

Modeling Real Situations With Linear Functions

Grade 8 math · Worksheet Answer Key · Standards: 8.F.B.4, 8.F.B.5

Every solution computes the rate of change as change in y over change in x , finds the initial value by substitution, and states a conclusion in context. Sketches and graphs are repeated with key features marked. Final answers are in bold.

Standards: 8.F.B.4, 8.F.B.5 · **Level:** Grade 8

Problem 1 Read the equation

(a) Compare with $mx + b$: rate 6, initial value 15. (b) Rewrite as $c = -8t + 120$: rate -8 , initial value 120.

(a) 6 and 15 (b) -8 and 120

Problem 2 Table to function

The outputs rise by 6 for every step of 1, so the rate is 6. At $x = 0$ the output is 20.

Rate 6; initial value 20; $y = 6x + 20$

Problem 3 Two points

Rate = $(21 - 9) \div (5 - 2) = 4$. Substitute $(2, 9)$: $9 = 4(2) + b$, so $b = 1$. Check $(5, 21)$: $4(5) + 1 = 21$.

$y = 4x + 1$

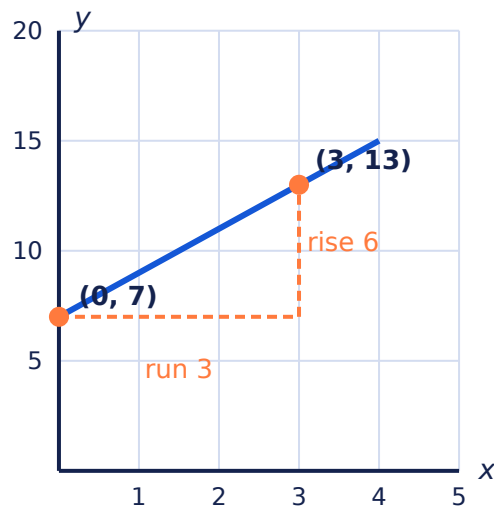
Problem 4 Gym fees

The rate is \$14 per month and the initial value is \$20. So $y = 14x + 20$. For $x = 6$: $14(6) + 20 = 104$.

$y = 14x + 20$; \$104

Problem 5 Equation from a graph

The line crosses the y -axis at $(0, 7)$, so $b = 7$. The rise from $(0, 7)$ to $(3, 13)$ is 6 over a run of 3, so $m = 2$.



Slope triangle.

$$y = 2x + 7$$

Problem 6 Describe the function

(a) The rate -3 is negative, so it is decreasing and linear. (b) Values 0, 2, 8, 18 grow by increasing amounts: increasing and nonlinear. (c) The output never changes: constant, which is linear.

(a) decreasing, linear (b) increasing, nonlinear (c) constant, linear

Problem 7 Negative coordinates

Rate = $(-7 - 11) \div (4 - (-2)) = -18 \div 6 = -3$. Substitute $(-2, 11)$: $11 = -3(-2) + b = 6 + b$, so $b = 5$. Check $(4, -7)$: $-12 + 5 = -7$.

$$y = -3x + 5$$

Problem 8 Table with gaps

From $x = 1$ to 3 the output rises 10 over a run of 2, so the rate is 5. Then $9 = 5(1) + b$ gives $b = 4$. Check: $5(7) + 4 = 39$.

$$y = 5x + 4$$

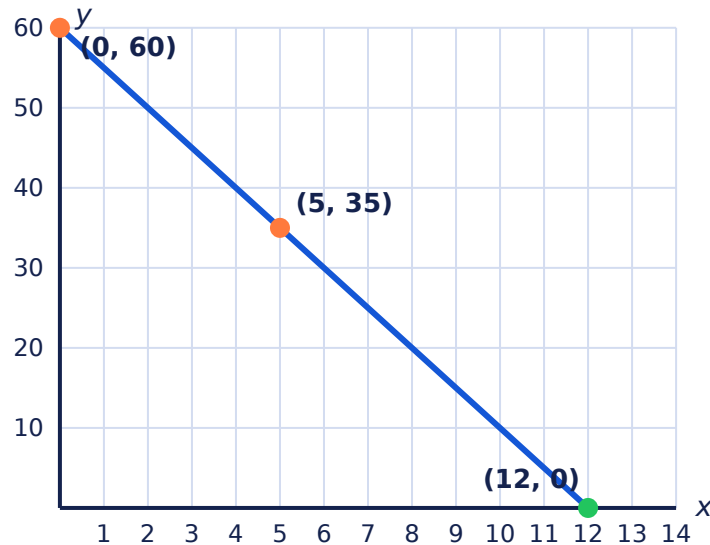
Problem 9 Van rental meaning

The 0.45 is the rate: each mile costs \$0.45. The 28 is the initial value: a \$28 base fee even at 0 miles. For 120 miles: $0.45(120) + 28 = 54 + 28 = 82$.

