IM 9–12 MATH v.1

Unit 2

Linear Equations, Inequalities, and Systems

ALGEBRA 1

Lesson 10

Connecting Equations to Graphs (Part 1)

Illustrative Mathematics®

Kendall Hunt

Learning Goal

Let's investigate what graphs can tell us about the equations and relationships they represent.

Algebra 1

Games and Rides

Warm-up

Jada has $20 to spend on games and rides at a carnival. Games cost $1 each and rides are $2 each.

1. Which equation represents the relationship between the number of games, x, and the number of rides, y, that Jada could do if she spends all her money?

   A: $x + y = 20$ B: $2x + y = 20$ C: $x + 2y = 20$

1. Explain what each of the other two equations could mean in this situation.

Graphing Games and Rides

Here are the three equations. Each represents the relationship between the number of games, x, the number of rides, y, and the dollar amount a student is spending on games and rides at a different amusement park.

Equation 1: $x + y = 20$

Equation 2: $2.50x + y = 15$

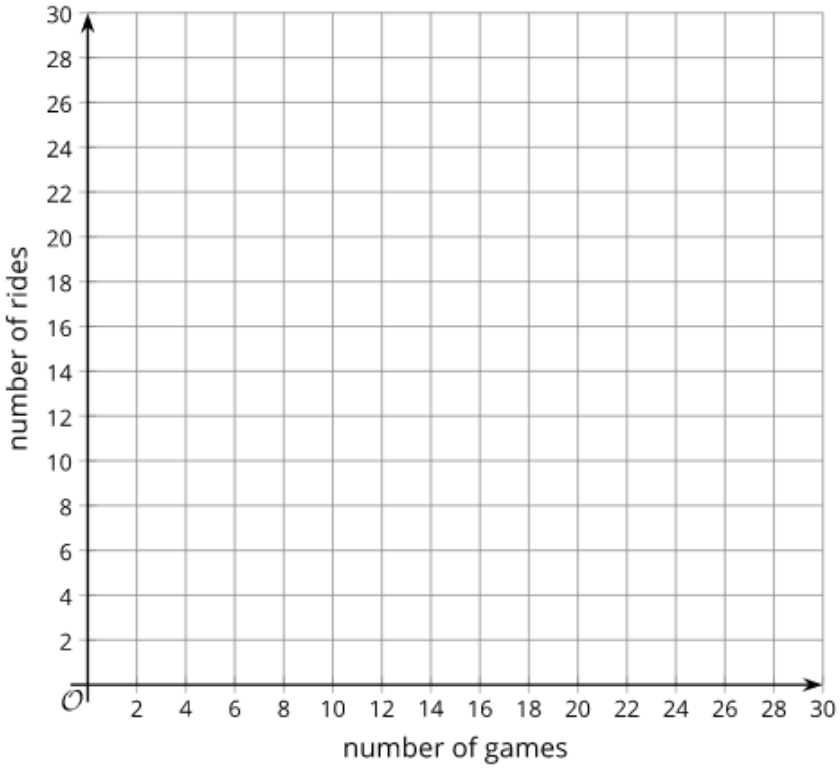
Equation 3: $x + 4y = 28$

Your teacher will assign to you (or ask you to choose) 1–2 equations. For each assigned (or chosen) equation, answer the questions.

Graphing Games and Rides

First equation: _____

1. What's the number of rides the student could get on if they don't play any games? On the coordinate plane, mark the point that represents this situation and label the point with its coordinates.
2. What's the number of games the student could play if they don't get on any rides? On the coordinate plane, mark the point that represents this situation and label the point with its coordinates.



