Preparation Guide for Accuplacer Next Generation Arithmetic

George Brown College Assessment Centre

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Whole Number Operations

Adding Whole Numbers

Addition refers to combining sets together. The final number after adding numbers together is called the **sum**.

To add whole numbers, first align the place values. To review, here are the place value settings for whole numbers:

Therefore, this number would read as one hundred and thirty-eight trillion, four hundred and sixty-eight billion, two hundred and eighty-seven million, three hundred and ninety-four thousand, and five hundred and sixty-one.

Let's take a closer look at the most common place values that you will use.

When adding numbers together, line up the place values and then begin combining the columns.

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Example:

Add: 12,432 + 7,629

Step 1

Write the numbers, one on top of the other, with the same place values lined up in columns.

```
   12,432
+   7,629
---------
```

Step 2

Begin adding numbers together, starting on the right-hand side with the ones column.

```
        1
   12,432
+   7,629
---------
        1
```

When we add the nine and the two together, we get eleven. This means that we have a 1 in the ones column and a 1 in the tens column. We are only adding the ones, so we carry the leftover amount from the tens column by writing it above the column.

Step 3

Continue the process by adding the numbers in the tens column, working your way towards the columns on the left. We had a 1 carried over to the tens column from the last step, so we will also include this.

```
       1
   12,432
+   7,629
---------
       61
```

Step 4

Next we move to the hundreds column and add those numbers together. Again, the resulting value exceeds ten, which means that we are left with 0 for the hundreds column and 1 for the thousands column. We re-write the 1 above the thousands column.

```
   1
  12,432
+  7,629
--------
     061
```

Step 5

Repeat the process with the thousands column, resulting in a value of 10. This means that we have 0 left in the thousands column, and the 1 is carried over to the ten thousands column.

```
  1
  12,432
+  7,629
--------
   0,061
```

Step 6

Lastly, add the numbers in the ten thousands column and write the resulting number below. If the number exceeds ten, write the whole number below since there is no place value left to add it to.

```
  1
  12,432
+  7,629
--------
  20,061
```

Subtracting Whole Numbers

Subtraction involves finding the **difference** between two numbers. This often means removing a certain amount from another number.

Example: simple subtraction

Subtract: 239 – 12

Step 1

Write the numbers, one on top of the other, with the same place values lined up in columns.

$$\begin{array}{r} 239 \\ -\quad 12 \\ \hline \end{array}$$

Step 2

Begin subtracting by starting at the ones column, working your way towards the columns to the left.

$$\begin{array}{r} 239 \\ -\quad 12 \\ \hline 7 \end{array}$$

Step 3

Continue subtracting with tens column.

$$\begin{array}{r} 239 \\ -\quad 12 \\ \hline 27 \end{array}$$

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Step 4

Subtract the hundreds column. Note that no number in the bottom column means that there is nothing to subtract, so the number remains the same.

```
   239
-   12
------
   227
```

Example: subtraction with borrowing

Subtract: 231 – 92

Step 1

Write the numbers, one on top of the other, with the same place values lined up in columns.

```
   231
-   92
------
```

Step 2

Begin subtracting by starting at the ones column. Unlike the previous example, we are trying to take away a number that is larger than the original number, and we cannot remove 2 from 1. Instead, we borrow a number from the tens column, changing the ones from 1 to 11. Because we removed 1 from the tens column, we re-write the number in the tens column as 2. Now, we subtract: 11 minus 2.

```
    2 11
   231
-   92
------
     9
```

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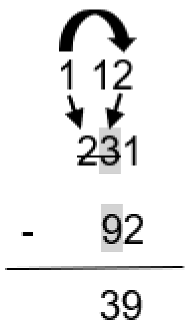
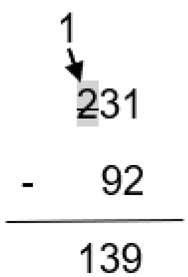
Step 3

Continue subtracting the tens column. After subtracting the ones column, we are left with 2 in the tens column and are trying to subtract 9. Again, we need to borrow a number from the column to the left and adjust the hundreds column from 2 to 1. Add a 1 in front of the number in the tens column. We now have 12 minus 9.



Step 4

Lastly, subtract the hundreds column. Whatever you had previously borrowed needs to be reflected in this step. In this case, we are subtracting 1 minus 0.



Multiplying Whole Numbers

Multiplication is equivalent to the repeated addition of same-size groups a specified number of times. The numbers being multiplied are called **factors** and the resulting answer after multiplying the factors is called the **product**.

Example:

Multiply: 57 X 43

Step 1

Write the numbers with the same place values lined up in columns.

$$\begin{array}{r} 57 \\ \times\ 43 \\ \hline \end{array}$$

Step 2

We will multiply 57 times 43 in stages. We start by multiplying 57 times 3 and will follow that by multiplying 57 times 40.

$$\begin{array}{r} 2 \\ 57 \\ \times\ 43 \\ \hline 1 \end{array}$$

3 times 7 is 21. Write the 1 in the ones column below, and carry the 2 and re-write above the tens column.

$$\begin{array}{r} 2 \\ 57 \\ \times\ 43 \\ \hline 171 \end{array}$$

3 times 5 is 15. There is 2 remaining in the tens column from the previous calculation, so we add this to 15 and re-write 17 on the bottom.

