A Review of Arithmetic

Although many hospitals use the unit-dose system when dispensing medicines, it is the nurse's responsibility to determine that the medication administered is exactly as prescribed by the health care provider. To give an accurate dose, the nurse must have a working knowledge of basic mathematics. This review is offered so that individuals may determine areas in which improvement is needed.

FRACTIONS

Objective

1. Demonstrate proficiency performing mathematic problems that involve the addition, subtraction, multiplication, and division of fractions.

Key Terms

numerator (NŪ-mĕr-ā-tŭr)
denominator (dĕ-NŎM-ĭ-nā-tŭr)

Fractions are one or more of the separate parts of a substance or less than a whole number or amount.

EXAMPLE

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

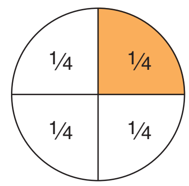
COMMON FRACTIONS

A common fraction is part of a whole number. The **numerator** (dividend) is the number above the line. The **denominator** (divisor) is the number below the line. The line that separates the numerator and the denominator tells us to divide.

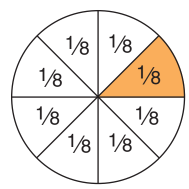
$$\frac{\text{Numerator (names how many parts are used)}}{\text{Denominator (tells how many pieces into which the whole is divided)}}$$

EXAMPLES

The denominator represents the number of parts or pieces into which the whole is divided.



The fraction ¼ means, graphically, that the whole circle is divided into four (4) parts; one (1) of the parts is being used.



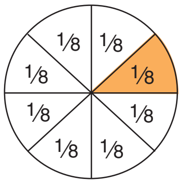
The fraction ⅛ means, graphically, that the whole circle is divided into eight (8) parts; one (1) of the parts is being used.

From these two examples—¼ and ⅛—you can see that the larger the denominator number, the smaller the portion is (i.e., each section in the ⅛ circle is smaller than each section in the ¼ circle). This is an important concept to understand for people who will be calculating medicine doses. The medicine ordered may be ¼ g, and the drug source available on the shelf may be ½ g. Before proceeding to do any formal calculations, you should first decide if the dose you need to give is smaller or larger than the drug source available on the shelf.

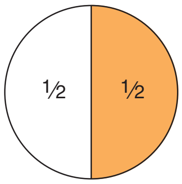
EXAMPLES

Decide: "Is what I need to administer to the patient a larger or smaller portion than the drug available on the shelf?" *Answer:* $\frac{1}{4}$ g is smaller than $\frac{1}{2}$ g; thus, the dose to be administered would be less than one tablet.

Try a second example: $\frac{1}{8}$ g is ordered; the drug source on the shelf is $\frac{1}{2}$ g.



1/8 g ordered



1/2 g source

Decide: "Is what I need to administer to the patient a larger or smaller portion than the drug available on the shelf?" *Answer:* $\frac{1}{8}$ g is smaller than $\frac{1}{2}$ g; thus, the dose to be administered would be less than one tablet.

TYPES OF COMMON FRACTIONS

1. *Simple:* Contains *one* numerator and *one* denominator: $\frac{1}{4}$, $\frac{1}{20}$, $\frac{1}{60}$, $\frac{1}{100}$
2. *Complex:* May have a simple fraction in the numerator or denominator:
   $\frac{1}{2}$ over 4 = $\frac{1/2}{4}$
3. *Proper:* Numerator is smaller than denominator: $\frac{1}{8}$, $\frac{2}{5}$, $\frac{1}{100}$
4. *Improper:* Numerator is larger than denominator: $\frac{4}{3}$, $\frac{6}{4}$, $\frac{100}{10}$
5. *Mixed number:* A whole number and a fraction: $4\frac{5}{8}$, $6\frac{2}{3}$, $1\frac{5}{100}$
6. *Decimal:* Fractions written on the basis of a multiple of 10: 0.5 = $\frac{5}{10}$, 0.05 = $\frac{5}{100}$, 0.005 = $\frac{5}{1000}$
7. *Equivalent:* Fractions that have the same value: $\frac{1}{3}$ = $\frac{2}{6}$

WORKING WITH FRACTIONS

When working with fractions, the rule is to reduce the fraction to the lowest terms using a common number that is found in both the numerator and denominator. Divide the numerator and the denominator by the number that will divide into both evenly (i.e., the common denominator).

EXAMPLE

$$\frac{25}{125} \div \frac{25}{25} = \frac{1}{5}$$

Reduce the following:

a. $\frac{5}{100}$ = ______

b. $\frac{3}{21}$ = ______

c. $\frac{6}{36}$ = ______

d. $\frac{12}{44}$ = ______

e. $\frac{2}{4}$ = ______

Finding the lowest common denominator of a series of fractions is not always easy. The following are some points to remember:

- If the numerator and denominator are even numbers, 2 will work as a common denominator, but it may not be the smallest one.
- If the numerator and denominator end with 0 or 5, 5 will work as a common denominator, but it may not be the smallest one.
- Check to see if the numerator divides evenly into the denominator; if it does, this will be the smallest term.

