

Substitute Guide: Linear Functions in Four Forms

Course: Algebra I (Grades 9–12) **Subject:** Mathematics **Time:** ~50 min standard · ~90 min block Math

Learning goal (plain language)

Students practice **linear functions** — connecting the same "straight-line" function across a **table**, a **graph**, an **equation** in function notation $f(x) = mx + b$, and a **real-world context**. They find the **slope** (the rate of change, m), the **y-intercept** (the starting amount, b), **write** equations from contexts, and **solve** equations such as $f(x) = k$. **You do not need a math background to run this.** Every formula and a worked example are printed in the student packet. Students **show their work**; you do not need to teach the method — the packet does the teaching. Your job is to hand it out, read the start script, keep the room on task, and collect the packets.

Standards alignment

Framework: 19 TAC §111.39 (Algebra I). Knowledge & skills for linear functions — slope as a rate of change, writing linear equations, solving linear equations, and interpreting linear functions in context.

- **Provisional — A.2(C):** write linear equations in slope-intercept form ($y = mx + b$ or $f(x) = mx + b$) given a table, a graph, or a verbal description.
- **Provisional — A.3(A):** determine the slope of a line as a rate of change given two points, a table, or a graph.
- **Provisional — A.3(B):** interpret the meaning of slope and intercepts of a linear function in the context of a real-world situation.
- **Provisional — A.5(A):** solve linear equations in one variable, including equations of the form $f(x) = k$.

Provisional — pending educator verification against the current official TAC source.

(Standards are paraphrased here, not quoted. Please confirm codes and wording against your official source. This packet is **not** claimed to be "aligned to the TEKS" until reviewed.)

Setup Before class (5 min)

- Count and hand out one **student packet** per student.
- Confirm each student has a **pencil**. A **basic or graphing calculator is allowed but not required**; students who have one may use it.
- Write the date on the board and remind students to fill in the name line.
- Keep the **answer key** with you — it is a separate file and is **not** in the student packet.
- **Standard vs. block:** on a ~50-minute period, students do items 1–6, 8, and ACE (item 7 is optional). On a ~90-minute block, students also complete **item 7**, the extra applied modeling task.

Materials What's needed

- Printed student packet (5–7 pages) per student.
- Pencil per student; a basic four-function or graphing calculator is optional.
- This guide and the separate answer key (teacher only).
- No technology, no internet, no special supplies.

Timing Suggested pacing (standard ~50 min • block ~90 min)

Segment	Standard (~50 min)	Block (~90 min)	What students do
Start — Retrieval warm-up	6 min	8 min	Q1–Q2 (evaluate $f(x)$; slope from two points)
Build — Study the math	8–12 min	12–15 min	Read reference box, worked example, graph; Q3
Apply — Use what you know	20–26 min	28–34 min	Q4–Q6 (four forms + solve, write from context, error analysis)
Block — Extra applied task	optional	12–15 min	Q7 (draining-tank modeling; x-intercept)
Explain — Justify (CER)	6–10 min	8–12 min	Q8 claim/evidence/reasoning
Close — ACE	5 min	5–7 min	Articulate / Connect / Extend
Continue — early finishers	optional	optional	Write a context for $f(x) = 7x + 20$

Script Read aloud to start

"Today's assignment is a paper math packet called *Linear Functions in Four Forms*. You will work by yourself with a pencil. A basic or graphing calculator is allowed if you have one, but you do not need one. The most important rule: **show your work** — write down the numbers and steps you use, not just a final answer. Everything you need is printed in the packet, including a worked example, a graph, and all the formulas. Start with the warm-up, then read the Build section before the Apply questions. If a question is tricky, skip it and come back. Put your name, class period, and date at the top now. You have about [50 / 90] minutes; raise your hand if you need help reading a question."

Support When students ask for help

- **Students show their work; you do not need to teach the method.** Point them back to the printed **reference box** and the **worked example** — the method is right there.
- **You may read any part aloud** to a student or the class.
- If a student is stuck, prompt with "What does the worked example do?" or "In $f(x) = mx + b$, which number is the rate and which is the starting amount?" rather than giving the answer.
- For slope, remind them the packet shows: $\text{slope} = \text{rise} \div \text{run} = (\text{change in output}) \div (\text{change in } x)$, with the output-difference on top.
- Remind students that **$f(4)$ means the output at $x = 4$** — it is not "f times 4."
- It is fine if a student cannot finish the optional early-finisher challenge.

