APPLICATIONS OF PERCENT

In this unit, you will apply the skills you learned about percent. You will look at estimating when exact answers are not necessary. You will learn a new method for solving the three types of percent problems using equations. You will solve many types of problems that are applications of percent such as finding discount and sale price, finding interest on a savings account or interest on a loan, finding the percent of increase or decrease, finding commission, and calculating interest charged for using credit cards. Percent problems are all around you in everyday life. Practice now so that you will become a wise consumer.

Estimating with Percent

Percent Equations

Discounts

Simple Interest

Commission

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Sales Tax

Estimating with Percent

Often times when we use percent, we only need to estimate an answer to have an idea of a value that is close to the actual value. There are many ways to estimate and you may choose different methods or combinations of methods depending on the type of numbers in the problem.

Example 1: Estimate 40% of 876.

1% of 876 is 8.76	$876 \times 0.01 = 8.76$
$8.76 \approx 9$	Round 8.76 to the nearest whole number.
$40 \times 9 = 360$	If 1% is approximately 9, then multiply 9 by 40 to get an estimate of 40% of 876.

40% of $876 \approx 360$

Example 2: Estimate 73% of 589.

73% is about 75% or $\dfrac{3}{4}$. Round the percent to the nearest percent equal to a simple fraction.

$589 \approx 600$ Round 589 to 600 to multiply by $\dfrac{3}{4}$.

$\dfrac{3}{4} \times 600$ $\dfrac{3}{\cancel{4}_1} \times \dfrac{\overset{150}{\cancel{600}}}{1} = 450$

73% of 589 $\approx$ 450

Example 3: When eating out at a restaurant, it is standard to give a tip of 15% for good service. If the family meal costs $43.28, about how much should be left as a tip?

Estimate 15% of $43.28.

$43.28 is about $44 (It is easier to round up to get an even number.)

10% of $44 is $4.40 $\rightarrow$ A quick way to find 10% of a number is to move the decimal point one place to the left of the number; thus, $44 \times 0.10 = 4.4$.

5% of $44 is $2.20   →   5% is half of 10%, therefore, half of $4.40 is $2.20.

10% + 5% = 15%   → $4.40 + $2.20 = $6.60

Thus, a tip that might be left for this meal could be $6.50, $6.60, or $7.00.

Percent Equations

In the previous lesson, you learned how to solve the three types of percent problems using proportions. Now we will examine how they can be solved as equations.

A general equation that is used for percent equations is **P = R · B.**

    P represents **P**ercentage (Part)
    R represents **R**ate,
    B represents **B**ase.

Let's look at how the formula is derived.

$\dfrac{P}{B} = \dfrac{R}{100}$	This is the relationship of *P, R*, and *B* in a proportion.
$\dfrac{P}{B} \cdot B = \dfrac{R}{100} \cdot B$	Multiply both sides of the proportion by B.
$P = \dfrac{R}{100} \cdot B$	Note: $\dfrac{P}{\cancel{B}}_{1} \cdot \dfrac{\cancel{B}^{\,1}}{1} = \dfrac{P}{1} = P$
$P = R \cdot B$	*R* represents the decimal form for $\dfrac{R}{100}$.

Example 1: What is 29% of 83?

Given: **R**: 29% is the rate.   Rate is the *percent* in the problem.

         B: The base is 83.   General rule: the number that
                                     follows "of" is the base.

Find: **P**: This represents the percentage. (Part)

$$P = R \times B$$

What **is** 29% **of** 83?
$$\downarrow \qquad \downarrow \quad \downarrow$$
$$P = 0.29 \times 83 \qquad\qquad 29\% = 0.29$$

$$P = 24.07$$

24.07 is 29% of 83.

Example 2: Forty-five is 60% of what number?

Given: **R**: 60% is the rate.   Rate is the percent in the problem.

         P: The percentage is 45.   Part

Find: **B**: This represents the base.   The unknown base follows "of".

$$P = R \times B$$

45 **is** 60% **of** what number?
$$\downarrow \qquad \downarrow \qquad \downarrow$$
$$45 = 0.6 \times B \qquad\qquad 60\% = 0.60 = 0.6$$

$$\frac{45}{0.6} = \frac{0.6\ B}{0.6} \qquad\qquad$$ Divide both sides of the equation

                                        by 0.6.

$$75 = B$$

45 is 60% of 75.

