HEALTHCARE CAREER READINESS PROGRAM

FAST TRACK TO SUCCESS

SADDLEBACK COLLEGE

MATH MODULES

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Preface

These math modules were constructed to support a rapid review of important mathematical skills necessary for recent high school graduates planning to pursue a career in the healthcare field here at Saddleback College. The content within this text assumes students require only a refresher course on many of the topics that are covered in a robust pre-algebra course.

The topics addressed in this text were chosen on the basis of student performance on a 20 minute pre-assessment written exam administered to the students prior to the start of this two week readiness program. Each module is designed for a 1 hour and 15 minute class time.

The modules have homework sets embedded within the lecture material to allow lecturing faculty to work some of the exercises upon completion of an objective. Secondly, introducing homework in this manner, will encourage students to read the text, rather than passing over the content and simply browse for homework exercises that are traditionally placed at the end of a section. Additionally, review exercises are included at the end of each module to remind students of past topics from previous high school math courses not addressed in this text.

There are several online resources designed to support these modules which include video content and unique smart pen documents.

The Algebra2go Team
1.1 Digits and Place Value

**1. Understand Digits and Place Value**

Digits are mathematical symbols that are arranged in a specific order to represent numeric values. There are ten different digits in our number system. They are listed below.

```
0 1 2 3 4 5 6 7 8 9
```

We use these ten digits (or ten symbols) to create numbers by placing them in a specific order. It is the position of each digit within a number that determines its place value. One digit alone can also represent a number. A single digit that represents a number is said to be in the ones place value position.

To assist us in determining place value, we use commas to separate *periods* of a number, and also use a decimal point to define the location of the ones place. The ones place is just to the left of the decimal point. When writing down whole numbers we normally do not write down the decimal point. In this case it is understood that the digit furthest to the right, or rightmost place, is in the ones place.

We will now look at a whole number with four full periods. The name of each period as well as the place value of each digit is labeled. Can you see a pattern in the diagram below?

Next we have a number that has digits to the right of the decimal point. Be sure to again look for a pattern by imagining the ones place as the middle of the number.

Can you see the pattern that is mirrored about the ones place? Once we learn how to identify the place value of digits, we then can learn how to read and write numbers properly.
Example 1: Write down the place value of the digit 4 in the following numbers. Use the place value diagrams on the previous page to help find the answer.

a) 114,235  The four is in the one-thousands place.
b) 2,297,465  The four is in the hundreds place.
c) 0.0004  The four is in the ten-thousandths place.
d) 10.259843  The four is in the hundred-thousandths place.
e) 0.1030804  The four is in the ten-millionths place.
f) 4,250,006,258  The four is in the one-billions place.

2. Understand How to Read and Write Whole Numbers

Knowing place values as well as knowing how the periods of a number are ordered, enables us to read and write whole numbers correctly.

When writing whole numbers using words, we always include the period(s) in our word statement with exception of the ones period. The diagram below will help us write the number 2,015,325 using words. Pay close attention to the numbers within each period and how the commas are used in the word statement below.

```
2, 0 1 5, 3 2 5.
```

Two million, fifteen thousand, three hundred twenty-five.

In the sentence above, notice how the commas break up the sentence to define the periods. Note that the ones period is excluded. Also, notice that we do not use the word “and” when writing down whole numbers using words. The word “and” is used to connect the decimal (or fractional) parts to the whole number. This will be addressed later in this section.

Now let’s write the number 11,982,050,307 using words.

```
1 1, 9 8 2, 0 5 0, 3 0 7.
```

Eleven billion, nine hundred eighty-two million, fifty thousand, three hundred seven.

Once again, notice how the commas break up the sentence to define the periods. Also, notice that the ones period is again excluded from the word statement.
3. Understand How to Read and Write Decimal Numbers Less Than 1.

Next we will learn how to correctly read and write decimal numbers less than 1. Let’s begin with 0.053 which represents a number less than 1.

To write a decimal number less than 1 using words, we first need to define the place value of the digit furthest to the right. In the number 0.053, the digit 3 is in the rightmost place. Using our place value pattern, we can see that the digit 3 is in the one-thousandths place.

\[
0.0\ 5\ 3
\]

Next, we write down the number to the right of the decimal point. In this case we have the number 53. Because the 53 terminates in the one-thousandths place, it means we have “fifty-three one-thousandths”. So we write this number using words as follows.

\textbf{Fifty-three one-thousandths}.

Recall that a decimal number represents a fraction. Therefore we can express 0.053 as \(\frac{53}{1,000}\) and both are written using words as “fifty-three one-thousandths”. Notice that the numerator of the fraction \(\frac{53}{1,000}\) is represented by the numeric value to the right of the decimal point.

\textbf{Note:} In many cases it is acceptable to write down “fifty-three thousandths” rather than “fifty-three one-thousandths”. Check with your instructor to see if this is acceptable.

Now let’s try the number 0.01089 which is again a number less than 1.

\[
0.0\ 1\ 0\ 8\ 9
\]

In this case, the number to the right of the decimal point is 1089 and it terminates in the hundred-thousandths place. Notice that the digit 9 is in the rightmost place. This means we have “one thousand eighty-nine hundred-thousandths”.

Therefore we can express 0.01089 as \(\frac{1,089}{100,000}\) and write the number using words as follows.

\textbf{One thousand eighty-nine hundred-thousandths}.
Module 1: Digits, Place Value, and Reading and Writing Numbers

Example 2: Write each of the following numbers using words.

a) 52,003  
Fifty-two thousand, three.

b) 907,000  
Nine hundred seven thousand.

c) 84,000,250  
Eighty-four million, two hundred fifty.

d) 108,581,609,004  
One hundred eight billion, five hundred eighty-one million, six hundred nine thousand, four.

e) 0.9  
Nine tenths.

f) 0.085  
Eighty-five one-thousandths.

g) 0.0030  
Thirty ten-thousandths.

h) 0.00000406  
Four hundred six hundred-millionths.

Notice in parts a) – d), the numbers given are whole numbers.

Remember, when writing whole numbers using words, we always include the period(s) in our word statement with exception of the ones period.

a) 5,200  
Notice we have 52 in the thousands period, and 3 in the ones period.
Fifty-two thousand, three.

b) 907,000  
Notice we have 907 in the thousands period.
Nine hundred seven thousand.

c) 84,000,250  
Here we have 84 in the millions period, and 250 in the ones period.
Eighty-four million, two hundred fifty.

d) 108,581,609,004  
Here we have 108 in the billions period, 581 in the millions period, 609 in the thousands period, and 4 in the ones period.
One hundred eight billion, five hundred eighty-one million, six hundred nine thousand, four.

Notice in parts e) – h), the numbers are less than 1.

