



UNIT OVERVIEW

Unit 2 — Foundations of Linear Functions

Proportional Relationships, Linear Equations, and Functions



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This overview guide contains...

The unit calendar — every objective and scheduled assessment through the end of the unit

Vocabulary — the terms you must build into your artifacts

Check Your Understanding problem sets — an extra tool to monitor your progress. Completing all questions is not required, but a guide kept up with, completed in full, and turned in at the end of the quarter raises your Standards Mastery Check score by **5%**. Answer keys for every question are posted on the class website.

Since this guide contains so much foundational information vital to success in this course, it is **essential** to keep up with it. It's THE **most important document** needed for success.

Unit Calendar

Monday, October 19th – Friday, November 13th

ARTIFACT 14 · Proportional and Nonproportional Relationships

WEEK 2 OCTOBER 19–23

BLOCK 3

MON–TUE, OCT 19–20

I can distinguish a table, graph, or equation as proportional or nonproportional and justify using attributes of proportional and nonproportional relationships. **8.5F, 8.5H**

I can solve for the independent and dependent variables given mathematical relationships involving direct variation, including completing a table to model. **8.5E**

Performance Task 2.1 · Distinguishing Proportional Relationships

in class Mon–Tue, Oct 19–20 · Revision Studio Friday, Oct 23 · revisions due Friday, Oct 30

BLOCK 4

WED–THU, OCT 21–22

Block 3, objective 2, continued. **8.5E**

FRIDAY

OCT 23

I can identify an equation in the form $y = mx + b$ that models a real-world situation, given the rate of change, graph, table, or initial value. **8.5I**

ARTIFACT 15 · Writing Linear Equations

WEEK 3 OCTOBER 26–30

BLOCK 5

MON–TUE, OCT 26–27

I can identify an equation in the form $y = mx + b$ that models a real-world situation, given the rate of change, graph, table, or initial value. **8.5I**

I can identify an equation in the form $y = mx + b$ that models a real-world situation, given a set of independent and dependent values. **8.5I**

I can identify an equation in the form $y = mx + b$ that models a linear relationship, given a real-world or mathematical context. **8.5I**

BLOCK 6

WED–THU, OCT 28–29

Block 5 objectives, continued. **8.5I**

Project Write-Up · Cost Analysis

introduced Wed–Thu, Oct 28–29 · due Friday, Nov 6

Performance Task 2.2 · Writing Linear Equations

Friday, Oct 30 · revisions due Tuesday, Nov 10

Q2 Mathematical Process · Weeks 10–12 Friday, Oct 30

ARTIFACT 16 · Identifying Functions**WEEK 4 NOVEMBER 2–6**

no school Tuesday

BLOCK 7

MON & WED, NOV 2 & 4

I can identify a relation as a function from a combination of representations (graphs, tables, ordered pair sets, mappings), justifying the decision using attributes of functions. **8.5G**

I can determine which point could be added to a relation so that the relation remains a function. **8.5G**

BLOCK 8

THU–FRI, NOV 5–6

Block 7 objectives, continued. **8.5G****Performance Task 2.3 · Identifying Functions**

in class Thu–Fri, Nov 5–6 · revisions due Tuesday, Nov 17

Q2 Mathia Mid-Quarter Check Friday, Nov 6**ARTIFACT 17 · Points of Intersection****WEEK 5 NOVEMBER 9–13****BLOCK 9**

MON–TUE, NOV 9–10

I can determine the point of intersection of two linear equations and write the coordinates of the ordered pair given a graph or equations in the form $y = mx + b$. **8.9A**

I can describe each coordinate of the ordered pair at the point of intersection representing a real-world situation given a graph. **8.9A**

I can verify that an ordered pair is the solution to two linear equations by substituting its coordinates into both equations. **8.9A**