Step 3

Of the number 43, we have multiplied 3 time 57. This leaves 40 that remains to be multiplied by 57.

```
    2
   57
X  43
-----
  171
   80
```

Start by writing a 0 in the ones column, since we are multiplying by 4 tens, and begin multiplying the tens column by 57. 4 times 7 is 28. Write the 8 below and carry the 2 to the next column.

```
    2
   57
X  43
-----
  171
 2280
```

Next, multiply 4 times 5 to get 20, and add the 2 that was carried over to get 22. Since there is no column left to carry over, write the answer below.

```
   57
X  43
-----
  171
 2280
-----
 2451
```

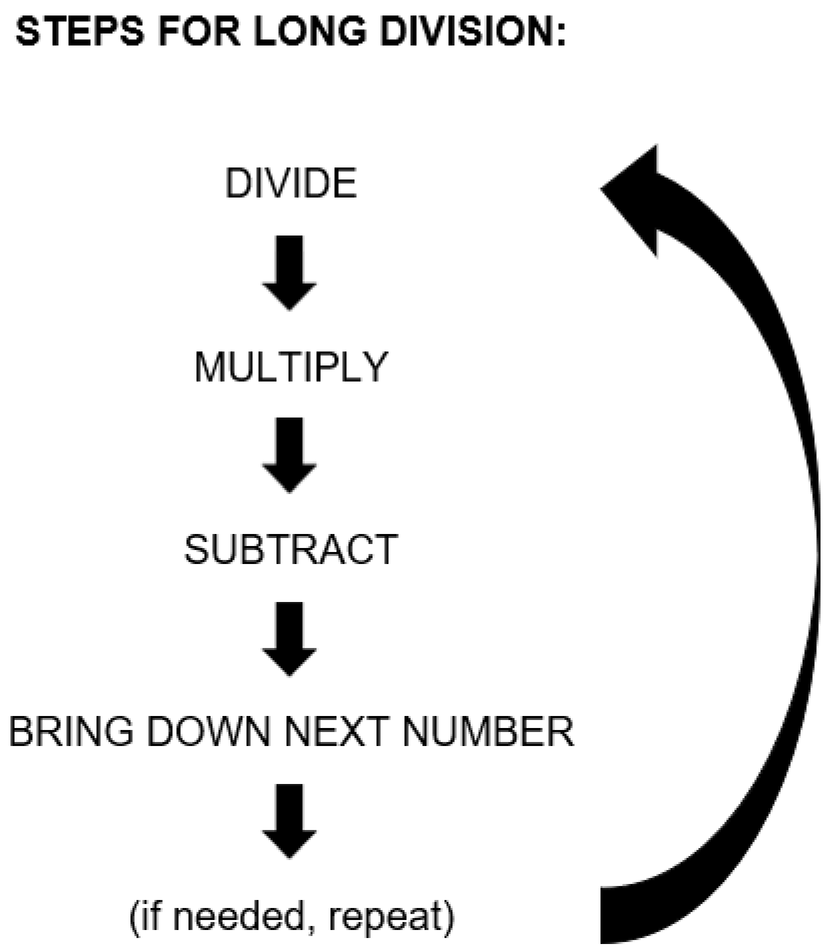
We needed to multiply 43 times 57. We have now multiplied 3 times 57 and 40 times 57. Add these calculations together to receive the final answer.

Dividing Whole Numbers

Division involves breaking up a number into equal-sized groups to determine how many of those equal-sized groups you will have. The resulting answer after dividing is called the **quotient**.

Example:

Divide: $5622 \div 8$



Here is how to set up the question for long division:

$8\overline{)5622}$

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```
     7
8 ) 5622
    56
    --
     2
```

Divide: beginning from the left-hand side of the number under the long division line, called the **dividend**, divide by 8. In this case, 8 cannot go into 5, so we include the next number and see how many times 8 can go into 56 evenly, which is 7 times. Write 7 above the long division line.

Multiply: whatever number you wrote on top of the long division line, use this to multiply your **divisor**, or the number you are dividing by, which in this case, is 8. Write the answer, 56, under the dividend starting from the left.

Subtract: draw a horizontal line to separate your steps, and subtract 56 minus 56. Because 8 goes into 56 equally, we are left with no remainder.

Bring down next number: moving from left to right, after 56 is a 2. Bring this number down and re-write it below the number line.

```
     70
8 ) 5622
    56
    --
     22
```

Repeat the steps: since we are not finished dividing, follow the same process again.

Divide: 8 does not go into 2. Write a 0 on the top.

Multiply: 0 times 8 equals 0, so there is nothing to write below the number line.

Subtract: since the result of the previous step was 0, there is nothing to subtract.

Bring down next number: moving from left to right, the next number to bring down is 2.

