

# Two quantities, one relationship



## GRADE 6 • EXPRESSIONS AND EQUATIONS

NC.6.EE.9 | Represent and analyze quantitative relationships by:

Teacher scripts • models • student organizers • 30 multiple-choice items • 30 open/performance tasks • worked keys • evidence records

A reusable resource bank, not a single 60-item assessment. Select a small core across several lessons; return to other tasks for practice and conferences.

Current North Carolina Standard Course of Study. Instructional contexts and graphics are original and fictional unless otherwise identified.

# Free sample | Contents

NC.6.EE.9 | Sixth Grade mathematics

This sample contains 21 complete selected pages from the 122-page resource, plus this sample contents page. Original printed page numbers are retained. Gaps are intentional.

Included original pages: 1-16, 45-46, 75, 90-91

## Representative activities

M01: sample PDF page(s) 16; original page(s) 15

M02: sample PDF page(s) 17; original page(s) 16

O01: sample PDF page(s) 18; original page(s) 45

O02: sample PDF page(s) 19; original page(s) 46

Selected teacher prompts and keys: original page(s) 75, 90-91

## Using this sample

Read the preparation and access guidance before using a selected activity.  
Keep teacher keys and private preparation pages separate from student copies.  
Use the original resource contents to see the scope of the complete packet.

## Complete paid download

The complete resource includes the full PDF task bank and teaching materials.

## TEACHER GUIDE

# Standard, targets and evidence

**Represent and analyze quantitative relationships by:**

- Using variables to represent two quantities in a real-world or mathematical context that change in relationship to one another.
- Analyze the relationship between quantities in different representations (context, equations, tables, and graphs).

A • I can: Define related quantities and identify input and dependent output.

B • I can: Connect a context, equation, table and graph; analyze change.

Define the two quantities before writing a rule. The independent input determines the dependent output in the stated model. Tables and graphs encode the same ordered pairs; a constant initial value may be nonzero. Context decides whether intermediate input values make sense.

Collect individual evidence: a written or dictated mathematical representation, an explained calculation, and a check in context. Choice answers locate a possible misconception; they do not substitute for the open performance.

## TEACHER GUIDE

# Plan, materials and navigation

Suggested sequence: three 35–45 minute lessons. Lesson 1: warm-up, model and shared practice. Lesson 2: collaborative and independent practice. Lesson 3: targeted reteach, transfer and exit. The seven sections offer a complete cycle; times are flexible, not speed criteria.

Core selections: M01/O01, M05/O05, M09/O09, M14/O14, M19/O19, M24/O24 and M28/O28. Use just one or two pairs per session. The remaining items are a bank, not mandatory extra work.

Prerequisites: Read ordered pairs and tables; evaluate simple expressions; interpret units and consistent graph scales.

Materials: this packet, pencil, eraser, ruler, blank paper and optional highlighter. All graphs, lines and organizers needed for tasks are supplied. No purchased manipulatives are required. Calculator use may support later checking after the required reasoning is visible.

Navigation: seven teaching scripts follow the reusable organizer. The student choice bank follows the scripts, then one open task per page. Teacher-only worked keys, evidence record, inquiry and source notes follow all student pages. Print student pages without the keys.

Bank allocation: warm-up 4+4; I Do 4+4; We Do 5+5; collaborative 5+5; independent 5+5; reteach 4+4; exit 3+3 (choice + open). Each item carries its own target code and section.

## TEACHER GUIDE

# Model the mathematical decision

Say: “A tank begins with 1 liter and gains 2 liters each hour. Let  $x$  be elapsed hours and  $y$  be liters. Then  $y = 2x + 1$ . For  $x = 0, 1, 2, 3$ , outputs are 1, 3, 5, 7. Plot (0,1), (1,3), (2,5), (3,7), with hours on the horizontal axis. One more hour adds 2 liters. Here intermediate hours are meaningful, so connect points across the displayed interval.” Contrast ticket counts, where only whole-number inputs are used.

Pause and ask: “What does the variable represent? What information determines the operation or comparison? How can another representation check it?” Wait for an individual explanation before displaying the completed reasoning.

## Anchor chart

1. Name the quantities and units.
2. Translate the relationship into symbols.
3. Calculate, substitute or represent carefully.
4. Compare the result with the original condition.
5. Explain what the result means and what values are allowed.

