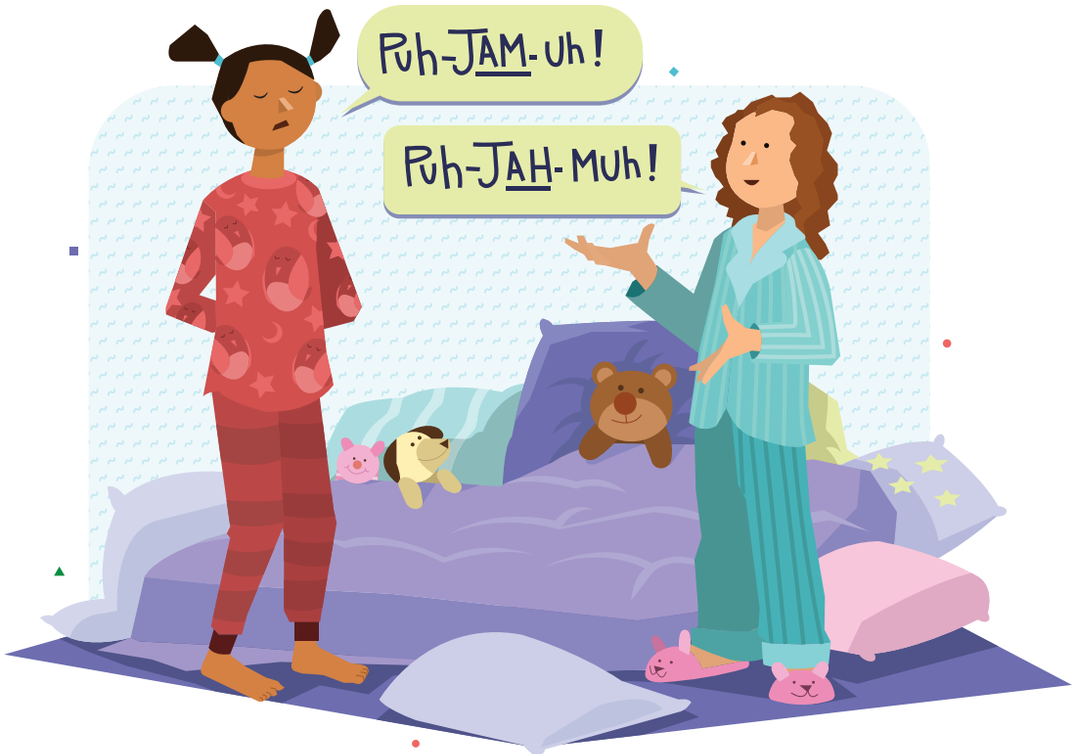
Amplify Math
INDIANA

Grade 7

UNIT 4 | INDIANA LESSON 1A

# Getting Reacquainted With Percentage Problems




FEATURING Amps POWERED BY desmos

# Getting Reacquainted With Percentage Problems

Let's revisit solving problems involving percentages.

## Focus

### Goals

1. Apply reasoning about percentages to solve real-world problems involving percentages.
2. **Language Goal:** Explain the solution methods using multiple representations to solve problems involving percentages. **(Speaking and Listening. Reading and Writing)**
3. Determine what information is needed to solve a problem involving percentages.

## Coherence

### Today

Students return to solving percentage problems in context. They have opportunities to choose representations and ratio strategies seen in Unit 2 and earlier grades that seem appropriate **(MP5)**. Though drawing a double number line is still a good strategy, students may opt for tables or even more abbreviated reasoning methods, such as using algorithms to write and evaluate expressions or equations. The problems students work with show applications of percentages in real-world scenarios, such as reporting data in the media and determining the best deal when presented with a variety of discounting methods **(MP4)**.

### Previously

In Grade 5, students saw that a percentage is a rate per 100. In Grade 6, students reasoned further about percentages and made connections between benchmark fractions, decimals and percentages.

### Coming Soon

In Lesson 2, students will expand on their understanding of whole number percentages to solve problems involving percentages that are not whole numbers.

## Rigor

- Students work with different types of percentage problems to solidify **procedural skills** for determining missing values.
- Students **apply** their understanding of percentages to different real-world scenarios, such as discounted items.

## Standards

### Addressing

**7.C.6**

**Use proportional relationships to solve ratio and percent problems with multiple operations, such as the following:** simple interest, tax, markups, markdowns, gratuities, commissions, fees, conversions within and across measurement systems, **percent increase and decrease,** and percent error.

# Pacing Guide

Suggested Total Lesson Time ~**45 min**

| Warm-up | Activity 1 | Activity 2 | Summary | Exit Ticket |
|---|---|---|---|---|
| 5 min | 10 min | 20 min | 5 min | 5 min |
| Independent | Pairs | Pairs | Whole Class | Independent |
| | MP5 | MP4 | | |
| 6.C.2* | 7.C.6 | 7.C.6 | 7.C.6 | 7.C.6 |

**In this activity, students build on their understanding of multiplying and dividing with fractions and decimals fluently, from Grade 6.*

**Amps** powered by desmos | **Activity and Presentation Slides**

For a digitally interactive experience of this lesson, log in to Amplify Math at learning.amplify.com.