```
   702
8 )5622
   56
    22
    16
     6
```

Repeat the steps: since we are not finished dividing, follow the same process again.

Divide: 8 goes into 22 twice. Write a 2 at the top.

Multiply: 2 times 8 equals 16. Write 16 under 22 and draw a horizonal line.

Subtract: 22 minus 16 is 6.

Bring down next number: there are no numbers left to bring down, so the process is complete.

The answer is written at the top of the long division line and the number at the bottom, if there is anything left, is the remainder. In this example, the answer is 702 with a remainder of 6.

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Fraction Operations

Fraction notation illustrates how many pieces of a whole there are, represented as the top number of the fraction or the **numerator**, and how many pieces are in a whole, represented as the bottom number of the fraction or the **denominator**. There are three types of fractions: **proper fractions, improper fractions, and mixed numbers**.

Proper fraction

$$\frac{3}{5}$$

Numerator is smaller than denominator (the decimal equivalent of this number is between 0 and 1)

Improper fraction

$$\frac{6}{4}$$

Numerator is larger than denominator (the decimal equivalent of this number is greater than 1)

Mixed fraction

$$2\frac{1}{5}$$

Whole numbers are written separately beside the proper fraction (the decimal equivalent of this number is greater than 1).

Converting Between Improper Fractions and Mixed Fractions

There will be instances where you need to change the form of the fraction before proceeding with the operation. Let's look at some examples.

Example: converting from a mixed fraction to an improper fraction

$$3\frac{1}{4}$$

Step 1

Multiply the whole number by the denominator.

$3\frac{1}{4}$

$3 \times 4 = 12$

Step 2

Add this value to the number in the numerator and re-write the fraction with the same denominator.

$$\frac{1+12}{4} = \frac{13}{4}$$

Example: converting from an improper fraction to a mixed fraction

$$\frac{14}{3}$$

Step 1

Recall that the denominator represents how many pieces there are in a whole. In this case, the whole consists of three pieces.

Start by taking the top number (numerator) and dividing it by the bottom number (denominator). 3 goes into 14 four times evenly. This means there are 4 whole numbers to be removed from the improper fraction.

Step 2

Multiply the number of whole numbers you removed from Step 1 by the denominator. This gives you the number of individual pieces from the numerator that will be removed.

$4 \times 3 = 12$

Step 3

Find the number of pieces that are still left in the numerator after removing the whole numbers by subtracting the number from Step 2 from the original numerator.

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$14 - 12 = 2$

Step 4

Re-write the number mixed fraction form with the whole numbers listed to the left and the proper fraction beside it on the right.

$$4\frac{2}{3}$$

Adding and Subtracting Fractions

When adding and subtracting fractions, we are adding or subtracting the number of equally sliced pieces.

If the question provides mixed fractions, change them to improper fractions before starting to add or subtract.

There are two types of questions: fractions with the same denominator and fractions with different denominators.

Example: denominators are the same

Step 1:

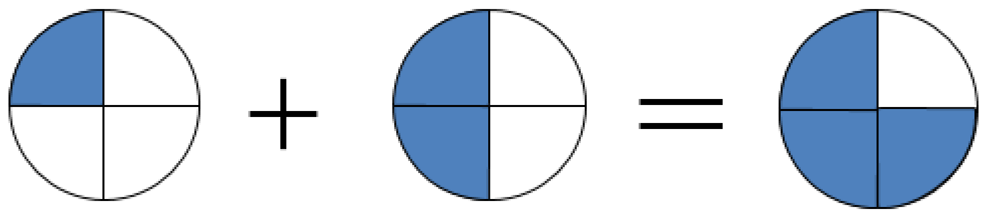
Keep the denominator the same.

Step 2:

Add or subtract the numerators.

Exercise 1: Add the fractions, $\frac{1}{4}+\frac{2}{4}$.
Let's draw a picture to see what this looks like.

The 4 in the denominator tells us that each whole circle is cut into 4 equal portions. By adding the fractions, we are grouping the total number of pieces.



We have **one** out of **four quarters**, $\frac{1}{4}$.

We have **two** out of **four quarters**, $\frac{2}{4}$.

Altogether, we have **3** out of 4 **quarters**, $\frac{3}{4}$.

How does the math work?

Step 1: Since the two fractions have equal sized slices, keep the denominator the same, $\frac{?}{4}$.

Step 2: Add the numerators, $\frac{1}{4} + \frac{2}{4} = \frac{1+2}{4} = \frac{3}{4}$.

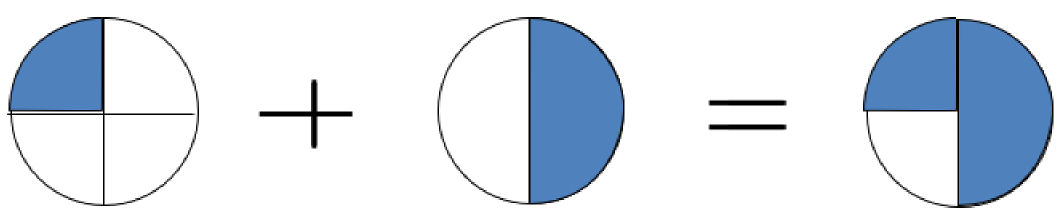
Thus, we have $\frac{3}{4}$ of a whole.

Example: denominators are different

Exercise 2: Add the fractions, $\frac{1}{4}$ and $\frac{1}{2}$.

Let's draw a picture to see what this looks like.

The 4 in the denominator of the first fraction tells us that the whole is cut into 4 equal slices. The 2 in the denominator of the second fraction tells us that the whole is cut into 2 equal slices.



We have **one** out of **four slices**, $\frac{1}{4}$.

We have **one** out of **two slices**, $\frac{1}{2}$.

Altogether, we have two slices that vary in size.

Can we add these two fractions together?