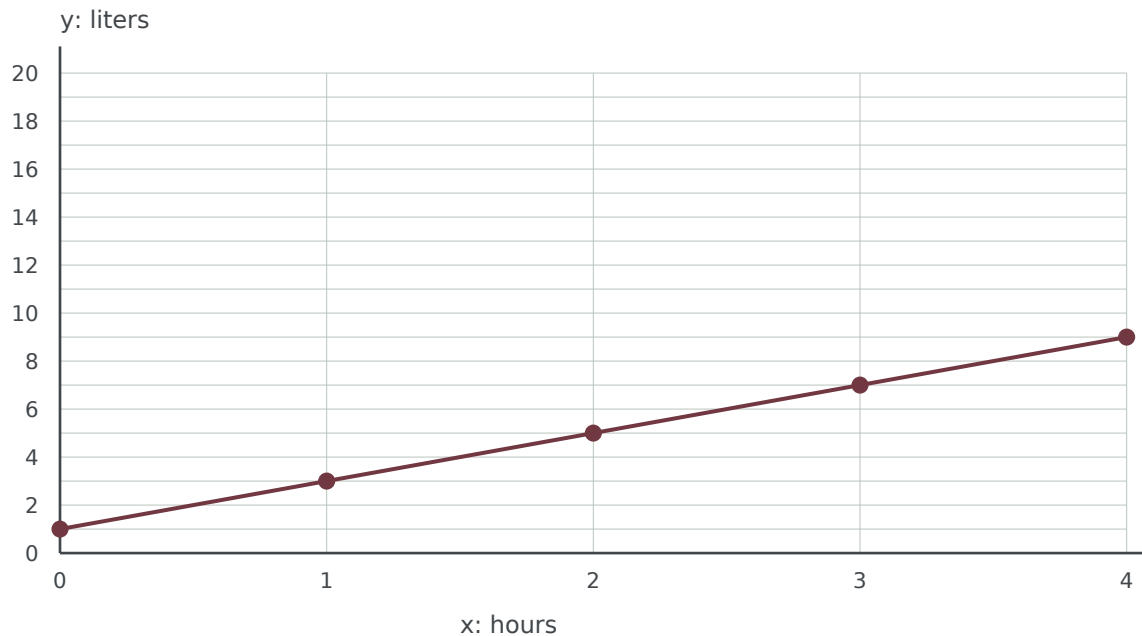
Misconception response: The initial output and rate have different jobs. Do not swap axes or use output as the independent variable without changing the rule. Read each axis scale separately. A graph may begin above the origin.

Teacher demonstration is supported learning. Do not score a copied model as independent evidence. Use a fresh bank item after the model is covered.

## TEACHER MODEL | REPRESENTATION

# Connect the picture and symbols

Teacher-only graph for  $y = 2x + 1$ .  $x$  is hours;  $y$  is liters. These plotted points come from substitution into the rule.



Each horizontal grid interval is 1 hour. Each small vertical interval is 1 liter; the printed vertical numbers are 2 liters apart. The graph begins at (0,1), and each additional hour adds 2 liters.

## TEACHER GUIDE

## Access and responsive teaching

Use a neutral read-aloud, enlarged print, extra processing time, an accessible digital copy, a scribe, speech-to-text, AAC or signed responses as appropriate. Keep quantities, operations and relational language unchanged. The student must choose the mathematics.

A scribe may record the student's words, symbols or point selections without completing an equation, choosing a direction or supplying a plotted point. Record access supports separately from answer-supplying cues. When drawing is inaccessible, allow exact oral coordinates/directions or student-directed placement; record the representation route.

Before reteach, ask the learner to name the unit and explain one choice. Use the relevant worked model, then remove it and present a new item. A direction cue, completed expression, provided solution point or selected operation changes independence and must be recorded.

Multilingual support: pair "quantity," "variable," "expression," "equation," "solution," "greater than," "less than," "input" and "output" with examples and the student's home-language explanation. Do not turn vocabulary translation into an answer hint.

Extend through explanation and counterexamples, not larger numbers alone. Ask for a different model or a context in which the same symbols would no longer be appropriate.

## REUSABLE STUDENT ORGANIZER

# Represent • work • check

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Quantity / variable / unit / permitted values

Representation: equation, expression, table or labelled sketch

Calculation or substitution evidence

Check and interpret the result

## TEACHER SCRIPT | WARM-UP

## Warm-up teaching moves

Bank: M01–M04 and O01–O04. Suggested core: M01, O01. Target(s): Define related quantities and identify input and dependent output. Connect a context, equation, table and graph; analyze change.

0–2 min: invite a quick quantity-and-unit read.

2–5 min: let each student choose and explain the core choice item.

5–8 min: compare reasoning, then begin the open item without displaying its key.

Say: “Before you calculate, tell me what the symbols and quantities mean. Show evidence that another person can check. What does your result say about the original condition?”

