1.4 Start Thinking

Absolute value is the measurement of the distance from zero on a number line. Use a ruler to construct a number line from -4 to 4 with equal amounts of space between the tick marks. Use your construction to compare the distance from 0 to 4 and from 0 to -4. Explain how this proves the absolute value of -4 and 4 are both equal to 4.

1.4 Warm Up

Determine whether the situation could involve negative numbers. Explain your reasoning.

1. the number of points one team scores in a basketball game
2. the amount of money in a bank account
3. the amount of electricity used on this month's bill compared to last month's bill

1.4 Cumulative Review Warm Up

Copy and complete the statement using $<$, $>$, or $=$.

1. $|-82| \underline{\ \ ?\ \ } |57|$
2. $|-67| \underline{\ \ ?\ \ } |-70|$
3. $|-70| \underline{\ \ ?\ \ } |-91|$
4. $|-27| \underline{\ \ ?\ \ } |42|$
5. $|22| \underline{\ \ ?\ \ } |-19|$
6. $|-61| \underline{\ \ ?\ \ } |61|$

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1.4 Practice A

In Exercises 1–4, simplify the expression.

1. $-|-2|$

2. $|-7|-|7|$

3. $|-3 \bullet 2|$

4. $\left|\frac{-15}{5}\right|$

In Exercises 5–12, solve the equation. Graph the solution(s), if possible.

5. $|r| = 5$

6. $|q| = -7$

7. $|b - 2| = 5$

8. $|k + 6| = 9$

9. $|-5p| = 35$

10. $\left|\frac{a}{3}\right| = 4$

11. $|8y - 3| = 13$

12. $|x + 4| + 7 = 3$

13. The minimum distance between two fence posts is 4 feet. The maximum distance is 10 feet.

a. Represent these two distances on a number line.

b. Write an absolute value equation that represents the minimum and maximum distances.

In Exercises 14–19, solve the equation. Check your solutions.

14. $|j| = |2j + 3|$

15. $|3f - 6| = |9f|$

16. $|b + 3| = |2b - 2|$

17. $|4h - 2| = 2|h + 3|$

18. $3|w - 5| = |2w + 10|$

19. $|2y + 5| = 3y$

20. Your friend says the absolute value equation $|2x + 9| + 7 = 3$ has two solutions because the constant on the right side of the equation is positive. Is your friend correct? Explain.

21. Describe a real-life situation that can be modeled by an absolute-value equation with the solutions $x = 5$ and $x = 10$.

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1.4 Practice B

In Exercises 1–10, solve the equation. Graph the solution(s), if possible.

1. $|p - 3| = 10$

2. $|-2k| = 6$

3. $|6f| = -2$

4. $\left|\frac{q}{5}\right| = 3$

5. $|-a + 2| + 9 = 6$

6. $3|4 - 3m| = 30$

7. $-4|5g - 12| = -12$

8. $|x - 3| + 9 = 30$

9. $3|2d - 6| + 2 = 2$

10. $7|2c - 6| + 4 = 32$

11. A company manufactures penny number 2 nails that are 1 inch in length. The actual length is allowed to vary by up to $\frac{1}{32}$ inch.

a. Write and solve an absolute value equation to find the minimum and maximum acceptable nail length.

b. A penny number 2 nail is 1.05 inches long. Is the nail acceptable? Explain.

In Exercises 12–14, write an absolute value equation that has the given solutions.

12. 3 and 9

13. -5 and 15

14. 4 and 11

In Exercises 15–20, solve the equation. Check your solutions.

15. $|9w - 4| = |2w + 10|$

16. $2|n + 7| = |4n + 8|$

17. $3|3t + 1| = 2|6t + 3|$

18. $|5r + 3| = 2r$

19. $|j - 5| = |j + 9|$

20. $|2k + 4| = |2k + 3|$

21. You conduct a random survey of your small town about having a townwide garage sale. Of those surveyed, 56% are in favor and 44% are opposed. The actual percent could be 5% more or 5% less than the acquired results.

a. Write and solve an absolute value equation to find the least and greatest percents of your town population that could be opposed to a townwide garage sale.

b. A friend claims that half the town is actually opposed to a townwide garage sale. Does this statement conflict with the survey data? Explain.