Since fractions are made up of equal sized slices, we can't have one slice smaller than another.

Note: We can only add or subtract fractions if their **denominators** are the **same.** If not, we must create equal sized slices by finding a **common denominator**.

Finding a Common Denominator

Step 1:

Find the Lowest Common Multiple (LCM) between the denominators of the given fractions.

Step 2:

Multiply the numerator and denominator of each fraction by a number so that they have the LCM as their new denominator. This process is called creating **equivalent fractions**.

Exercise 3: Add the two fractions, $\frac{1}{2} + \frac{1}{4}$.

Step 1: List the multiples of 2 and 4.
Multiples of 2: 2, **4**, 6, 8, 10…
Multiples of 4: **4**, 8, 12, 16…

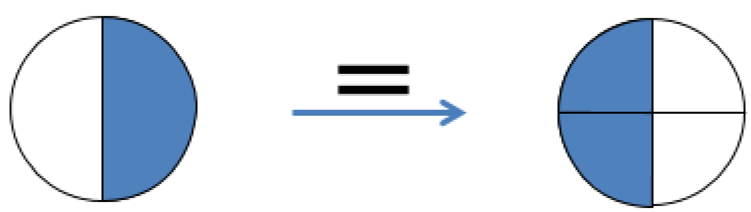
Note that 2 and 8 are multiples of 4 and 2 BUT 2 is the Lowest Common Multiple.

Step 2: a) We need to find a number that when multiplied to the top and bottom of $\frac{1}{2}$, we get the LCM (4) as the new denominator.

$$\frac{1\times ?}{2\times ?} = \frac{?}{4}$$

Since $2 \times \mathbf{2} = 4$, we need to multiply the numerator and the denominator by **2**.

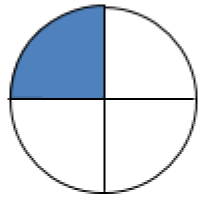
$$\frac{1\times \mathbf{2}}{2\times \mathbf{2}} = \frac{\mathbf{2}}{\mathbf{4}}$$

$\frac{1}{2}$  $\frac{2}{4}$

Notice that, $\frac{1}{2} = \frac{2}{4}$ since they share the same amount of shaded area. Hence, we created an **equivalent fraction**.

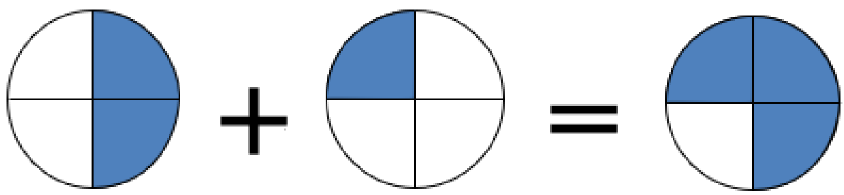
b) Looking at the second fraction, $\frac{1}{4}$, we notice that the LCM (4) is already in the denominator. Thus, we leave the fraction as it is.

$\frac{1}{4}$



Step 3: Now that our wholes are cut into equal sized slices, we can add their numerators just as we did in **Case 1**.

Thus, in total we have, $\frac{2}{4} + \frac{1}{4} = \frac{2+1}{4} = \frac{3}{4}$ of a whole.



$$\frac{2}{4} \quad + \quad \frac{1}{4} \quad = \quad \frac{3}{4}$$

Exercise 4: Find a common denominator between the two fractions, $\frac{2}{3}$ and $\frac{1}{4}$ in order to create equivalent fractions.

Step 1: List the multiples of 3 and 4.
Multiples of 3: 3, 6, 9, **12,** 15, 18, 21, **24**…
Multiples of 4: 4, 8, **12,** 16, 20, **24,** 28…

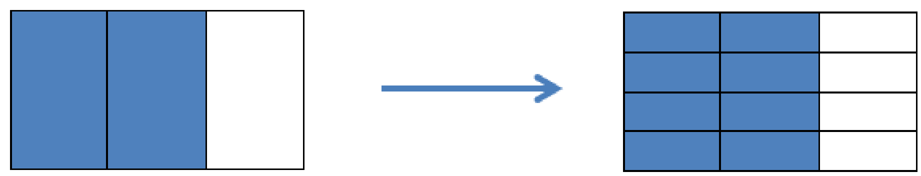
Note that 12 and 24 are multiples of 3 and 4 BUT 12 is the **Lowest Common Multiple**.

Step 2: a) We need to find a number that when multiplied to the top and bottom of $\frac{2}{3}$, we get the LCM (12) as the new denominator.

$$\frac{2 \times ?}{3 \times ?} = \frac{?}{12}$$

Since $\times\ \mathbf{4} = \mathbf{12}$, we need to multiply the numerator and the denominator by 4.

$$\frac{\mathbf{2} \times \mathbf{4}}{\mathbf{3} \times \mathbf{4}} = \frac{\mathbf{8}}{\mathbf{12}}$$

$\frac{2}{3}$  $\frac{8}{12}$

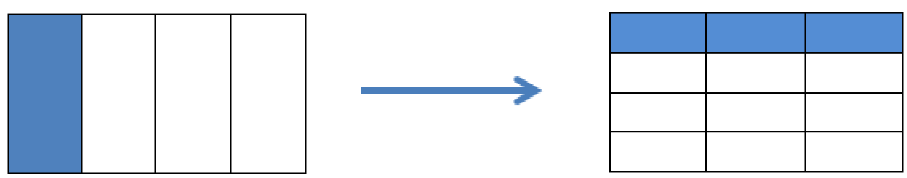
Notice that, $\frac{2}{3} = \frac{8}{12}$ since they share the same amount of shaded area.

$$\frac{1 \times ?}{4 \times ?} = \frac{?}{12}$$

Since $4 \times 3 = 12$, we need to multiply the numerator and the denominator by **3**.

$$\frac{1 \times 3}{4 \times 3} = \frac{3}{12}$$

b) Now, we need to find a number that when multiplied to the top and bottom of $\frac{1}{4}$, we get the LCM (12) as the new denominator.

$\frac{1}{4}$  $\frac{3}{12}$

Notice that, $\frac{1}{4} = \frac{3}{12}$ since they share the same amount of shaded area.

Thus, our **equivalent fractions** are $\frac{2}{3} = \frac{8}{12}$ and $\frac{1}{4} = \frac{3}{12}$.

Exercise 5: Using our findings from Exercise 4, add the two fractions, $\frac{2}{3}$ **and** $\frac{1}{4}$ **.**

In Exercise 3, we learned that $\frac{2}{3} = \frac{8}{12}$ and $\frac{1}{4} = \frac{3}{12}$ **.**

Since our fractions now have equal sized slices, we can add their numerators just as we did in **Case 1**.

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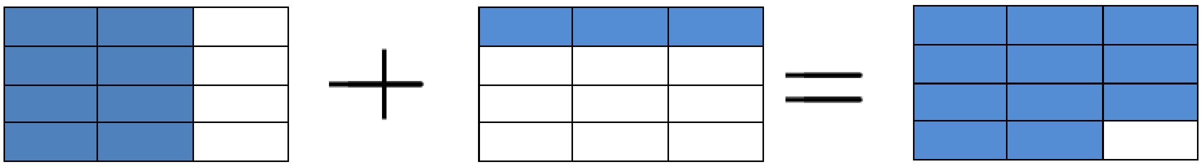

$\frac{8}{12}$ $\frac{3}{12}$ $\frac{11}{12}$

Thus, in total we have, $\frac{8}{12} + \frac{3}{12} = \frac{8+3}{12} = \frac{\mathbf{11}}{\mathbf{12}}$ of a whole.

Exercise 6: Perform subtraction on the following fractions, $\frac{1}{4} - \frac{1}{5}$.

Step 1: List the multiples of 4 and 5.

Multiples of 4: 4, 8, 12, 16, **20**, 24, 28…
Multiples of 5: 5, 10, 15, **20**, 25, 30…

The Lowest Common Multiple between 4 and 5 is **20**.

Step 2: a) We need to find a number that when multiplied to the top and bottom of $\frac{\mathbf{1}}{\mathbf{4}}$, we get the LCM (20) as the new denominator.

$$\frac{1 \times ?}{4 \times ?} = \frac{?}{20}$$

Since $4 \times \mathbf{5} = 20$, we need to multiply the numerator and the denominator by **5.**

$$\frac{1 \times \mathbf{5}}{4 \times \mathbf{5}} = \frac{\mathbf{5}}{\mathbf{20}}$$

Thus, $\frac{5}{20}$ is equivalent to $\frac{1}{4}$.