To write a decimal number less than 1 using words, we first write down the numeric value to the right of the decimal point, followed by the place value of the rightmost digit.

e) 0.9  
Here we have the number 9 to the right of the decimal point and it is in tenths place.
Nine tenths.

f) 0.085  
Here we have the number 85 to the right of the decimal point. The 5 is the rightmost digit and it is in the one-thousandths place.
Eighty-five one-thousandths.

g) 0.0030  
Here we have the number 30 to the right of the decimal point. The 0 is the rightmost digit and it is in the ten-thousandths place.
Thirty ten-thousandths.

h) 0.00000406  
Here we have the number 406 to the right of the decimal point. The 6 is the rightmost digit and it is in the hundred-millionths place.
Four hundred six hundred-millionths.
Answer the following questions.

1) Write down the place value of the digit 7 in the following numbers.
   a) 947,025 e) 0.007000
   b) 306.007 f) 0.065070
   c) 580.85670 g) 9.871324
   d) 657,289,634 h) 6.0578238

2) Using the number below, identify the digit in the given place value.
   20,546,318.72968467
   a) one-millions
   b) ten-millionths
   c) one-thousandths
   d) hundred-thousands
   e) hundreds
   f) hundredths
   g) one-millionths
   h) ten-thousands

3) Write each of the following numbers using words.
   a) 500,009
   b) 0.0018
   c) 456,800
   d) 0.00507
   e) 13,000,060,105
   f) 0.08060

4) Write each of the following numbers using digits.
   a) Seventy-five one-thousandths.
   b) One hundred eight million.
   c) Sixteen ten-millionths.
   d) Thirty-three thousand.
   e) Four million, six-hundred seventy-five.
   f) Ninety million, two thousand, one hundred four.

4. Understand How to Read and Write Numbers

The number 125.87 has a whole number part and a decimal (or fractional) part. The whole number part represents a quantity that is greater than 1, and the decimal part represents a quantity that is less than 1.

The whole part of the number 125.87 is 125 and is read “one hundred twenty-five”. The decimal part of the number is .87 and is read “eighty-seven hundredths”. The decimal point is used to connect the whole number part to the decimal (or fractional) part by addition. This means that the number 125.87 actually represents a mixed number!

\[
125.87 = 125 + .87 = 125 + \frac{87}{100} = 125 \frac{87}{100}
\]

Recall that the mixed number format represents a sum of a whole number part and a fractional part.

To write the number 125.87 using words, we first write down the whole number part. Next, we use the word “and” to connect the whole number part to the decimal (or fractional) part.

\[
125.87 \downarrow
\]

One hundred twenty-five and eighty-seven hundredths.
Suppose we are given the number 1,002.0050 which again has both a whole number part and a decimal (or fractional) part. The whole number part is 1,002 and is written “one thousand, two”. The decimal part of the number is .0050 and is written “fifty ten-thousandths”.

As before, to write the number 1,002.0050 using words, we first write down the whole number part. Next, we use the word “and” to connect the decimal (or fractional) part.

\[
1,002.0050 \quad \downarrow \quad \text{One thousand, two and fifty ten-thousandths.}
\]

When we need to write out a check, we must always indicate the dollar amount in two forms. First we write the number using digits, and second we write the number using words.

**Example 3: In the appropriate space, write in the dollar amount of the check using words.**

The dollar amount of the check is 1,834.18 which has both a whole number part and a decimal (or fractional) part. To fill in the indicated dollar amount using words, we write the following words on the dollar amount line in the check above.

\[
1,834.18 \quad \downarrow \quad \text{One thousand, eight hundred thirty-four and eighteen hundredths}
\]

It is also acceptable to write the decimal part as a fraction.

\[
1,834.18 \quad \downarrow \quad \text{One thousand, eight hundred thirty-four and } \frac{18}{100}
\]
Now we will look at how to write a number using digits given a word statement. We will begin with a whole number. The word statement we will work with is written below.

Fifty billion, three thousand, twenty-one.

Notice that a \textit{millions} period is not present in the word statement above. When writing the number using digits, the \textit{millions} period must be included. To represent the \textit{millions} period in this case, we place three 0’s within this period. The result is represented in the diagram below.

\begin{itemize}
  \item \textbf{Fifty billion, three thousand, twenty-one.}
  \item \begin{equation}
      5\,0,000,003,021.
  \end{equation}
\end{itemize}

Observe the three 0’s in the \textit{millions} period. These zeros are required in order to represent the number “fifty billion, three thousand, twenty one” correctly.

Additionally, notice that there are always three digits between any two commas. In the case of the \textit{ones} period, always remember that it must contain three digits before you begin entering digits in the \textit{thousands} period.

Next we will deal with a number that contains both a whole number part and a decimal part.

Suppose we are asked to write “three hundred two thousand, twenty and two hundred one ten-thousandths” using digits. The diagram below represents the result.

\begin{itemize}
  \item \textbf{Three hundred two thousand, twenty and two hundred one ten-thousandths.}
  \item \begin{equation}
      3\,020.0201
  \end{equation}
\end{itemize}

Notice that the digits 3, 0, and 2, are in the \textit{thousands} period. This represents “three hundred two thousand”. In the \textit{ones} period are the digits 0, 2, and 0, which represent twenty.

To the right of the decimal point are the digits 0, 2, 0, and 1. Because the digit 1 is the rightmost digit and is located in the \textit{ten-thousandths} place, the decimal part .0201 represents “two-hundred one ten-thousandths”. We can also say that 201 terminates in the ten-thousandths place.
Module 1: Digits, Place Value, and Reading and Writing Numbers

Example 4: Write each of the following numbers using digits.

a) Three hundred one.
   301 Here we have 301 in the ones period.

b) One thousand and fifty-four hundredths.
   1,000.54 Here we have 1 in the thousands period, three 0's in the ones period, and to the right of the decimal point, 54 terminates in the hundredths place.

c) Two thousand, thirteen and eighty-seven one-thousandths.
   2,013.087 Here we have 2 in the thousands period, 13 in the ones period, and to the right of the decimal point, 87 terminates in the one-thousandths place.

d) Six hundred ninety-three billion, nine thousand and six one-millionths.
   693,000,009,000.000006 Here we have 693 in the billions period, three 0's in the millions period, 9 in the thousands period, three 0's in the ones period, and to the right of the decimal point, 6 is in the one-millionths place.

For Exercises 5 – 10, write each of the numbers using words.

5) 687.05
6) 1,000.001
7) 32,870,051.369
8) 50,000,090.0030
9) 304,000,000,000
10) 0.000050801

For Exercises 11 – 16, write the number using digits.

11) Three and five hundredths.
12) Sixteen ten-thousandths.
13) Four million and one one-thousandth.
14) Two hundred-thousandths.
15) Nine thousand and nine hundred hundred-thousandths.
16) Thirty-two thousand, eight hundred one-millionth.

Review Exercises

Evaluate the expression.

17) 9 − 5 + 4
18) 4 − 8 + 2
19) 3 − (−2 − 4)
20) |7 − 11| − 2^2
21) −3^2
22) (−3)^2
23) −(−5)^2
24) −|−6|^2

For Exercises 25 – 28, find the value of each expression if x = 3 and y = −2.