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1.4 Enrichment and Extension

Extraneous Solutions in Algebra

In many algebraic problems, there is the possibility of finding an apparent solution to a problem that does not solve the equation correctly. These solutions are called *extraneous solutions*. When solving absolute value equations, you see extraneous solutions for the first time, and they continue to come up as you continue through algebra. Solving square root equations is another time when you may find extraneous solutions. Recall that you cannot have a negative value under the radical, and when you take the square root of a number, the answer is never negative.

Example: Solve $\sqrt{12 - x} = x$.

$\sqrt{12 - x} = x$	Write the equation.
$\left(\sqrt{12 - x}\right)^2 = x^2$	Square each side.
$12 - x = x^2$	Simplify.
$x^2 + x - 12 = 0$	Write in standard form.
$(x + 4)(x - 3) = 0$	Factor.
$x + 4 = 0$	Set each factor equal to zero and solve.
$x = -4$	
$x - 3 = 0$	
$x = 3$	

Check:

$$\sqrt{12 - (-4)} \stackrel{?}{=} (-4)$$
$$\sqrt{16} \stackrel{?}{=} -4$$
$$4 \neq -4$$

$$\sqrt{12 - (3)} \stackrel{?}{=} 3$$
$$\sqrt{9} \stackrel{?}{=} 3$$
$$3 = 3$$

The apparent solution, $x = -4$ is extraneous. So, the only solution of the equation is $x = 3$.

Solve the equation. Check your answer for extraneous solutions.

1. $|x - 2| = 3x - 4$

2. $\dfrac{x + 3}{x + 2} = 1 - \dfrac{x + 1}{x + 2}$

3. $m = \sqrt{56 - m}$

4. $\dfrac{k + 8}{k} - \dfrac{k - 4}{k} = 3$

5. $|3 + x| = 3x + 5$

6. $\sqrt{90 - n} = n$

7. $\dfrac{y - 3}{y - 1} + \dfrac{2y}{y - 1} = 2$

8. $|-3x| = x$

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1.4 Puzzle Time

Did You Hear About The Two Ducks In A Race?

A	B	C	D	E	F
G	H	I	J	K	L
M	N				

Complete each exercise. Find the answer in the answer column. Write the word under the answer in the box containing the exercise letter.

Simplify the expression.

A. $\left|-7\right|$

B. $\left|-17\right|$

C. $\left|16\right| - \left|-16\right|$

D. $\left|-\frac{36}{9}\right|$

Find the value of the variable which satisfies the equation. Check your solution.

E. $\left|x\right| = 7$

F. $\left|b\right| = -19$

G. $\left|w - 4\right| = 11$

H. $\left|-8e\right| = 24$

I. $\left|2q + 5\right| = 17$

J. $6\left|5p + 4\right| - 16 = 20$

K. $\left|c - 24\right| = 7c$

L. $\left|3s - 11\right| = \left|s + 9\right|$

M. $\left|h - 8\right| = \left|h + 10\right|$

N. During last year's volleyball season, the coach concluded that the number of points scored in each game could be given by the equation $\left|x - 7\right| = 2.$ How many points were scored in each game?

5, 9	FEET
−7, 7	THRILL
4	THE
−3, 3	AND
3	OF
−14, 7	FAST
17	RESULTED
$-\frac{1}{2}, \frac{1}{4}$	TIE
−11, 6	THE

0	IN
$\frac{1}{2}, 10$	SEVERAL
7	IT
−2, 2	WINNER
$-2, \frac{2}{5}$	AGONY
no solution	OF
−1	WEBBED
−7, 15	VICTORY
−11	SECOND