b) We need to find a number that when multiplied to the top and bottom of $\frac{\mathbf{1}}{\mathbf{5}}$, we get the LCM (20) as the new denominator.

$$\frac{1 \times ?}{5 \times ?} = \frac{?}{20}$$

Since $5 \times \mathbf{4} = 20$, we need to multiply the numerator and the denominator by 4.

$$\frac{1 \times \mathbf{4}}{5 \times \mathbf{4}} = \frac{\mathbf{4}}{\mathbf{20}}$$

Thus, $\frac{1}{5}$ is equivalent to $\frac{4}{20}$.

Step 3: Since our fractions now have equal sized slices, we can subtract their numerators just as we did in **Case 1**.

Thus, we now have,

$$\frac{5}{20} - \frac{4}{20} = \frac{5-4}{20} = \frac{1}{20}$$

of a whole.

Multiplying Fractions

Multiplying fractions has fewer steps than adding and subtracting fractions, as there is no need to find a common denominator.

Example:

Multiply:

$$\frac{2}{3}\ X\ \frac{1}{5}$$

Step 1

Check if the fractions are written in proper or improper form. If they are, continue to Step 2. If a fraction in the question is illustrated in mixed fraction form, convert it to an improper fraction and then proceed to Step 2.

Step 2

Multiply the numerators and re-write the total. 2 times 1 is 2.

$$\frac{2}{3}\ X\ \frac{1}{5} = \frac{2}{\square}$$

Step 3

Multiply the denominators and re-write the total. 3 times 5 is 15.

$$\frac{2}{3}\ X\ \frac{1}{5} = \frac{2}{15}$$

Step 4

If possible, reduce the fraction to its lowest form. This means that we are trying to create an equivalent fraction by removing multiples that are common in both the numerator and the denominator. In this example, there is no number that we can divide 2 by that also divides into fifteen, so the answer is already in its reduced form.

Dividing Fractions

The process for dividing fractions is the like the process of multiplying fractions.

Example:

Divide:

$$\frac{2}{3} \div \frac{4}{5}$$

Step 1

Check if the fractions are written in proper or improper form. If they are, continue to Step 2. If a fraction in the question is illustrated in mixed fraction form, convert it to an improper fraction and then proceed to Step 2.

Step 2

This step is the step that differs from the process of multiplying fractions. To divide fractions, take the second fraction, flip it, and then multiply the fractions.

$$\frac{2}{3} X \frac{5}{4}$$

Note that the second fraction read 4 over 5 before. Reversing the numerator and denominator, it now reads 5 over 4.

Remember to change the division symbol to a multiplication symbol at the same time as you are flipping your second fraction.

Step 3

Following the rest of the multiplication steps, now we multiply the numerators.

$$\frac{2}{3} X \frac{5}{4} = \frac{10}{\square}$$

Step 4

Next, multiply the denominators.

$$\frac{2}{3}\ X\ \frac{5}{4} = \frac{10}{12}$$

Step 5

Reduce the fraction to its lowest form. In this case, 2 is the largest multiple that we can divide both 10 and 12 by. After removing a factor of 2 from the numerator, and removing a factor of 2 from the denominator, re-write the answer.

$$\frac{10 \div 2}{12 \div 2}$$

$$= \frac{5}{6}$$

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Decimal Operations

Like fractions, decimals are another notation that can be used to illustrate a portion of a whole number. Let's look at the place values for decimal numbers.

The number to the left of the decimal point is the number of whole numbers, while the values to the right of the decimal point represent a fraction of a whole number. Using whole numbers and fraction notation, the number above is equivalent to:

$$5 + \frac{3}{10} + \frac{7}{100} + \frac{1}{1000} + \frac{2}{10{,}000} + \frac{4}{100{,}000}$$

Adding and Subtracting Decimals

When adding or subtracting, whether the numbers include decimals or not, line up the place value columns and decimal points before starting. Add/subtract using the same process as the one for whole numbers, being careful to record the decimal point exactly where it aligns in the place value columns for the final answer.

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Example:

Add: $122.2 + 76.89$

Step 1

Write the numbers, one on top of the other, with the same place values lined up in columns. Note that 122.2 does not have a value in the hundredths column; anything after the final number in the tenths column is assumed to be a zero. To align the columns properly, it may be easier to add a zero to 122.2 so it reads as 122.20 before adding the numbers.

$$\begin{array}{r} 122.20 \\ +\ \ 76.89 \\ \hline \end{array}$$

Step 2

Begin adding numbers together, starting on the right-hand side with the hundredths column, recording the answer below.

$$\begin{array}{r} 122.20 \\ +\ \ 76.89 \\ \hline 9 \end{array}$$

Step 3

Continue the process by adding the numbers in the tenths column, working your way towards the columns on the left.

