LESSON MAKER PRO

# Integral Accumulation

*Use antiderivatives to find exact accumulated change.*

**HIGH SCHOOL · MA.912.C.4**

**MA.912.C.4** "Develop an understanding for and determine integrals."

NAME _____ DATE _____

### EVALUATE A DEFINITE INTEGRAL

A definite integral adds up a rate of change over an interval. Find an antiderivative F(x), then subtract the lower value from the upper value: F(b) - F(a).

### WORKED EXAMPLE

Evaluate $\int_{-1}^{0} 13x^{12}\,dx$.

1. An antiderivative of $13x^{12}$ is $x^{13}$.
2. Apply the bounds: $[x^{13}]_{-1}^{0} = 0^{13} - (-1)^{13}$.
3. $0 - (-1) = 1$.

**Answer: 1**

## PRACTICE 6 problems

**1** Evaluate $\int_{3}^{4} 5x^{3}\,dx$.

**ANSWER** _____

**2** Evaluate $\int_{4}^{5} (6x^{4} - 9)\,dx$.

**ANSWER** _____

**3** Evaluate $\int_{3}^{6} 5x\,dx$.

**ANSWER** _____

**4** Evaluate $\int_{-4}^{-2} (x^{3} + 10)\,dx$.

**ANSWER** _____

**5** Evaluate $\int_{5}^{9} (14 - x)\,dx$.

**ANSWER** _____

**6** Evaluate $\int_{4}^{9} 3\text{sqrt}(x)\,dx$.

**ANSWER** _____

## APPLY IT Show your work

**1** A robotics club tests a delivery robot. Its velocity is $v(t) = 6t + 14$ meters per minute from $t = 3$ to $t = 5$ minutes. How far does the robot travel during this interval?

WORK SPACE

**ANSWER** _____

**2** At a school concert, the rate of ticket sales is $r(t) = 4t^2 + 9$ tickets per hour from $t = 3$ to $t = 6$ hours after sales open. How many tickets are sold during this interval?

WORK SPACE

**ANSWER** _____

## CHALLENGE One step up

Evaluate $\int_{-6}^{4} |x + 3|\, dx$. Show how you split the integral at the point where the expression inside the absolute value equals zero.

WORK SPACE AND ANSWER

**ANSWER KEY**

# Integral Accumulation



## PART 1 · PRACTICE

| # | PROBLEM | ANSWER |
|---|---|---|
| 1 | Evaluate $\int_3^4 5x^3\,dx$. | **875/4** |
| 2 | Evaluate $\int_4^5 (6x^4 - 9)\,dx$. | **12561/5** |
| 3 | Evaluate $\int_3^6 5x\,dx$. | **135/2** |
| 4 | Evaluate $\int_{-4}^{-2} (x^3 + 10)\,dx$. | **-40** |
| 5 | Evaluate $\int_5^9 (14 - x)\,dx$. | **28** |
| 6 | Evaluate $\int_4^9 3\text{sqrt}(x)\,dx$. | **38** |

## PART 2 · APPLY IT

1. **76 meters** Integrate the positive velocity: $\int_3^5 (6t + 14)\,dt$. Evaluate $[3t^2 + 14t]_3^5$ to get 76.
2. **279 tickets** Find accumulated tickets with $\int_3^6 (4t^2 + 9)\,dt$. Evaluate $[(4/3)t^3 + 9t]_3^6$ to get 279.

## CHALLENGE

**29**

Accept equivalent exact fraction forms for the definite integrals. For the challenge, students should split at x = -3 and may use geometric areas or piecewise antiderivatives.