Unit 2 End-of-Unit Assessment · Artifacts 14–17

in class Wed–Thu, Nov 11–12 · revisions due Thursday, Dec 3

Public Forum · Cost Analysis

Friday, Nov 13

AFTER THE UNIT**Public Presentations · Cost Analysis**

Friday, Nov 20 – Wednesday, Dec 2

Q2 Mathematical Process · Weeks 13–15 Friday, Nov 20

Vocabulary

All of these terms must be eventually added to at least one artifact (Artifact 14, 15, 16, and/or 17!)

proportional relationship	a relationship in which y is always the same multiple of x ; the graph is a straight line through the origin, and the equation has the form $y = kx$
constant of proportionality	the number k that x is multiplied by in $y = kx$; found from any pair using $k = \frac{y}{x}$
unit rate	the amount y changes for exactly 1 unit of x (e.g. dollars per 1 pound); in a proportional relationship the unit rate equals k
rate of change	how much y changes for each increase of 1 in x ; the m in $y = mx + b$; constant in every linear relationship
linear relationship	a relationship whose graph is a straight line; the rate of change is constant
nonproportional relationship	a linear relationship whose line does <i>not</i> pass through the origin; its equation is $y = mx + b$ with $b \neq 0$
initial value	the value of y when $x = 0$; the starting amount in a situation (the b in $y = mx + b$)
y-intercept	the point where a graph crosses the y -axis, written $(0, b)$
slope	the number m multiplying x in $y = mx + b$; measures the steepness and direction of the line
origin	the point $(0, 0)$, where the axes cross; a proportional graph must pass through it
direct variation	another name for a proportional relationship: y varies directly with x when $y = kx$
independent variable	the input quantity (x); the value you choose or control
dependent variable	the output quantity (y); its value depends on the value of x
relation	any set of ordered pairs (x, y)

function	a relation in which every input x has exactly one output y
input / output	the x -value going into a relation and the y -value it produces
ordered pair	two coordinates written (x, y) , pairing an input with an output
mapping (mapping diagram)	a picture of a relation: inputs in one oval, outputs in another, with an arrow pairing each input with its output
vertical line test	a check for functions on a graph: if any vertical line would pass through more than one point of the graph, an input repeats, so the relation is not a function
point of intersection	the point where two graphed lines cross; its coordinates satisfy both equations
satisfy (an equation)	a pair of values satisfies an equation if substituting them makes the equation true
substitution	replacing x and y in an equation with values to check whether the equation is true
nonlinear	a relationship whose graph is not a straight line; the rate of change is not constant (not covered by $y = kx$ or $y = mx + b$)

Check Your Understanding

Unit 2 – Foundations of Linear Functions

Proportional Relationships, Linear Equations, and Functions

Questions 1–23 cover Artifact 14 (Proportional and Nonproportional Relationships)

1. The table shows a proportional relationship between x and y . Complete the table.

x	2	3		8
y	9	13.5	22.5	

2. A print shop charges the same price for every poster. An order of 6 posters costs \$40.50. Write an equation for the cost y , in dollars, of x posters, and identify the constant of proportionality.

3. Which table represents a proportional relationship between x and y ?

(A)

x	y
2	9
4	18
6	27

(B)

x	y
1	3
2	5
3	7

(C)

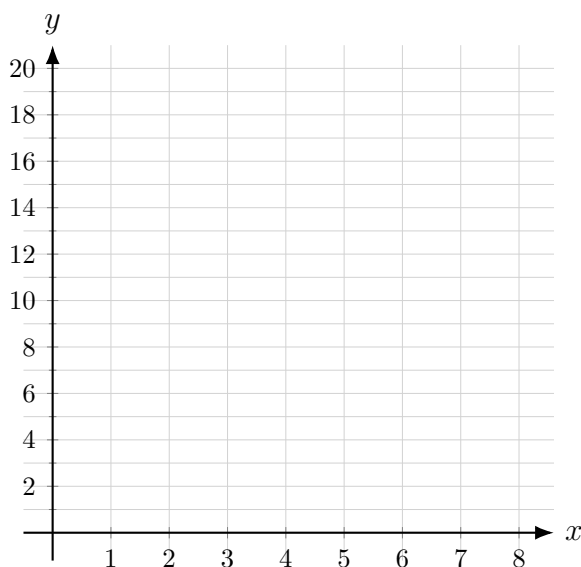
x	y
2	4
3	9
4	16

(D)

x	y
0	2
1	4
2	6

4. The table shows a proportional relationship. Graph the relationship on the grid. Plot at least three points and draw the line.