Core response to listen for: Let  $x$  be tickets (independent input); let  $y$  be dollars (dependent output).  $y = 3x$ . For  $x = 4$ ,  $y = 3 \times 4 + 0 = 12$ . Table  $(x, y)$ :  $(0, 0)$ ,  $(1, 3)$ ,  $(2, 6)$ ,  $(3, 9)$ ,  $(4, 12)$ . Each increase of 1 input unit changes  $y$  by 3 dollars. At  $x = 0$ ,  $y = 0$ . Plot  $x$  horizontally and  $y$  vertically. Use separate points; fractional counts are not allowed in this context. Domain: nonnegative whole-number inputs. From  $x = 1$  to  $x = 3$ , the output changes from 3 to 9, a change of 6 dollars.

If stuck: The initial output and rate have different jobs. Do not swap axes or use output as the independent variable without changing the rule. Read each axis scale separately. A graph may begin above the origin. Give access support first; if a mathematical cue is needed, record it and use a fresh item later.

Early finisher: change one quantity or condition and predict how the answer changes before computing. Record item ID, observed evidence, support level and the next question you will ask.

## TEACHER SCRIPT | I DO

# I Do teaching moves

Bank: M05–M08 and O05–O08. Suggested core: M05, O05. Target(s): Define related quantities and identify input and dependent output. Connect a context, equation, table and graph; analyze change.

0–3 min: read the scenario and name the quantities.

3–8 min: think aloud through the teacher model; display each step only after naming its purpose.

8–12 min: invite students to explain the check; try the core open item with the model covered.

Say: “Before you calculate, tell me what the symbols and quantities mean. Show evidence that another person can check. What does your result say about the original condition?”

Core response to listen for: Let  $x$  be rides (independent input); let  $y$  be dollars (dependent output).  $y = 2x + 3$ . For  $x = 3$ ,  $y = 2 \times 3 + 3 = 9$ . Table  $(x, y)$ :  $(0, 3)$ ,  $(1, 5)$ ,  $(2, 7)$ ,  $(3, 9)$ ,  $(4, 11)$ . Each increase of 1 input unit changes  $y$  by 2 dollars. At  $x = 0$ ,  $y = 3$ . Plot  $x$  horizontally and  $y$  vertically. Use separate points; fractional counts are not allowed in this context. Domain: nonnegative whole-number inputs. From  $x = 1$  to  $x = 3$ , the output changes from 5 to 9, a change of 4 dollars.

If stuck: The initial output and rate have different jobs. Do not swap axes or use output as the independent variable without changing the rule. Read each axis scale separately. A graph may begin above the origin. Give access support first; if a mathematical cue is needed, record it and use a fresh item later.

Early finisher: change one quantity or condition and predict how the answer changes before computing. Record item ID, observed evidence, support level and the next question you will ask.

## TEACHER SCRIPT | WE DO

## We Do teaching moves

Bank: M09–M13 and O09–O13. Suggested core: M09, O09. Target(s): Define related quantities and identify input and dependent output. Connect a context, equation, table and graph; analyze change.

0–3 min: students restate the problem in their own words.

3–10 min: build a representation together, asking for the reason behind each mark.

10–15 min: each student completes the check and interpretation independently.

Say: “Before you calculate, tell me what the symbols and quantities mean. Show evidence that another person can check. What does your result say about the original condition?”

Core response to listen for: Let  $x$  be hours (independent input); let  $y$  be kilometers (dependent output).  $y = 4x$ . For  $x = 0$ ,  $y = 4 \times 0 + 0 = 0$ . Table  $(x, y)$ :  $(0, 0)$ ,  $(1, 4)$ ,  $(2, 8)$ ,  $(3, 12)$ ,  $(4, 16)$ . Each increase of 1 input unit changes  $y$  by 4 kilometers. At  $x = 0$ ,  $y = 0$ . Plot  $x$  horizontally and  $y$  vertically. A line segment through the plotted points represents intermediate inputs in the displayed interval. Domain: nonnegative real inputs in this idealized model. From  $x = 1$  to  $x = 3$ , the output changes from 4 to 12, a change of 8 kilometers.

If stuck: The initial output and rate have different jobs. Do not swap axes or use output as the independent variable without changing the rule. Read each axis scale separately. A graph may begin above the origin. Give access support first; if a mathematical cue is needed, record it and use a fresh item later.

Early finisher: change one quantity or condition and predict how the answer changes before computing. Record item ID, observed evidence, support level and the next question you will ask.

## TEACHER SCRIPT | COLLABORATIVE PRACTICE

# Collaborative practice teaching moves

Bank: M14–M18 and O14–O18. Suggested core: M14, O14. Target(s): Define related quantities and identify input and dependent output. Connect a context, equation, table and graph; analyze change.

0–2 min: assign solver and checker roles.

2–9 min: each student first records a solution, then partners compare representations.

9–13 min: switch roles; each submits a distinct written explanation.

Say: “Before you calculate, tell me what the symbols and quantities mean. Show evidence that another person can check. What does your result say about the original condition?”