Access Accommodations & language support

- **Read-aloud** of any question is allowed for all students.
- Point students to the **worked example**, the **formulas** in the reference box, and the **sentence stems** for Q8 and ACE.
- A **calculator is allowed** for any student who wants one — this removes the arithmetic barrier so students can focus on the reasoning.
- Extended time is fine; the core can stop after Q8 if time runs short.
- Students may show work with numbers and short phrases if writing full sentences is a barrier, as long as the reasoning is clear.

- The packet is grayscale-safe — the graph uses black lines, labeled points, and text, so it prints and reads clearly in black and white.

Tools Allowed & not allowed

Allowed: pencil, the printed packet, a basic or graphing calculator, quiet self-read-aloud. **Not needed / not allowed:** phones for messaging, internet, AI tools, or getting answers from another student.

Collect at the end: Collect every packet, whether finished or not, with names on them. Stack them for the teacher. Note on a sticky how far most students got and any questions that caused confusion.

Answer key: The **answer key is a separate file** (answerkey.html) and is for the teacher only. Please do not hand it to students.

Teacher follow-up (for the returning teacher)

The highest-value items to review next class are the **error analysis (Q6)** and the **justification (Q8)**, which reveal the reversed rise/run slope error and whether students can compare two linear functions using both slope and y-intercept. Watch for **slope vs. y-intercept swaps** on the four-forms item (Q4), the **f(x)-as-multiplication** misconception, and the belief that **every line is proportional** (Q4e, Q8 check this — only lines through the origin are). The **solve** items (Q4d, Q7c) and the ACE Articulate prompt show who can move from evaluating a function to solving $f(x) = k$. The separate answer key lists worked steps, alternate strategies, misconceptions, and a 3-point rubric for Q8.

HS_ALG1_LinearFunctions_01 — Linear Functions in Four Forms Substitute Guide

Linear Functions in Four Forms

Course: Algebra I (Grades 9–12) **Subject:** Mathematics **Time:** ~50 min standard · ~90 min block **Work mode:** Independent · pencil + packet Math

Start Here

This is a **paper math packet** about **linear functions** — functions whose graphs are straight lines. You will connect the **same** function shown four ways: a **table**, a **graph**, an **equation** in **function notation $f(x)$** , and a **real-world context**. You will also **write** equations from information and **solve** equations such as $f(x) = a$. Work by yourself with a pencil. **A calculator is not required, but a basic or graphing calculator is allowed** if you have one. **Show your work** — every answer should show the numbers and steps you used, not just a final number. Everything you need (formulas, a worked example, a graph) is printed right here. If a question is hard, skip it, keep going, and come back. Circle or box your final answers.

Start Warm-Up: Retrieval 6 min

Bring back what you already know about evaluating a function and finding slope.

1Evaluate a function. A function is defined by $f(x) = 2x + 3$. Find $f(4)$. Show the multiplication and the addition you used. (Remember: $f(4)$ means "the output when the input x is 4" — it does *not* mean f times 4.)

2Find slope from two points. A line passes through the points **(1, 5)** and **(4, 11)**. Find the **slope m** . Show $m = (y_2 - y_1) \div (x_2 - x_1)$ with your numbers.

Build Study the Math 8–12 min

What you need to know (with formulas)

A **linear function** has a graph that is a **straight line**. Its output changes by the **same amount** for each equal step of the input.

Function notation. We write $f(x)$ ("f of x") for the **output** of the function at input x . So $f(4)$ is the output when $x = 4$. The notation $f(x)$ is *not* multiplication — it names the output, not "f times x."

The **slope** (written m) is the **rate of change**: how much the output changes for each 1 that x increases. From two points (x_1, y_1) and (x_2, y_2) :

$$m = \text{rise} \div \text{run} = (y_2 - y_1) \div (x_2 - x_1)$$

The **y-intercept** (written b) is the output when $x = 0$ — the point **(0, b)** where the line crosses the vertical axis. The **x-intercept** is where the line crosses the horizontal axis; it is the value of x that makes the output **0** (solve $f(x) = 0$). Slope and y-intercept give the **slope-intercept form**:

$$y = mx + b \quad \text{or, in function notation,} \quad f(x) = mx + b$$

These say the same thing: y and $f(x)$ both name the output. Use "y" when you graph an ordered pair (x, y) ; use " $f(x)$ " when you want to talk about the function's output at a named input.