## Practice

Independent

### Materials

- Exit Ticket
- Additional Practice
- Activity 2 PDF (instructions, for display)
- *Prize Cards* PDF, pre-cut cards
- *Double Number Lines: Percentage Problems* PDF (as needed)
- *Percentage Algorithms* PDF
- *Tape Diagrams* PDF (as needed)
- calculators

### Math Language Development

**Review words**

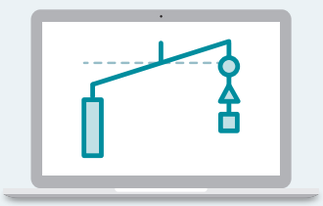
- *percent*
- *percentage*

## Amps | Featured Activity

**Activity 2**

### Digital Diagrams and Representations

Students can choose from a menu of tools to help show their thinking: double number lines, tables, tape diagrams, or free-form sketches.



Amps powered by desmos

### Building Math Identity and Community

Connecting to Mathematical Practices

Throughout these activities, students might be overwhelmed by the process of determining the part, whole, and percentage in each problem, as each quantity may vary in how it is expressed in a verbal description. As students reason about the quantities **(MP2)**, have them take a step back and consider how to motivate themselves to persist. They should think about ways to search for and identify patterns, even when they are not obvious.

### Modifications to Pacing

You may want to consider these additional modifications if you are short on time.

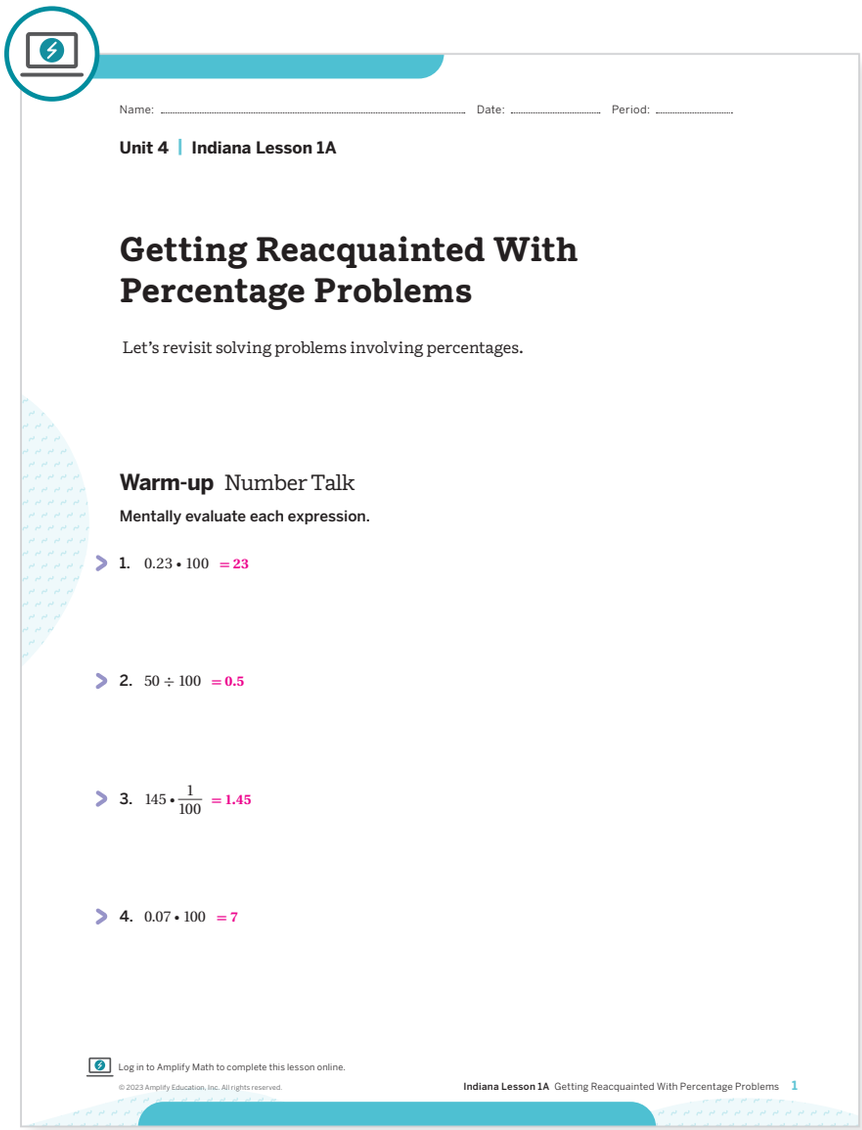
- The **Warm-up** may be omitted.
- In **Activity 1**, do not have students write the headlines. This activity may be done as a whole class, as well.

