates at -2 $m/s^2$ for 6 s. How far does it travel in that time? | **72 m** |
| 4 | A cart moves at 14 m/s and accelerates at 3 $m/s^2$ for 6 s. What is its final velocity? | **32 m/s** |
| 5 | A cart slows from 30 m/s to 10 m/s in 10 s. What is its acceleration? | **-2 $m/s^2$** |
| 6 | A cart starts from rest and accelerates at 2 $m/s^2$. How long does it take to travel 121 m? | **11 s** |

## PART 2 · APPLY IT

1. **30 m** $\Delta x = (2)(6) + (1/2)(1)(6^2) = 12 + 18 = 30$ m.
2. **The cyclist travels 36 m and stops 4 m before the crosswalk.** From $0 = 12 + (-2)t$, stopping takes 6 s. The cyclist travels $(12)(6) + (1/2)(-2)(6^2) = 36$ m, leaving 40 - 36 = 4 m.

## CHALLENGE

**During acceleration, the go-kart travels $(1/2)(2)(8^2) = 64$ m and reaches $(2)(8) = 16$ m/s. At that speed, it travels $(16)(10) = 160$ m. Total distance: 224 m.**

Accept equivalent calculations with correct units. In the challenge, look for separate distances for the accelerating and constant-speed parts of the trip.