LESSON MAKER PRO

Motion in Motion

Model positions and find where moving objects go.

HIGH SCHOOL · P.IPE.A.2

P.IPE.A.2 "Use parametric equations to model and solve motion problems."

NAME _____ DATE _____

ONE TIME, TWO COORDINATES

A moving object's position at time t is given by the pair (x(t), y(t)). To find when it reaches a given coordinate, solve for t and use that same time in the other equation. Two objects meet only if both their x-coordinates and their y-coordinates match at the same time.

WORKED EXAMPLE

A drone's horizontal position is x(t) = 19 + 11t, and its height is y(t) = 67 - 9t. Distances are in meters and t is in seconds. When does it reach x = 74, and what is its height then?

1. Set 19 + 11t = 74.
2. Solve: 11t = 55, so t = 5.
3. Substitute: y(5) = 67 - 9(5) = 22.

Answer: After 5 seconds, the drone is 22 meters high.

PRACTICE 6 problems

1 An object moves according to x(t) = 2 + 4t and y(t) = 16 - t. Find its position at t = 3.

ANSWER _____

2 An object moves according to x(t) = 1 + 3t and y(t) = 24 - 2t. When does it reach x = 13, and what is its y-coordinate then?

ANSWER _____

3 A ball's position is x(t) = 2 + 3t and y(t) = 24 + 2t - t^2, for t ≥ 0. When does it hit the ground, y = 0, and what is its x-coordinate then?

ANSWER _____

4 A drone starts at (2, 18). It flies right at 3 meters per second and down at 4 meters per second. Write equations for x(t) and y(t), where t is the number of seconds since it started.

ANSWER _____

5 Object A follows x(t) = 2 + 2t and y(t) = 4 + t. Object B follows x(t) = 14 - t and y(t) = 16 - 2t. Do they meet? If so, give the time and position.

ANSWER _____

6 An object follows x(t) = 2 + 4t and y(t) = 12 + 2t, for t ≥ 0. Does it pass through (18, 18)? Explain using time.

ANSWER _____

APPLY IT Show your work

1 A camera drone starts 2 meters east of a launch marker and 30 meters above it. It flies east at 4 meters per second and descends at 3 meters per second. Let t be seconds after launch. Write x(t) for its distance east of the marker and y(t) for its height. When is it 12 meters high, and how far east is it then?

WORK SPACE

ANSWER _____

2 In a video game, an avatar starts at horizontal position 0 and moves right at 4 grid units per second. Its height is $y(t) = 12t - 2t^2$. Write x(t). At what two times is the avatar at height 16, and what is its horizontal position at each time?

WORK SPACE

ANSWER _____

CHALLENGE One step up

Two game characters move for $0 \le t \le 6$. A follows $x(t) = 2t$ and $y(t) = 12t - 2t^2$. B follows $x(t) = 12 - 2t$ and $y(t) = 4t + 8$. Both visit (8, 16). Do they ever collide? Show when each visits (8, 16), then check the only time their x-coordinates match.

WORK SPACE AND ANSWER

Motion in Motion

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	An object moves according to x(t) = 2 + 4t and y(t) = 16 - t. Find its position at t = 3.	**(14, 13)**
2	An object moves according to x(t) = 1 + 3t and y(t) = 24 - 2t. When does it reach x = 13, and what is its y-coordinate then?	**t = 4; y = 16**
3	A ball's position is x(t) = 2 + 3t and y(t) = 24 + 2t - t^2, for t ≥ 0. When does it hit the ground, y = 0, and what is its x-coordinate then?	**t = 6; x = 20**
4	A drone starts at (2, 18). It flies right at 3 meters per second and down at 4 meters per second. Write equations for x(t) and y(t), where t is the number of seconds since it started.	**x(t) = 2 + 3t; y(t) = 18 - 4t**
5	Object A follows x(t) = 2 + 2t and y(t) = 4 + t. Object B follows x(t) = 14 - t and y(t) = 16 - 2t. Do they meet? If so, give the time and position.	**Yes. They meet at t = 4 at (10, 8).**
6	An object follows x(t) = 2 + 4t and y(t) = 12 + 2t, for t ≥ 0. Does it pass through (18, 18)? Explain using time.	**No. When x = 18, t = 4 and y = 20, not 18.**

PART 2 · APPLY IT

1. **x(t) = 2 + 4t; y(t) = 30 - 3t. After 6 seconds, it is 26 meters east of the marker.** Set 30 - 3t = 12 to get t = 6. Then x(6) = 2 + 4(6) = 26.
2. **x(t) = 4t. At t = 2, x = 8; at t = 4, x = 16.** Solve 12t - $2t^2$ = 16 to get t = 2 or t = 4. Substitute each time into x(t) = 4t.

CHALLENGE

They do not collide. A visits (8, 16) at t = 4, while B visits it at t = 2. Their x-coordinates match only at t = 3; then A is at (6, 18) and B is at (6, 20).

Accept equivalent parametric equations and explanations that compare coordinates at the same time. In problem 3, t = -4 also solves y(t) = 0, but it is outside the given time domain.