Building Linear Functions

Apply the skill to decisions and designs

Name _____ **Date** _____ **Score** _____ / 10

QUICK REVIEW

In a linear model, a constant fee or starting amount becomes b, and a per-unit increase becomes m. A tank beginning with 30 liters and losing 4 liters per minute has $V = 30 - 4t$. State units and a meaningful domain. Two measurements can also determine the rate and initial amount through substitution.

Worked example

Example for form 3: construct a line. Use $(0, 4)$ and $(2, 10)$. Write $y = mx + b$.

1. The slope is $m = (10 - (4))/(2 - (0)) = 3$. Substitute $(0, 4)$ into $y = mx + b$.

2. $4 = 3(0) + b$, so $b = 4 - (0) = 4$. The rule is $y = 3x + 4$.

3. Check the other point: $3(2) + (4) = 10 = 10$. Both given pairs satisfy the equation.

Answer: $y = 3x + 4$

Practice Problems

Show your thinking.

1. A pool starts with 50 liters and gains 6 liters per minute. Write $V(t)$ and find $V(4)$.

2. A candle starts at 24 cm and burns 2 cm per hour. Write $H(t)$ and give its physical time domain.

3. A taxi charges y dollars for x miles. Build the fare rule. Use $(2, 11)$ and $(5, 20)$. Write $y = mx + b$.

4. A plant has height y cm at day x. Predict its day-8 height. Use points $(1, 7)$ and $(4, 13)$; find y at $x = 8$.

5. A tank contains y liters at minute x. Recover the draining rule. Use $(2, 34)$ and $(5, 25)$. Write $y = mx + b$.

6. Design a rental plan costing 18 dollars for 2 hours, with hourly rate 5 dollars. Find the fixed fee.

7. A club begins with a debt of 12 dollars and earns 4 dollars per ticket. Model net funds $F(n)$ and find the break-even ticket count.

8. A printer uses y sheets for x copies. Determine its linear rule. Use $(1, 8)$ and $(4, 23)$. Write $y = mx + b$.

9. Design a linear savings plan with $S(0) = 10$ dollars and $S(6) = 40$ dollars. Find the weekly deposit.

10. A temperature y falls linearly over x minutes. Predict the minute-6 reading. Use points $(0, 30)$ and $(4, 18)$; find y at $x = 6$.

Answer Key

1. $V = 6t + 50$; 74 liters.
2. $H = 24 - 2t$, $0 \le t \le 12$.
3. $y = 3x + 5$
4. $y = 21$; $y = 2x + 5$
5. $y = -3x + 40$
6. $C = 5h + 8$; fee 8 dollars.
7. $F = 4n - 12$; 3 tickets.
8. $y = 5x + 3$
9. $S = 5w + 10$; 5 dollars per week.
10. $y = 12$; $y = -3x + 30$

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. The initial amount gives $b = 50$ and the filling rate gives $m = 6$, so $V(t) = 6t + 50$.

2. At $t = 4$, $V(4) = 6(4) + 50 = 24 + 50 = 74$ liters. Time inputs are nonnegative while this filling process continues.

Problem 2

1. The starting height is 24 and the signed rate is -2, giving $H(t) = 24 - 2t$.

2. Solve $24 - 2t = 0$: $2t = 24$, so $t = 12$. Heights remain nonnegative only for $0 \le t \le 12$ in this model.

Problem 3

1. The slope is $m = (20 - (11))/(5 - (2)) = 3$. Substitute $(2, 11)$ into $y = mx + b$.

2. $11 = 3(2) + b$, so $b = 11 - (6) = 5$. The rule is $y = 3x + 5$.

3. Check the other point: $3(5) + (5) = 20 = 20$. Both given pairs satisfy the equation.

Problem 4

1. The slope is $m = (13 - (7))/(4 - (1)) = 2$. Substitute $(1, 7)$ into $y = mx + b$.

2. $7 = 2(1) + b$, so $b = 7 - (2) = 5$. The rule is $y = 2x + 5$.

3. Evaluate the completed model: $y = 2(8) + (5) = 21$. This is the output at the requested input.

Problem 5

1. The slope is $m = (25 - (34))/(5 - (2)) = -3$. Substitute $(2, 34)$ into $y = mx + b$.

2. $34 = -3(2) + b$, so $b = 34 - (-6) = 40$. The rule is $y = -3x + 40$.

3. Check the other point: $-3(5) + (40) = 25 = 25$. Both given pairs satisfy the equation.

Problem 6

1. Use $C = 5h + b$ and the required pair $(2, 18)$: $18 = 5(2) + b = 10 + b$.

2. Then $b = 18 - 10 = 8$. The plan $C = 5h + 8$ charges $5(2) + 8 = 18$ dollars at two hours, as required.

Problem 7

1. The starting balance is -12 and each ticket adds 4, so net funds are $F(n) = 4n - 12$.

2. For break-even, $0 = 4n - 12$, so $4n = 12$ and $n = 3$. Ticket counts are whole numbers, and three tickets exactly clears the debt.

Problem 8

1. The slope is $m = (23 - (8))/(4 - (1)) = 5$. Substitute $(1, 8)$ into $y = mx + b$.

2. $8 = 5(1) + b$, so $b = 8 - (5) = 3$. The rule is $y = 5x + 3$.

3. Check the other point: $5(4) + (3) = 23 = 23$. Both given pairs satisfy the equation.

Problem 9

1. The starting balance gives $b = 10$. The six-week increase is $40 - 10 = 30$, so the weekly rate is $30/6 = 5$.

2. Thus $S(w) = 5w + 10$. At week 6, $5(6) + 10 = 40$, confirming the design and the deposit of 5 dollars each week.

Problem 10

1. The slope is $m = (18 - (30))/(4 - (0)) = -3$. Substitute $(0, 30)$ into $y = mx + b$.

2. $30 = -3(0) + b$, so $b = 30 - (0) = 30$. The rule is $y = -3x + 30$.

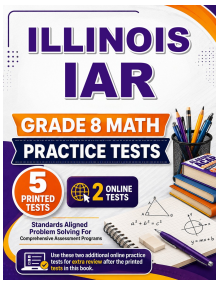
3. Evaluate the completed model: $y = -3(6) + (30) = 12$. This is the output at the requested input.

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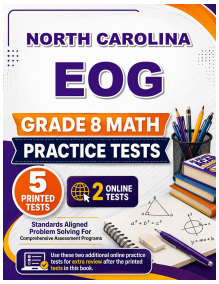
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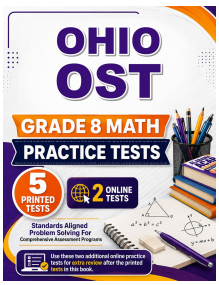
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