```
     1
 122.20
+ 76.89
-------
    .09
```

When we add the two and the eight together, we get ten. This means that we have 10 tenths, so we record the zero below the tenths column, re-write the decimal place, and carry the leftover 1 to the ones column by writing it above.

Step 4

Next we move to the ones column and add those numbers together.

```
     1
 122.20
+ 76.89
-------
   9.09
```

Step 5

Repeat the process with the tens column.

```
 122.20
+ 76.89
-------
  99.09
```

Step 6

Lastly, add the numbers in the hundreds column and write the resulting number(s) below. Recall that if there is no number in a hundreds column, it is the same thing as adding zero. Once finished adding all the place values, this is your final answer.

```
 122.20
+ 76.89
-------
 199.09
```

Multiplying Decimals

The process for multiplying whole numbers, illustrated earlier, is very similar to multiplying decimal numbers.

Let's look at an example using similar numbers as the whole number example, but this time, the numbers will include decimals.

Example:

Multiply: 5.7 X 0.43

Step 1

Count and record the number of decimal places present. You will need this information at the end.

5.7 = 1 decimal point

0.43 = 2 decimal points

Therefore, there is a total of **3 decimal points**.

Step 2

Remove the decimals and write the numbers as whole numbers with the same place values lined up in columns.

```
    57
X   43
------
```

Step 3

Multiply the numbers the same way you would with whole numbers. To start, we will multiply 57 times 3.

$$\begin{array}{r} {}^{2} \\ 57 \\ \times \; 43 \\ \hline 1 \end{array}$$

3 times 7 is 21. Write the 1 in the ones column below, and carry the 2 to re-write above the tens column.

$$\begin{array}{r} {}^{2} \\ 57 \\ \times \; 43 \\ \hline 171 \end{array}$$

3 times 5 is 15. There is 2 remaining in the tens column from the previous calculation, so we add this to 15 and re-write 17 on the bottom.

Step 4

Of the number 43, we have multiplied 3 time 57. This leaves 40 that remains to be multiplied by 57.

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```
    2
   57
X  43
-----
  171
   80
```

Start by writing a 0 in the ones column, since we are multiplying by 4 tens, and begin multiplying the tens column by 57. 4 times 7 is 28. Write the 8 below and carry the 2 to the next column.

```
    2
   57
X  43
-----
  171
 2280
```

Next, multiply 4 times 5 to get 20, and add the 2 that was carried over to get 22. Since there is no column left to carry over, write the answer below.

```
   57
X  43
-----
  171
 2280
-----
 2451
```

We have now multiplied 3 times 57 and 40 times 57. Add these calculations together to receive the total.

Step 5

Lastly, using the information collected in Step 1, insert the correct number of decimal places into the answer. The initial question contained 3 decimal places, so the answer will include 3 decimal places, as well.

Recall that the decimal point is to the right of the whole number, if it is not shown.

$= 2.451$

Dividing Decimals

Dividing decimal numbers is very similar to dividing whole numbers, with a few extra steps.

Let’s look at an example using similar numbers as the whole number example, but this time, the numbers will include decimals.

Example:

Divide: $56.24 \div 0.8$

Setting Up Long Division for Decimal Numbers

One strategy to avoid misplacing the decimal place during division is to remove the decimals before dividing. This can be accomplished by creating an equivalent expression. Recall that a fraction line means division, so the following expressions mean the exact same thing:

$$1 \div 5 = \frac{1}{5}$$

Let’s re-write the example question in fraction notation:

$$\frac{56.24}{0.8}$$

To clear the decimals from this fraction, we will need to determine how much we should multiply both the numerator and the denominator by in order to receive whole numbers. This always occurs in factors of 10, 100, 1000, etc..

In this case, 56.24 has the greatest number of decimal places, so the minimum amount we would need to multiply both the top and the bottom of the fraction by in order to remove the decimals would be 100.

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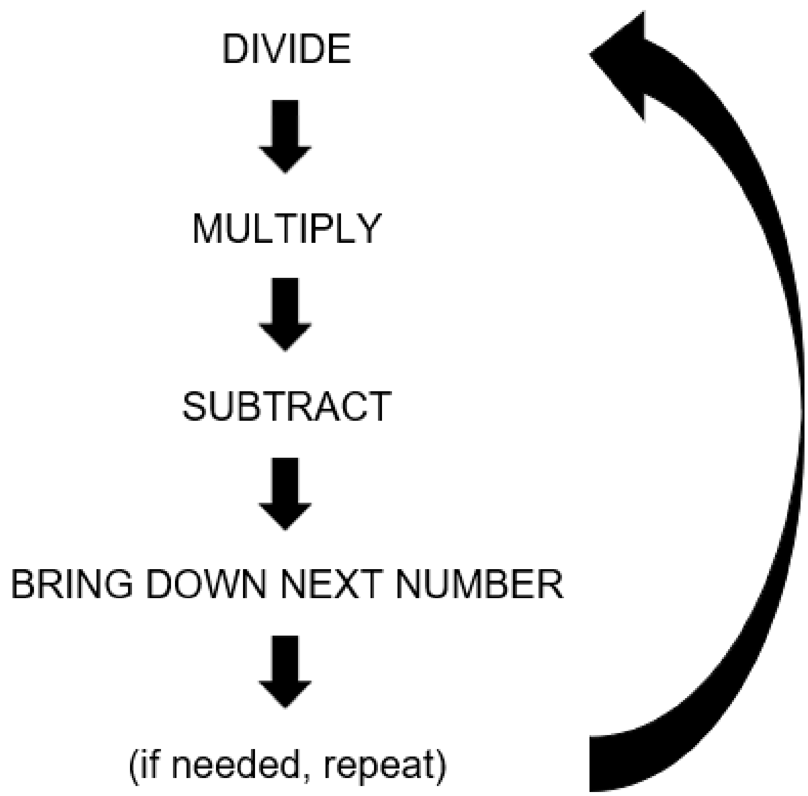
$$\frac{56.24}{0.8}\frac{X\,100}{X\,100}=\frac{5624}{80}$$

We now have created an equivalent fraction with whole numbers. Proceed with the same steps for division as we used earlier for whole numbers.