Example 3: Twelve is what percent of 18?

Given: **P**: The percentage is 12. Part

 B: The base is 18. 18 follows "of".

Find: **R**: This represents the rate. Unknown rate

$$P = R \times B$$

12 **is** R **of** 18?
↓   ↓   ↓
$12 = R \times 18$

$$\frac{12}{18} = \frac{18\,R}{18}$$ Divide both sides of the equation

by 18.

$0.666... = R$

$66.7\% = R$ Multiply by 100 for percent, 66.66
rounds to 66.7.)

$66\frac{2}{3}\% = R$ $0.666... = \dfrac{2}{3}$

12 is $66\frac{2}{3}\%$ of 18.

Work for the division in Example 3.

```
     0.6666              0.66    12/18 = 0.66⅔ = 66⅔%
18)12.0000      or    18)12.00
   108                   108
   120                   120
   108                   108
   120                    12
   108
   120
   108
    12
```

Discounts

A **discount**, or **markdown**, is the amount of money that you save by buying an item at a discounted price, or sale price. To find the discount or markdown when the percent of reduction is given, first express the percent as a decimal and multiply it by the regular price. The result will be the discount amount that will be subtracted from the original price.

Example 1: Annie purchased a sweater at Gaylord's. The regular price was $39.95. The markdown rate was 20%. What was her discount and sale price?

Step 1: Change 20% into **0.20**.

Step 2: Multiply the regular price by 0.20.

$$0.20 \times 39.95 = \textbf{7.99}$$

Step 3: Subtract 7.99 from the original price of 39.95.

$$39.95 - 7.99 = \textbf{\$31.96}$$

Annie paid \$31.96 for her sweater.

Example 2: Lyle went shopping with his mom and found a jacket that was on sale and marked **25% off**. The cost of the jacket was approximately $40.00. He wanted to figure the savings quickly

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Here is how Lyle figured his discount.

From math class, Lyle remembered that 25% can be written as a fraction, $\dfrac{25}{100}$, and then simplifed to $\dfrac{1}{4}$.
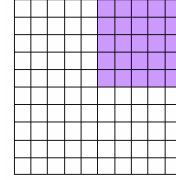
He multiplied $40 $\times \dfrac{1}{4}$ and figured that the discount was $10.

$$\dfrac{1}{4} \text{ of } 40 \;=\; \dfrac{1}{4}\times\dfrac{40}{1} \;=\; \dfrac{1}{\cancel{4}_{1}}\times\dfrac{\overset{10}{\cancel{40}}}{1} \;=\; \dfrac{10}{1} \;=\; 10$$

He subtracted $40 − $10.

Lyle told his mom that the price of the jacket was $30 on sale.

Lyle's mother had a calculator in her purse and decided to check his math. She found the discount another way. She thought of 25% as the decimal, 0.25, and then multiplied by $40.00. She also figured $10 for the discount. Since$10 was a good discount on the jacket and the final price of $30 was reasonable, Lyle took home a new jacket!

$$
\begin{array}{r}
40 \\
\times\ 0.25 \\
\hline
200 \\
80 \\
\hline
10.00
\end{array}
\qquad
\begin{array}{r}
\$40 \\
-10 \\
\hline
\$30
\end{array}
$$

Simple Interest

Calculating interest is a very important application of percent. Interest is used when saving money through a financial institution. Interest is also used when making a car loan or a house mortgage from a bank.

We will look at the simple interest formula that is the basis for more complicated types of interest like compound interest or interest on car loans.

The simple interest formula is $I = p\,r\,t$, where I represents *i*nterest, p represents *p*rincipal, r represents *r*ate, and t represents *t*ime.

> *Example*: Find the interest on $2,500 at an annual interest rate of $6\frac{1}{2}\%$ for 18 months.

When we calculate the interest, rate and time must agree over time. In this problem, since the interest rate is an annual yearly rate, the time must also be expressed in years.

Rate: $\qquad 6\dfrac{1}{2}\% = 6.5\% = 0.065$ (Express as a decimal.)