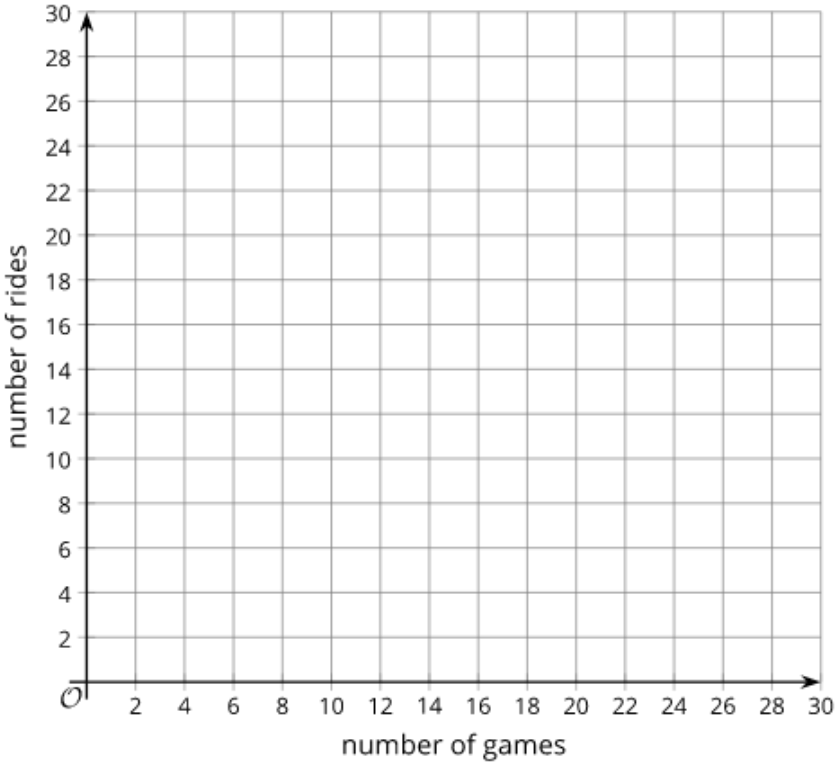
Graphing Games and Rides

3. Draw a line to connect the two points you've drawn.
4. Complete the sentences: "If the student played no games, they can get on _____ rides. For every additional game that the student plays, x, the possible number of rides, y, _____ (increases or decreases) by _____."
5. What is the slope of your graph? Where does the graph intersect the vertical axis?
6. Rearrange the equation to solve for y.
7. What connections, if any, do you notice between your new equation and the graph?

Graphing Games and Rides

Second equation: _____

1. What's the number of rides the student could get on if they don't play any games? On the coordinate plane, mark the point that represents this situation and label the point with its coordinates.
2. What's the number of games the student could play if they don't get on any rides? On the coordinate plane, mark the point that represents this situation and label the point with its coordinates.



Graphing Games and Rides

3. Draw a line to connect the two points you've drawn.
4. Complete the sentences: "If the student played no games, they can get on _____ rides. For every additional game that a student plays, x, the possible number of rides, y, _____ (increases or decreases) by _____."
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Graphing Games and Rides

- How did you find the number of possible rides when the student plays no games?
- How did you find the number of possible games when the student gets on no rides?
- Where on the graph do we see those two situations (all games and no rides, or all rides and no games)?
- The three equations are all given in the same form: $Ax + By = C$. What information can you get from an equation in this form? What do the A, B, and C represent in each equation?

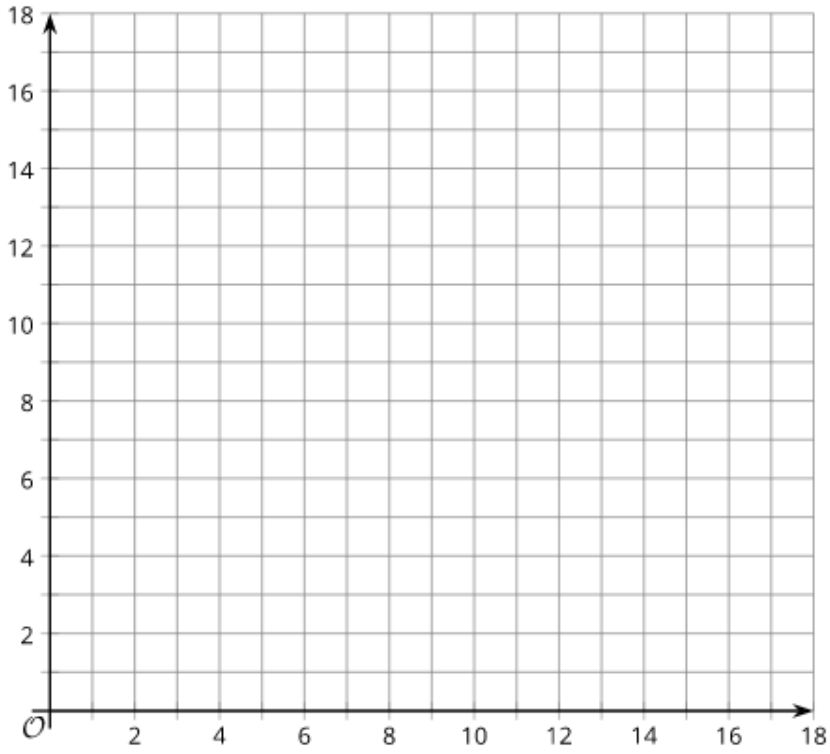
Graphing Games and Rides

- If we rearrange the first equation and solve for y, we get the equation $y = 20 - x$. Is the graph of this equation different from that of the original equation?
- You were asked to complete some sentences about what would happen if the student played more games. How did the graph help you complete the sentences?
- Would you have been able to see the trade-offs between games and rides by looking at the original equations in standard form?
- Do the rearranged equations still describe the same relationships between games and rides?
- What new insights does this form of equation give us?

