Fractions, decimals and percents are all ways to divide things up. Fractions can have any number of parts, like a half of a pie, or a sixteenth of an inch. With decimals, everything is based on multiples of ten. Percents measure things only in parts of one hundred.

Literally, "per cent" means "per hundred." Written as a fraction, 1% is $\frac{1}{100}$, one per hundred, or "one hundredth." Written as a decimal, 1% is .01, also "one hundredth."

The difference between fractions, decimals and percents is how the value is formatted. Any fraction can be written as a decimal; any decimal can be written as a percent. Percents are useful in real-life situations because we can use a familiar, standard way to compare quantities.

Convert Between Fractions and Decimals

Remember that a fraction is really a way to show division, and that $\frac{1}{4}$ is the same as 1 ÷ 4. If we solve that division, 1 ÷ 4 = 0.25. That method, dividing the numerator by the denominator, works to convert every fraction to a decimal. Some results may have many decimal places, so we may round to a significant decimal place.

A fraction which has a denominator of 10, or any power of 10, can be converted to decimal format without any division. For example, $\frac{3}{10}$ = .3, and $4\frac{537}{1000}$ = 4.537. Another example, $\frac{2}{5}$ can be easily converted to have a denominator of 10 when it is multiplied by 1 in the form of the fraction $\frac{2}{2}$; $\frac{2}{5} \times \frac{2}{2} = \frac{4}{10}$, which is the same as 0.4, four tenths.

To convert a decimal to a fraction, put the number of the decimal over its complete place value. For example, 0.13 is "thirteen hundredths" which is $\frac{13}{100}$. We usually simplify fractions, so 0.5 is "five tenths" or $\frac{5}{10}$, which can be simplified to $\frac{1}{2}$.

Convert Between Decimals and Percents

The hundredths place value of a decimal is really the "per cent." So for example, 0.13 in decimal format is pronounced "thirteen hundredth." Written as a percent it is 13%.

To show a decimal as a percent: move the decimal two places to the right and add a percent sign. For example, 0.13 = 13%. If a decimal has more places than hundredths, do the same thing: 0.492756 = 49.2756%. (Some sources call this multiplying by 100 and adding the percent sign. Don't be confused. We are not changing the value with multiplication, we are only changing the format.)

To convert a percent to a decimal, reverse the process. Drop the percent sign and move the decimal two places to the left. For example: 87.5% = 0.875.

Convert Between Fractions and Percents

Remember that a percent is a number per hundred, so the fraction's denominator is 100. 49% = $\frac{49}{100}$. If there are decimal places in the percent, the method is not really different. For example, 92.3% = $\frac{92.3}{100}$. However, we don't generally want a mixture of a decimal and a fraction, so we multiply by 1 in the form of fraction with a factor of 10 until the decimal point is eliminated. In this example, $\frac{92.3}{100}$ x $\frac{10}{10}$ = $\frac{923}{1000}$. So, 92.3% is $\frac{923}{1000}$ in fraction format.

Converting a fraction to a percent is like converting to a decimal—divide the numerator by the denominator. Then move the decimal two places to the right and add the percent sign.

Percent of

Common questions are "What is 10% of 32?" and "54 is what percent of 300?"

You will find more information on translating English to Math in Section 10 - Word Problems. However, here is one important translation: "of" means "to multiply".

"10% of 32" means 10% x 32. We can do that calculation in decimal format by multiplying 0.10 x 32 = 3.2. We get the same answer if we perform the calculation with a fraction, using

$\frac{10}{100}$ x $\frac{32}{1}$ = $\frac{320}{100}$ = $3\frac{2}{10}$. Regardless of what format we use, the value is the same.

There are several ways to solve "54 is what percent of 300?" A literal translation of English to Math is: 54 = Y% x 300. If you already have some experience solving for a variable, you know that the next step is to divide both sides of the equation by 300: $\frac{54}{300}$ = Y%. And the last step is to simplify that fraction so the denominator is 100: $\frac{54 \div 3}{300 \div 3}$ = $\frac{18}{100}$. 18 per hundred is 18%, so 54 is 18% of 300.

Another good solution for this kind of problem is to set up a proportion. That method will be covered Section 7 – Ratios and Proportions.

Percent Change

Another common use for percents is to calculate the percentage of change from one value to another. For example, if gasoline costs $2 per gallon this month, and it costs $2.50 per gallon next month, what is the percentage of change?

The formula for a percent change is: $\frac{change}{original}$, or amount of change divided by the original (first) value. To find the "change," subtract the original value from the new value. In this example, that's $2.50 - $2.00, which equals $0.50. That difference, the change, is then divided by the original value, which is $2.00 in this example.

$\frac{.50}{2.00}$ = .25 = 25%. So, there is a 25% increase in price per gallon from one month to the next.

Notice how we state the answer: the price went up, so that was a price increase. If the price had gone down, we would say there was a price decrease. The process is consistent. If the price had decreased from $2.50 to $2.00, when we subtract the original value from the new value, we get $2.00 - $2.50, which is *negative* $.50. (Negative values will be covered in Section 5). The final answer would also be negative, and we would therefore know it was a percent decrease.