25) 3 − x − y
26) x^2 + y^2
27) \frac{3 + y^3}{5 − x^2}
28) \frac{x}{2y} − \frac{2y}{x}
2.1 Review of Fractions

1. Understand Fractions on a Number Line

Fractions are used to represent quantities between the whole numbers on a number line. A ruler or tape measure is basically a number line that has both whole numbers and fractions represented on their labels. When measuring objects with a ruler, an essential skill is to be able to read off measurements of length that involve mixed number representations such as $3\frac{1}{8}$ inches. To develop this skill, we will first look at some number lines with different fractional representations.

These number lines can be used to help us visually understand the meaning of equivalent fractions and the concept of basic mathematical operations with fractions. Additionally, they can help us master the skill of reading off measures using a variety of measuring scales.

Let’s first discuss the meaning of equivalent fractions. Equivalent fractions have the same location on the number line. Since $\frac{3}{8}$ and $\frac{6}{16}$ have the same location on the number line, they are considered to be equivalent fractions. You may recall that the fraction $\frac{6}{16}$ can be reduced by dividing both the numerator and denominator by the common factor of 2. Doing so results in the fraction $\frac{3}{8}$. 
Module 2: Working with Fractions and Mixed Numbers

Suppose you are asked to evaluate the expression \( \frac{1}{3} + \frac{1}{4} + \frac{1}{6} \). You may recall, in order to add fractions, they must all be written with the same denominator. These fractions can each be re-written as an equivalent fraction with a denominator of 12.

Using our fraction number lines, we can see that \( \frac{1}{3} \) is equivalent to \( \frac{4}{12} \), \( \frac{1}{4} \) is equivalent to \( \frac{3}{12} \), and \( \frac{1}{6} \) is equivalent to \( \frac{2}{12} \).

We can now evaluate the expression by replacing each fraction with its equivalent fraction.

\[
\frac{1}{3} + \frac{1}{4} + \frac{1}{6} = \frac{4}{12} + \frac{3}{12} + \frac{2}{12} = \frac{4 + 3 + 2}{12} = \frac{9}{12} = \frac{3}{4}
\]

This addition process can also be demonstrated on a number line as follows.

We can also use shaded areas to create a visual representation of this arithmetic operation.
Module 2: Working with Fractions and Mixed Numbers

Use the fraction number line diagram to answer the following questions.

For Exercises 1 – 6, represent each fraction as an equivalent fraction with the indicated denominator.

1) $\frac{3}{4}$, 16
2) $\frac{1}{4}$, 12
3) $\frac{4}{10}$, 5
4) $\frac{12}{16}$, 4
5) $\frac{2}{3}$, 12
6) $\frac{1}{2}$, 10

For Exercises 9 – 12, use the fraction number line diagram to re-write each fraction with the same denominator. Then evaluate the expression.

9) $\frac{3}{5}$, 10
10) $\frac{11}{16}$, 8
11) $\frac{2}{3}$, 3
12) $\frac{5}{6}$, 3

7) Where is $\frac{0}{6}$ on the number line?
8) Where is $\frac{8}{8}$ on the number line?

9) Can $\frac{1}{3}$ be written as a fraction with a denominator of 16? Why or why not?
10) How do we represent the whole number 1 as a fraction with a denominator of 12?

2. Adding and Subtracting Unlike Fractions

Now, let’s look at the arithmetic approach of finding the value of the expression $\frac{1}{3} + \frac{1}{4} + \frac{1}{6}$.

Recall that we need to make all the fractions have the same denominator before we add the fractions. Therefore, we first need to determine what the least common denominator (LCD) is.

Remember, the LCD is the smallest number that all the denominators divide evenly into.

The smallest number that a 3, 4, and 6 divide evenly into is 12. Therefore, 12 is our LCD. We now multiply each fraction by a factor of 1 to get the equivalent fraction having the LCD.

\[
\frac{1}{3} = \frac{1}{3} \left( \frac{4}{4} \right) = \frac{4}{12}
\]

\[
\frac{1}{4} = \frac{1}{4} \left( \frac{3}{3} \right) = \frac{3}{12}
\]

\[
\frac{1}{6} = \frac{1}{6} \left( \frac{2}{2} \right) = \frac{2}{12}
\]


\[
\frac{4}{12} + \frac{3}{12} + \frac{2}{12} = \frac{9}{12}
\]

Each fraction is now re-written with a denominator of 12.

Add the numerators of the fractions in the previous step. The denominator remains unchanged.

Reduce the fraction by dividing both the numerator and denominator by 3.

\[
\frac{3}{4}
\]
Module 2: Working with Fractions and Mixed Numbers

Example 1: Evaluate the expression \( \frac{5}{8} - \frac{3}{4} + \frac{1}{2} - \frac{3}{16} \).

We first determine that the LCD = 16 since it is the smallest number that 8, 4, 2, and 16 divide evenly into. We now multiply each fraction by a factor of 1 to get its equivalent fraction having the LCD of 16.

\[
\begin{align*}
\frac{5}{8} &= \frac{5}{8} \cdot \left( \frac{2}{2} \right) = \frac{10}{16} \\
\frac{3}{4} &= \frac{3}{4} \cdot \left( \frac{4}{4} \right) = \frac{12}{16} \\
\frac{1}{2} &= \frac{1}{2} \cdot \left( \frac{8}{8} \right) = \frac{8}{16} \\
\frac{3}{16} &= \frac{3}{16} \\
\end{align*}
\]

\[\text{LCD} = 16\]

Add or subtract as indicated the numerators of the fractions in the previous step. The denominator remains unchanged.

\[
\begin{align*}
\frac{5}{8} - \frac{3}{4} + \frac{1}{2} - \frac{3}{16} &= \frac{10}{16} - \frac{12}{16} + \frac{8}{16} - \frac{3}{16} \\
&= \frac{3}{16}
\end{align*}
\]

For Exercises 15 – 22, identify the LCD and then re-write each fraction as an equivalent fraction having the LCD.

15) \( \frac{2}{3}, \frac{5}{6} \)  
16) \( \frac{3}{4}, \frac{5}{8} \)
17) \( \frac{1}{9}, \frac{2}{3} \)  
18) \( \frac{2}{7}, \frac{2}{21} \)
19) \( \frac{5}{6}, \frac{1}{4}, \frac{3}{8} \)  
20) \( \frac{1}{2}, \frac{2}{3}, \frac{2}{5} \)
21) \( \frac{3}{8}, \frac{4}{5}, \frac{7}{10} \)  
22) \( \frac{9}{14}, \frac{3}{4}, \frac{6}{7} \)

23) Where is the fraction \( \frac{3}{2} \) on the number line?

24) Where is the fraction \( \frac{7}{3} \) on the number line?