A linear function can be shown **four ways**, and all four match the same m and b :

- **Table:** as x goes up by a fixed step, the output goes up (or down) by a fixed step. $m = (\text{change in output}) \div (\text{change in } x)$. The row where $x = 0$ gives b .
- **Graph:** a straight line. It crosses the y -axis at $(0, b)$ and rises m units for each 1 unit right.
- **Equation:** $f(x) = mx + b$.
- **Context:** a real situation with a **starting amount** (b) and a steady **rate of change** (m) per one unit.

Solving $f(x) = k$. To find the input x that gives a chosen output k , replace $f(x)$ with k and solve the linear equation:

$$mx + b = k \rightarrow mx = k - b \rightarrow x = (k - b) \div m$$

Tip: "evaluate" means you are **given x** and you find the output. "Solve" means you are **given the output** and you find x . They are opposite directions.

Worked Example — one function, four forms

A tutoring service charges a flat booking fee plus a steady hourly rate. The cost **starts at \$3** (a booking fee) and rises **\$2 for every hour**. Let x = hours and let $f(x)$ = total cost in dollars. Because there is a **starting amount of 3**, this line does **not** pass through the origin.

Slope (rate of change): $m = 2$ dollars per hour. **y-intercept:** $b = 3$ dollars (the cost at 0 hours).

Equation (function notation): $f(x) = 2x + 3$.

Check the slope from two table rows: using $(1, 5)$ and $(3, 9)$, $m = (9 - 5) \div (3 - 1) = 4 \div 2 = 2$. ✓

Evaluate: $f(4) = 2(4) + 3 = 8 + 3 = 11$, so 4 hours costs \$11.

Solve $f(x) = 15$: $2x + 3 = 15 \rightarrow 2x = 12 \rightarrow x = 6$, so \$15 buys 6 hours.

Cost over hours ($f(x) = 2x + 3$).

Hours x Cost $f(x)$ (dollars) Change in output

0	3	— (start)
1	5	+2
2	7	+2
3	9	+2
4	11	+2

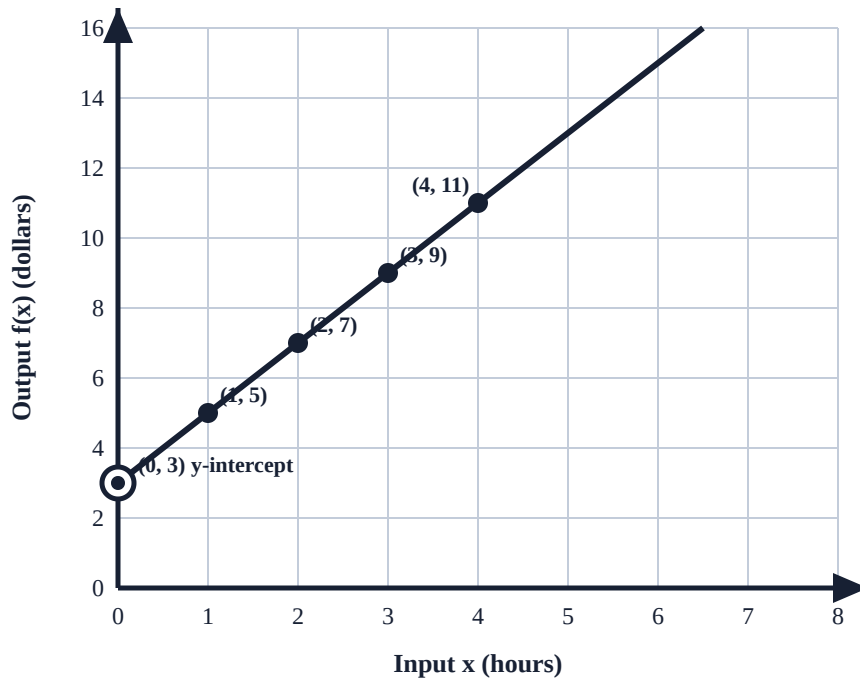


Figure 1. The graph of $f(x) = 2x + 3$. It is a straight line that crosses the vertical axis at **(0, 3)** — not at the origin — so it is **linear but not proportional**. Each printed point (1, 5), (2, 7), (3, 9), (4, 11) matches a table row and rises 2 units for every 1 unit right. The line and points are drawn in black with text labels so the figure reads clearly in grayscale.

