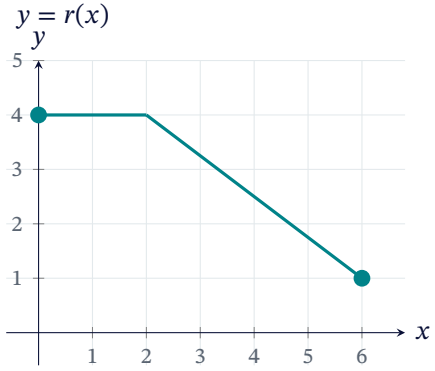
6.1 / Practice workbook

Exploring Accumulations of Change

Practice

Problems 1–6 / Show your reasoning

1 Grain is loaded into a silo at a rate of $r(t)$ tons per hour. The graph of r, made of two segments, is shown for $0 \le t \le 6$. How many tons of grain are loaded from $t = 0$ to $t = 6$?



2 Snow falls at a rate of $s(t)$ inches per hour, t hours after midnight. The area under the graph of s from $t = 2$ to $t = 5$ is 4. Which of the following is the best interpretation of this area?

A. Snow falls at 4 inches per hour at $t = 5$.

B. The snow is 4 inches deep at $t = 5$.

C. 4 inches of snow fall from $t = 2$ to $t = 5$ hours.

D. The rate of snowfall goes up by 4 inches per hour from $t = 2$ to $t = 5$.

3 Water flows into a pool at a rate of $r(t)$ liters per minute. For $0 \le t \le 4$, $r(t) = k$; then r decreases linearly to 0 at $t = 10$. If 56 liters flow in from $t = 0$ to $t = 10$, what is k?

A. 5.6

B. 8

C. 11.2

D. 14

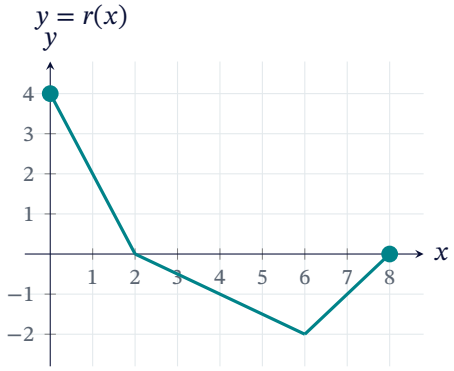
4 A factory uses electric power at a rate of $P(t) = 1 + t$ megawatts, t hours after it opens, $0 \le t \le 8$.

(a) Find the area under the graph of P from $t = 0$ to $t = 6$.

(b) Explain the meaning of that area in context, with units.

(c) How many megawatt-hours of energy does the factory use from $t = 6$ to $t = 8$?

5 A liquid is at 30°C at $t = 0$. Its temperature changes at a rate of $r(t)$ degrees per minute. The graph of r is shown.



(a) Find the temperature at $t = 2$.

(b) From $t = 0$ to $t = 8$, find the area above the axis minus area below. Explain its meaning in context, with units.

(c) At what time $t > 0$ is the temperature 30°C again?

6 The number of people in a line changes at a rate of $r(t) = |t - 3| - 1$ people per minute, $0 \le t \le 6$. A negative rate means the line gets shorter. At $t = 0$ there are 10 people in line. How many people are in line at $t = 6$?

A. 9
B. 11
C. 13
D. 15

6.1 / Answer key

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P01 Tons = the area under r: a rectangle, then a trapezoid.
$0 \to 2:\ 4 \cdot 2 = 8, \quad 2 \to 6:\ \frac{1}{2}(4+1) \cdot 4 = 10$
$8 + 10 = 18$ tons.

P02 (C) $\frac{\text{in}}{\text{hr}} \times \text{hr} = \text{in}$: the integral is an amount of snow, from $t = 2$ to $t = 5$.
(A) and (D) are rates; (B) is the depth, not the change. Answer C.

P03 (B) Water = area under r: a rectangle on $[0, 4]$, a triangle on $[4, 10]$.
$4k + \frac{1}{2} \cdot 6 \cdot k = 7k = 56 \ \to \ k = 8$
Answer B.

P04 $\frac{1}{2}(1+7) \cdot 6 = 24$
24 megawatt-hours of energy used from t = 0 to t = 6 hours
$\frac{1}{2}(7+9) \cdot 2 = 16$

P05 $30 + \frac{1}{2} \cdot 2 \cdot 4 = 34$
$\frac{1}{2} \cdot 2 \cdot 4 - \frac{1}{2} \cdot 6 \cdot 2 = 4 - 6 = -2$
below the axis from 2 to 6: 1/2 * 4 * 2 = 4, the 4 degrees gained are lost again at t = 6

P06 (C) $r(t) = |t-3| - 1 = 0 \ \to \ t = 2,\ 4$
$0 \to 2:\ +2, \quad 2 \to 4:\ -\frac{1}{2} \cdot 2 \cdot 1 = -1, \quad 4 \to 6:\ +2$
$10 + 2 - 1 + 2 = 13$
Answer C.