25) \( \frac{2}{3} - \frac{1}{6} + \frac{3}{2} \)
26) \( \frac{3}{4} - \frac{2}{3} + \frac{1}{6} \)
27) \( \frac{9}{7} - \frac{1}{2} - \frac{3}{4} \)
28) \( \frac{13}{8} - \frac{1}{5} - \frac{3}{4} \)
### 3. Adding and Subtracting Mixed Numbers

Many calculations in Health Care careers require calculations that involve mixed numbers. A mixed number is simply the sum of a whole number and a fraction.

\[
2 \frac{2}{3} = 2 + \frac{2}{3} = \frac{6}{3} + \frac{2}{3} = \frac{6+2}{3} = \frac{8}{3}
\]

Notice that we find that \(2 \frac{2}{3} = \frac{8}{3}\). Recall that the improper fraction \(\frac{8}{3}\) represents a number that is greater than 1. We can also verify this by performing the division problem \(8 \div 3\) which is represented by the fraction \(\frac{8}{3}\).

\[
\text{2 R2} = 2 \frac{\frac{8}{3}}{\frac{2}{3}} = \frac{8}{3}
\]

**Note:** When we add mixed numbers, we can add the whole number parts and the fractional parts separately. Using these two results, we then write our answer in mixed number format.

**Example 2:** Find the value of \(2 \frac{2}{3} + 1 \frac{1}{4}\). Write your answer in mixed number format.

\[
2 \frac{2}{3} + 1 \frac{1}{4} = (2 + 1) + \left( \frac{2}{3} + \frac{1}{4} \right)
\]

Add the whole number parts and fractional parts separately.

\[
= 3 + \left( \frac{8}{12} + \frac{3}{12} \right)
\]

Both fractions from the previous step are re-written as equivalent fractions with an LCD of 12.

\[
= 3 + \left( \frac{11}{12} \right)
\]

Add both fractions in the previous step.

\[
= 3 \frac{11}{12}
\]

Write the final answer in mixed number format.

When we subtract mixed numbers, we can subtract the whole number parts and the fractional parts separately. Using these two results, we again write our answer in mixed number format.

**Note:** These problems can be approached by first changing the mixed numbers into improper fractions and then performing the operation. This approach will be demonstrated later in this section.
Module 2: Working with Fractions and Mixed Numbers

Example 3: Find the value of $4\frac{5}{6} - 2\frac{2}{3}$. Write your answer in mixed number format.

$$4\frac{5}{6} - 2\frac{2}{3} = \left(4 - 2\right) + \left(\frac{5}{6} - \frac{2}{3}\right)$$

Subtract the whole number parts and fractional parts separately.

$$= 2 + \left(\frac{5}{6} - \frac{4}{6}\right)$$

Notice that $\frac{2}{3}$ was re-written as an equivalent fraction with an LCD of 6.

$$= 2 + \left(\frac{1}{6}\right)$$

Subtract both fractions in the previous step.

$$= 2\frac{1}{6}$$

Write the final answer in mixed number format.

Note: In some cases, when finding the sum of mixed numbers, we need to carry over a whole number from the fractional part. The following example demonstrates the process.

Example 4: Find the value of $2\frac{7}{8} + 1\frac{3}{4}$. Write your answer in mixed number format.

$$2\frac{7}{8} + 1\frac{3}{4} = \left(2 + 1\right) + \left(\frac{7}{8} + \frac{3}{4}\right)$$

Add the whole number parts and fractional parts separately.

$$= 3 + \left(\frac{7}{8} + \frac{6}{8}\right)$$

Notice that $\frac{3}{4}$ was re-written as an equivalent fraction with an LCD of 8.

$$= 3 + \left(\frac{13}{8}\right)$$

To get this result, we added the fractional parts. Notice we have an improper fraction which will be re-written as a sum in the next step.

$$= 3 + \left(1 + \frac{5}{8}\right)$$

Here we write the improper fraction as a sum of a whole number and fraction.

$$= 4 + \left(\frac{5}{8}\right)$$

Here we added the whole numbers parts.

$$= 4\frac{5}{8}$$

Write the final answer in mixed number format.

Note: In some cases, when finding the difference of mixed numbers, we need to borrow from the whole number part of the mixed number to avoid a negative result in the fractional part. The following example demonstrates the process.
Example 5: Find the value of $5\frac{2}{3} - 2\frac{3}{4}$. Write your answer in mixed number format.

$$5\frac{2}{3} - 2\frac{3}{4} = (5 - 2) + \left(\frac{2}{3} - \frac{3}{4}\right)$$

Subtract the whole number parts and fractional parts separately.

$$= 3 + \left(\frac{8}{12} - \frac{9}{12}\right)$$

From the previous step, both fractions are re-written as equivalent fractions with an LCD of 12. Notice that performing the subtraction operation would give us a negative result.

$$= 2 + \left(1 + \frac{8}{12} - \frac{9}{12}\right)$$

In this step, we borrowed a 1 from the whole number part to avoid the negative result.

$$= 2 + \left(\frac{12}{12} + \frac{8}{12} - \frac{9}{12}\right)$$

Here we represent the number 1 with an equivalent fraction having an LCD of 12.

$$= 2 + \left(\frac{20}{12} - \frac{9}{12}\right)$$

Here we followed the rule for order of operations and worked left to right adding the first two fractions in the previous step.

$$= 2 + \left(\frac{11}{12}\right)$$

Subtract both fractions in the previous step.

$$= 2\frac{11}{12}$$

Write the final answer in mixed number format.

Example 6: Evaluate $4\frac{1}{10} + 2\frac{1}{2} - 3\frac{5}{6}$. Write your answer in mixed number format.

$$4\frac{1}{10} + 2\frac{1}{2} - 3\frac{5}{6} = (4 + 2 - 3) + \left(\frac{1}{10} + \frac{1}{2} - \frac{5}{6}\right)$$

As indicated, add and subtract the whole number parts and fractional parts separately.

$$= 3 + \left(\frac{3}{30} + \frac{15}{30} - \frac{25}{30}\right)$$

From the previous step, all fractions are re-written as equivalent fractions with an LCD of 30.

$$= 3 + \left(\frac{18}{30} - \frac{25}{30}\right)$$

Here we followed the rule for order of operations and worked left to right adding the first two fractions in the previous step. We can see that performing the subtraction in this step would give us a negative result.

$$= 2 + \left(1 + \frac{18}{30} - \frac{25}{30}\right)$$

Here we borrowed a 1 from the whole number part to avoid the negative result.

$$= 2 + \left(\frac{30}{30} + \frac{18}{30} - \frac{25}{30}\right)$$

Here we represent the number 1 with an equivalent fraction having an LCD of 30.

$$= 2 + \left(\frac{48}{30} - \frac{25}{30}\right)$$

Again we follow the rule for order of operations and work left to right adding the first two fractions in the previous step.

$$= 2 + \left(\frac{23}{30}\right)$$

Subtract both fractions in the previous step.

$$= 2\frac{23}{30}$$

Write the final answer in mixed number format.
Module 2: Working with Fractions and Mixed Numbers

As was mentioned earlier, we can first change the mixed numbers to improper fractions before we add or subtract. In some cases this is easier, and in some cases it may be more difficult. In Example 7, we will repeat the problem given in Example 5 using this approach.