Core response to listen for: Let  $x$  be days (independent input); let  $y$  be centimeters (dependent output).  $y = 1x + 2$ . For  $x = 4$ ,  $y = 1 \times 4 + 2 = 6$ . Table  $(x, y)$ :  $(0, 2)$ ,  $(1, 3)$ ,  $(2, 4)$ ,  $(3, 5)$ ,  $(4, 6)$ . Each increase of 1 input unit changes  $y$  by 1 centimeters. At  $x = 0$ ,  $y = 2$ . Plot  $x$  horizontally and  $y$  vertically. A line segment through the plotted points represents intermediate inputs in the displayed interval. Domain: nonnegative real inputs in this idealized model. From  $x = 1$  to  $x = 3$ , the output changes from 3 to 5, a change of 2 centimeters.

If stuck: The initial output and rate have different jobs. Do not swap axes or use output as the independent variable without changing the rule. Read each axis scale separately. A graph may begin above the origin. Give access support first; if a mathematical cue is needed, record it and use a fresh item later.

Early finisher: change one quantity or condition and predict how the answer changes before computing. Record item ID, observed evidence, support level and the next question you will ask.

## TEACHER SCRIPT | INDEPENDENT PRACTICE

# Independent practice teaching moves

Bank: M19–M23 and O19–O23. Suggested core: M19, O19. Target(s): Define related quantities and identify input and dependent output. Connect a context, equation, table and graph; analyze change.

0–2 min: clarify only directions and permitted access supports.

2–13 min: students complete one selected choice and open item without answer cues.

13–17 min: invite self-checks and collect evidence before feedback.

Say: “Before you calculate, tell me what the symbols and quantities mean. Show evidence that another person can check. What does your result say about the original condition?”

Core response to listen for: Let  $x$  be hours (independent input); let  $y$  be kilometers (dependent output).  $y = 4x$ . For  $x = 0$ ,  $y = 4 \times 0 + 0 = 0$ . Table  $(x, y)$ :  $(0, 0)$ ,  $(1, 4)$ ,  $(2, 8)$ ,  $(3, 12)$ ,  $(4, 16)$ . Each increase of 1 input unit changes  $y$  by 4 kilometers. At  $x = 0$ ,  $y = 0$ . Plot  $x$  horizontally and  $y$  vertically. A line segment through the plotted points represents intermediate inputs in the displayed interval. Domain: nonnegative real inputs in this idealized model. From  $x = 1$  to  $x = 3$ , the output changes from 4 to 12, a change of 8 kilometers.

If stuck: The initial output and rate have different jobs. Do not swap axes or use output as the independent variable without changing the rule. Read each axis scale separately. A graph may begin above the origin. Give access support first; if a mathematical cue is needed, record it and use a fresh item later.

Early finisher: change one quantity or condition and predict how the answer changes before computing. Record item ID, observed evidence, support level and the next question you will ask.

## TEACHER SCRIPT | SMALL-GROUP RETEACH

## Small-group reteach teaching moves

Bank: M24–M27 and O24–O27. Suggested core: M24, O24. Target(s): Define related quantities and identify input and dependent output. Connect a context, equation, table and graph; analyze change.

0–2 min: identify the exact misconception from previous work.

2–7 min: model one decision using the anchor chart; have students explain it back.

7–10 min: remove the model and use a new bank item to check transfer.

Say: “Before you calculate, tell me what the symbols and quantities mean. Show evidence that another person can check. What does your result say about the original condition?”

Core response to listen for: Let  $x$  be days (independent input); let  $y$  be centimeters (dependent output).  $y = 1x + 2$ . For  $x = 2$ ,  $y = 1 \times 2 + 2 = 4$ . Table  $(x, y)$ :  $(0, 2)$ ,  $(1, 3)$ ,  $(2, 4)$ ,  $(3, 5)$ ,  $(4, 6)$ . Each increase of 1 input unit changes  $y$  by 1 centimeters. At  $x = 0$ ,  $y = 2$ . Plot  $x$  horizontally and  $y$  vertically. A line segment through the plotted points represents intermediate inputs in the displayed interval. Domain: nonnegative real inputs in this idealized model. From  $x = 1$  to  $x = 3$ , the output changes from 3 to 5, a change of 2 centimeters.

If stuck: The initial output and rate have different jobs. Do not swap axes or use output as the independent variable without changing the rule. Read each axis scale separately. A graph may begin above the origin. Give access support first; if a mathematical cue is needed, record it and use a fresh item later.

Early finisher: change one quantity or condition and predict how the answer changes before computing. Record item ID, observed evidence, support level and the next question you will ask.

## TEACHER SCRIPT | EXIT TICKET

## Exit ticket teaching moves

Bank: M28–M30 and O28–O30. Suggested core: M28, O28. Target(s): Define related quantities and identify input and dependent output. Connect a context, equation, table and graph; analyze change.

