LESSON MAKER PRO

Motion Function Mission

Use initial conditions to build velocity and position functions.

HIGH SCHOOL · MA.912.C.5.1

MA.912.C.5.1 "Find specific antiderivatives using initial conditions, including finding velocity functions from acceleration functions, finding position functions from velocity functions and solving applications related to motion along a line."

NAME _____ DATE _____

BUILD THE FUNCTION

When you integrate a rate, include + C because many functions have the same derivative. Use the given value to solve for C. In motion, integrate acceleration to get velocity, then integrate velocity to get position.

WORKED EXAMPLE

Find v(t) if a(t)=14t+11 and v(0)=9.

1. $v(t)=\int(14t+11)\,dt=7t^2+11t+C$.
2. Use v(0)=9: 9=C.
3. Substitute C: $v(t)=7t^2+11t+9$.

Answer: $v(t)=7t^2+11t+9$

PRACTICE 6 problems

1 Find v(t) if a(t)=12t+8 and v(5)=10.

ANSWER _____

2 Find s(t) if $v(t)=15t^2+4t$ and s(6)=12.

ANSWER _____

3 Find v(t) if a(t)=16-10t and v(8)=13.

ANSWER _____

4 Find s(t) if v(t)=20t-12 and s(4)=8.

ANSWER _____

5 Find f(x) if $f'(x)=24x^3+10x$ and f(5)=15.

ANSWER _____

6 Find s(t) if $v(t)=24t^2-16t+12$ and s(2)=18.

ANSWER _____

APPLY IT Show your work

1 A skateboard moves along a straight track. Its acceleration is $a(t)=20t-8$ ft/s^2, where t is measured in seconds. At t=2, its velocity is 16 ft/s and its position is 30 ft from a marker. Find its position at t=4.

WORK SPACE

ANSWER _____

2 A robotics team tests a cart moving along a straight rail. Its velocity is $v(t)=12t^2+16t-20$ cm/s. At t=3, the cart is 24 cm from the rail's reference point. Find the cart's position at t=5.

WORK SPACE

ANSWER _____

CHALLENGE One step up

A cart moves along a line with acceleration $a(t)=30t^2-24t+8$. At t=2, v(2)=12 and s(2)=18. Find the position function, then find s(4).

WORK SPACE AND ANSWER

ANSWER KEY

Motion Function Mission

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PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Find v(t) if a(t)=12t+8 and v(5)=10.	**$v(t)=6t^2+8t-180$**
2	Find s(t) if v(t)=$15t^2$+4t and s(6)=12.	**$s(t)=5t^3+2t^2-1140$**
3	Find v(t) if a(t)=16-10t and v(8)=13.	**$v(t)=16t-5t^2+205$**
4	Find s(t) if v(t)=20t-12 and s(4)=8.	**$s(t)=10t^2-12t-104$**
5	Find f(x) if f'(x)=$24x^3$+10x and f(5)=15.	**$f(x)=6x^4+5x^2-3860$**
6	Find s(t) if v(t)=$24t^2$-16t+12 and s(2)=18.	**$s(t)=8t^3-8t^2+12t-38$**

PART 2 · APPLY IT

1. **s(4)=458/3 ft** Integrate acceleration and use v(2)=16 to get v(t)=$10t^2$-8t-8. Integrate again, use s(2)=30, and evaluate the position function at t=4.
2. **s(5)=504 cm** Integrate the velocity and use s(3)=24 to get s(t)=$4t^3$+$8t^2$-20t-96. Substitute t=5.

CHALLENGE

$s(t)=5/2t^4-4t^3+4t^2-36t+66$, and s(4)=370

Accept equivalent antiderivative forms, including reordered terms. Require students to use both initial conditions in the challenge to determine both constants.