Independent | 5 min

# Warm-up Number Talk

6.C.2

Students review the connections between place value and multiplication and division by 100 to help with their calculations involving percentages in the rest of the lesson.



Name: Date: Period:

Unit 4 | Indiana Lesson 1A

## Getting Reacquainted With Percentage Problems

Let's revisit solving problems involving percentages.

### Warm-up Number Talk

Mentally evaluate each expression.

1. $0.23 \cdot 100$ $= 23$
2. $50 \div 100$ $= 0.5$
3. $145 \cdot \frac{1}{100}$ $= 1.45$
4. $0.07 \cdot 100$ $= 7$

Log in to Amplify Math to complete this lesson online.





## 1 Launch

Conduct the *Number Talk* routine. Display one problem at a time, keeping previous problems displayed. Give students 30 seconds of think time for each problem.

## 2 Monitor

**Help students get started** by suggesting they check the reasonableness of their answers by asking themselves questions like,"Should the result be greater than or less than the first number in the expression? 100? 1?"

**Look for points of confusion:**

- **"Moving" the decimal point in the wrong direction or the wrong number of places.** Ask, "How do place values change when you multiply/divide by 10?"
- **Using 100 (as in Problem 1) instead of $\frac{1}{100}$ in Problem 3.** Ask, "How is dividing by one hundredth different from dividing by 100?"

**Look for productive strategies:**

- Recognizing and using the relationship between multiplication and division.
- Understanding how place value affects the location of the decimal point when multiplying or dividing by 100.

## 3 Connect

**Have individual students share** their responses, collecting a variety of strategies for each problem.

**Ask:**

- "How is multiplying by $\frac{1}{100}$ related to division?"
- "What is important to remember when dividing a one digit number by 100?"

**Highlight** that, depending on the given information, multiplying and dividing by 100 is often necessary when working with percentages because percentages are a rate per 100.

## Math Language Development

### *MLR8: Discussion Supports*

During the Connect, consider asking these additional probing questions:

- "For which expressions is the result 100 times greater than the first factor or the dividend?" The expressions in Problems 1 and 4.
- "For which expressions is the result 100 times less than the first factor or the dividend?" The expressions in Problems 2 and 3.
- "Will multiplying a value by 100 or by $\frac{1}{100}$ produce a product that is 100 times greater than the value? Multiplying by 100. 100 times less?" Multiplying by $\frac{1}{100}$.
- "Will dividing a value by 100 produce a quotient that is 100 times greater or 100 times less than the original value?" 100 times less.

## Power-up

**To power up students' ability to use 10% and 1% benchmarks to find other percent values, have students complete:**

1. What is 10% of $20.00? $2.00
2. What is 5% of $20.00? $1.00
3. What is 1% of $20.00? $0.20
4. What is 6% of $20.00? $1.20

**Use:** After the Warm-up.

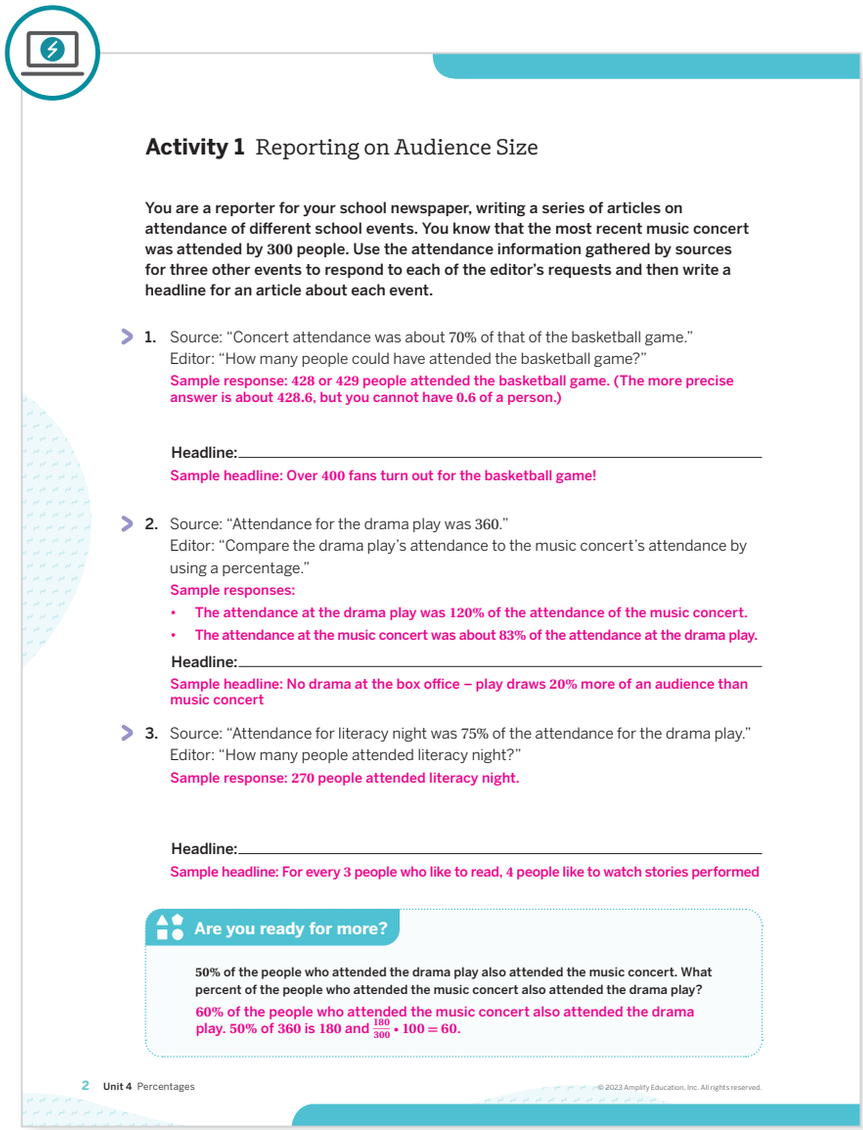
**Informed by:** Performance on Lesson 1, Practice Problem 6