3Using the worked example, find **f(7)** (the cost at 7 hours). Use $f(x) = 2x + 3$ and show your work.

Apply Use What You Know 20–26 min

Show the numbers you use in every item. A calculator is allowed.

4**Match the four forms.** A phone-repair shop charges a diagnostic fee plus a fixed price for each part used. The **same** linear function is shown below as a table, a graph description, an equation, and a context. Study Table B, then answer 4a–4e.

Table B. Total repair cost as a function of parts used.

Parts x Total cost g(x) (dollars)

0	25
2	55
4	85
6	115

Context: "A repair shop charges a one-time **\$25 diagnostic fee**, then **\$15 for each part** used. Total cost = diagnostic fee + \$15 times the number of parts."

4a. Find the **slope** m (dollars per part). Use two rows of the table and show $m = (\text{change in output}) \div (\text{change in } x)$.

4b. Find the **y-intercept** b (the cost at 0 parts), then write the equation in function notation, $g(x) = mx + b$.

4c. Interpret in context. What does the **slope** mean, and what does the **y-intercept** mean? Use the words "per part" and "diagnostic fee."

4d. Solve $g(x) = 145$. A repair cost a total of **\$145**. How many **parts** were used? Set up your equation and solve for x , showing every step.

4e. Is this function **proportional** or **not proportional**? Explain using the y-intercept in one sentence.

5 Write the equation from a context. A gym membership starts with a **\$40 sign-up fee** and then costs **\$12 per month**. Let x = number of months and let $h(x)$ = total cost in dollars.

5a. Identify the **slope** m and the **y-intercept** b from the context, then write $h(x) = mx + b$.

5b. Use your equation to find **$h(9)$** , the total cost after 9 months. Show your work.

6 Error analysis (a mis-found slope). A student found the slope for Table B and wrote the work shown. **Find the mistake, explain it, and give the correct slope.**

Student's work (using the rows (2, 55) and (4, 85)):

$$m = \text{run} \div \text{rise} = (4 - 2) \div (85 - 55)$$

$$m = 2 \div 30 \approx 0.07. \text{ So the slope is about 0.07 dollars per part.}$$

What is wrong, and what is the correct slope? Fix it in the box.

Block Extra Applied Task block only • ~12–15 min

If your class is on a ~90-minute block schedule, complete Item 7. (On a standard ~50-minute period, this item is optional.)

7 Real-world modeling. A water tank begins with **60 gallons** and is **draining at 4 gallons per minute**. Let x = minutes and let $V(x)$ = gallons of water left in the tank.

7a. Write the function $V(x) = mx + b$. (Careful: the water is going *down*, so the rate of change is **negative**.)

7b. Find **$V(6)$** — how much water is left after 6 minutes? Show your work.

7c. Solve $V(x) = 0$ (the x-intercept). After how many minutes is the tank empty? Show your steps, then interpret what the x-intercept means in this story.

Explain Justify Your Strategy 6–10 min

Question 8. Two streaming services charge a monthly bill. **Plan A:** $f(x) = 3x + 8$ (an \$8 base charge plus \$3 per premium channel). **Plan B:** $g(x) = 5x$ (just \$5 per premium channel, no base charge). **For 3 premium channels, which plan costs less, and why?** Also state which plan is **proportional**. Write a **Claim** (your answer), **Evidence** (the numbers you calculated), and **Reasoning** (why your strategy works, using slope and y-intercept).

Sentence stems you may use: "For 3 channels, Plan ____ costs less because..." · "I found Plan A's cost by... and Plan B's cost by..." · "Plan B is proportional because its y-intercept is..." · "The slope tells me... and the y-intercept tells me..."

Claim (your answer / strategy)

Evidence (the numbers you used)

Reasoning (why the strategy works)

Close ACE Wrap-Up 5 min

Articulate

In your own words, explain the difference between **evaluating** $f(x)$ at a value and **solving** $f(x) = k$. Which one gives an output, and which gives an input?

Connect

Point to one item in this packet where you used **function notation $f(x)$** to find an output. Give its number.