0–1 min: present one fresh core item with no model displayed.

1–4 min: collect a calculation, representation and explanation.

4–5 min: ask for a confidence note and record a next teaching step.

Say: “Before you calculate, tell me what the symbols and quantities mean. Show evidence that another person can check. What does your result say about the original condition?”

Core response to listen for: Let  $x$  be weeks (independent input); let  $y$  be dollars (dependent output).  $y = 2x + 2$ . For  $x = 4$ ,  $y = 2 \times 4 + 2 = 10$ . Table  $(x, y)$ : (0, 2), (1, 4), (2, 6), (3, 8), (4, 10). Each increase of 1 input unit changes  $y$  by 2 dollars. At  $x = 0$ ,  $y = 2$ . Plot  $x$  horizontally and  $y$  vertically. Use separate points; fractional counts are not allowed in this context. Domain: nonnegative whole-number inputs. From  $x = 1$  to  $x = 3$ , the output changes from 4 to 8, a change of 4 dollars.

If stuck: The initial output and rate have different jobs. Do not swap axes or use output as the independent variable without changing the rule. Read each axis scale separately. A graph may begin above the origin. Give access support first; if a mathematical cue is needed, record it and use a fresh item later.

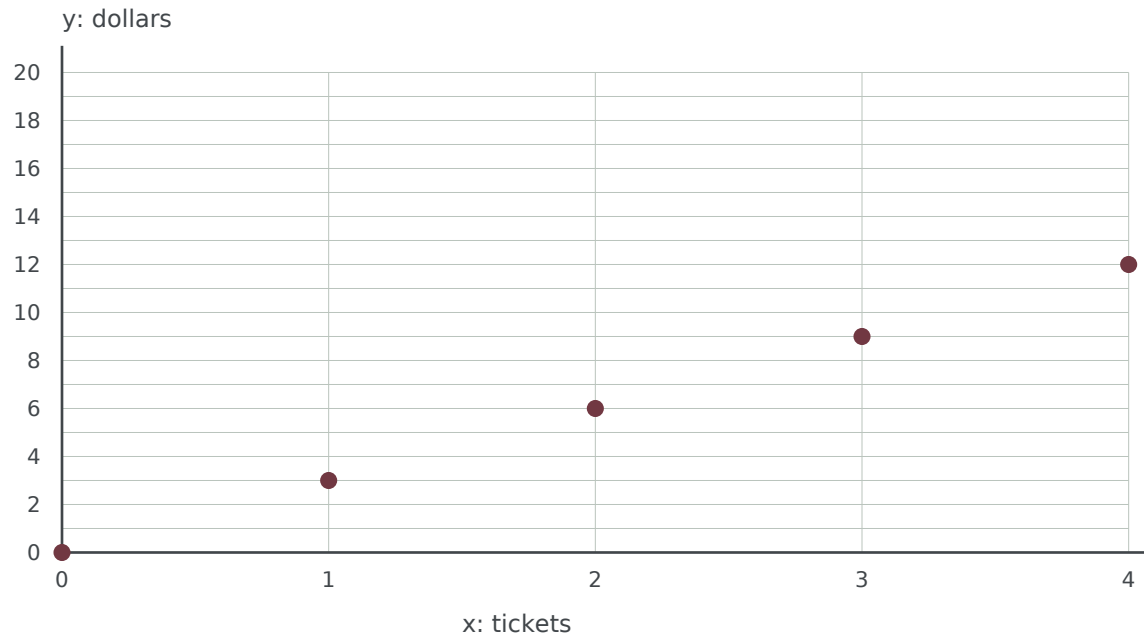
Early finisher: change one quantity or condition and predict how the answer changes before computing. Record item ID, observed evidence, support level and the next question you will ask.

## STUDENT CHOICE BANK

# Choose and explain

**M01 | Warm-up | Target B**

The graph uses  $x$  = tickets and  $y$  = dollars. What output corresponds to  $x = 4$ ?



A. 12

B. 3

C. 9

D. 6

Evidence / check: \_\_\_\_\_

## STUDENT CHOICE BANK

# Choose and explain

**M02 | Warm-up | Target B**

A tank begins with 1 liter and fills at 2 liters per hour. If  $x$  changes from 1 to 3 hours, by how much does  $y$  change?

- A. 0
- B. 9
- C. 6
- D. 4

Evidence / check: \_\_\_\_\_

STUDENT OPEN TASK | WARM-UP

001 • Show your reasoning

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Target A+B

Each ticket costs \$3. Define  $x$  and  $y$  with units. Identify the independent and dependent quantities. Write an equation and complete a table for  $x = 0, 1, 2, 3, 4$ . On the blank grid, label both axes and plot your table; decide whether to connect the points. Find  $y$  when  $x = 4$ . Explain the initial value and the change in  $y$  when  $x$  increases by 1.

