Using a Linear Model

Name: _____	Date: _____	Score: _____ / 24

Quick Review

Once you have a linear model $y = mx + b$ for real data, you can *use* it to make predictions and interpret it. To **predict**, substitute a value of x and compute y. The **slope** m is a *rate*: it tells how much y changes for each 1-unit increase in x (and its sign tells the direction). The y**-intercept** b is the *starting value* of y when $x = 0$. Always keep the real-world units in mind — a slope might be "dollars per hour" or "cm per week." Predictions inside the data range are usually trustworthy; far outside it, be cautious.

◇ **Example:** A pool is filling by the model $y = 15x + 40$, where x is minutes and y is gallons. Interpret the slope and intercept, and predict the water after 20 minutes.

⇒ Let's read the model like a sentence. The slope is 15, so the pool gains 15 **gallons every minute** — that is the filling rate. The intercept is 40, so when $x = 0$ (before we start timing) there were already 40 **gallons** in the pool. To predict the water after 20 minutes, substitute $x = 20$: $y = 15(20) + 40 = 300 + 40 = 340$. So we expect about 340 gallons.

Answer: slope $= 15$ gal/min, intercept $= 40$ gal; $y = 340$

PRACTICE

Use each linear model to predict or interpret. Show your substitution.

1. $y = 3x + 2$, find y when $x = 10$ _____
2. $y = 5x + 3$, find y when $x = 6$ _____
3. $y = 2x + 1$, find y when $x = 8$ _____
4. $y = -2x + 20$, find y when $x = 7$ _____
5. $y = 4x - 1$, find y when $x = 9$ _____
6. $y = 10x$, find y when $x = 12$ _____
7. $y = 6x + 5$, find y when $x = 0$ _____
8. $y = -3x + 30$, find y when $x = 10$ _____
9. $y = 7x + 4$, find y when $x = 5$ _____
10. $y = \frac{1}{2}x + 6$, find y when $x = 8$ _____
11. $y = 2x + 1$, find x when $y = 15$ _____
12. $y = 3x - 5$, find x when $y = 16$ _____
13. $y = -x + 12$, find x when $y = 4$ _____
14. In $y = 8x + 50$, what does the slope 8 mean? _____
15. In $y = 8x + 50$, what does 50 mean? _____
16. $y = 1.5x + 2$, find y when $x = 10$ _____
17. $y = -4x + 100$, find y when $x = 15$ _____
18. $y = 5x + 3$, find x when $y = 28$ _____
19. $y = 12x + 60$, find y when $x = 4$ _____
20. $y = -2x + 9$, find x when $y = 1$ _____

Word Problems

21. A plumber charges by $y = 45x + 60$, where x is hours and y is dollars. What does each number mean, and what is the cost of a 3-hour job? _____
22. A snowpack melts by $y = -3x + 48$, where x is days and y is depth in inches. After how many days will the snow be gone? _____
23. A reading app models pages read as $y = 25x + 10$, where x is days. Predict the total pages after 2 weeks. _____
24. A car's value follows $y = -1500x + 24000$, where x is years owned. In how many years will the car be worth \$9000? _____

Answer Keys

1. $\boxed{32}$
2. $\boxed{33}$
3. $\boxed{17}$
4. $\boxed{6}$
5. $\boxed{35}$
6. $\boxed{120}$
7. $\boxed{5}$
8. $\boxed{0}$
9. $\boxed{39}$
10. $\boxed{10}$
11. $\boxed{x = 7}$
12. $\boxed{x = 7}$
13. $\boxed{x = 8}$
14. $\boxed{y \text{ rises } 8 \text{ per unit } x}$
15. $\boxed{\text{starting value of } y \text{ at } x = 0}$
16. $\boxed{17}$
17. $\boxed{40}$
18. $\boxed{x = 5}$
19. $\boxed{108}$
20. $\boxed{x = 4}$
21. $\boxed{\$60 \text{ service fee, } \$45 \text{ per hour; } y = \$195}$
22. $\boxed{16 \text{ days}}$
23. $\boxed{360 \text{ pages}}$
24. $\boxed{10 \text{ years}}$

Step-by-Step Explanations

1. Substitute: $y = 3(10) + 2 = 30 + 2 = 32$.
2. Substitute: $y = 5(6) + 3 = 30 + 3 = 33$.
3. Substitute: $y = 2(8) + 1 = 16 + 1 = 17$.
4. Substitute: $y = -2(7) + 20 = -14 + 20 = 6$.
5. Substitute: $y = 4(9) - 1 = 36 - 1 = 35$.
6. Substitute: $y = 10(12) = 120$.
7. At $x = 0$, $y = 6(0) + 5 = 5$ — that is just the y-intercept.
8. Substitute: $y = -3(10) + 30 = -30 + 30 = 0$.
9. Substitute: $y = 7(5) + 4 = 35 + 4 = 39$.
10. Substitute: $y = \frac{1}{2}(8) + 6 = 4 + 6 = 10$.
11. Set $2x + 1 = 15$, so $2x = 14$ and $x = 7$.
12. Set $3x - 5 = 16$, so $3x = 21$ and $x = 7$.
13. Set $-x + 12 = 4$, so $-x = -8$ and $x = 8$.
14. The slope is the rate of change: y goes up by 8 for every 1-unit increase in x.
15. The y-intercept 50 is the value of y when $x = 0$ — the starting amount.
16. Substitute: $y = 1.5(10) + 2 = 15 + 2 = 17$.
17. Substitute: $y = -4(15) + 100 = -60 + 100 = 40$.
18. Set $5x + 3 = 28$, so $5x = 25$ and $x = 5$.
19. Substitute: $y = 12(4) + 60 = 48 + 60 = 108$.
20. Set $-2x + 9 = 1$, so $-2x = -8$ and $x = 4$.
21. The intercept \$60 is a flat service fee charged before any work, and the slope \$45 is the hourly rate. For 3 hours: $y = 45(3) + 60 = 135 + 60 = 195$ dollars.
22. The snow is gone when $y = 0$: set $-3x + 48 = 0$, so $3x = 48$ and $x = 16$ days. The slope -3 means it melts 3 inches per day.
23. Two weeks is $x = 14$ days. Substitute: $y = 25(14) + 10 = 350 + 10 = 360$ pages. The slope 25 is pages per day.
24. Set $-1500x + 24000 = 9000$, so $-1500x = -15000$ and $x = 10$ years. The slope -1500 means it loses \$1500 of value each year.

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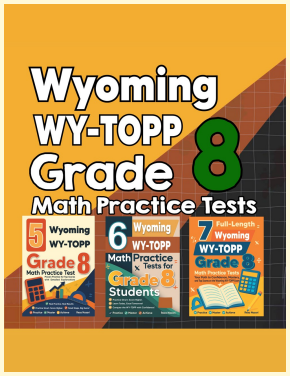

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