Pairs | 10 min

# Activity 1 Reporting on Audience Size

MP5
7.C.6

Students interpret three scenarios to determine different missing values in percentage problems — part, whole, and percentage.



**Activity 1** Reporting on Audience Size

**You are a reporter for your school newspaper, writing a series of articles on attendance of different school events. You know that the most recent music concert was attended by 300 people. Use the attendance information gathered by sources for three other events to respond to each of the editor's requests and then write a headline for an article about each event.**

1. Source: "Concert attendance was about 70% of that of the basketball game."
Editor: "How many people could have attended the basketball game?"
Sample response: 428 or 429 people attended the basketball game. (The more precise answer is about 428.6, but you cannot have 0.6 of a person.)

Headline: _____
Sample headline: Over 400 fans turn out for the basketball game!

2. Source: "Attendance for the drama play was 360."
Editor: "Compare the drama play's attendance to the music concert's attendance by using a percentage."
Sample responses:
- The attendance at the drama play was 120% of the attendance of the music concert.
- The attendance at the music concert was about 83% of the attendance at the drama play.

Headline: _____
Sample headline: No drama at the box office – play draws 20% more of an audience than music concert

3. Source: "Attendance for literacy night was 75% of the attendance for the drama play."
Editor: "How many people attended literacy night?"
Sample response: 270 people attended literacy night.

Headline: _____
Sample headline: For every 3 people who like to read, 4 people like to watch stories performed

**Are you ready for more?**

50% of the people who attended the drama play also attended the music concert. What percent of the people who attended the music concert also attended the drama play?
60% of the people who attended the music concert also attended the drama play. 50% of 360 is 180 and $\frac{180}{300} \cdot 100 = 60$.

2 Unit 4 Percentages



## 1 Launch

Read through the introduction and Problem 1 as a class. Ask, "Which event had more people in attendance, the concert or the basketball game?" Conduct the *Think-Pair-Share* routine.

## 2 Monitor

**Help students get started** by asking, "What information do you have? What do you need to determine?"

**Look for points of confusion:**

- **Multiplying or dividing values indiscriminately (e.g., 300 • 0.70).** Ask, "Did the concert have more or fewer people than the basketball game? Does your answer match your estimate?"

**Look for productive strategies:**

- Identifying the missing value as a part, whole, or percentage, and applying the proper known representation, expression or algorithm correctly **(MP5)**.
- Recognizing and using benchmark percentages.

## 3 Connect

**Have pairs of students share** their answers and different strategies for each problem, focusing on ratio reasoning, and then allow several pairs to share their headlines, one problem at a time.

**Ask,** "How can it be that attendance at the music concert was 70% and attendance at literacy night was 75%, but more people attended the music concert?"

**Highlight** that each of the three possible missing values to be determined in percentage problems were presented here: Problem 1 — whole, Problem 2 — percentage, and Problem 3 — part. In each case, equivalent ratios could be used, but there are also efficient strategies (or algorithms) to determine each quantity more directly.

## Differentiated Support

### Accessibility: *Vary Demands to Optimize Challenge, Optimize Access to Tools*

The audience size of the music concert could be changed from 300 to 100, which simplifies the dependent calculations from problem to problem, thus making a double number line more accessible. If you choose to alter this value, provide copies of the *Double Number Lines: Percentage Problems* PDF for students to use during the activity.

## Math Language Development

### *MLR7: Compare and Connect*

During the Connect, as students share their strategies, make sure you hear from students with different strategies for each problem. Encourage students to make comparisons and connections between when they are able to use familiar percentages and when they cannot.