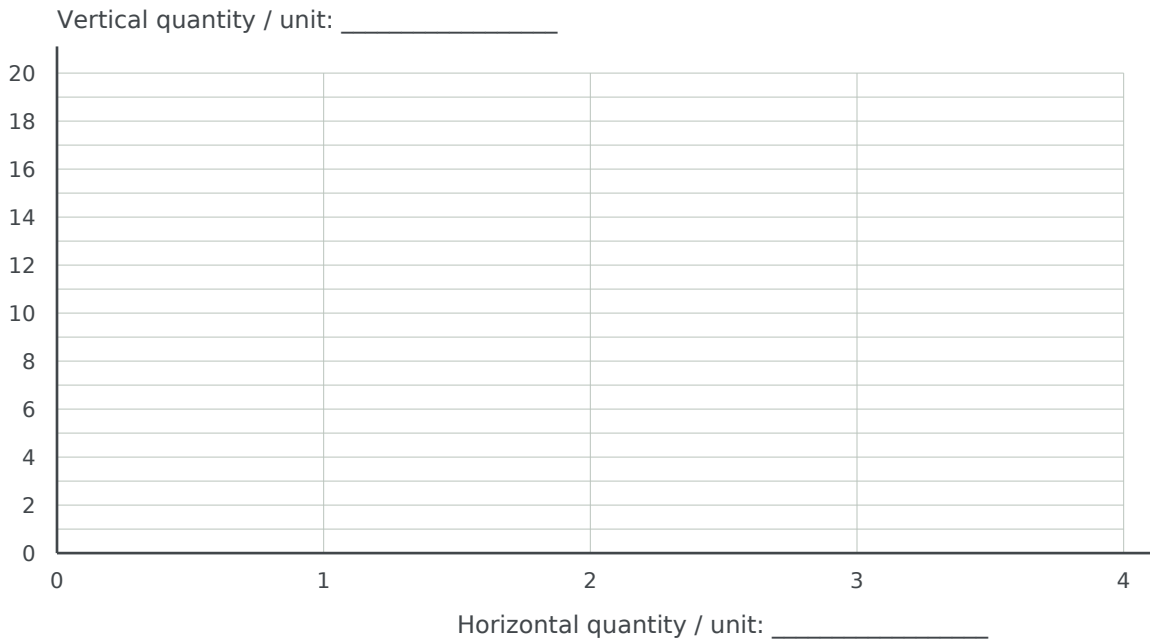


Table: input  $x$  / output  $y$ ; equation and calculation

Interpret the units, initial value, rate and graph connection

STUDENT OPEN TASK | WARM-UP

# 002 • Show your reasoning

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Target A+B

A tank begins with 1 liter and fills at 2 liters per hour. Define  $x$  and  $y$  with units. Identify the independent and dependent quantities. Write an equation and complete a table for  $x = 0, 1, 2, 3, 4$ . On the blank grid, label both axes and plot your table; decide whether to connect the points. Find  $y$  when  $x = 1$ . Explain the initial value and the change in  $y$  when  $x$  increases by 1.