x	2	4	6
y	5	10	15



5. Which equation represents a proportional relationship?

(A) $y = 3x + 1$

(B) $y = 2x - 4$

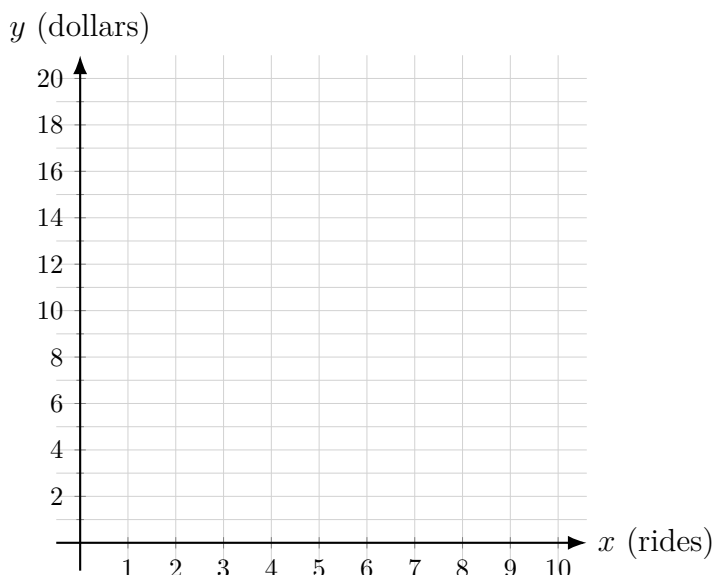
(C) $y = x + 7$

(D) $y = \frac{x}{5}$

6. A rain barrel already holds 6 gallons of water. During a storm it collects 1.5 gallons each hour. Complete the table for the total number of gallons y in the barrel after x hours.

x (hours)	0	1	2	4
y (gallons)		7.5		

7. A bus pass starts with \$20 on it, and each ride costs \$1.25. On the grid, graph the amount y , in dollars, left on the pass after x rides. Plot at least three points and draw the line.



8. Determine whether each representation shows a proportional or a nonproportional relationship. Place a check in the correct column for each row.

					Proportional	Nonproportional
$y = 3x - 2$					☐	☐
$y = \frac{x}{4}$					☐	☐
	x	1	2	4	☐	☐
	y	5	10	20		
	x	0	1	2	☐	☐
	y	3	5	7		

9. Which situation represents a proportional relationship between the two quantities?
- (A) A parking garage charges \$4.00 to enter plus \$2.00 for each hour parked.
 - (B) Movie tickets cost \$9.50 each.
 - (C) A plant is 8 cm tall and grows 3 cm each week.
 - (D) A phone plan costs \$25.00 per month plus \$0.10 for each text sent.
10. Which situation represents a non-proportional linear relationship?
- (A) Candy costs \$0.85 per piece.
 - (B) A train travels at a constant speed of 55 miles per hour.
 - (C) Raffle tickets cost \$2.00 each.
 - (D) A tutoring center charges a \$12.00 registration fee plus \$5.00 for each session.

11. The distance a spring stretches varies directly with the weight attached to it. A 12-pound weight stretches the spring 3 inches. Complete the table, then give the distance the spring stretches for a 30-pound weight.

x (pounds)	4	12	20	30
y (inches)		3		

12. The variable y varies directly with x . When $x = 6$, $y = 21$. What is the value of y when $x = 14$?

- (A) 49
(B) 29
(C) 42
(D) 56

13. The cost of grapes varies directly with their weight. A bag weighing 5 pounds costs \$11.25. How many pounds of grapes can be bought for \$20.25? Show your work.