### English Learners

Have students refer to the class display to support their use of mathematical language.

Pairs | 20 min

# Activity 2 What's the Better Deal?

**MP4**
**7.C.6**

Students continue to practice determining missing parts, wholes, and percentages in a game show setting involving different types of retail discounts.

**Amps Featured Activity** Digital Diagrams and Representations

Name: ..... Date: ..... Period: .....

**Activity 2** What's the Better Deal?

**You and your partner are contestants on a new game show. In each of four rounds, you will be presented with two options describing different deals on the same item.**

**Your goal is to choose the option that is the better deal. Once you come to a decision together, you must *explain* your choice to the host (while riding a unicycle backwards across a tightrope and juggling blobs of oobleck). The host will then award you a prize card based on your explanation and choice.**

**After you complete all four rounds, your final prize will be revealed!**

| | Option 1 | Option 2 | Which would you choose? |
|---|---|---|---|
| 1. | An item costs \$99.99 at Store A.<br>There is a coupon for 25% off the price of the item.<br>$\$74.99;\ 99.99 \cdot 0.75 = 74.9925$ | The same item costs \$109.99 at Store B.<br>There is a coupon for 30% off the price of the item.<br>$\$76.99;\ 109.99 \cdot 0.7 = 76.993$ | ☑ Store A<br>☐ Store B |
| 2. | An item normally costs \$375, but due to a generous donation from a nearby middle school, the cost is reduced to \$75.<br>What percent is \$75 of the original cost?<br>$\frac{75}{375} \cdot 100 = 20$<br>The reduced cost is 20% of the original cost. | An item costs \$25 at a store.<br>The sale price is \$22.50.<br>What percent is the sale price of the original cost?<br>$\frac{22.5}{25} \cdot 100 = 90$<br>The sale price is 90% of the original cost. | ☑ Price reduction<br>☐ Sale |





## 1 Launch

Reference the first page of the *Activity 2 – Instructions* PDF to explain how each pair will participate in the game show. Have copies of the *Activity 2 – Prize Cards* PDF available to distribute. Calculators may be made available. Before starting the activity, consider asking, "If an item on sale is 30% off, what percent of the normal price would you pay?" 70%

## 2 Monitor

**Help students get started** by asking, "What do you know and what do you need to determine?" Consider also suggesting pairs work with "friendlier" values first to determine a process and then work out the problems with the given values to make their choice.

**Look for points of confusion:**

- **Not identifying what is being solved for.** Ask, "What do you need to determine in this problem: the part, whole, or percentage?"
- **Getting stuck trying to use a double number line.** Refer to the *Percentage Algorithms* PDF.
- **Having trouble understanding and organizing the information given in each problem.** Have students reread the problem and help them organize the information given.
  - » Problem 1: Assuming that the greater percentage off must result in the better deal.
  - » Problem 2: Thinking that the price was reduced *by* \$75 instead of being reduced to \$75.
  - » Problem 3: Forgetting to account for the first full price of the item in Problem 3, Store C, or thinking that 35% off at Store D is for only the second pair.
  - » Problem 4: Comparing just the original prices for a one month supply.

**Activity 2 continued** ›

## Differentiated Support

### Accessibility: *Vary Demands to Optimize Challenge*

Consider rounding dollar amounts, such as \$100 in Problem 1 and \$110 in Problem 2. This will still allow students to participate in the mathematical goal of the activity, but will simplify calculations.

### Accessibility: *Optimize Access to Technology, Optimize Access to Tools*

Have students use the Amps slides for this activity, in which they can select from a menu of digital tools to show their thinking, such as double number lines, tables, tape diagrams, or free-form sketches. If you choose to use the print version for this activity, provide copies of the *Double Number Lines: Percentage Problems and Tape Diagrams* PDF.

## Math Language Development

### *MLR7: Compare and Connect*

During the Connect, as students share how they determined the better deal, ask them to make connections between the various representations.

Ask:

- "Can you think of another way or another representation you can use to verify your response?"
- "Which representation do you think is the most efficient? Why?"
- "Which representation(s) help you visualize the relationships?"

### English Learners

Display and annotate various representations that can be used to determine the better deal for one of the problems.