Here is another example that is frequently misunderstood. Last year 25% of the students ate hot dogs for lunch; this year 30% of the students ate hot dogs for lunch. What is the percent change in students who ate hot dogs for lunch? People who do not understand percent change might conclude that it is a 5% increase because 30% – 25% = 5%.

But people who do understand percent change will use the formula:

$\frac{change}{original} = \frac{.30 - .25}{.25} = \frac{.05}{.25}$ = .20 = 20%.

There was a 20% increase in students who ate hot dogs for lunch. If you are the person in charge of buying hot dogs, you need to buy 20% more hot dogs, not 5% more!

Practice Problems

Convert the following to decimal format:

1. $\frac{2}{5}$ 2. 56% 3. 100%

Convert the following to fraction format, and simplify if possible:

4. 75% 5. 9.37 6. 90%

Convert the following to percent format:

7. $1\frac{1}{2}$ 8. 0.32756 9. $\frac{2}{5}$

10. What is 15% of 150?

11. 9 is what percent of 36?

12. If the price of something goes from $250 up to $275, what is the percent change?
13. If a county's sales tax goes from 7% to 8%, what is the percent increase, to the nearest percent?
14. How much do you save on a $200 television when you purchase it at a 25% off sale?

Answer Key for Practice Problems

1. 0.4	2. 0.56	3. 1	4. $\frac{3}{4}$	5. $9\frac{37}{100}$	6. $\frac{9}{10}$
7. 150%	8. 32.756%	9. 40%	10. 22.5	11. 25%	12. 10%
13. 14%	14. $50				

Practice Problems Solved with Explanation

1. $\frac{2}{5} \times \frac{2}{2} = \frac{4}{10} = 0.4$ — Decimals are based on multiples of 10. Since the current denominator is 5, which is a factor of 10, we can easily change to a denominator of 10 by multiplying by 1 in the form of $\frac{2}{2}$. The result is four tenths, which is written 0.4.

   OR $2 \div 5 = 0.4$ — Another method is to divide the numerator by the denominator.

2. 56% = .56 — To convert a percent to a decimal, remove the percent sign and move the decimal two places to the left. Remember that 56% is the same as 56 per hundred, or 56 hundredths.

3. 100% = 1 — To convert a percent to a decimal, remove the percent sign and move the decimal two places to the left. 100% = 1.00, or 1.

4. $75\% = \frac{75}{100} = \frac{\cancel{25} \times 3}{\cancel{25} \times 4} = \frac{3}{4}$ — 75% is 75 per hundred. 25 is a factor of both 75 and 100, so we can simplify the fraction to $\frac{3}{4}$.

5. $9.37 = 9\frac{37}{100}$ — Read the decimal correctly, as "nine and 37 hundredths, and it is easy to see that is the same as $9\frac{37}{100}$.

6. $90\% = \frac{90}{100} = \frac{\cancel{10} \times 9}{\cancel{10} \times 10} = \frac{9}{10}$ — 90% is 90 per hundred. 10 is a factor of both 90 and 100, so we can simplify the fraction.

7. $1\frac{1}{2} = 1.5 = 150\%$ — First convert the fraction to a decimal; $1 \div 2 = .5$ and keep the whole number 1. To convert a decimal to a percent, move the decimal two places to the right and add the percent sign. Note that we need to add a 0 as a place value holder.

8. .32756 = 32.756%

To convert a decimal to a percent, move the decimal two places to the right and add the percent sign.

9. $\frac{2}{5}$ = .4 = 40%

2 ÷ 5 = .4. To convert the decimal to a percent, move the decimal two places to the right and add the percent sign. Note that we need to add a 0 as a place holder when we move the decimal.

10. .15 x 150 = 22.5

"Of" means to multiply. We can write "15% of 150" as .15 x 150, changing 15% to the decimal format .15. The result after multiplying is 22.5.

11. 9 = X%(36)
$\frac{9}{36} = X\%$
.25 = X%
25%

Literally "9 is what % of 36" translates as 9 = X%(36). Remember that the parentheses stand for multiplication. Divide both sides by 36; 9 ÷ 36 = .25. Convert to a percent by moving the decimal two places to the right and adding the percent sign. This solution uses some basic techniques for solving equations.

12. $\frac{change}{original} = \frac{275-250}{250} = \frac{25}{250}$ = .10 = 10%

Use the formula "change over original." The change is 275 – 250, and the original price is 250. The result of division is .10, which converts to 10%.

13. $\frac{change}{original} = \frac{.08-.07}{.07} = \frac{.01}{.07}$ = 0.1428 = 14%

The change, in decimal format, is .08 - .07, which is .01. Dividing .01 by .07 gives us 0.1428 (to four decimal places). Converting to a percent by moving the decimal two places to the right and add the percent sign, which is 14.28%. We want to round to the nearest percent, so look at the tenths place, which is 2, less than 5. We therefore keep the 4, and the answer is 14%.

14. .25 x 200 = 50

The 25% off sale means the store will deduct 25% of the original price, which was $200. "Of" means to multiply. In decimal format, .25 x 200 = 50. Therefore, the savings are $50. Note that if the question had asked "how much will we pay" we would deduct $50 from $200: 200 – 50 = 150. We would pay $150.