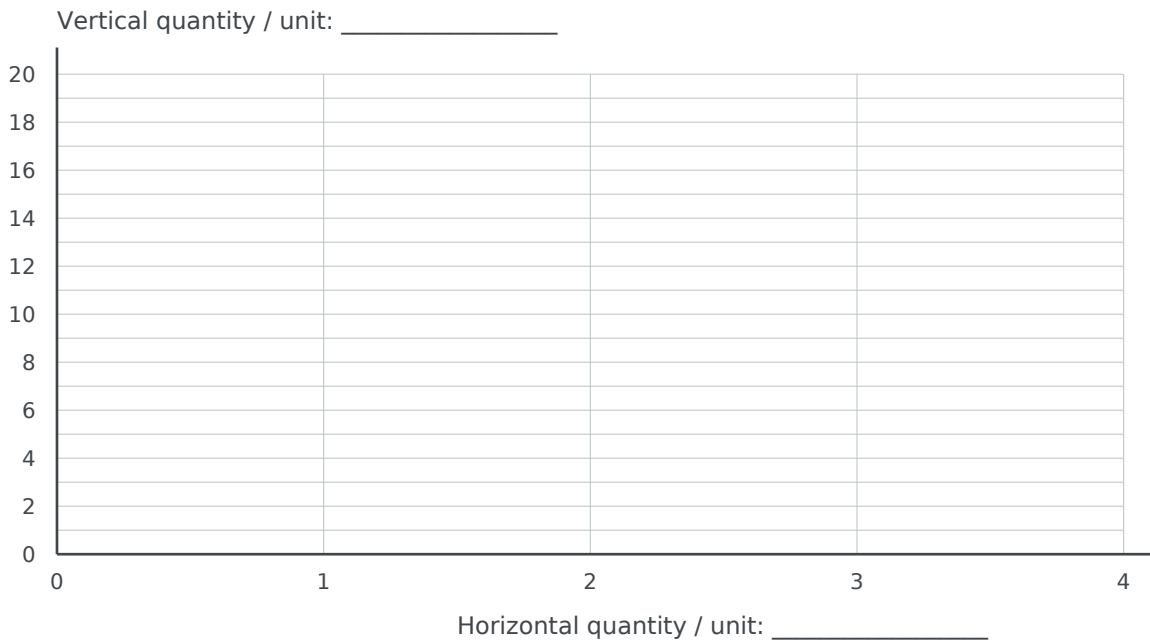


Table: input  $x$  / output  $y$ ; equation and calculation

Interpret the units, initial value, rate and graph connection

## TEACHER-ONLY WORKED KEY

## Choice solutions 1-2

### M01 • A. 12

Let  $x$  be tickets (independent input); let  $y$  be dollars (dependent output).  $y = 3x$ . For  $x = 4$ ,  $y = 3 \times 4 + 0 = 12$ . Table  $(x, y)$ :  $(0, 0)$ ,  $(1, 3)$ ,  $(2, 6)$ ,  $(3, 9)$ ,  $(4, 12)$ . Each increase of 1 input unit changes  $y$  by 3 dollars. At  $x = 0$ ,  $y = 0$ . Plot  $x$  horizontally and  $y$  vertically. Use separate points; fractional counts are not allowed in this context. Domain: nonnegative whole-number inputs. From  $x = 1$  to  $x = 3$ , the output changes from 3 to 9, a change of 6 dollars.

B: reads the output for  $x = 1$  instead of  $x = 4$ .

C: reads the output for  $x = 3$  instead of  $x = 4$ .

D: reads the output for  $x = 2$  instead of  $x = 4$ .

### M02 • D. 4

Let  $x$  be hours (independent input); let  $y$  be liters (dependent output).  $y = 2x + 1$ . For  $x = 1$ ,  $y = 2 \times 1 + 1 = 3$ . Table  $(x, y)$ :  $(0, 1)$ ,  $(1, 3)$ ,  $(2, 5)$ ,  $(3, 7)$ ,  $(4, 9)$ . Each increase of 1 input unit changes  $y$  by 2 liters. At  $x = 0$ ,  $y = 1$ . Plot  $x$  horizontally and  $y$  vertically. A line segment through the plotted points represents intermediate inputs in the displayed interval. Domain: nonnegative real inputs in this idealized model. From  $x = 1$  to  $x = 3$ , the output changes from 3 to 7, a change of 4 liters.

A: treats the output as unchanged.

B: adds five extra output units to the change.

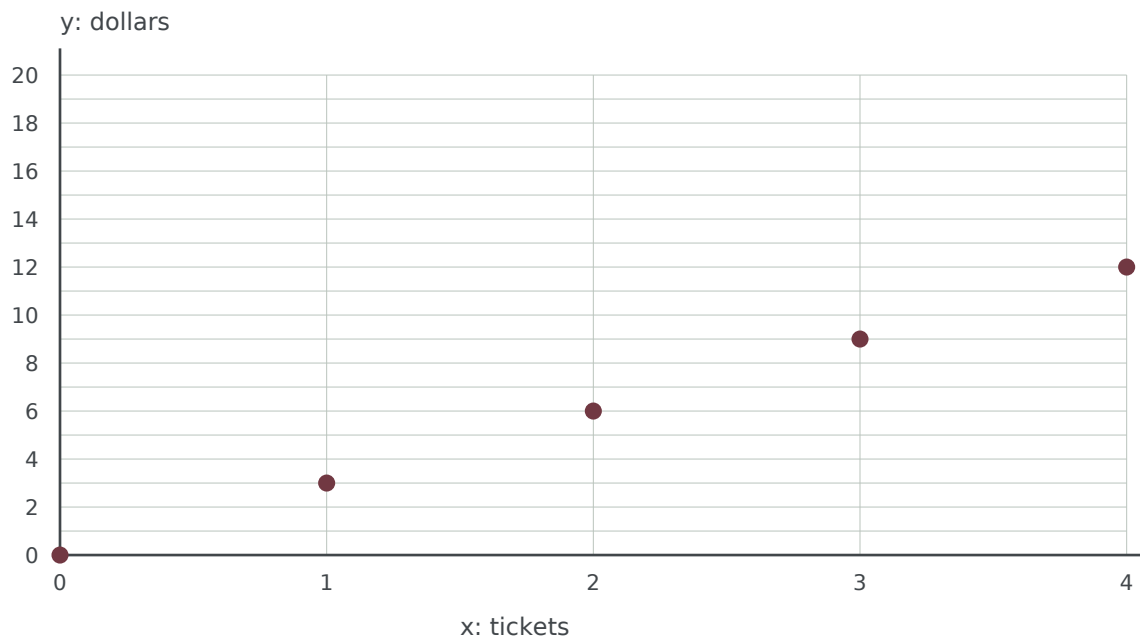
C: adds an incorrect starting amount into the change.

