

## MATH REVIEW FOR MEDICATION DOSING

After the completion of this module you will be able to:

- Identify the parts of a fraction.
- Determine the value of a fraction compared to another fraction.
- Multiply fractions and reduce product to lowest terms.
- Identify the names of each place value of numbers in relation to a decimal.
- Convert a fraction to its decimal equivalent.
- Safely determine when to round up or down when computing dosage calculations.

### KEY TERMS

[Apothecary Measurement System](#): Measurement system for weighing drugs and solutions which uses both Roman and Arabic numerals together with fractions to identify parts of the unit of measure. To express an amount less than one, fractions are used.

[Denominator](#): The number on the bottom portion of the fraction that represents the number of parts into which the whole is divided.

[Dividing Line](#): The line separating the top portion or the fraction from the bottom portion of the fraction.

[Household Measurement System](#): Measurement system commonly used in cookbooks and recipes, which uses whole numbers and fractions. It is considered the least accurate measurement system because of the differences between measuring devices. It is also known as the U.S. Customary Measurement.

[Leading zero](#): Referred to as the additive identity. Used before a decimal notation to add emphasis to the presence of a decimal.

[Metric Measuring System](#): A decimal system of weights and measures based on units of ten in which gram, meter, and liter are the basic units of measurement. The gram and the liter are used in medication administration.

[Numerator](#): The number on the top portion of the fraction that represents the number of parts of the whole fraction.

[Roman Numerals](#): A numeral system originating from Rome adapted from Etruscan numerals. Based on certain letters which are given values as numerals.

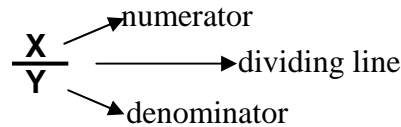
[Scored Tablet](#): A tablet with one or two grooves that divides the tablet in half or in four quarter sections of equal size.

## FRACTIONS

As a healthcare provider, you may have to interpret prescriptions written with fractions. Therefore, it is important that you are able to understand what the fraction represents and to manipulate it in order to provide the correct dosage for a patient.

### Review of fractional parts

A fraction is a number that represents part of a whole number and contains three parts: numerator, dividing line, and denominator (devisor). If these are mixed up, you can cause series injury to your patient.



### Value of a fraction

Sometimes it may be necessary to determine the value of a fraction compared to another. You can do this using three methods:

1. When the denominators are the same, the fraction with the highest numerator has the highest value.

$$\frac{1}{4} \text{ vs. } \frac{3}{4} \longrightarrow \text{highest numerator – highest value}$$

2. When the numerators are the same, the fraction with the lowest denominator has the highest value.

$$\frac{1}{8} \text{ vs. } \frac{1}{16} \longleftarrow \text{lowest denominator – highest value}$$

3. When there is no common numerator or denominator in each fraction, convert each fraction to its decimal equivalent so that you can compare the value of the two fractions.

$$\frac{1}{3} \text{ vs. } \frac{3}{5}$$

$$\frac{1}{3} = 0.33 \quad \frac{3}{5} = 0.60 \longrightarrow \text{highest decimal – highest value}$$

### Multiplying and Reducing Fractions

In order to administer medications safely, it is important to be able to multiply and reduce fractions. When multiplying fractions, remember to

1. Multiply the numerators.
2. Multiply the denominators.
3. Reduce the product to the lowest terms.

$$\frac{1}{2} \times \frac{2}{3} = \frac{1 \times 2}{2 \times 3} = \frac{2}{6}$$

To reduce a fraction, divide the numerator and the denominator of the fraction by the same largest whole number that will divide into both numbers. In the above example, the largest whole number that will divide into both numbers is two.

Therefore,

$$\frac{2}{6} \div 2 = \frac{2 \div 2}{6 \div 2} = \frac{1}{3}$$

Thus,

$$\frac{1}{2} \times \frac{2}{3} = \frac{2}{6} = \frac{1}{3}$$

**SAFETY ALERT:** It is very important to calculate the lowest term correctly so that you do not dose a patient incorrectly.

## DECIMALS

### Place Value System

Early civilizations in China and India used an Abacus to help them with establishing place value. This is where our current Place Value System of numbers comes from. Each numeral in a decimal number has a value based on its location from the decimal point.

Place Value Table														
5	4	3	2	1	.				1	2	3	4		
Ten Thousands	Thousands	Hundreds	Tens	Ones	Decimal Point	Tenths	Hundredths	Thousandths	Ten Thousandths					

← Increasing Value
Decreasing Value →

**SAFETY ALERT:** It is very important to always include the [leading zero](#) to a decimal that does not have a whole number. This will help you to avoid potential life threatening errors when you are calculating a drug dose.