14. The table shows a relationship between x and y .

x	y
2	7
4	13
6	19

Determine whether the relationship is proportional or nonproportional. Justify your decision using attributes of the relationship.

15. Which table represents a linear non-proportional relationship between x and y ?

(A)

x	y
1	3
2	6
3	9

(B)

x	y
0	0
2	7
4	14

(C)

x	y
1	2
2	5
3	10

(D)

x	y
0	4
1	9
2	14

16. A ride service charges the amounts shown in the table.

x (miles)	2	5	7
y (dollars)	8.50	17.50	23.50

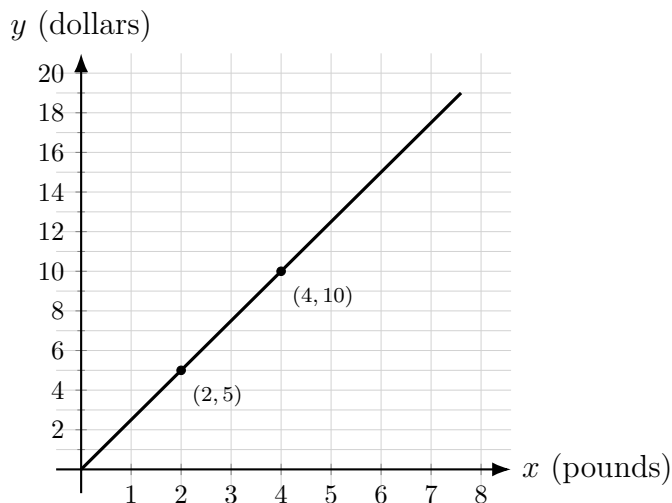
Determine whether the relationship is proportional or nonproportional. Justify your decision using values from the table.

17. The table represents a proportional relationship between x and y .

x	y
4	7
6	10.5
12	?

What is the missing value of y when $x = 12$?

- (A) 14
(B) 17.5
(C) 21
(D) 24
18. The graph shows the cost y , in dollars, of x pounds of pecans at a farmers market stand.



(a) Write an equation for the relationship shown in the graph.

(b) Explain how the graph shows the relationship is proportional.

19. A proportional relationship between x and y includes the point $(4, 10)$. What is the unit rate of the relationship?
- (A) 2.5
(B) 0.4
(C) 6
(D) 40

20. The table shows the cost y , in dollars, of bowling x games at Lane Ten. The cost at Strike Zone is given by $y = 4.5x + 10$.

x (games)	2	4	6
y (dollars)	14	28	42

Determine which bowling alley's cost is proportional to the number of games. Then a student says, "Strike Zone always costs less, because it charges less for each game." Decide whether the student is correct. Use values to justify your decision.

21. A conveyor belt moves 8.5 meters each second. Which equation represents the total distance y , in meters, the belt moves in x seconds?

- (A) $y = x + 8.5$
 (B) $y = 8.5x + 8.5$
 (C) $y = 8.5x$
 (D) $y = \frac{x}{8.5}$

22. Determine whether each situation represents a proportional or a nonproportional relationship. Place a check in the correct column for each row.

	Proportional	Nonproportional
A gym charges \$25 to join plus \$15 each month	☐	☐
Trail mix costs \$3.40 per pound	☐	☐
A rideshare charges \$2.50 plus \$1.75 per mile	☐	☐
A printer prints 22 pages each minute	☐	☐

23. A student graphs a relationship and says, "The graph is a straight line, so the relationship is proportional." Decide whether the student is correct. Use a labeled example, with values, to justify your decision.

Questions 24–38 cover Artifact 15 (Writing Linear Equations)

24. A school supply drive collects 750 notebooks. Each classroom that signs up receives 18 notebooks. Write an equation for the number of notebooks y left after x classrooms receive theirs.

