Unit 3 Summary

Prior Learning	Grade 8, Unit 3	Later in Grade 8	High School
Grade 6 • Calculating unit rates Grade 7 • Exploring proportional relationships Grade 8, Unit 2 • Calculating slope	• Revisit proportional relationships. • Write equations in slope-intercept form ($y = mx + b$). • Interpret equations in standard form ($ax + by = c$).	• Solve systems of linear equations. • Analyze linear functions and piecewise linear functions.	• Analyze quadratic and exponential functions. • Calculate average rate of change.

Proportionality Revisited

Here is an example of a proportional relationship between the amount of carpet bought and its cost. We can identify the **constant of proportionality** or **slope** (1.5) in every representation.

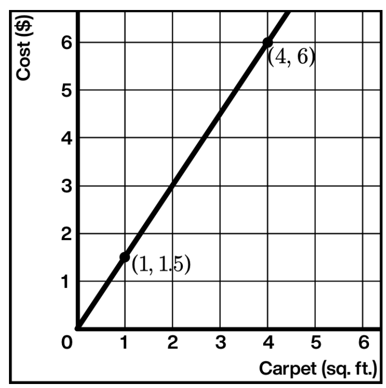
Table

Carpets (sq. ft.)	Cost (dollars)
0	0
1	1.50
4	6

Equation

$$y = 1.5x$$

Graph



Slope-Intercept Form

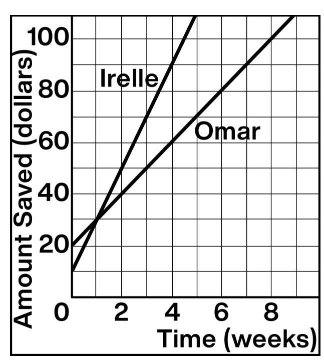
A relationship between two quantities is called a **linear relationship** if its graph is a line.

For example, Irelle and Omar save some of the money they earned.

Let w represent the number of weeks passed.
Let s represent the amount saved.

Equation for Irelle's savings: $s = 20w + 10$

Equation for Omar's savings: $s = 10w + 20$



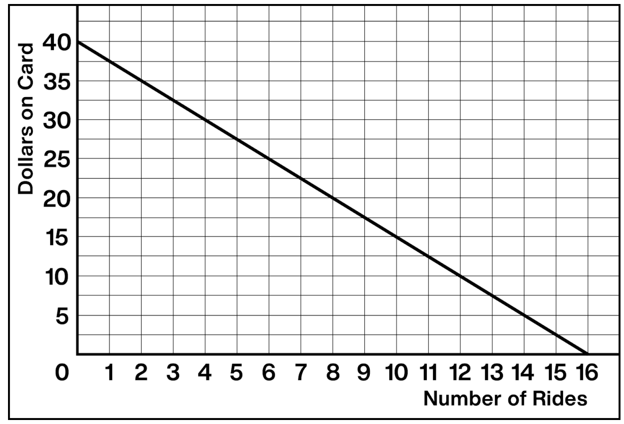
Another example is measuring the amount of money on a public transit fare card over time.

The steepness of this line (called the **slope**) is

$$\frac{\textit{vertical change}}{\textit{horizontal change}} = \frac{40}{16} = -2.5.$$

The y-intercept of this line is $(0, 40)$, which means the card started out with $\$40$ on it.

One equation for this relationship is $y = -2.5x + 40$, where x represents the number of rides you take and y represents the money left on the card.



In general, the slope-intercept form of a linear equation looks like:

$y = mx + b$	x and y represent the two related quantities. m represents the slope of the graphed line. b represents the y-intercept of the line.

Solutions and Standard Form

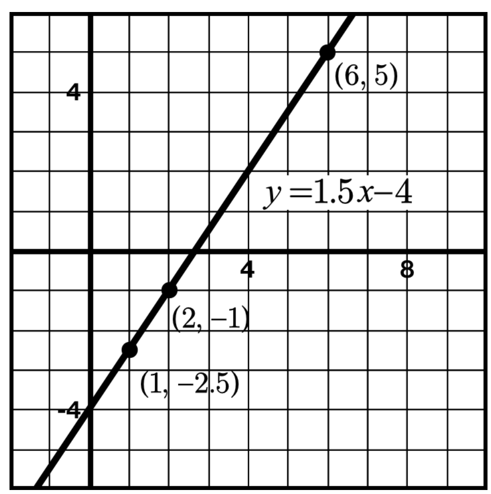
A *solution* to an equation is a value (or values) that makes the equation true.

The graph of an equation is all of the ordered pairs that make the equation true.

The point $(2, -1)$ is on the line $y = 1.5x - 4$.

We can show that the point is a solution to the equation by substituting 2 and -1 for x and y.

$$\begin{aligned} y &= 1.5x - 4 \\ -1 &= 1.5(2) - 4 \\ -1 &= 3 - 4 \\ -1 &= -1 \ \checkmark \end{aligned}$$



Another form for a linear equation is **standard form**.
An equation for this line in standard form is $3x - 2y = 8$.