Extend

Give a **new** real-life example of a **non-proportional** linear function (a starting amount plus a steady rate) that was *not* in this packet.

Continue Early Finisher optional

If you finish early (a challenge — no new materials needed):

Write a context for a function. Here is a function with no story: **$f(x) = 7x + 20$** . On the back of this page: (1) invent a **real-world situation** that this function could describe, clearly telling what **x** and **$f(x)$** stand for; (2) explain what the **slope 7** and the **y-intercept 20** mean in your story; (3) **evaluate $f(5)$** , showing your work; and (4) **solve $f(x) = 90$** , showing your steps. Make sure your story is **non-proportional** (it must have a starting amount).

Turn in: Hand in this whole packet with your name, class period, and date filled in. Make sure items 1–6 and 8 and the ACE box are answered **with your work shown** (item 7 too if you are on a block schedule). The early-finisher challenge is optional but turn it in too if you did it.

HS_ALG1_LinearFunctions_01 — Linear Functions in Four Forms Student Packet



TEACHER ANSWER KEY FOLLOWS

Do not copy the pages after this divider for students.

Answer Key: Linear Functions in Four Forms

Course: Algebra I (Grades 9–12) **Subject:** Mathematics **For teacher use only** Math

How to use this key

Answers are grouped by section and question number, with full worked steps. Accept any correct method that reaches the right value — alternate strategies (using different table rows, counting up on the graph, or reasoning from the context) are noted where they apply. Watch-for notes flag common misconceptions. A basic or graphing calculator is allowed, so grade the **reasoning and steps**, not just the arithmetic. Estimated grading time: ~6–8 min per packet.

Start Warm-Up: Retrieval ~1 min

1 Evaluate $f(x) = 2x + 3$ at $x = 4$, i.e. find $f(4)$.

$f(4) = 2 \times 4 + 3 = 8 + 3 = 11$. Full credit for showing the multiply-then-add order. *Watch-for:* a student who reads $f(4)$ as "f times 4" or who writes $2 \times (4 + 3) = 14$, adding before multiplying. Remind them $f(4)$ names the output at $x = 4$, and mx is done before adding b .

2 Slope through $(1, 5)$ and $(4, 11)$.

$m = (11 - 5) \div (4 - 1) = 6 \div 3 = 2$. Accept the points taken in either order as long as x -differences and y -differences use the **same** order: $(5 - 11) \div (1 - 4) = (-6) \div (-3) = 2$. *Watch-for:* reversing to run over rise, $(4 - 1) \div (11 - 5) = 3 \div 6 = 0.5$, which is wrong.

Build Study the Math ~1 min

3 Find $f(7)$ for $f(x) = 2x + 3$.

$f(7) = 2 \times 7 + 3 = 14 + 3 = 17$ (so 7 hours costs \$17). *Alternate:* extend the table by adding 2 each hour ($11 \rightarrow 13 \rightarrow 15 \rightarrow 17$). Both are correct.

Apply Use What You Know ~3–4 min

4 Match the four forms (repair cost, Table B).

4a. Using rows $(2, 55)$ and $(4, 85)$: $m = (85 - 55) \div (4 - 2) = 30 \div 2 = 15$ **dollars per part**. (Any two rows work: e.g., $(0, 25)$ and $(6, 115) \rightarrow 90 \div 6 = 15$.)

4b. y -intercept $b = 25$ (the cost at $x = 0$ parts, read straight from the table). Equation: **$g(x) = 15x + 25$** .

4c. The **slope** means the cost goes up **\$15 per part** (each part adds \$15). The **$y$ -intercept** means the **\$25 diagnostic fee** charged before any parts (at 0 parts the cost is already \$25).

4d. Solve $g(x) = 145$: $15x + 25 = 145 \rightarrow$ subtract 25: $15x = 120 \rightarrow$ divide by 15: $x = 8$ **parts**. *Check:* $15(8) + 25 = 120 + 25 = 145$. ✓ *Alternate:* $x = (145 - 25) \div 15 = 120 \div 15 = 8$.

4e. It is **NOT proportional**, because the y -intercept is 25, not 0 — the line does not pass through the origin $(0, 0)$. (A proportional function must have $b = 0$.)

5 Write the equation from a context (gym membership).

5a. Slope $m = 12$ (dollars per month) and y-intercept $b = 40$ (the \$40 sign-up fee, the cost at 0 months).

