

## 10.5: Percent

We have to work with money every day. Calculating your monthly expenses, splitting the tab on a restaurant bill, or figuring out how much the tip should be, requires only arithmetic. But when we start saving for the future, planning for retirement, or need a loan, then we need more mathematics.

When one hears the word “percent,” other words come immediately to mind, words such as “century,” “cents,” or “centimeters.” A century equals 100 years. There are one hundred cents in a dollar and there are 100 centimeters in a meter. Thus, it should come as no surprise that percent means “parts per hundred.”

### The Meaning of Percent

In the square shown in Figure 10.5.1, a large square has been partitioned into ten rows of ten little squares in each row. We have shaded 20 of 100 possible little squares, or 20% of the total number of little squares.

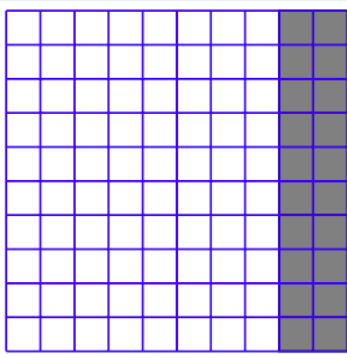


Figure 10.5.1 Shading 20 of 100 little squares, or 20% of the total number of little squares.

Notice in the figure that 80 out of a possible 100 squares are left unshaded. Thus, 80% of the little squares are unshaded. If instead we shaded 35 out of the 100 squares, then 35% of the little squares would be shaded. If we shaded all of the little squares, then 100% of the little squares would be shaded (100 out of 100).

So, when you hear the word “percent,” think “parts per hundred.”

## Changing a Percent to a Fraction

Based on the discussion above, it is fairly straightforward to change a percent to a fraction.

### Percent to Fraction

To change a percent to a fraction, drop the percent sign and put the number over 100.

#### ✓ Example 1

Change 24% to a fraction.

#### **Solution**

Drop the percent symbol and put 24 over 100.

$$\begin{aligned} 24\% &= \frac{24}{100} && \text{Percent: Parts per hundred.} \\ &= \frac{6}{25} && \text{Reduce.} \end{aligned}$$

Hence,  $24\% = 6/25$ .

### ? Exercise

Change 36% to a fraction reduced to lowest terms.

**Answer**

9/25

### ✓ Example 2

Change  $14\frac{2}{7}\%$  to a fraction.

**Solution**

Drop the percent symbol and put  $14\frac{2}{7}$  over 100.

$$\begin{aligned}
 14\frac{2}{7}\% &= \frac{14\frac{2}{7}}{100} && \text{Percent: Parts per hundred.} \\
 &= \frac{\frac{100}{7}}{100} && \text{Mixed to improper fraction.} \\
 &= \frac{100}{7} \cdot \frac{1}{100} && \text{Invert and multiply.} \\
 &= \frac{\cancel{100}}{7} \cdot \frac{1}{\cancel{100}} && \text{Cancel.} \\
 &= \frac{1}{7}
 \end{aligned}$$

Hence,  $14\frac{2}{7}\% = 1/7$ .

### ? Exercise

Change  $11\frac{1}{9}\%$  to a fraction reduced to lowest terms.

**Answer**

1/9

### ✓ Example 3

Change 28.4% to a fraction.

**Solution**

Drop the percent symbol and put 28.4 over 100.

$$\begin{aligned}
 28.4\% &= \frac{28.4}{100} && \text{Percent: Parts per hundred.} \\
 &= \frac{28.4 \cdot 10}{100 \cdot 10} && \text{Multiply numerator and denominator by 10.} \\
 &= \frac{284}{1000} && \text{Multiplying by 10 moves decimal point one place right.} \\
 &= \frac{71 \cdot 4}{250 \cdot 4} && \text{Factor.} \\
 &= \frac{71}{250} && \text{Cancel common factor.}
 \end{aligned}$$

### ? Exercise

Change 87.5% to a fraction reduced to lowest terms.

**Answer**

7/8

## Changing a Percent to a Decimal

To change a percent to a decimal, we need only remember that percent means “parts per hundred.”

### ✓ Example 4

Change 23.25% to a decimal.

**Solution**

Drop the percent symbol and put 23.25 over 100.

$$\begin{aligned} 23.25\% &= \frac{23.25}{100} && \text{Percent: Parts per hundred.} \\ &= 0.2325 && \text{Dividing by 100 moves decimal point 2 places left.} \end{aligned}$$

Therefore,  $23.25\% = 0.2325$ .

### ? Exercise

Change 2.4% to a decimal.

**Answer**

0.024

This last example motivates the following simple rule.

### Percent to a Decimal

To change a percent to a decimal, drop the percent symbol and move the decimal point two places to the left.

### ✓ Example 5

Change  $5\frac{1}{2}\%$  to a decimal.

**Solution**

Note that  $1/2=0.5$ , then move the decimal 2 places to the left.

$$\begin{aligned} 5\frac{1}{2}\% &= 5.5\% && 1/2 = 0.5. \\ &= 0.055 && \text{Drop \% symbol.} \\ &= 0.055 && \text{Move decimal point 2 places left.} \end{aligned}$$

Thus,  $5\frac{1}{2}\% = 0.055$ .