### Converting a Fraction to a Decimal

Many students have what is termed “fraction phobia” and would prefer to avoid fractions all together. Most of the time, it is a good idea to change a fraction into a decimal because it can make your math seem easier to compute. You can do this by dividing the numerator by the denominator using your calculator:

$$\frac{7}{10} = 7 \div 10 = 0.7$$

## Multiplying Decimals

When you need to multiply a decimal number, simply :

1. Multiply as if the numbers were whole numbers. (don't worry about the decimals yet)

$$\begin{array}{r} 0.25 \\ \times 0.05 \\ \hline \end{array}$$

2. As you compute the problem, place the last digit of each additional product to the left of the previous product's last digit.

$$\begin{array}{r} 1\ 2 \\ 0.25 \\ \times 0.05 \\ \hline 0125 \\ 000 \\ 000 \\ \hline \end{array}$$

3. Then add the products together.

$$\begin{array}{r} 1\ 2 \\ 0.25 \\ \times 0.05 \\ \hline 0125 \\ 000 \\ 000 \\ \hline 00125 \\ \hline \end{array}$$

4. In order to place the decimal point in the correct spot, count the number of digits to the right of each decimal in the problem.

$$\begin{array}{r} 0.25 \\ \times 0.05 \end{array}$$

A total of four digits are to the right of each decimal.

5. Count an equal number of digits in the answer starting from the left and place the decimal point there.

$$\begin{array}{r} 1\ 2 \\ 0.25 \\ \times 0.05 \\ \hline 0125 \\ 000 \\ 000 \\ \hline 00125 \\ \hline 0.0125 \end{array}$$

6. If there are fewer digits in the answer than the total number of decimal places needed, you must add zeros to the left of the answer digits.

## Dividing Decimals

Let's first review some terms:

1. divisor - In  $a/b = c$ ,  $b$  is the divisor
2. dividend – In  $a/b = c$ ,  $a$  is the dividend
3. quotient – In  $a/b = c$ ,  $c$  is the quotient

Example:  $3/2 =$

Quotient  
Divisor 2)3 Dividend

Here's another example. In order to divide decimals you must remember one important thing: the Divisor must be a whole number.

$$\begin{array}{r} 4.25 \text{ Dividend} \\ \div 0.5 \text{ Divisor} \\ \hline \text{Quotient} \end{array}$$

In order to make the decimal a whole number you must:

1. Move the Divisor's decimal to the right of the digits to make the number whole.

$$\begin{array}{r} 0.5)4.25 \\ \hline 05) \end{array}$$

2. Then the decimal point in the Dividend must be moved the same number of places to the right as the Divisor's decimal was moved.

$$05)42.5$$

3. Compute the problem. The decimal point in the quotient is placed directly above the new position of the decimal point in the dividend.

$$\begin{array}{r} 8.5 \\ 05)42.5 \end{array}$$

### Rounding Rules

Medications are administered in several different forms including liquid, powder, tablets, capsules, injections, and infusions. The most common forms of drug that you will prepare and administer are liquid and tablets. When you calculate the dose of medication to be administered, there will be occasions when your answer will not be a whole number. You must decide how much medication to administer based on your answer and the form of drug to be administered.

More often than not, when you prepare and administer a liquid or injectable medication you will need to round to the nearest **tenths place**.

Place Value Table													
5	4	3	2	1	.				1	2	3	4	
Ten Thousands	Thousands	Hundreds	Tens	Ones	Decimal Point	Tenths	Hundredths	Thousandths	Ten Thousandths				

However, when preparing medications for infants and children or when administering specific drugs, you have to round to the nearest **hundredths place**.

Rules:

1. Rounding to nearest whole number

- a. If the amount to be administered is greater than 0.5, then round up to the whole number.

Example: You have calculated a dose to be 4.7 tablets. Because 0.7 is greater than 0.5, you would round up to the whole number. Therefore, the dose would be 5 tablets.

- b. If the amount to be administered is less than 0.5, round down to the whole number.

Example: You have calculated a dose to be 2.4 tablets. Because 0.4 is less than 0.5, you would round down to the whole number. Therefore, the dose would be 2 tablets.

2. Rounding to the nearest tenths place

- a. If the amount to be administered is greater than 0.5, then round up to the tenths place.

Example: You have calculated a dose to be 4.56 mL's. Because 0.56 is greater than 0.5, you would round up the tenths place. Therefore, the dose would be 4.6 mL's.

- b. If the amount to be administered is less than 0.5, then round down to the tenths place.

Example: You have calculated a dose to be 4.34 mL's. Because 0.34 is less than 0.5, you would round down to the tenths place. Therefore, the dose would be 4.3 mL's.

When your answer is not a whole number you must determine if the dosage form can be safely divided. Certain types of medication cannot or should be divided

- 1. unscored tablets
- 2. extended release medications – designated with XL, XR, or ER
- 3. enteric coated tablets – designated with EC
- 4. capsules

These types of medications cannot be broken or divided safely and would cause the drug to be improperly absorbed and utilized by the body. Some tablets are [scored](#) with one or two dividing lines. These tablets can safely be broken in half or in fourths to provide the correct dose.

**SAFETY NOTE:** When you are unsure, always clarify the appropriate dose with the patient's physician and remember that a pharmacist is a very valuable resource as well.