Example 7: Find the value of \(5\frac{2}{3} - 2\frac{3}{4}\) by first writing the mixed numbers as improper fractions. Write your answer in mixed number format.

\[
\frac{5\frac{2}{3} - 2\frac{3}{4}}{3}\quad \frac{17}{4}
\]

Both mixed numbers are re-written as improper fractions.

\[
= \frac{68}{12} - \frac{33}{12}
\]

From the previous step, both fractions are re-written as equivalent fractions with an LCD of 12.

\[
= \frac{68 - 33}{12}
\]

Here we write the difference of the two fractions in the previous step.

\[
= \frac{35}{12}
\]

Here we calculated the difference of 68 and 33. The denominator remains unchanged.

\[
= 2\text{R}1\frac{11}{12}
\]

To get this result, we perform long division and divide 12 into 35.

\[
= 2\frac{11}{12}
\]

The result is finally written in mixed number format.

For Exercises 29 – 38, evaluate each expression.

29) \(2\frac{1}{3} + 1\frac{1}{4}\)  
30) \(3\frac{7}{8} - 1\frac{3}{4}\)

31) \(3\frac{4}{5} + 1\frac{5}{6}\)  
32) \(4\frac{1}{3} - 2\frac{4}{7}\)

33) \(6\frac{7}{8} + 5\frac{7}{10}\)  
34) \(8\frac{3}{16} - 4\frac{5}{8}\)

35) \(7\frac{1}{2} + 6\frac{9}{10}\)  
36) \(11\frac{3}{4} - 5\frac{11}{16}\)

37) \(5\frac{4}{5} + 4\frac{5}{6} - 6\frac{2}{3}\)

38) \(2\frac{2}{3} - 1\frac{7}{8} + 9\frac{1}{4}\)

For Exercises 39 – 44, evaluate each expression by first changing the mixed numbers to improper fractions. Write your final answer in mixed number format.

39) \(3\frac{1}{10} + 2\frac{3}{8}\)

40) \(4\frac{5}{6} - 2\frac{2}{3}\)

41) \(6\frac{3}{8} + 4\frac{1}{5}\)

42) \(2\frac{1}{3} - 1\frac{1}{4}\)

43) \(6 - 3\frac{7}{10} + 2\frac{4}{5}\)

44) \(8\frac{3}{10} - 5 + 7\)
Review Exercises

For Exercises 45 – 56, evaluate the expression.

45) $10 \cdot 9 \cdot 7$
46) $10 \cdot 6 \cdot 8$
47) $6-14+3$
48) $17-31+8$
49) $13 + 7 \cdot 6$
50) $11 - 2 \cdot 9$
51) $16 \div 4 \cdot 2$
52) $32 \div 2 \cdot 4$
53) $4 + 3^2 \cdot 2$
54) $40 - 20 \div 2^2$
55) $(11 - 7)^2 \div 2^3$
56) $(6-2)^3 - (2 \cdot 3)^2$

57) In your own words, write down the rules for order of operations.
58) When was the last time you had to perform a multiplication problem for a household task? Write down the event in your own words.
59) When was the last time you had to perform a division problem for a household task? Write down the event in your own words.
60) Besides math instructors, what type of careers use mathematics on a daily basis? Write down at least five careers.
Module 3: Understanding the Metric System

3.1 The Metric System

1. Understand the Basic Units of Length used in Health Care Careers

The metric system is the most commonly used system of measurement in the Health Care career field. A **meter** is the basic unit of length in the metric system and 1 meter (abbreviated 1 m) is approximately 3 inches longer than 1 yard. Both larger and smaller units of measure are expressed using a prefix on the word **meter**. Below are diagrams of meter sticks whose lengths are scaled with markings of unit measures that are less than 1 meter. The abbreviations for the prefix on the word meter are shown in the parenthesis.

1 meter = 10 **decimeters (dm)**

![1 meter = 10 decimeters (dm)](image)

1 meter = 100 **centimeters (cm)**

![1 meter = 100 centimeters (cm)](image)

1 meter = 1,000 **millimeters (mm)**

![1 meter = 1,000 millimeters (mm)](image)

Use the above meter sticks and previous content to answer the following questions.

1) Write down the abbreviations for **meters**, **decimeters**, **centimeters**, and **millimeters**.

2) How does the abbreviation for miles differ from the abbreviation for meters?

3) Order the following lengths of measure from smallest to largest.
   - 1 dm, 1 mm, 1 m, 1 cm

4) Order the following lengths of measure from largest to smallest.
   - 450 mm, 40 cm, \( \frac{1}{2} \) m, 6 dm, 1 yd

5) A length of 3 dm is equal to a length of how many millimeters?

6) A length of 70 cm is equal to a length of how many decimeters?

7) A length of \( \frac{1}{4} \) m is equal to a length of how many millimeters?

8) A length of \( \frac{1}{5} \) m is equal to a length of how many decimeters?
Module 3: Understanding the Metric System

Many of the things we use on a daily basis can help us estimate lengths of other objects. For example, the length of a dollar bill is 6.14 inches and its width is 2.61 inches. In metric units its length is approximately 16 cm and its width approximately 7 cm. A mechanical pencil is slightly smaller than the length of a dollar bill, and therefore its length can be approximated as 15 cm.

Here are some other items that we may use on a daily basis that can help us estimate metric lengths.

- The diameter of a quarter is about 25 mm.  
- A dime is about 1 mm thick.
- A USB plug is about 1 cm wide.  
- The diameter of a DVD is about 14 cm.

Using an incorrect metric prefix to represent measurements of quantities such as length, mass (weight), or drug dosages, can result in dangerous errors. In order to determine if a given or calculated quantity makes sense, we need to develop good estimation skills. Let’s now begin developing our estimation skills by doing problems that require us to write in an appropriate metric unit.

Fill in the blank with the appropriate metric unit. Choose m, dm, cm, or mm.

9) The width of the palm of your hand is \( \_\_\_ \) mm.  
10) The height of a soda can is 12 \( \_\_\_ \) cm. 
Module 3: Understanding the Metric System

11) The length of a key is 50 ____.

12) The diameter of a nickel is about 2 ____.

13) The length of your index finger is about 7 ____.

14) The average length of an adult female femur bone is about 45 ____.

15) A cellular phone is approximately 120 ____ in length.

16) A plastic fork is approximately 16 ____ in length.

17) Your teacher is about 1.7 ____ tall.

18) A CD-ROM disk has a thickness of 1.2 ____.

2. Converting between Metric Units using Powers of 10

Looking at the meter stick diagrams below, we notice that the prefix *deci* is used to represent unit lengths that are \( \frac{1}{10} \) of a meter and therefore \( 10 \text{ dm} = 1 \text{ m} \). Similarly, we see that *centi* is used to represent unit lengths that are \( \frac{1}{100} \) of a meter. Therefore, \( 100 \text{ cm} = 1 \text{ m} \). Finally, we see that *milli* is used to represent unit lengths that are \( \frac{1}{1,000} \) of a meter and therefore \( 1,000 \text{ mm} = 1 \text{ m} \).

You may have noticed that one-half of a meter, or 0.5 m, is equal to 5 dm. The diagrams below show us that 5 dm is equal to 50 cm, and that 50 cm is equal to 500 mm. Summarizing this, we get the relationship \( 0.5 \text{ m} = 5 \text{ dm} = 50 \text{ cm} = 500 \text{ mm} \). Do you see a pattern?
Module 3: Understanding the Metric System

Let’s now complete a table to demonstrate the pattern. Fill in the blank cells.