Equation: $h(x) = 12x + 40$.

5b. $h(9) = 12(9) + 40 = 108 + 40 = \148 after 9 months. *Watch-for:* a student who writes $h(9) = 12 + 40(9)$ by swapping which number multiplies x — anchor that the **per-month rate** multiplies the months and the **sign-up fee** is the constant b .

6 Error analysis: a mis-found slope for Table B.

The mistake: The student **reversed rise and run** — they divided $\text{run} \div \text{rise}$ instead of $\text{rise} \div \text{run}$. Slope is the change in the output (rise) over the change in x (run), so the differences are flipped.

Correct work: $m = \text{rise} \div \text{run} = (85 - 55) \div (4 - 2) = 30 \div 2 = 15$ **dollars per part** (not 0.07).

Full credit requires (1) naming that they flipped rise and run (used run/rise), and (2) the correct slope of 15.

Sense-check to offer: 0.07 dollars per part would mean about 7¢ a part, which does not match the table jumping \$30 for every 2 parts.

Block Extra Applied Task block only • ~1–2 min

7 Real-world modeling: draining tank (block schedule).

7a. Starting amount $b = 60$ gallons; the tank **loses** 4 gallons per minute, so the rate of change is **-4**. Function:

$V(x) = -4x + 60$. *Watch-for:* a student who writes +4 and forgets the water is decreasing.

7b. $V(6) = -4(6) + 60 = -24 + 60 = 36$ **gallons** left after 6 minutes.

7c. Solve $V(x) = 0$: $-4x + 60 = 0 \rightarrow -4x = -60 \rightarrow x = 15$ **minutes**. *Check:* $V(15) = -4(15) + 60 = -60 + 60 = 0$.

✓ **Interpretation:** the x -intercept $(15, 0)$ is the moment the tank is **empty** — the input that makes the output 0.

Alternate: $x = (0 - 60) \div (-4) = (-60) \div (-4) = 15$.

Explain Justify Your Strategy (Q8) ~1–2 min

8 3 premium channels: Plan A $f(x) = 3x + 8$ vs. Plan B $g(x) = 5x$.

Model answer. Claim: For 3 premium channels, **Plan B** costs less; and **Plan B is the proportional one**.

Evidence: Plan A: $f(3) = 3(3) + 8 = 9 + 8 = \17 . Plan B: $g(3) = 5(3) = \$15$. Since $\$15 < \17 , Plan B is cheaper for 3 channels. Reasoning: Plan B has y-intercept $b = 0$, so it passes through the origin and is **proportional** ($g(x) = 5x$). Plan A has y-intercept $b = 8$ (an \$8 base charge), so it is **not proportional**. Even though Plan A's slope (\$3/channel) is smaller than Plan B's (\$5/channel), Plan A's \$8 head start makes it cost more at 3 channels.

Note: Full credit requires both computed costs (\$17 and \$15), naming Plan B as cheaper, and identifying Plan B as proportional ($b = 0$). *Extension worth noting:* the two plans are equal when $3x + 8 = 5x \rightarrow 2x = 8 \rightarrow x = 4$ channels; beyond 4 channels Plan A becomes cheaper. Students are not required to find this, but it is a strong discussion point.

Justification scoring rubric (3 points)

Score	Claim	Evidence	Reasoning
3	Names Plan B as cheaper for 3 channels AND names Plan B as proportional.	Both costs computed correctly (\$17 and \$15) with the numbers shown.	Explains proportional means $b = 0$ and correctly links slope and y-intercept to the comparison.
2	Names Plan B as cheaper (proportional part missing or partly right).	One cost computed, or both with a minor arithmetic slip.	Reasoning present but incomplete or missing the y-intercept link.
1	A plan named with weak or no support.	Evidence largely missing or incorrect.	Little or flawed reasoning.

Score	Claim	Evidence	Reasoning
0	No/incorrect claim.	No evidence.	No reasoning.

Close ACE ~1 min

ACE Articulate / Connect / Extend.

Articulate: Accept any correct explanation: "Evaluating $f(x)$ means you are **given the input x** and you compute the **output** (e.g., $f(4) = 11$). **Solving** $f(x) = k$ means you are **given the output k** and you find the **input x** that produces it (e.g., $2x + 3 = 15 \rightarrow x = 6$). Evaluating gives an output; solving gives an input."