Nickels and Dimes

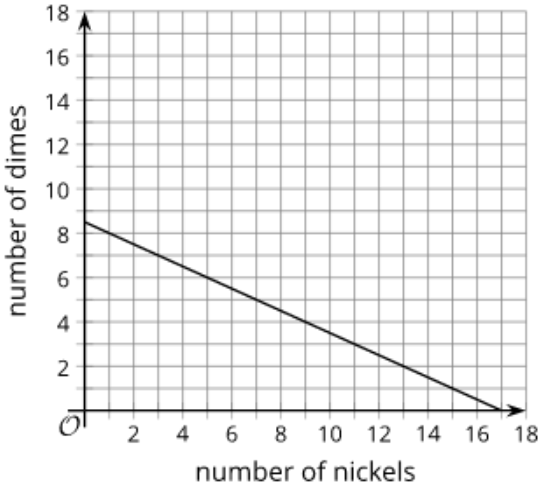
Andre's coin jar contains 85 cents. There are no quarters or pennies in the jar, so the jar has all nickels, all dimes, or some of each.

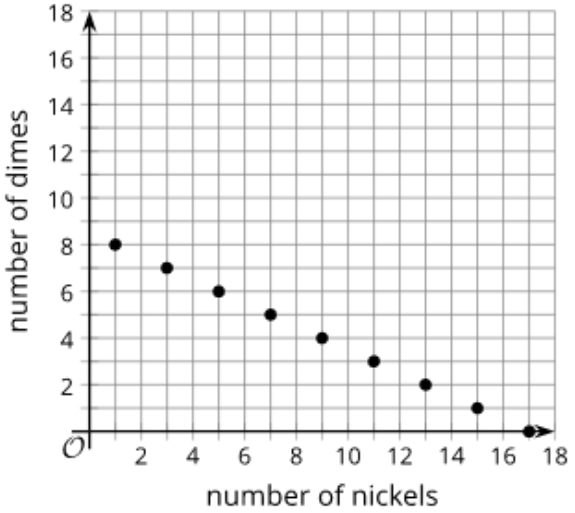
1. Write an equation that relates the number of nickels, n, the number of dimes, d, and the amount of money, in cents, in the coin jar.
2. Graph your equation on the coordinate plane. Be sure to label the axes.
3. How many nickels are in the jar if there are no dimes?
4. How many dimes are in the jar if there are no nickels?

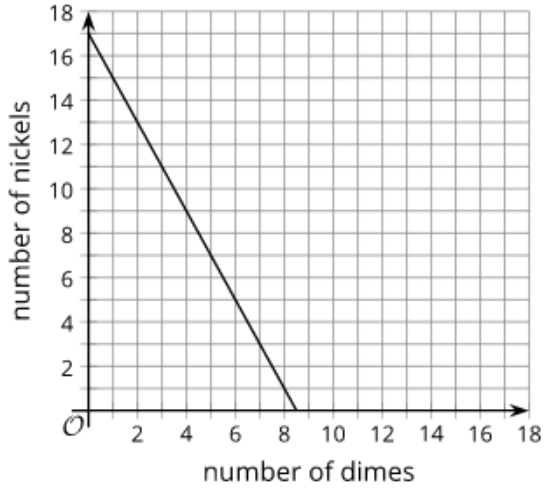


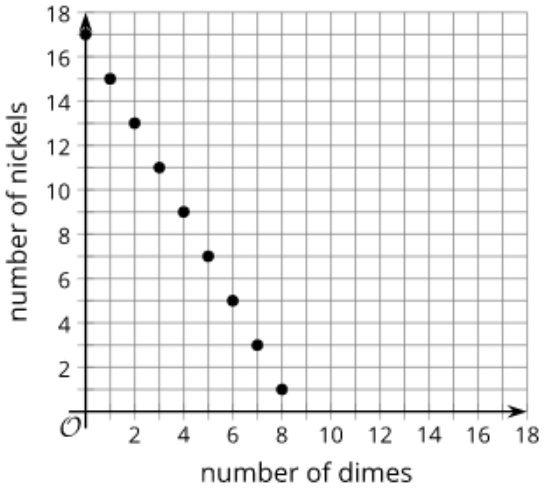
Nickels and Dimes

- Could each of these graphs be used to represent the relationship between the quantities?