<table>
<thead>
<tr>
<th>Equivalent Lengths</th>
<th>0.5 m</th>
<th>5 dm</th>
<th>50 cm</th>
<th>500 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.7 m</td>
<td>dm</td>
<td>cm</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>m</td>
<td>dm</td>
<td>cm</td>
<td>625 mm</td>
<td></td>
</tr>
<tr>
<td>m</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

When moving across each row to the right, we see that the numbers are multiplied by a factor of 10. When moving across each row to the left, the numbers are divided by a factor of 10. Remember that multiplying a number by 10 moves the decimal point to the right one place value. Dividing a number by 10 moves the decimal point to the left one place value.

Now let’s apply what we have learned to the following questions.

Convert each measure to the indicated unit.

19) 25 cm to mm  
20) 35 dm to mm 
21) 0.2 m to cm  
22) 0.7 cm to mm  
23) 7.6 dm to cm  
24) 278 mm to cm  
25) 3.2 dm to m  
26) 5 mm to dm  
27) 1.5 m to cm  
28) 17.5 dm to m 
29) 1,578 mm to m  
30) 349 cm to m

3. Understand Units of Length Greater Than 1 Meter

Up to this point we have mainly dealt with lengths that measure less than 1 meter. What about lengths that are more than 1 meter? In this case we again use a prefix on the word meter to represent measures of length that are greater than 1 meter.

The prefix deka is used to represent a length that is 10 meters. 1 dekameter = 10 meters  
The prefix hecto is used to represent a length that is 100 meters. 1 hectometer = 100 meters  
The prefix kilo is used to represent a length that is 1,000 meters. 1 kilometer = 1,000 meters

Again you may notice that there is a pattern involving powers of 10. Notice that the prefix deka is used to represent unit lengths that are 10 times that of a meter. Therefore, 1 dekameter = 10 m. Next, we see that hecto is used to represent unit lengths that are 100 times that of a meter. Therefore, 1 hectometer = 100 m. Finally, we see that kilo is used to represent unit lengths that are 1,000 times that of a meter and therefore 1 kilometer = 1,000 m.
Let’s again complete a table to demonstrate the pattern. Fill in the blank cells. The abbreviations for the prefix on the word meter are shown in the parenthesis.

<table>
<thead>
<tr>
<th>Equivalent Lengths</th>
<th>kilometers (km)</th>
<th>hectometers (hm)</th>
<th>dekameters (dam)</th>
<th>meters (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 km</td>
<td>hm</td>
<td>dam</td>
<td>m</td>
<td></td>
</tr>
<tr>
<td>km</td>
<td>hm</td>
<td>86.5 dam</td>
<td>4,675 m</td>
<td></td>
</tr>
<tr>
<td>km</td>
<td>10.09 hm</td>
<td>dam</td>
<td>m</td>
<td></td>
</tr>
</tbody>
</table>

Again we can see that when moving across each row to the right, the numbers are multiplied by a factor of 10. When moving across each row to the left, the numbers are divided by a factor of 10. Remember that multiplying a number by 10 moves the decimal point to the right one place value. Dividing a number by 10 moves the decimal point to the left one place value.

Let’s now continue to develop our estimation skills by doing problems that require us to write in an appropriate metric unit.

Fill in the blank with the appropriate metric unit. Choose m, dam, hm, or km.

31) The length of a car is about 5 ____.  
32) The height the Empire State Building is about 45 ____.  
33) The radius of the earth is approximately 6,000 ____.  
34) The distance from New York to Los Angeles is about 4,000 ____.  
35) The height of the Statue of Liberty is about 1 ____.  
36) The traveled length across the Golden Gate Bridge is about 2 ____.  
37) A Boeing 747 Jumbo Jet is approximately 6.4 ____ in length.  
38) The length of a NFL football field is approximately 9.1 ____ in length.
Module 3: Understanding the Metric System

The following diagram organizes the unit measures covered in this section in order from largest to smallest. Notice how the powers of ten are used to move from one unit measure to the next. Each arrow represents the movement of the decimal point one time. Use this diagram to answer the following questions.

Convert each measure to the indicated unit by moving the decimal point appropriately. Write down the number of times you moved the decimal point and the direction you moved it.

39) 3.8 hm to dm
40) 2,385 mm to hm
41) 0.7 cm to m
42) 0.91 dam to dm
43) 80.04 cm to hm
44) 31.08 m to hm
45) 19 hm to m
46) 31 dam to cm
47) 3,498 dm to km
48) 0.164 km to cm
49) 0.028 dam to dm
50) 1,578 mm to dm

Review Exercises

Evaluate the expression.

51) \( \frac{2}{3} - \frac{5}{6} + 8 \)
52) \(-3 + 8\left(\frac{3}{2}\right)^3 \div 9 \)

Fill in the blank with the appropriate metric unit.

57) The length of a paper clip is approximately 3.2 ____.
58) The diameter of a nickel is approximately 21____.

Simplify the expression as much as possible.

53) \(-16 - 12x - 5 + 3x \)
54) \(8 - 5(2x - 3) + 6x \)
55) \(-2|-3 - 8| + 7 \)
56) \(6 - |5 + 12| + 11 \)

Answer True or False.

59) Dividing a number by 1,000 is the same as multiplying by \( \frac{1}{1,000} \).
60) 220 cm is 20 cm more than 2 dm.
Module 4: Conversion Calculations and Dosage Calculations

4.1 Conversions with Lengths, Weight (Mass), and Volume

1. Learn How to Perform Conversions using One Conversion Factor

A conversion factor is a fraction or ratio involving two equivalent quantities that are expressed in different units. For example, if you wish to convert inches to centimeters, you will need to use a conversion factor to perform the calculation. Recall that \( 2.54 \text{ cm} = 1 \text{ in.} \).

This gives us the conversion factor \( \frac{2.54 \text{ cm}}{1 \text{ in.}} \) which is equivalent to \( \frac{1 \text{ in.}}{2.54 \text{ cm}} \). Next, we will need to develop a sense of how to choose the appropriate conversion factor or factors, for a given conversion calculation.

Example 1: How many centimeters are in 10 inches?

In this example we are being asked to convert 10 in. to cm. We begin the conversion calculation by first writing the given quantity as a ratio using a 1 to represent the denominator.

\[
\left( \frac{10 \text{ in.}}{1} \right)
\]

Next, we will multiply are given quantity using the appropriate conversion factor to get the desired result in centimeters.

\[
\left( \frac{10 \text{ in.}}{1} \right) \left( \frac{2.54 \text{ cm}}{1 \text{ in.}} \right)
\]

Notice that the denominator of our conversion factor contains units of inches. This allows us to divide out the units of inches leaving the desired units of centimeters. Here is what our completed conversion calculation will look like.

\[
\left( \frac{10 \text{ in.}}{1} \right) \left( \frac{2.54 \text{ cm}}{1 \text{ in.}} \right) = 25.4 \text{ cm}
\]

Based on our conversion calculation, we can now answer the question by stating there are 25.4 centimeters in 10 inches.