To start, set up the numbers for long division and then follow the steps for long division, as before.

$$80\,\overline{)\,5624}$$

STEPS FOR LONG DIVISION:



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```
       7
80 ) 5624
     560
     ----
       24
```

Divide: beginning from the left-hand side of the number under the long division line, divide by 80. In this case, 80 cannot go into 5 or 56, but it can go into 562 seven times evenly. Write 7 above the long division line.

Multiply: whatever number you wrote on top of the long division line, use this to multiply the number you are dividing by, which in this case, is 80. 7 times 80 is 560. Record this number under the dividend starting from the left.

Subtract: draw a horizontal line to separate your steps. Subtract 562 minus 560.

Bring down next number: moving from left to right, after 562 is a 4. Bring this number down and re-write it below the number line.

```
       70.
80 ) 5624.00
     56
     -----
       240
```

Repeat the steps: since we are not finished dividing, follow the same process again.

Divide: 80 does not go into 24. Write a 0 on the top.

Multiply: 0 times 80 equals 0, so there is nothing to write below the number line.

Subtract: since the result of the previous step was 0, there is nothing to subtract.

Bring down next number: when there are no numbers left in the dividend and there are still numbers left to divide, write the decimal point to the right of the dividend and add a couple of zeros. 5624.00 is the same as 5624, but it allows us to use the zeros to "bring down next number". Remember to record the decimal point on top of the long division sign too. Then, bring down a 0.

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```
       70.3
80 ) 5624.00
     56
       240
       240
         0
```

Repeat the steps: since we are not finished dividing, follow the same process again.

Divide: 80 goes into 240 three times. Write a 3 at the top.

Multiply: 3 times 80 equals 240. Write under 22 and draw a horizonal line.

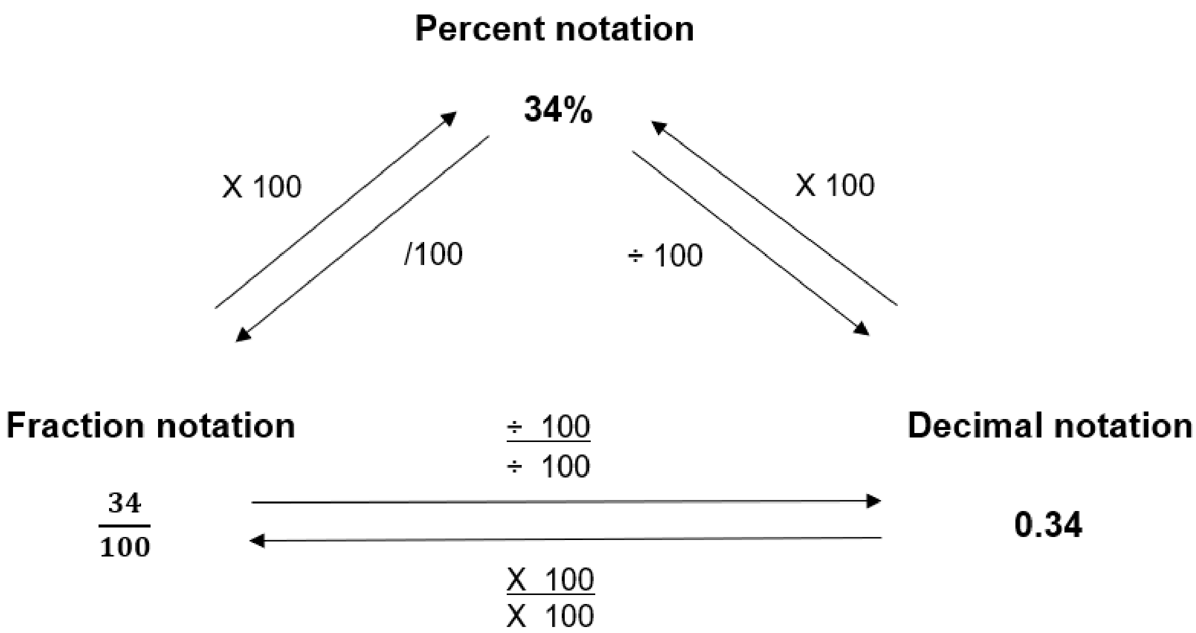
Subtract: draw a horizontal line to separate your steps and subtract 240 minus 240, which is zero.

Bring down next number: there are no numbers left to divide, so the process is complete.

The answer is written at the top of the long division line and the number at the bottom, if there is anything left, is the remainder. In this example, the answer is 70.3 and no remainder.

Percentage Operations

Percentages are one way to illustrate a proportion, which is a certain amount in relation to a whole. Percentages can be displayed in three different forms: percent notation, fraction notation, or decimal notation. We are able to convert between the different notations by following the processes indicated beside the arrows listed below:



Solving Questions Using Percent

To solve questions involving percent, it’s important to note that you must use decimal notation or fraction notation when using the percentage value. Your answer will be incorrect if you insert a number in percent notation, so make sure you convert the percentage to either decimal or fraction notation before performing the calculation.