\$0.45 per mile; \$28 base fee; \$82

Problem 10 Draining tank

Rate = $(35 - 60) \div (5 - 0) = -5$ gallons per minute. Initial value 60. So $y = -5x + 60$. The tank is empty when $-5x + 60 = 0$, so $x = 12$.



Empty at 12 minutes.

Rate -5 ; initial 60; $y = -5x + 60$; empty after 12 minutes

Problem 11 Drone climb

Rate = $(54 - 30) \div (5 - 2) = 8$ feet per second. Then $30 = 8(2) + b$ gives $b = 14$. So $y = 8x + 14$, and at 10 seconds: $8(10) + 14 = 94$.

$y = 8x + 14$; 94 feet

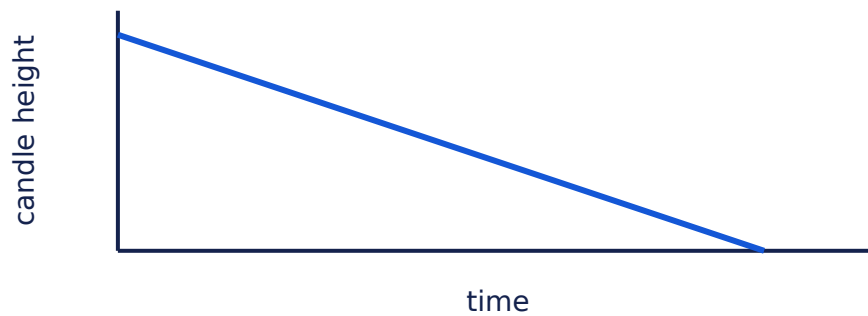
Problem 12 Cyclist's trip

A: distance increases steadily. B: the graph is level, so the cyclist is resting. C: distance increases again, and the segment is steeper than A, so the cyclist rides faster.

A increasing, B constant, C increasing faster

Problem 13 Sketch a story

The height starts high and falls at a steady rate, so the graph is a straight line sloping down from the vertical axis to the horizontal axis.



Candle height over time.

Decreasing and linear

Problem 14 Missing values

From $7 = 4(1) + b$, $b = 3$, so $y = 4x + 3$. At $x = 6$: $24 + 3 = 27$. For $y = 51$: $4x + 3 = 51$, so $4x = 48$ and $x = 12$.

$y = 27$; $x = 12$

Problem 15 Ride-share fare

Rate = $(19 - 11.5) \div (6 - 3) = 7.5 \div 3 = 2.50$. Then $11.5 = 2.5(3) + b$ gives $b = 4$. So $y = 2.5x + 4$, and 14 miles cost $2.5(14) + 4 = 39$.

\$2.50 per mile; \$4.00 starting fee; \$39.00

Problem 16 Phone battery

Rate = $(58 - 82) \div (5 - 2) = -8$ percent per hour. Then $82 = -8(2) + b$ gives $b = 98$. So $y = -8x + 98$. After 10 hours: $-80 + 98 = 18$. At 0%: $x = 98 \div 8 = 12.25$.

$y = -8x + 98$; 18%; after 12.25 hours

Problem 17 Is a line a good model?

The changes in y are 3, 6 and 12. They are not constant, so a linear function does not fit. Each output doubles, so the function is increasing and nonlinear.

Not linear; increasing and nonlinear (outputs double)

Problem 18 A ball in the air

The height increases quickly at first, then more slowly, reaches the highest point, and then decreases. The graph bends, so the function is nonlinear. At the highest point the ball stops rising and starts to fall.

Increasing then decreasing; nonlinear

Problem 19 Savings race

Noah's rate is $(100 - 20) \div 4 = 20$ and his initial value is 20, so $y = 20x + 20$. Set $15x + 60 = 20x + 20$. Then $40 = 5x$ and $x = 8$. Savings: $15(8) + 60 = 180$.

Week 8; \$180 each

Problem 20 Candle burn time

Rate = $(13.5 - 18) \div 3 = -1.5$ inches per hour, so $h = -1.5t + 18$. The height is 0 when $t = 18 \div 1.5 = 12$ hours. At 15 hours the formula gives $18 - 22.5 = -4.5$, a negative height, which is impossible.

$h = -1.5t + 18$; 12 hours; the model only applies for $0 \leq t \leq 12$