When performing conversion calculations it is always important to show how you reached your solution. This will allow someone else to easily verify that your calculation is correct by checking your work.

Note: In Example 1 above, the conversion factor was written for converting inches to centimeters. In the next example we will convert from centimeters to inches. Notice how the conversion factor differs in Example 2.
Example 2: How many inches are in 35 centimeters?

In this example we are being asked to convert 35 cm to inches. Again, we begin the conversion calculation by first writing the given quantity as a ratio using a 1 to represent the denominator.

\[
\frac{35 \text{ cm}}{1}
\]

Next, we will multiply our given quantity using the appropriate conversion factor to get the desired result in inches.

\[
\frac{35 \text{ cm}}{1} \times \frac{1 \text{ in.}}{2.54 \text{ cm}}
\]

In this example, notice that the denominator of our conversion factor contains units of centimeters. This allows us to divide out the units of centimeters leaving the desired units of inches. Here is what our completed conversion calculation will look like. We will round our final answer to the nearest one-thousandth.

\[
\frac{35 \text{ cm}}{1} \times \frac{1 \text{ in.}}{2.54 \text{ cm}} = 13.780 \text{ in.}
\]

Based on our conversion calculation, we can now answer the question by stating there are approximately 13.780 inches in 35 centimeters.

Perform the following conversion calculations using one conversion factor.

1) How many seconds are in 17 minutes?
2) How many feet are in 40 yards?
3) Convert 10 cm to inches.
4) Convert 25 inches to centimeters.
5) Convert 2 liters to quarts.
6) Convert 5,000 pounds to tons.
7) If one tablet contains 150 mg of ibuprofen, how much ibuprofen is in \(3\frac{1}{2}\) tablets?
8) Given that 1 kilogram = 2.2 pounds, how many kilograms does a 175 lb adult male weigh?
2. Learn How to Perform Conversions using Multiple Conversion Factors

Many conversion calculations require the use of more than one conversion factor to obtain the desired result. In these cases, we let the dimensions guide us through the calculations, telling us where to put the numeric values. This approach will be demonstrated in Example 3 and Example 4. We will be using the following equivalent relationships to perform these types of conversion calculations.

\[
12 \text{ in.} = 1 \text{ ft} \quad 3 \text{ ft} = 1 \text{ yd} \quad 5,280 \text{ ft} = 1 \text{ mile} \quad 2.54 \text{ cm} = 1 \text{ in.}
\]

Other equivalent relationships can be found on the conversion handout sheet found at the end of this section's material.

**Example 3: How many miles are in 500,000 inches?**

As always, we begin the conversion calculation by first writing the given quantity as a ratio using a 1 to represent the denominator.

\[
\left( \frac{500,000 \text{ in.}}{1} \right)
\]

Our first conversion factor will convert inches to feet by placing units of inches in the denominator and feet in the numerator.

\[
\left( \frac{500,000 \text{ in.}}{1} \right) \left( \frac{1 \text{ ft}}{12 \text{ in.}} \right)
\]

Our second conversion factor will now convert feet to miles by placing feet in the denominator and miles in the numerator.

\[
\left( \frac{500,000 \text{ in.}}{1} \right) \left( \frac{1 \text{ ft}}{12 \text{ in.}} \right) \left( \frac{1 \text{ mi}}{5,280 \text{ ft}} \right)
\]

Notice that the denominators of our conversion factors divide out the units in the preceding numerators. This leaves us with the desired units of miles. Here is what our completed conversion calculation will look like. We will round our final answer to the nearest one-thousandth.

\[
\left( \frac{500,000 \text{ in.}}{1} \right) \left( \frac{1 \text{ ft}}{12 \text{ in.}} \right) \left( \frac{1 \text{ mi}}{5,280 \text{ ft}} \right) = 7.891 \text{ mi}
\]

Based on our conversion calculation, we can now answer the question by stating there are approximately 7.891 miles in 500,000 inches.
Example 4: How many yards are in 4,500 centimeters?

Again, we first write the given quantity as a ratio using a 1 to represent the denominator.

\[
\frac{4,500 \text{ cm}}{1}
\]

Our first conversion factor will convert centimeters to inches by placing units of centimeters in the denominator and inches in the numerator.

\[
\frac{4,500 \text{ cm}}{1 \text{ in.}} \times \frac{2.54 \text{ cm}}{1 \text{ in.}}
\]

Our second conversion factor will now convert inches to feet by placing inches in the denominator and feet in the numerator.

\[
\frac{4,500 \text{ cm}}{1 \text{ in.}} \times \frac{1 \text{ in.}}{2.54 \text{ cm}} \times \frac{1 \text{ ft}}{12 \text{ in.}}
\]

Our third conversion factor will now convert feet to yards by placing feet in the denominator and yards in the numerator.

\[
\frac{4,500 \text{ cm}}{1 \text{ in.}} \times \frac{1 \text{ in.}}{2.54 \text{ cm}} \times \frac{1 \text{ ft}}{12 \text{ in.}} \times \frac{1 \text{ yd}}{3 \text{ ft}}
\]

Again we see that the denominators of our conversion factors divide out the units in the preceding numerators. Doing so leaves us with the desired units of yards. Here is what our completed conversion calculation will look like. We will round our final answer to the nearest one-thousandth.

\[
4,500 \text{ cm} \times \frac{1 \text{ in.}}{2.54 \text{ cm}} \times \frac{1 \text{ ft}}{12 \text{ in.}} \times \frac{1 \text{ yd}}{3 \text{ ft}} = 49.213 \text{ yd}
\]

Based on our conversion calculation, we can now answer the question by stating there are approximately 49.213 yards in 4,500 centimeters.

Perform the following conversion calculations using multiple conversion factors.

9) How many meters are in 1 mile?  
10) How many seconds are in 1 year?  
11) Convert 3 pounds to grams.  
12) Convert 2 liters to ounces.
3. Solve Applied Problems using Conversion Calculations

Conversion calculations can be used to solve many of the applied problems seen within the Health Care career field. Probably the most important types of conversion calculations are applied problems that involve dosage calculations. With these types of problems, a given solution strength ratio or dosage strength ratio is used as a conversion factor. The following examples represent common dosage calculations using this approach.

Example 5: Suppose you found that 100 mL of a solution contains 1 gram of lidocaine. How many mg of lidocaine are in \(2\frac{1}{2}\) mL of the solution?