25. The drama club paid to rent a stage, then sold tickets at a constant price. The table shows the club's profit y , in dollars, after x tickets are sold. Write an equation for the profit y after x tickets.

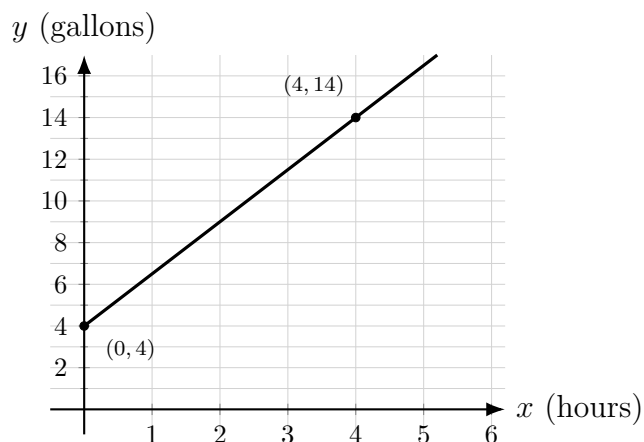
x	y
10	-30
25	60
40	150

26. The table shows a linear relationship between x and y .

x	y
0	8
3	23
6	38
9	53

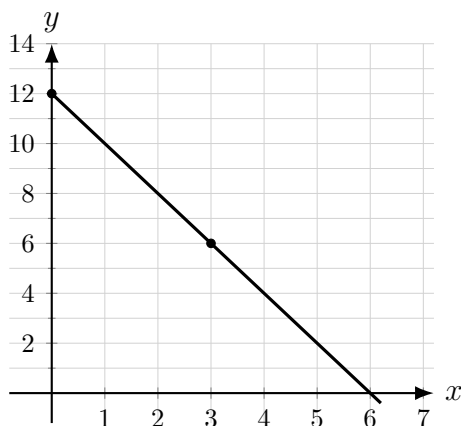
Which equation represents this relationship?

- (A) $y = 8x + 5$
(B) $y = 5x + 8$
(C) $y = 15x + 8$
(D) $y = 5x$
27. The graph shows the total number of gallons y in a rain tank after x hours of steady rain.



Write an equation for the number of gallons y in the tank after x hours.

28. The graph of a linear relationship is shown.



Which equation represents the graph?

- (A) $y = 2x + 12$
- (B) $y = 12x - 2$
- (C) $y = -2x + 12$
- (D) $y = -12x + 2$

29. A candle burns down at a constant rate of 0.6 centimeter each hour. After 5 hours of burning, the candle is 17 centimeters tall. Write an equation for the height y , in centimeters, of the candle after x hours. Show how you found the starting height.

30. A moving company charges a flat fee plus a fixed rate per mile. A 3-mile move costs \$10.25, and an 8-mile move costs \$22.75. Which equation models the total cost y , in dollars, of a move of x miles?

- (A) $y = 2.75x + 2.50$
- (B) $y = 2.50x + 2.75$
- (C) $y = 2.50x + 10.25$
- (D) $y = 2.50x$

31. Write an equation in the form $y = mx + b$ or $y = kx$ for each relationship described.

(a) a \$12 sign-up fee plus \$8 each month

(b) the table

x	0	2	4
y	15	27	39

(c) starts at 25 and decreases by 4 each week

(d) the table

x	1	2	3
y	9	16	23

32. A food truck sells tamales for \$2.75 each, with no other charges. Write an equation for the total cost y , in dollars, of x tamales, and state the value of b in your equation.

33. A phone battery is fully charged at 100% and loses 12 percentage points each hour of video playback. Which equation models the battery percentage y after x hours?

- (A) $y = 12x + 100$
(B) $y = 100x - 12$
(C) $y = -100x + 12$
(D) $y = -12x + 100$

34. The table pairs the number of weeks x with the amount y , in dollars, left on a student lunch account: $(1, 76)$, $(3, 48)$, $(5, 20)$. Write an equation for the amount y left after x weeks. Show your work.