Time: $\qquad$ 18 months $= \dfrac{18}{12} = 1\dfrac{6}{12} = 1\dfrac{1}{2} = 1.5$ years

$$I = \quad p \quad \cdot \quad r \quad \cdot \quad t$$

$$I = 2500 \cdot 0.065 \cdot 1.5$$

$$I = \$243.75$$

The interest on \$2500 for 18 months at $6\frac{1}{2}\%$ is \$243.75.

Commission

In some jobs, an employee's pay depends on the amount of goods or services the person sells. The salesperson receives a **commission,** or specified amount of money for sales made during a pay period. Commission is usually expressed as a percentage of sales and has the purpose of encouraging salespeople to sell more goods or services. The percent of total sales paid as commission is the **commission rate**.

Example: Mr. Green sells $25,000 worth of computer equipment. His rate of commission is 1.4%. What is his commission on the sale?

Commission = Sales × Commission Rate

Step 1: Change the percent to a decimal.

$$1.4\% = 0.014$$

Step 2: Multiply the sales by 0.014.

$$25,000 \times 0.014 = 350.00$$

Mr. Green's commission on his sales is $350.00.

Percent Change

In our daily living, we see many changes transpire through the years. In the financial world, changes can be charted through percent. We will now look at how to represent changes of increase and changes of decrease in percent.

Percent of change is the ratio of the **amount of change** to **the original amount**.

$$\text{Percent Change} = \frac{\text{Amount of Change}}{\text{Original Amount}}$$

Percent of Increase

Example 1: Union High School's enrollment increased from 525 students last year to 562 students this year. What is the percent of increase in the number of students this year?

Step 1: Subtract to find the amount of change.

$$562 - 525 = 37$$

Step 2: Write a proportion to solve, "37 (change) is what percent of 525 (original enrollment)".

$$\frac{\text{Amount of Change}}{\text{Original Amount}} = \frac{37}{525} = \frac{n}{100}$$

$$\frac{37}{525} = \frac{n}{100}$$

$$525n = 3700$$

$$n = \frac{3700}{525}$$

$$n = 7\% \qquad \text{*Round to the nearest whole percent.}$$

There is a 7% increase in students at Union High School this year.

Percent of Decrease

Example 2: The town population decreased from 4000 to 3350 in the last census year. Find the percent of decrease.

Step 1: Subtract to find the amount of change.

$4000 - 3350 = 650$

Step 2: Write a proportion to solve, "650 (change) is what percent of 4000 (original enrollment)".

$$\frac{\text{Amount of Change}}{\text{Original Amount}} = \frac{650}{4000} = \frac{n}{100}$$

$$\frac{650}{4000} = \frac{n}{100}$$

$$4000n = 65000$$

$$n = \frac{65000}{4000}$$

$$n = 16.25\%$$

There is a 16.25% decrease in the town population.

Sales Tax

When you make a purchase at the store, **sales tax** may be added to the total amount of the purchase. A sales tax is a percentage of the total sales and is collected on behalf of the state, county, or local government. The percentage of sales tax varies between states.

To find the amount of sales tax on your purchase, you will multiply the amount of your purchase by the decimal value of the percent. If you are trying to find the total amount of the purchase, then you want to **add** the sales tax to your purchase amount.

Example 1: Greg purchased a television set for $296.50. How much sales tax did he have to pay if the tax rate was 5%?

Think: 5% = 0.05

Purchase price	$\times$	Rate	=	Sales tax
296.50	$\times$	0.05	=	14.83

Greg will have to pay $14.83 sales tax for his purchase.

Example 2: Amy purchased a computer totaling $598.50 before tax was added. In her state, sales tax is 7%. Determine her final cost.

Step 1: Find the sales tax. (Round to the nearest cent.)

Think: 7% = 0.07

Purchase price	$\times$	Rate	=	Sales tax
598.50	$\times$	0.07	=	**41.90** (41.8950 rounds to 41.90)

Step 2: Find the final cost of the purchase by adding the amount of sales tax to the purchase price.

598.50	+	41.90	=	**$640.40**

Amy's total price for her computer is $640.40.