Connect: Valid items where function notation was used to find an output include Q1 ($f(4)$), Q3 ($f(7)$), Q5b ($h(9)$), Q7b ($V(6)$), or Q8 ($f(3)$, $g(3)$). Any of these earns credit if correctly named.

Extend: Any genuine non-proportional linear function with a starting amount and a steady rate — e.g., a taxi with a base fare plus a per-mile rate, a phone plan with a monthly fee plus a per-gigabyte charge, a savings account starting at some balance and growing by a fixed weekly deposit. Must have a nonzero starting amount ($b \neq 0$) to count as non-proportional.

Challenge Early Finisher (optional)

EF Write a context for $f(x) = 7x + 20$ (must be non-proportional).

(1) A sample situation: "A caterer charges a **\$20 setup fee** plus **\$7 per guest**. Let x = number of guests and $f(x)$ = total charge in dollars." Many correct stories exist (a \$20 flat delivery fee plus \$7 per item; a gift-card starting balance plus deposits, etc.).

(2) Meaning: The **slope 7** is the **rate of \$7 per guest** (each guest adds \$7). The **y-intercept 20** is the **\$20 starting amount / setup fee** charged before any guests (the cost at $x = 0$).

(3) Evaluate $f(5)$: $f(5) = 7(5) + 20 = 35 + 20 = \55 .

(4) Solve $f(x) = 90$: $7x + 20 = 90 \rightarrow 7x = 70 \rightarrow x = 10$ **guests**. *Check:* $7(10) + 20 = 90$. ✓

Full credit requires a clear x and $f(x)$, a story with a real starting amount (so it is non-proportional), a correct interpretation of 7 and 20, and the correct values 55 and 10.

Watch Common misconceptions

- **Slope vs. y-intercept.** Students may swap the two — reporting the starting amount as the rate, or the rate as the starting amount. In $g(x) = 15x + 25$, $m = 15$ is the per-part rate and $b = 25$ is the diagnostic fee. Anchor: the number multiplied by x is the slope; the number added on is the y-intercept (the output at $x = 0$).
- **Reversing rise and run.** The Q6 error: computing $\text{run} \div \text{rise}$ (giving ≈ 0.07) instead of $\text{rise} \div \text{run}$ (giving 15). Slope is **change in output over change in x** — always the y-difference on top. Subtract the x-values and y-values in the **same order**.
- **Confusing $f(x)$ with multiplication.** $f(4)$ does **not** mean "f times 4"; it names the **output** when the input is 4. Reinforce this on Q1, Q3, Q5b, Q7b, Q8. A student who "distributes" f across (4) has misread the notation.
- **Assuming all lines are proportional.** Students often treat any straight line as proportional. A linear function is proportional **only if it passes through (0, 0)**, i.e., $b = 0$. Figure 1 and Table B both have $b \neq 0$, so they are linear but **not** proportional (Q4e and Q8 check this).
- **Evaluate vs. solve.** Some students "solve" when asked to evaluate, or plug in the output where the input goes. Anchor: **given $x \rightarrow$ evaluate** (find output); **given output $\rightarrow$ solve** (find x). Q4d, Q7c, and the ACE Articulate item test this.
- **Dropping the negative rate.** In Q7, water is draining, so $m = -4$. A student who writes $V(x) = 4x + 60$ has missed that the output decreases. Encourage a check: after 15 minutes the tank should be empty, not overflowing.

- **Stopping at the wrong step when solving.** In Q4d/Q7c, after isolating the mx term a student may forget to divide by m . Encourage a check by substituting the answer back into the equation.

Teacher follow-up based on likely errors

If many students miss Q6, do a quick 5-minute practice labeling rise and run on two or three graphs, always keeping the output-difference on top. If Q4e or Q8 show the "all lines are proportional" idea, re-anchor that only a line through $(0, 0)$ is proportional ($b = 0$), and contrast it with a line that has a fee. The Q4c interpretations reveal who can attach meaning to slope and y-intercept in context. The Q4d and Q7c items show who can move from evaluating to **solving** $f(x) = k$, and Q8 shows who can compare two functions using both slope and y-intercept — all good warm-up discussions next class.

HS_ALG1_LinearFunctions_01 — Linear Functions in Four Forms Teacher Answer Key