## ROMAN NUMERALS AND ARABIC NUMERALS

Authorities believe that numbers originated from a variety of societal needs including religion, dates for planting crops, and economics. In earliest times, numbers were recorded with three dimensional tokens. The Romans used an *additive* numeration system. Numbers are repeated to produce a total. The [Apothecary Measurement System](#) uses [Roman Numerals](#). The Arabs adopted a *place value* system that originated in China and India. The [Household Measurement System](#) and [Metric System of Measurement](#) uses Arabic Numerals.

### Equivalency Table

<u>Roman Numerals</u>	<u>Arabic Numerals</u>
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I	1
V	5
X	10
L	50
C	100
D	500
M	1000

Be sure to memorize the above values. Many prescribers will use Roman Numerals when writing a medication order. You will need to understand and be able to convert between Roman and Arabic Numerals to be able to translate the order.

## Practice Problems

### Simple Problems

**Problem 1 :  $0.25 + 0.66$**

Solution:

Remember to keep the decimals aligned

$$\begin{array}{r} 0.25 \\ + 0.66 \\ \hline 0.91 \end{array}$$

**Problem 2:  $0.75 - 1/3$**

Solution:

Keep decimals aligned

$$\begin{array}{r} 0.75 \\ - 0.33 \\ \hline 0.42 \end{array}$$

**Problem 3:  $\frac{3}{4} \times \frac{1}{200}$**

Solution:

Multiply numerators, denominators and reduce to lowest terms

$$3 \times 1 = 3$$

$$4 \times 200 = 800 \quad 3/800 \text{ is lowest term}$$

**Problem 4 :  $\frac{2}{3}$  (divide sign)  $\frac{1}{2}$**

Solution:

Remember to invert the second fraction and multiply

$$\frac{2}{3} \times \frac{2}{1}$$

Multiply numerators and denominators

$$2 \times 2 = 4$$

$$3 \times 1 = 3$$

Reduce to lowest terms

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



## Mixed Fractions and Decimals: Arabic and Roman Numerals

### Problem 5 : $\frac{1}{4} + V$

Solution:

Recall that  $V = 5$

$$\frac{1}{4} + 5 = 5 \frac{1}{4}$$

### Problem 6 : $0.25 + \frac{1}{2}$

Solution:

Change the fraction into a decimal

$$\frac{1}{2} = 0.5$$

Keep decimals aligned

$$\begin{array}{r} 0.25 \\ + 0.50 \\ \hline 0.75 \end{array}$$

### Problem 7: $\frac{2}{3} - 0.33$

Solution:

Change the fraction into a decimal

$$\frac{2}{3} = 0.66$$

Keep decimals aligned

$$\begin{array}{r} 0.66 \\ - 0.33 \\ \hline 0.33 \end{array}$$

### Problem 8 : $\frac{3}{4} - 0.33$

Solution:

Change the fraction to a decimal

$$\frac{3}{4} = 0.75$$

Keep decimals aligned

$$\begin{array}{r} 0.75 \\ - 0.33 \\ \hline 0.42 \end{array}$$

**Problem 9: I x 0.5**

Solution:

Recall that Roman numeral I means 1

$$1 \times 0.5 = 0.5$$

**Problem 10 : V x 1/100**

Recall that Roman numeral V means 5

$$5 \times 1/100$$

Recall that whole numbers expressed as a fraction are simply the whole number over 1

$$5 = 5/1$$

Multiply numerators and denominators

$$5/1 \times 1/100$$

$$5 \times 1 = 5$$

$$1 \times 100 = 100$$

Reduce to lowest terms

$$5/100 = 1/20$$

**Problem 11 : C (divide sign) 0.25**

Solution:

Recall that Roman numeral C means 100

$$100 \text{ (divide sign) } 0.25$$

$$0.25 \text{ ) } 100 \quad \text{answer } 400.$$

Remember to move the decimal out of the dividend to make a whole number, then the decimal must move an equal amount of spaces in the divisor.

**Problem 12: L (divide sign) 1/3**

Solution:

Recall that the Roman numeral L means 50

50 (divide sign) 1/3

Multiply by the reciprocal

$$\begin{array}{r} 50 \quad \times 3 \\ 1 \quad \times 1 = 150 \end{array}$$

**Problem 13 : 1/200 x III**

Solution:

Recall that Roman numeral I means 1, so III means 3

1/200 x 3

Multiply numerators and denominators

$$\begin{array}{r} 1 \times 3 \\ 200 \times 1 = 3/200 \text{ this is the lowest term} \end{array}$$

**Problem 14: D x 2/3**

Solution:

Recall that the Roman numeral D means 500

500 x 2/3

Multiply numerators and denominators

$$\begin{array}{r} 500 \times 2 = 1000 \\ 1 \quad \times 3 = 3 \end{array}$$

Reduce to lowest terms

3 ) 1000 answer is 333 1/3

<http://www.austincc.edu/rxsucces/MathReview9.html>