**Activity 2** What's the Better Deal? (continued)

| | Option 1 | Option 2 | Which would you choose? |
|---|---|---|---|
| 3. | An item costs \$30 at Store C.<br>There is a sale for "Buy 1, Get 1 half off."<br>Two items are bought.<br>$30 + \frac{1}{2} \cdot 30 = 45$<br>Two items cost \$45 | A similar item costs \$32 at Store D.<br>There is a sale for, "Buy two, get 35% off."<br>Two items are bought.<br>$(32 + 32) \cdot \frac{65}{100} = 41.6$<br>Two items cost \$41.6 | ☐ Store C<br>☑ Store D |
| 4. | If a 6-month supply of an item is bought at a store, there is a \$20 mail-in rebate.<br>The price for one month is \$11.33.<br>\$47.98;<br>$6 \cdot 11.33 - 20 = 47.98$ | The online price of one month's supply of the same item is \$19.24.<br>If you buy 6, you receive 50% off.<br>\$57.72;<br>$19.24 \cdot \frac{50}{100} \cdot 6 = 57.72$ | ☑ Mail-in rebate<br>☐ Online |

STOP





**Look for productive strategies:**

- Identifying what is the unknown: the part, whole, or percentage, and choosing a respective algorithm, representation, or applicable ratio reasoning **(MP4)**.
- Recognizing the difference between the percentage off and the percentage paid.
- Using rounding and benchmark values in Problem 1.

## 3 Connect

**Display** the final prize images from the second page of the *Activity 2 – Instructions* PDF.

**Have pairs of students share** first, for the options in each round, "How were you thinking about the meaning of 'a better deal'?" Then have pairs share explanations of their choices, including those that chose the more obvious/correct option and those that made convincing arguments for the other option. Emphasize how students determined their strategy to use based on the information given and the information they were trying to determine, connecting any representations some groups used (such as double number lines or tables) to the expressions, algorithms, or calculations of other groups.

**Highlight** that the representations used up until this point are helpful to visualize the math, but sometimes it is more efficient to use an algorithm.

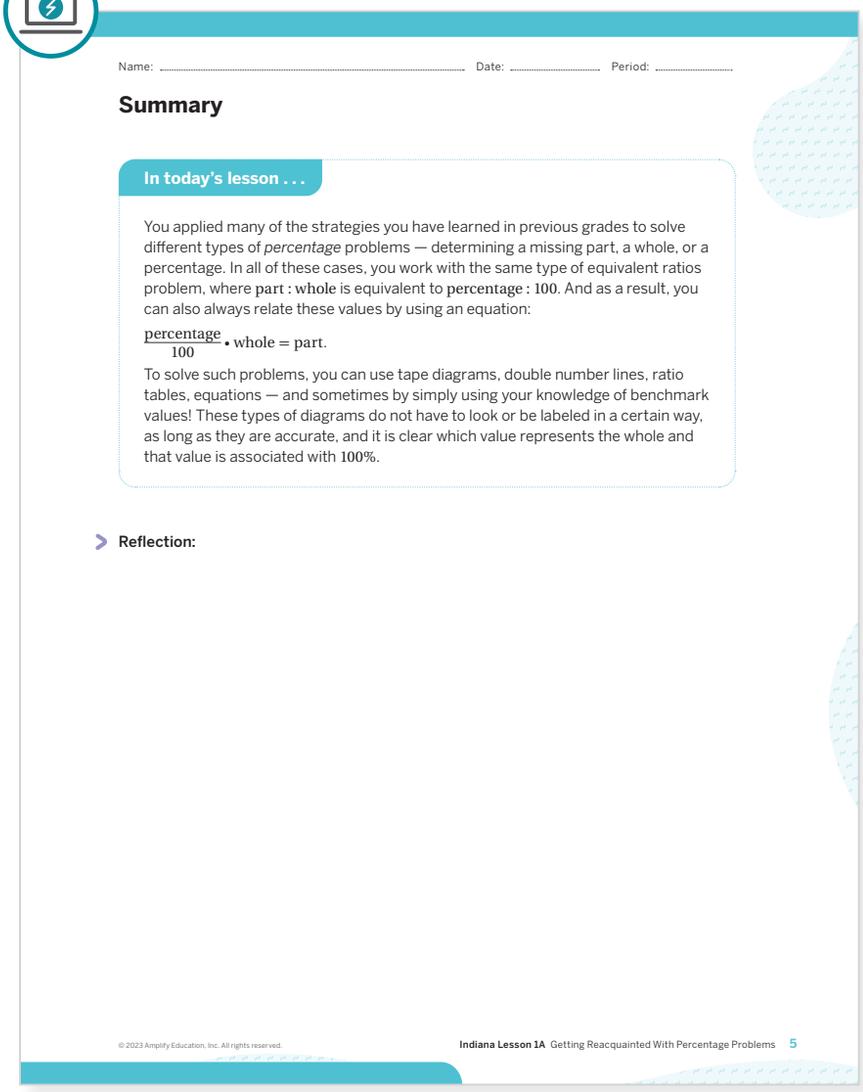
**Ask**, "How is an algorithm connected to the other strategies that can be used to solve percent problems?" An algorithm is usually a shorter, more efficient way of solving the problem, but the steps are similar to the other strategies.

Whole Class | 5 min

# Summary

7.C.6

Review and synthesize strategies used for finding part, whole, and percent in percentage problems.



Name: ..... Date: ..... Period: .....