Nickels and Dimes

- Suppose you were to express the relationship between the same quantities but in dollars instead of in cents. What would the equation look like?
- What would the graph of this equation look like? Try graphing it on the same coordinate plane.
- Why would the graph of this equation be identical to the other one?

Connecting Equations to Graphs (Part 1)

Lesson Synthesis

- We saw equations in different forms representing the same constraint. For example, $x + 4y = 28$ and $y = -\frac{1}{4}x + 7$ both represent the games and rides that a student could do with a fixed budget. What information about the situation and about the graph can we gain from the standard form, $Ax + By = C$?
- What information does the slope-intercept form give us?
- What might be an efficient way to graph an equation of the form $Ax + By = C$?

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- I can describe the connections between an equation of the form $ax + by = c$, the features of its graph, and the rate of change in the situation.
- I can graph a linear equation of the form $ax + by = c$.
- I understand that rewriting the equation for a line in different forms can make it easier to find certain kinds of information about the relationship and about the graph.

Learning Targets

Algebra 1

Illustrative Mathematics®

Kendall Hunt

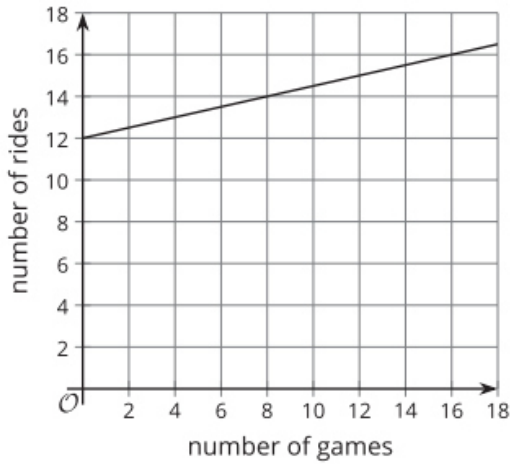
Kiran at the Carnival

Cool-down

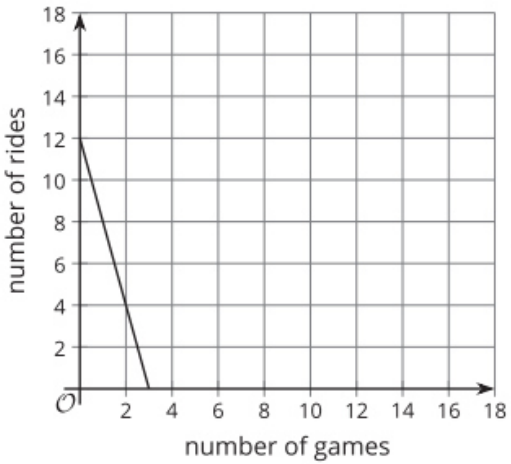
Kiran is spending $12 on games and rides at another carnival, where a game costs $0.25 and a ride costs $1.

1. Write an equation to represent the relationship between the dollar amount Kiran is spending and the number of games, x, and the number of rides, y, he could do.
2. Which graph represents the relationship between the quantities in this situation? Explain how you know.

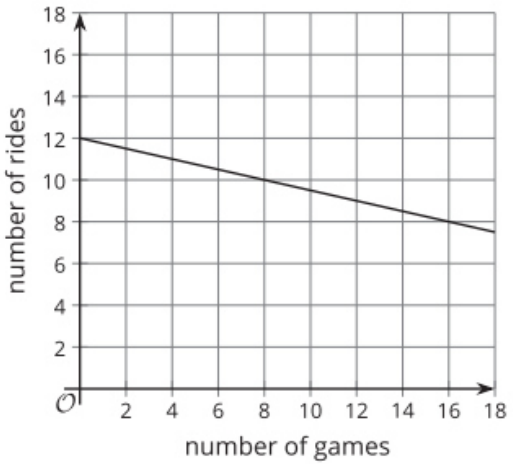
A



B



C



equivalent equations

Equations that have the exact same solutions are equivalent equations.