35. The equation $y = 32 + 2.5x$ gives the length y , in centimeters, of a bamboo shoot x days after it is first measured. A student says, “The shoot was 2.5 centimeters long when it was measured, and it grows 32 centimeters each day.” Decide whether the student is correct. Then determine the length of the shoot on day 12.

36. Which table represents the equation $y = 4x - 3$?

(A)

x	y
1	1
2	5
3	9

(B)

x	y
1	4
2	8
3	12

(C)

x	y
1	7
2	11
3	15

(D)

x	y
1	1
2	4
3	7

37. Two students each write an equation for the line that passes through the points $(-2, 1)$ and $(4, 4)$. Student A writes $y = 0.5x + 2$. Student B writes $y = 2x + 5$. Determine which equation, if either, represents the line. Justify your decision using both points.

38. Two tanks are filling with water. The tables show the number of gallons y in each tank after x minutes.

Tank P				Tank Q			
x	0	2	4	x	0	2	4
y	30	38	46	y	18	32	46

Write an equation for each tank. Then determine which tank has the greater rate of change and which has the greater starting value, and state what each of those values means in this situation.

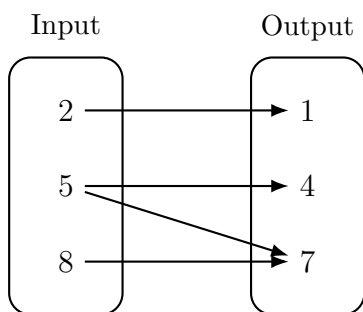
Questions 39–50 cover Artifact 16 (Identifying Functions)

39. Which set of ordered pairs represents a function?
- (A) $\{(2, 4), (2, 6), (3, 1), (5, 2)\}$
- (B) $\{(1, 3), (2, 3), (4, 6), (5, 1)\}$
- (C) $\{(0, 2), (1, 5), (0, 7), (3, 3)\}$
- (D) $\{(1, 1), (3, 4), (3, 7), (6, 2)\}$
40. Write a set of four ordered pairs that uses only the inputs 1, 3, and 5 and is *not* a function. Explain what makes your set not a function.

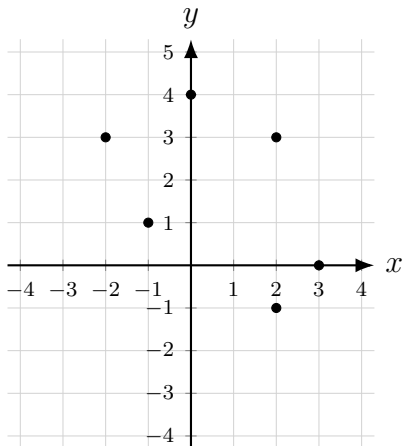
41. The table shows a relation. Determine whether the relation is a function. Explain why or why not.

x	1	2	3	4
y	6	6	9	9

42. The mapping diagram shows a relation. Determine whether the relation is a function. Explain why or why not.



43. The points shown on the grid are the complete relation. Determine whether the relation is a function. Explain why or why not.



44. A relation contains the points $(2, 7)$, $(3, 1)$, and $(6, 5)$. Which point can be added to the relation so that it remains a function?
- (A) $(2, 9)$
- (B) $(6, 2)$
- (C) $(4, 7)$
- (D) $(3, 3)$
45. A relation contains the points $(-3, 4)$, $(0, 4)$, and $(2, -1)$. A student adds the point $(4, 4)$ and says, “Now 4 is an output three times, so the relation is no longer a function.” Decide whether the student is correct. Then give one point that, if added, would make the relation not a function.