To help decipher how to solve a percentage problem, we can use the following terms as a legend:

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OF means multiply

WHAT means a variable

IS means an equal sign

% means percent,
represented in percent notation

Any number provided in the question is re-written in the equation as that same number.

Example:

What is 10% of 123?

Step 1

Translate the question to an equation using the legend provided above.

What	is	10%	of	123?
↓	↓	↓	↓	↓
a	=	10%	X	123

Step 2

Recall that the answer will be incorrect if we use the value of 10 for the percent; we must first convert 10% from percent notation to decimal or fraction notation before doing the calculation.

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To convert from percent notation to decimal notation, divide by 100.

$$10 \div 100 = 0.1$$

Step 3

Now that the equation is set up to include the percent value expressed in decimal notation, solve the question by finding the missing variable.

$$a = 0.1 \times 123$$
$$= 12.3$$

Solving Questions With Percent Increase or Percent Decrease

Percent increases and decreases are commonly used within industries when selling products and services.

An example of a percent increase is when a product's original price becomes higher, whereas an example of a percent decrease would be when the product's original price becomes lower.

To solve a question about percent increase, find the percent increase value and add it to the original amount.

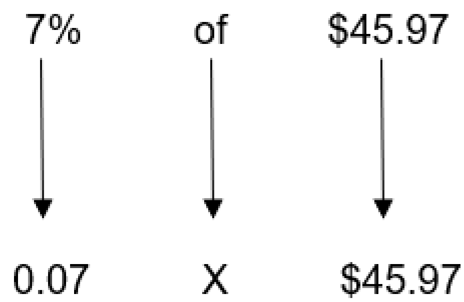
To solve a question about percent decrease, find the percent decrease value and subtract it from the original amount.

Example: percent increase

Last year's model of a certain product was $45.97. The company revised the product with updates and would like to charge a percent increase of 7%. Find the final price of the product.

Step 1

Using the legend from the previous example, translate 7% of $45.97 into a mathematical expression.



Step 2

Solve the calculation.

0.07 x $45.97 = $3.22

Step 3

Find the total amount for the latest product by adding the value of the seven percent increase to the original value of the product.

$45.97 + $3.22 = $49.19

Therefore, the total price for the new product is $49.19.

Example: percent decrease

A customer buys a new car for $29 450. One year later, the customer wants to sell the car and is told that the total value has decreased by 20%. What should be the listing price of the one-year-old car?

Step 1

Using the legend, translate 20% of $29 450 into a mathematical expression.

20% of $29 450

0.2 X $29 450

Step 2

Solve the calculation.

0.2 x $29 450 = $5 890

Step 3

Find the total amount for the latest product by subtracting the value of the twenty percent increase from the original value of the product.

$29 450 - $5 890 = $23 560

Therefore, the total price for the new product is $23 560.

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Number Comparisons and Equivalents

For numbers with the same mathematical values, they can be written using different notations, such as percent notation, decimal notation, and fraction notation. We examined how to convert between these different forms in previous examples.

For numbers with different mathematical values, they can be compared or ranked in a few different ways, including using inequality signs and number lines. Let's look at an example of each.

Example: comparing numbers using inequality signs

Recall the following list of inequality signs and their corresponding meaning:

$\geq$	greater than or equal to
$>$	greater than
$\leq$	less than or equal to
$<$	less than

The inequality signs are used in between numbers to illustrate the difference in values.

Compare the numbers 0.18 and $\frac{1}{5}$ using inequality signs.

Step 1

Right now, the numbers are listed in different notations. In order to compare them, they must first be converted to the same notation. If using fraction notation, the fractions also need to have the same denominator (bottom number). Let's use fraction notation.

$$0.18\,X\,\frac{100}{100} = \frac{18}{100}$$

We know from converting percentages that to convert from decimal notation to fraction notation we need to multiply by 100 over 100.

$$\frac{1}{5} X \frac{20}{20} = \frac{20}{100}$$

For the fraction of 1 over 5, we can convert this to a fraction with a common denominator of 100 by multiplying by 20 over 20.

Step 2

Now that the numbers are written in the same notations with the same denominators, we can see that 1 over 5 is a bigger number than 0.18 since 20 over 100 is bigger than 18 over 100.

The open part of an inequality sign always faces the bigger number, while the pointed part of the inequality sign points towards the smaller number. If the numbers are different, which they are, we will use the greater than or less than symbol since the numbers are not equivalent.

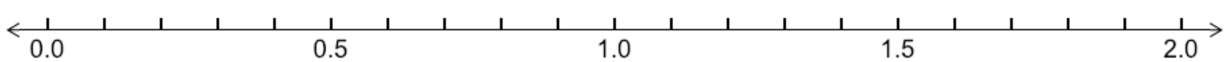
$$0.18 < \frac{1}{5}$$

$$\frac{1}{5} > 0.18$$

Either of the statements above are correct. They are read from left to right. The first statement reads 0.18 is less than 1 over 5, and the second one reads 1 over 5 is greater than 0.18.

Example: comparing numbers using a number line

Another way to illustrate the differences between numbers is to plot them on a number line, with values generally written from smallest to largest as you read the number line from left to right.



Compare the numbers 0.18 and $\frac{1}{5}$ by plotting them on the number line.

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Step 1

Convert the numbers to the same notation. This is akin to comparing apples to apples instead of apples to oranges. This time let’s use decimal notation since it will be easier to plot the values on the number line.

Note that these are the same numbers from the previous question, so we already calculated the following:

$$\frac{1}{5} X \frac{20}{20} = \frac{20}{100}$$

To change from fraction notation to decimal notation, divide the fraction.

$$20 \div 100 = 0.2$$

Step 2

Plot the values on the number line. Recall that 1 over 5 is equal to 0.2.