**Summary**

**In today's lesson . . .**

You applied many of the strategies you have learned in previous grades to solve different types of *percentage* problems — determining a missing part, a whole, or a percentage. In all of these cases, you work with the same type of equivalent ratios problem, where **part : whole** is equivalent to **percentage : 100**. And as a result, you can also always relate these values by using an equation:

$\frac{\text{percentage}}{100} \cdot \text{whole} = \text{part}.$

To solve such problems, you can use tape diagrams, double number lines, ratio tables, equations — and sometimes by simply using your knowledge of benchmark values! These types of diagrams do not have to look or be labeled in a certain way, as long as they are accurate, and it is clear which value represents the whole and that value is associated with 100%.

**Reflection:**





## Synthesize

**Display** the three representations, and also display or reference the *Percentage Algorithms* PDF as needed.

**Ask:**

- "What were some ways you found helpful for identifying missing values in percentage problems?"
- "Looking at the second tape diagram, what is the algorithm you could use to determine the part corresponding to 49% if $x = 60$?"

**Have individual students share** responses to the questions, referencing the diagrams in the Summary and the *Percentage Algorithms* PDF as necessary, and including an expression or equation for the second question such as: $\frac{49}{100} \cdot 60 = part.$

**Highlight** how rates and unit rates per 1 and percentages per 100, are all related by the larger concept of ratios (and specifically equivalent ratios), which was seen in real-world applications in this lesson. These problems have many possible representations, which are all connected to algorithms in some way; and those representations make determining and communicating answers more accessible and clear.

## Reflect

After synthesizing the concepts of the lesson, allow students a few moments for reflection. Encourage them to record any notes in the *Reflection* space provided in the Student Edition. To help them engage in meaningful reflection, consider asking:

- "How did you reason with the problems to determine which algorithm or strategy to use?"

Independent | 5 min

# Exit Ticket

7.C.6

Students demonstrate their understanding of solving percentage problems for missing values by determining sale prices of three items.

Printable

Name: ..... Date: ..... Period: .....

## Exit Ticket 4.1A

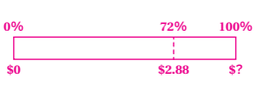
**The marching band is selling three different items at various school events to raise money for new instruments. Since there are 72 members of the marching band, they decided to sell every item for 72% of its regular price. Complete the table. Show or explain your thinking.**

| | Item 1 | Item 2 | Item 3 |
|---|---|---|---|
| Regular price ($) | 1 | 4 | 55 |
| Sale price ($) | 0.72 | 2.88 | 39.60 |

Item 1

$1 \cdot \frac{72}{100} = 0.72$

Item 2




$2.88 \cdot \frac{100}{72} = 4.00$

Item 3


$55 \div 1 = 55$

$0.72 \cdot 55 = 39.60$

**Self-Assess**

1 I don't really get it | 2 I'm starting to get it | 3 I got it

a. I can choose from various representations to help solve problems about percentages. 1 2 3

b. I know how to divide or multiply, or do both, to solve percentage problems involving missing parts, wholes, or percentages. 1 2 3





## Success looks like . . .

1. **Goal:** Applying reasoning about percentages to solve real-world problems involving percentages.
2. **Language Goal:** Explaining the solution methods using multiple representations to solve problems involving percentages. **(Speaking and Listening. Reading and Writing)**
   - Using different strategies to solve the missing prices for different items.
3. **Goal:** Determining what information is needed to solve a problem involving percentages.

## Suggested next steps

- If students use double number lines to solve a problem, consider referring back to the *Percentage Algorithms* PDF. Have students recalculate the problems using those algorithms. As they do, students can describe and connect the steps that are performed to what is happening in the double number lines.
- If students have difficulty identifying the missing value, consider reviewing what the "part" is and what the "whole" is.

## Professional Learning

This professional learning moment is designed to be completed independently or collaboratively with your fellow mathematics educators. Prompts are provided so that you can reflect on this lesson before moving on to the next lesson.

### Points to Ponder . . .

- In earlier lessons, students relied heavily on visual representations to solve percentage problems. How did that support using algorithms in this lesson? Were students able to connect the visual representations to the algorithms?
- What did the interactions during Activity 2 reveal about your students as cooperative learners? How will you use this information to guide future cooperative activities?

# Practice

Independent

Practice

Name: Date: Period:

**1.** Determine each missing value. Show or explain your thinking.

a. 160 is what percent of 40?

400%

Sample responses:

- $\frac{160}{40} \cdot 100 = 400$;
- 100% of 40 is 40, so 200% of 40 is 80, 300% of 40 is 120, and 400% of 40 is 160.

b. 40 is 160% of what number?

25

Sample response: If $x$ is unknown, then $\frac{160}{100} \cdot x = 40$; $x = 25$

c. What number is 40% of 160?