46. Which table does *not* represent a function?

(A)

x	y
1	4
2	4
3	4
4	4

(B)

x	y
0	1
2	5
4	9
6	13

(C)

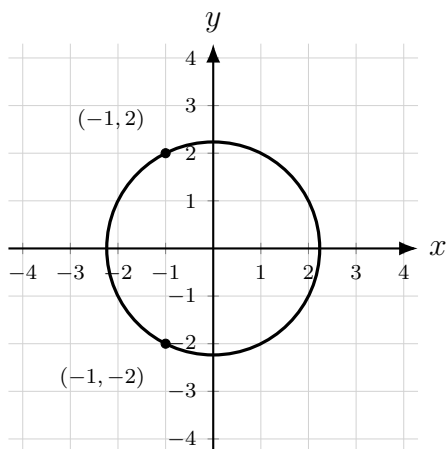
x	y
1	7
2	5
3	3
4	1

(D)

x	y
3	2
5	8
3	11
7	1

47. Write the relation $\{(2, 4), (3, 4), (5, 9)\}$ as a mapping diagram. Then determine whether the relation is a function, and explain how your diagram shows it.

48. In which relation is y a function of x ?
- (A) x is a Longfellow student, and y is that student's date of birth.
 - (B) x is a date of birth, and y is a student born on that date.
 - (C) x is a grade level, and y is a student in that grade.
 - (D) x is a bus route, and y is a student who rides that route.
49. The graph of a relation is shown, with two of its points labeled. Determine whether the relation is a function. Explain why or why not, naming points from the graph as evidence.



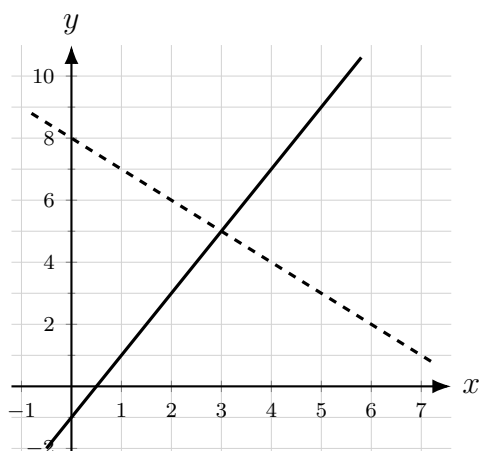
50. The table shows a relation.

x	5	1	4	2
y	3	3	8	0

A student says, “The x -values are not in order, so this relation is not a function.” Decide whether the student is correct, and explain using the definition of a function. Then draw the relation as a mapping diagram.

Questions 51–60 cover Artifact 17 (Points of Intersection)

51. The graphs of $y = 2x - 1$ and $y = -x + 8$ are shown.



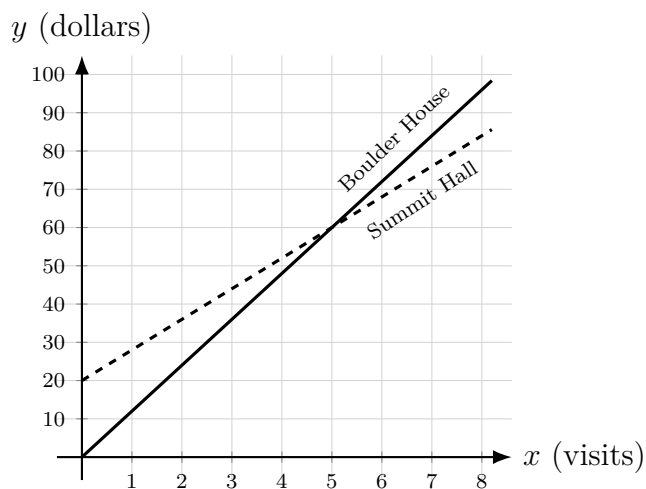
(a) Write the coordinates of the point of intersection.

(b) Verify your ordered pair by substituting its coordinates into both equations. Show the check for each.