We begin the conversion calculation by first writing the given quantity as a ratio using a 1 to represent the denominator.

\[
\left(\frac{2.5 \text{ mL}}{1}\right)
\]

Next, we multiply our given quantity by the solution strength ratio. This conversion factor will convert milliliters to grams by placing units of milliliters in the denominator and grams in the numerator. This allows us to divide out the units of mL leaving us with grams of lidocaine.

\[
\left(\frac{2.5 \text{ mL}}{1}\right) \left(\frac{1 \text{ g}}{100 \text{ mL}}\right)
\]

Now we must convert the grams of lidocaine to mg. To accomplish this, we add a second conversion factor that will convert grams to milligrams.

\[
\left(\frac{2.5 \text{ mL}}{1}\right) \left(\frac{1 \text{ g}}{100 \text{ mL}}\right) \left(\frac{1,000 \text{ mg}}{1 \text{ g}}\right)
\]

Once again the denominators of our conversion factors divide out the units in the preceding numerators. Doing so leaves us with the desired units of milligrams of lidocaine. Here is what our completed conversion calculation will look like. We will round our final answer to the nearest one-thousandth.

\[
\left(\frac{2.5 \text{ mL}}{1}\right) \left(\frac{1 \text{ g}}{100 \text{ mL}}\right) \left(\frac{1,000 \text{ mg}}{1 \text{ g}}\right) = 25.000 \text{ mg of lidocaine}
\]

Based on our conversion calculation, we can now answer the question by stating there are 25,000 mg of lidocaine in 2.5 mL of solution.
Example 6: Suppose you found that 1,000 mL of a solution contains 1 g of epinephrine. How many mg of epinephrine are in 2 tbsp of solution? Assume 1 tbsp = 15 mL.

Notice that we are given a volume measured by tablespoons. Because our solution strength ratio involves volume by milliliters, we must begin our conversion calculation by first converting tablespoons to milliliters.

We start by first representing the given quantity as a ratio using a 1 to represent the denominator.

\[
\left( \frac{2 \text{ tbsp}}{1} \right)
\]

Our first conversion factor will convert tablespoons to milliliters. Notice that by placing units of tablespoons in the denominator and milliliters in the numerator, we can divide out the units of tablespoons leaving us with milliliters of epinephrine.

\[
\frac{2 \text{ tbsp}}{1} \cdot \frac{15 \text{ mL}}{1 \text{ tbsp}}
\]

Next, we use our solution strength ratio as the second conversion factor to convert milliliters to grams. Notice that milliliters are placed in the denominator and grams in the numerator. This allows us to divide out the units of milliliters leaving us with grams of epinephrine. At this point, the calculation will give us the grams of epinephrine in 2 tbsp of solution.

\[
\frac{2 \text{ tbsp}}{1} \cdot \frac{15 \text{ mL}}{1 \text{ tbsp}} \cdot \frac{1 \text{ g}}{1,000 \text{ mL}}
\]

Because we are asked to calculate the dosage of epinephrine in mg, we need to add an additional conversion factor that will convert grams to milligrams. Doing this leaves us with the desired units of milligrams of epinephrine.

\[
\frac{2 \text{ tbsp}}{1} \cdot \frac{15 \text{ mL}}{1 \text{ tbsp}} \cdot \frac{1 \text{ g}}{1,000 \text{ mL}} \cdot \frac{1,000 \text{ mg}}{1 \text{ g}}
\]

Here is what our completed conversion calculation will look like. We will round our final answer to the nearest one-thousandth.

\[
\left( \frac{2 \text{ tbsp}}{1} \right) \left( \frac{15 \text{ mL}}{1 \text{ tbsp}} \right) \left( \frac{1 \text{ g}}{1,000 \text{ mL}} \right) \left( \frac{1,000 \text{ mg}}{1 \text{ g}} \right) = 30.000 \text{ mg epinephrine}
\]

Based on our conversion calculation, we can now answer the question by stating there are approximately 30.000 mg of epinephrine in 2 tbsp of solution.
Solve the applied problems.

13) The solution strength label of a solution indicates that 100 mL contains 10 grams of magnesium sulfate. How many mL of solution will contain 350 mg of magnesium sulfate?

14) The solution strength label of a solution indicates that 2,000 mL contains 1 gram of epinephrine. How many mL of solution will contain 0.25 mg of epinephrine?

15) Suppose you found that 5 mL of a solution contains 0.25 grams of Amoxicillin. How many mg of Amoxicillin are in 2 tbsp of solution? Assume 1 tbsp = 15 mL.

16) Suppose you found that 5 mL of a solution contains 0.1 grams of Motrin®. How many mg of Motrin® are in 2 tsp of solution? Assume 1 tsp = 5 mL.

Review Exercises

Evaluate the expression.

17) \[ \frac{3}{4} \cdot \frac{6}{7} \cdot \frac{10}{4} \]

18) \[ 3 + \frac{6}{5} \div \frac{3}{20} \]

Simplify the expression as much as possible.

19) \[ \frac{4y^3}{x^2} \cdot \frac{x}{3} \div \frac{y}{4} \]

20) \[ \frac{5a^3}{b^{-2}} \div \frac{15b^3}{7} \cdot \frac{a^{-1}b}{21} \]

Fill in the blank with the appropriate metric unit.

21) The width of a dollar bill is approximately 6.6 ____. 

22) The diameter of a quarter is approximately 24 ____. 

Fill in the blanks with the appropriate metric prefix.

23) _____ means \( \frac{1}{1,000} \).

24) _____ means \( \frac{1}{100} \).
### Equivalent Measurement Table

<table>
<thead>
<tr>
<th>Conversion</th>
<th>Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 inches</td>
<td>1 foot</td>
</tr>
<tr>
<td>3 feet</td>
<td>1 yard</td>
</tr>
<tr>
<td>5,280 feet</td>
<td>1 mile</td>
</tr>
<tr>
<td>2.54 centimeter</td>
<td>1 inch</td>
</tr>
<tr>
<td>1 pound</td>
<td>16 ounces</td>
</tr>
<tr>
<td>1 Ton</td>
<td>2,000 pounds</td>
</tr>
<tr>
<td>28.3 grams</td>
<td>\approx 1 ounce</td>
</tr>
<tr>
<td>2.20 pounds</td>
<td>\approx 1 kilogram</td>
</tr>
<tr>
<td>1 cup</td>
<td>8 fluid ounces</td>
</tr>
<tr>
<td>2 cups</td>
<td>1 pint</td>
</tr>
<tr>
<td>2 pints</td>
<td>1 quart</td>
</tr>
<tr>
<td>4 quarts</td>
<td>1 gallon</td>
</tr>
<tr>
<td>16.39 milliliter</td>
<td>1 in³</td>
</tr>
<tr>
<td>1 milliliter</td>
<td>1 cc (1 cm³)</td>
</tr>
<tr>
<td>1 teaspoon</td>
<td>\approx 5 milliliters</td>
</tr>
<tr>
<td>1 tablespoon</td>
<td>\approx 15 milliliters</td>
</tr>
<tr>
<td>1 fluid ounce</td>
<td>\approx 29.6 milliliters</td>
</tr>
<tr>
<td>1,000 mL</td>
<td>1 L</td>
</tr>
<tr>
<td>1,000,000 μL</td>
<td>1 L</td>
</tr>
<tr>
<td>1.06 quarts</td>
<td>\approx 1 L</td>
</tr>
<tr>
<td>1 gallon</td>
<td>3.79 L</td>
</tr>
</tbody>
</table>

\[
C° = \frac{5(F° - 32)}{9}
\]

\[
F° = \frac{9}{5}C° + 32
\]