## TEACHER-ONLY WORKED KEY

# Open solution 1

## 001 • Sample response

Let  $x$  be tickets (independent input); let  $y$  be dollars (dependent output).  $y = 3x$ . For  $x = 4$ ,  $y = 3 \times 4 + 0 = 12$ . Table  $(x, y)$ :  $(0, 0)$ ,  $(1, 3)$ ,  $(2, 6)$ ,  $(3, 9)$ ,  $(4, 12)$ . Each increase of 1 input unit changes  $y$  by 3 dollars. At  $x = 0$ ,  $y = 0$ . Plot  $x$  horizontally and  $y$  vertically. Use separate points; fractional counts are not allowed in this context. Domain: nonnegative whole-number inputs. From  $x = 1$  to  $x = 3$ , the output changes from 3 to 9, a change of 6 dollars.



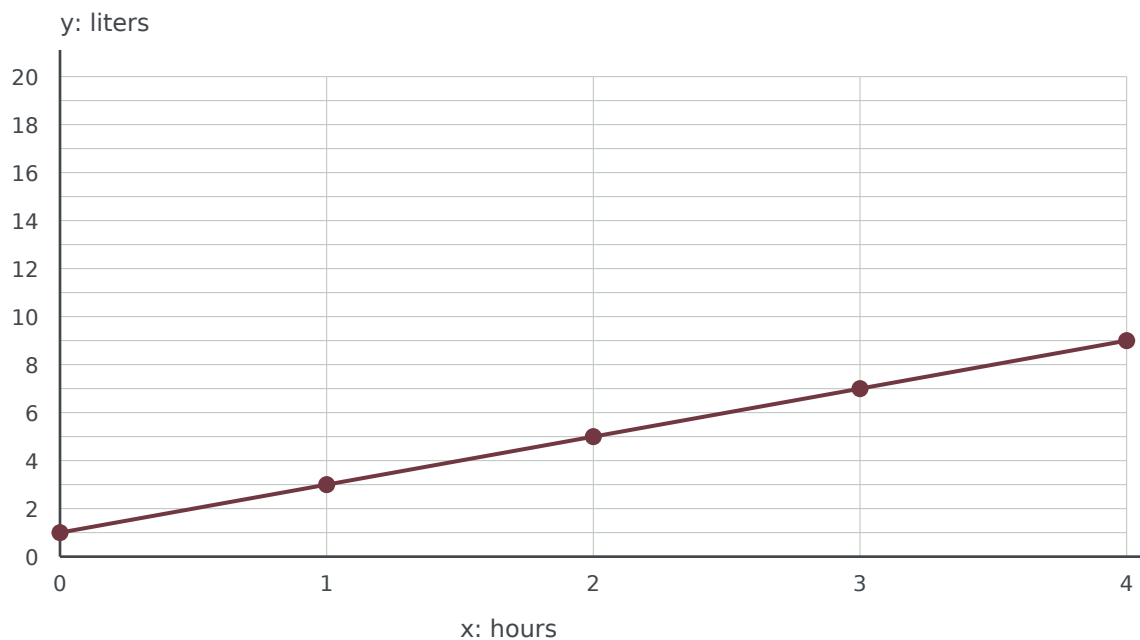
Evidence: representation matches the condition; computation is checkable; explanation includes units or allowed values. Equivalent valid strategies and wording are accepted.

## TEACHER-ONLY WORKED KEY

# Open solution 2

## 002 • Sample response

Let  $x$  be hours (independent input); let  $y$  be liters (dependent output).  $y = 2x + 1$ . For  $x = 1$ ,  $y = 2 \times 1 + 1 = 3$ . Table  $(x, y)$ :  $(0, 1)$ ,  $(1, 3)$ ,  $(2, 5)$ ,  $(3, 7)$ ,  $(4, 9)$ . Each increase of 1 input unit changes  $y$  by 2 liters. At  $x = 0$ ,  $y = 1$ . Plot  $x$  horizontally and  $y$  vertically. A line segment through the plotted points represents intermediate inputs in the displayed interval. Domain: nonnegative real inputs in this idealized model. From  $x = 1$  to  $x = 3$ , the output changes from 3 to 7, a change of 4 liters.



Evidence: representation matches the condition; computation is checkable; explanation includes units or allowed values. Equivalent valid strategies and wording are accepted.