64

Sample response: If $x$ is unknown, then $160 \cdot \frac{40}{100} = x$; $x = 64$

**2.** A store is having a 20%-off sale on all merchandise. If Mai buys one item and saves $13, what was the original price of her purchase? Show or explain your thinking.

$65; Sample response: if $x$ is the original price, then $\frac{20}{100} \cdot x = 13$; $x = 65$

**3.** To determine what number is 40% of 75, Priya calculates $\frac{2}{5} \cdot 75$.

a. Does Priya's calculation give the correct value for 40% of 75? Show or explain your thinking.

Yes, Priya's calculation does give the correct solution; Sample response: When I calculate 40% of 75, the result is 30, and when I calculate Priya's equation, the result is also 30.

b. If $x$ represents a number, does $\frac{2}{5} \cdot x$ always represent 40% of that number? Explain your thinking.

Yes; Sample response: $\frac{2}{5}$ is equivalent to $\frac{40}{100}$, and 40% of $x$ is equal to $\frac{40}{100} \cdot x$.





Practice

Name: Date: Period:

**4.** An ant travels at a constant rate. It can travel 30 cm every 2 minutes.

a. At what rate does the ant travel per centimeter? Show or explain your thinking.

The ant travels $\frac{1}{15}$ minutes per cm; Sample response: $\frac{1}{15}$ minutes is equal to 4 seconds, so you can also say 4 seconds per cm.

b. At what rate does the ant travel per minute?

The ant travels at a rate of 15 cm per minute.

**5.** There are about 4.2 cups in 1 liter, and 16 cups in 1 gallon. Select the expression that gives the number of liters in a gallon.

A. $4.2 \cdot 16$

B. $4.2 \div 16$

C. $16 \cdot 4.2$

D. $16 \div 4.2$

**6.** Select the tape diagram that best represents the following problem.

$7.50 is what percent of $10.00?

A.


B.


C.


D.

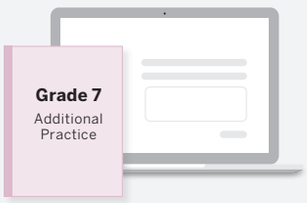





## Practice Problem Analysis

| Type | Problem | Refer to | Standard(s) | DOK |
|---|---|---|---|---|
| On-lesson | 1 | Activity 1 | 7.C.6 | 2 |
| | 2 | Activity 2 | 7.C.6 | 2 |
| | 3 | Activity 2 | 7.C.6 | 2 |
| Spiral | 4 | Unit 2 Lesson 6 | 7.C.5 | 2 |
| | 5 | Unit 1 Lesson 12 | 7.C.6 | 1 |
| Formative | 6 | Unit 4 Lesson 2 | 7.C.6 | 1 |

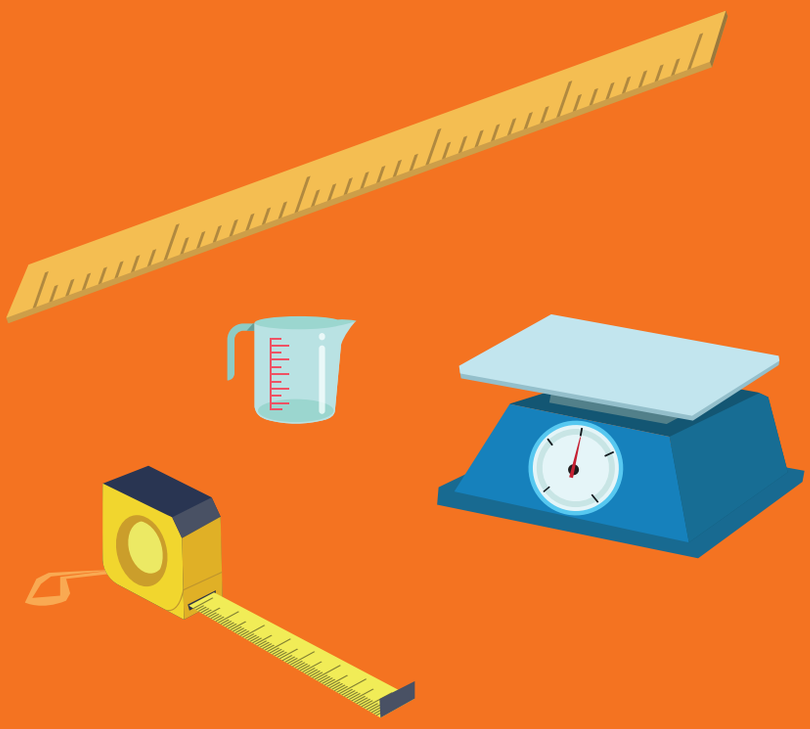
## Additional Practice Available




For students who need additional practice in this lesson, assign the **Grade 7 Additional Practice**.

## My Notes:

# For more information on Amplify Math, visit **indianamath.amplify.com**.



Amplify. desmos



**MA0161**