52. Which ordered pair is the solution to $y = x + 3$ and $y = 3x - 1$?

- (A) (1, 4)
- (B) (2, 5)
- (C) (3, 8)
- (D) (0, 3)

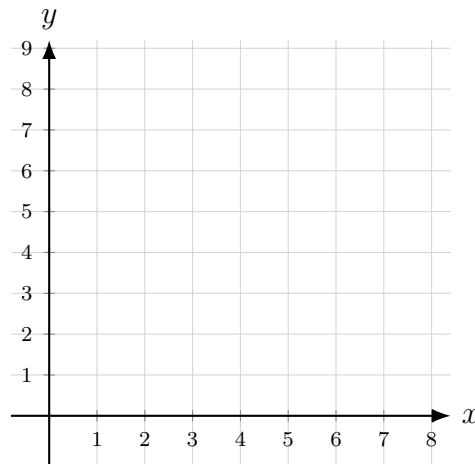
53. The graph shows the total cost y , in dollars, of x visits at two climbing gyms. Boulder House charges \$12 per visit. Summit Hall charges a \$20 membership plus \$8 per visit.



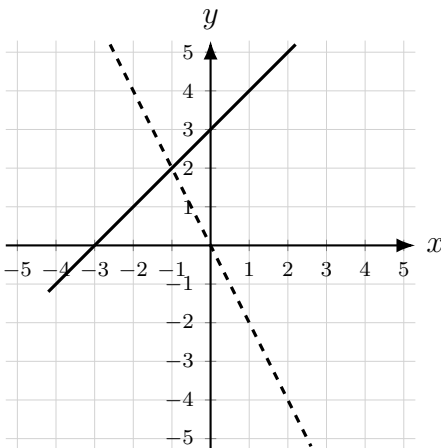
(a) Write the coordinates of the point of intersection.

(b) Describe what each coordinate of the point of intersection represents in this situation.

54. Graph $y = x + 1$ and $y = -2x + 7$ on the grid. Then write the coordinates of the point of intersection.



55. The graphs of two linear equations are shown.



Which ordered pair gives the point of intersection of the two lines?

- (A) $(2, -1)$
- (B) $(1, 2)$
- (C) $(-1, 2)$
- (D) $(-1, -2)$

56. A student says $(4, 2)$ is the solution to $y = -x + 6$ and $y = 0.5x + 1$. Decide whether the student is correct by substituting the coordinates into both equations. Show the check for each equation.

57. The graphs showing the total cost y , in dollars, of x months at two gyms intersect at the point $(6, 45)$. What does this point represent?

- (A) The gyms cost a total of \$45 for 6 months combined.
- (B) One gym costs \$6 more per month than the other.
- (C) Both gyms cost \$6 for 45 months of membership.
- (D) Both gyms cost \$45 for 6 months of membership.

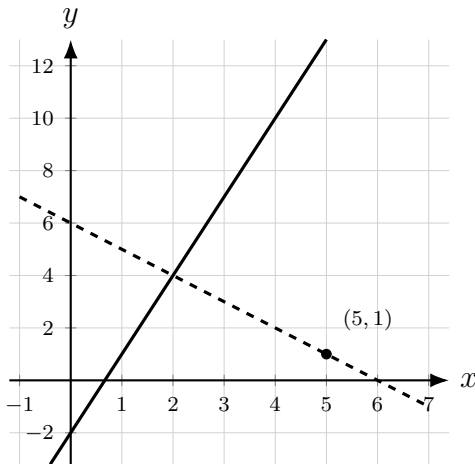
58. Two moving companies charge by the hour: $y = 2.5x$ and $y = 1.5x + 4$ give each cost y , in dollars, for x hours. Complete the table for both companies.

x (hours)	2	4	6
$y = 2.5x$			
$y = 1.5x + 4$			

Then write the ordered pair where the two graphs would intersect, and explain how the table shows it.

59. The graphs of two linear equations intersect at the point $(3, 27)$. Write a real-world situation that the two equations could represent, and state what each coordinate of the point of intersection means in your situation.

60. The graphs of $y = 3x - 2$ and $y = -x + 6$ are shown, with the point $(5, 1)$ labeled.



A student says $(5, 1)$ is a solution to both equations because it is on one of the lines. Decide whether the student is correct. Justify your decision by substituting the coordinates into both equations.