### ? Exercise 10.5.1

Change  $6\frac{3}{4}\%$  to a decimal.

**Answer**

0.0675

## Changing a Decimal to a Percent

Changing a decimal to a percent is the exact opposite of changing a percent to a decimal. In the latter case, we drop the percent symbol and move the decimal point 2 places to the left. The following rule does just the opposite.

### Decimal to a Percent

To change a decimal to a percent, move the decimal point two places to the right and add a percent symbol.

### ✓ Example 6

Change 0.0725 to a percent.

**Solution**

Move the decimal point two places to the right and add a percent symbol.

$$\begin{aligned} 0.0725 &= 007.25\% \\ &= 7.25\% \end{aligned}$$

### ? Exercise

Change 0.0375 to a percent.

**Answer**

3.75%

### ✓ Example 7

Change 1.025 to a percent.

**Solution**

Move the decimal point two places to the right and add a percent symbol.

$$\begin{aligned} 1.025 &= 102.5\% \\ &= 102.5\% \end{aligned}$$

### ? Exercise

Change 0.525 to a percent.

**Answer**

52.5%

## Changing a Fraction to a Percent

One way to proceed is to first change the fraction to a decimal, then change the resulting decimal to a percent.

### Fractions to Percents: Technique #1

To change a fraction to a percent, follow these steps:

1. Divide numerator by the denominator to change the fraction to a decimal.
2. Move the decimal point in the result two places to the right and append a percent symbol.

#### ✓ Example 8

Use Technique #1 to change  $5/8$  to a percent.

##### **Solution**

Change  $5/8$  to a decimal, then change the decimal to a percent.

To change  $5/8$  to a decimal, divide 5 by 8. Since the denominator is a product of twos, the decimal should terminate.

$$\begin{array}{r} 0.625 \\ 8 \overline{)5.000} \\ \underline{48} \phantom{00} \\ 20 \phantom{0} \\ \underline{16} \phantom{0} \\ 40 \\ \underline{40} \\ 0 \end{array}$$

To change 0.625 to a percent, move the decimal point 2 places to the right and append a percent symbol.

$$0.625 = 0.625\% = 62.5\%$$

#### ? Exercise

Change  $5/16$  to a percent.

##### **Answer**

31.35%

A second technique is to create an equivalent fraction with a denominator of 100.

### Fractions to Percents: Technique #2

To change a fraction to a percent, create an equivalent fraction with a denominator of 100.

#### ✓ Example 9

Use Technique #2 to change  $5/8$  to a percent.

##### **Solution**

Create an equivalent fraction for  $5/8$  with a denominator of 100.

$$\frac{5}{8} = \frac{x}{100}$$

Solve this proportion for  $x$ .

$$\begin{aligned}
 8x &= 500 && \text{Cross multiply.} \\
 \frac{8x}{8} &= \frac{500}{8} && \text{Divide both sides by 8.} \\
 x &= \frac{125}{2} && \text{Reduce: Divide numerator and denominator by 4.} \\
 x &= 62.5 && \text{Divide.}
 \end{aligned}$$

Thus,

$$\frac{5}{8} = \frac{62.5}{100} = 62.5\%.$$

### Alternate Ending

We could also change  $125/2$  to a mixed fraction; i.e.,  $125/2 = 62 \frac{1}{2}$ . Then,

$$\frac{5}{8} = \frac{62\frac{1}{2}}{100} = 62\frac{1}{2}\%.$$

Same answer.

### ? Exercise

Change  $4/9$  to a percent.

#### Answer

$$44\frac{4}{9}\%$$

Sometimes we will be content with an approximation.

### ✓ Example 10

Change  $4/13$  to a percent. Round your answer to the nearest tenth of a percent.

#### Solution

We will use Technique #1.

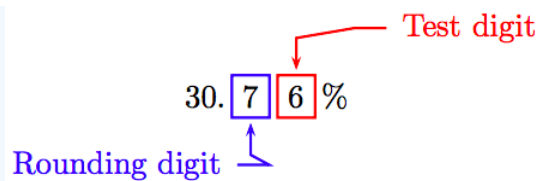
To change  $4/13$  to a decimal, divide 4 by 13. Since the denominator has factors other than 2's and 5's, the decimal will repeat. However, we intend to round to the nearest tenth of a percent, so we will carry the division to four decimal places only. (*Four places are necessary because we will be moving the decimal point two places to the right.*)

$$\begin{array}{r}
 0.625 \\
 8 \overline{)5.000} \\
 \underline{48} \phantom{00} \\
 20 \phantom{00} \\
 \underline{16} \phantom{00} \\
 40 \phantom{00} \\
 \underline{40} \phantom{00} \\
 0
 \end{array}$$

To change the decimal to a percent, move the decimal point two places to the right.

$$0.3076 \approx 0.3076\% \approx 30.76\%$$

To round to the nearest tenth of a percent, identify the rounding and test digits.



Because the test digit is greater than or equal to 5, add 1 to the rounding digit and truncate. Thus,

$$0.03076 \approx 30.8\%.$$

### ? Exercise

Change  $\frac{4}{17}$  to a percent. Round your answer to the nearest tenth of a percent.

#### Answer

23.5%

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