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Try This At Home

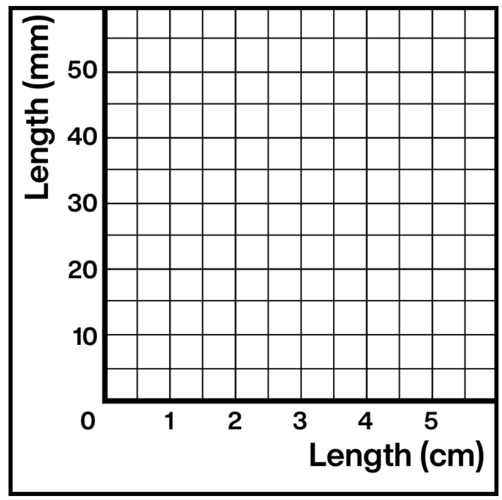
Proportionality

This table shows some lengths measured in centimeters and the equivalent lengths in millimeters.

1.1 Complete the table.

Length (cm)	Length (mm)
1	10
2.5	
4	
	55

1.2 Sketch a graph of the relationship between centimeters and millimeters.



1.3 How would the graph look different if the y-axis were scaled by 10s instead of by 5s?

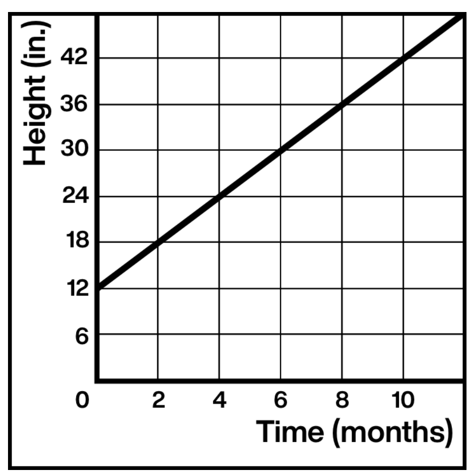
Slope-Intercept Form

This graph shows the height, in inches, of a bamboo plant each month after it was planted.

2.1 What is the slope of this line? What does that value mean in this context?

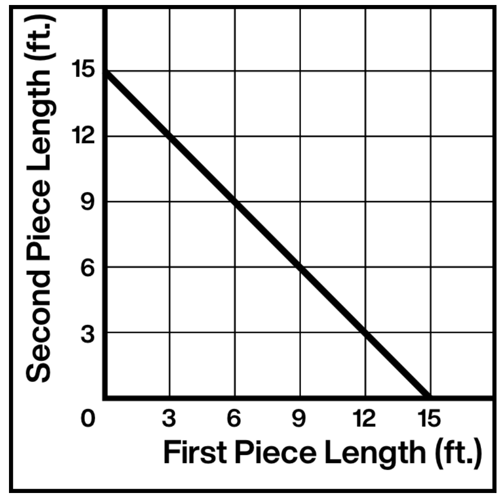
2.2 At what point does the line intersect the y-axis? What does that value mean in this context?

2.3 Write an equation showing the relationship between the two variables. Use x for the time in months and y for the height in inches.



Solutions and Standard Form

A length of ribbon is cut into two pieces. The graph shows the length of the second piece, y, for each possible length of the first piece, x.



3.1 How long is the original ribbon?

Explain how you know.

3.2 What is the slope of the line?

What does it represent?

3.3 List two possible pairs of lengths for the two pieces and explain what they mean.

3.4 Write an equation for the relationship between the length of the first piece (x) and the length of the second piece (y).

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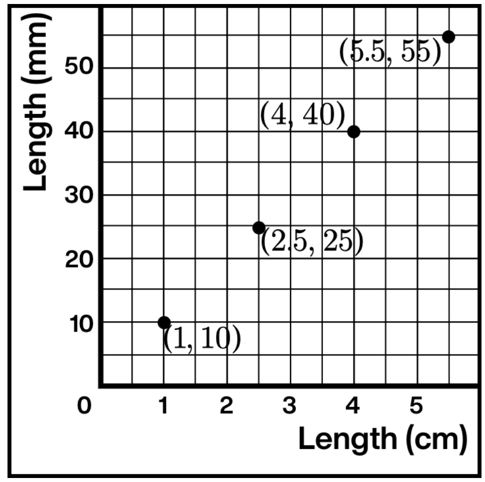
Solutions:

1.1

Length (cm)	Length (mm)
1	10
2.5	25
4	40
5.5	55

1.2



1.3 The graph would look less steep because each point would be twice as close to the x-axis.

2.1 3. Every month that passes, the bamboo plant grows an additional 3 inches.

2.2 $(0, 12)$. This bamboo plant was planted when it was 12 inches tall.

2.3 $y = 3x + 12$

3.1 15 feet. When the first piece is 0 feet long, the second is 15 feet long, so that is the length of the ribbon.

3.2 -1. For each length the first piece increases by, the second piece must decrease by the same length. For example, if we want the first piece to be 1 foot longer, then the second piece must be 1 foot shorter.

3.3 *Responses vary*. Two possible pairs: $(14.5, 0.5)$, which means the first piece is 14.5 feet long, so the second piece is only a half foot long. $(7.5, 7.5)$, which means each piece is 7.5 feet long, so the original ribbon was cut in half.

3.4 $x + y = 15$