Addition

Adding Common Fractions

When denominators are the same figure, add the numerators.

EXAMPLES

$$\frac{1}{4}+\frac{2}{4}+\frac{3}{4}=1+2+3=6 \text{ or } \frac{6}{4}=1\frac{1}{2}$$

Add the following:

$$\frac{2}{6}+\frac{3}{6}+\frac{4}{6}+\frac{9}{6}=\frac{2+3+4+9}{6}=\frac{18}{6}=3$$

$$\frac{1}{100}+\frac{3}{100}+\frac{5}{100}=\frac{9}{100}$$

When the denominators are unlike, change the fractions to equivalent fractions by finding the lowest common denominator.

EXAMPLE

$$\frac{2}{5}+\frac{3}{10}+\frac{1}{2}=\_\_\_\_$$

Answer

1. Determine the lowest common denominator. (Use 10 as the common denominator.)
2. Divide the denominator of the fraction being changed into the common denominator, and then multiply the product (answer) by the numerator.

$\frac{2}{5} = \frac{4}{10}$ (Divide 5 into 10, and then multiply the answer [2] by 2.)

$\frac{3}{10} = \frac{3}{10}$ (Divide 10 into 10, and then multiply the answer [1] by 3.)

$\frac{1}{2} = \frac{5}{10}$ (Divide 2 into 10, and then multiply the answer [5] by 1.)

4 + 3 + 5 = 12

$\frac{12}{10} = 1\frac{1}{5}$ (Add the numerators, and then place the total over the denominator [10]. Convert the improper fraction to a mixed number, and then reduce it to its lowest terms.)

Add the following:

a.
$$\frac{2}{8}=\frac{\quad}{64}$$
$$+\frac{4}{64}=\frac{\quad}{64}$$
$$+\frac{5}{16}=\frac{\quad}{64}$$
$$\frac{\quad}{64}$$

b.
$$\frac{3}{7}=\frac{\quad}{28}$$
$$+\frac{9}{14}=\frac{\quad}{28}$$
$$+\frac{1}{28}=\frac{\quad}{28}$$
$$\frac{\quad}{28}$$

Adding Mixed Numbers

Add the fractions first, and then add the whole numbers.

EXAMPLE

$$2\frac{3}{4}+2\frac{1}{2}+3\frac{3}{8}=\_\_\_\_$$

Answer

1. Determine the lowest common denominator. (Use 8 as the common denominator.)
2. Divide the denominator of the fraction being changed into the common denominator, and then multiply the product (answer) by the numerator.

$2\frac{3}{4}=\frac{6}{8}$	(Divide 4 into 8, and then multiply the answer [2] by 3.)
$2\frac{1}{2}=\frac{4}{8}$	(Divide 2 into 8, and then multiply the answer [4] by 1.)
$\frac{3}{8}=\frac{3}{8}$	(Divide 8 into 8, and then multiply the answer [1] by 3.)
$6+4+3=\frac{13}{8}$	(Add the numerators, and then place the total over the denominator [8].)
$2+2+3=7$	(Add the whole numbers.)
$7+1\frac{5}{8}=8\frac{5}{8}$	(Convert the improper fraction $^{13}/_{8}$ to a mixed number $1^{5}/_{8}$, and then add it to the whole numbers.)

Add the following:

a. $\frac{1}{4}+\frac{3}{4}=\frac{\quad}{4}$

b.
$$\frac{1}{2}=\frac{\quad}{6}$$
$$+\frac{1}{3}=\frac{\quad}{6}$$
$$+\frac{1}{6}=\frac{\quad}{6}$$
$$=\frac{\quad}{6}$$

c.
$$\frac{3}{5}=\frac{\quad}{50}$$
$$+\frac{4}{50}=\frac{\quad}{50}$$
$$=\frac{\quad}{50}$$ (Reduce to lowest term.)

Subtraction

Subtracting Fractions

When the denominators are unlike, change the fractions to equivalent fractions by finding the lowest common denominator.

EXAMPLE

$$\frac{1}{4}-\frac{3}{16}=\_\_\_\_$$

Answer

1. Determine the lowest common denominator. (Use 16 as the common denominator.)
2. Divide the denominator of the fraction being changed into the common denominator, and then multiply the product (answer) by the numerator.

$\frac{1}{4}=\frac{4}{16}$	(Divide 4 into 16, and then multiply the answer [4] by 1.)
$-\frac{3}{16}$	
$\frac{1}{16}$	(Subtract the numerators, and then place the total [1] over the denominator [16].)

Subtract the following:

a. $\frac{3}{8}-\frac{2}{8}=\frac{\quad}{8}$

$3-2=1$ (Place answer over denominator.)

b.
$$\frac{1}{100}=\frac{\quad}{300}$$
$$-\frac{1}{150}=\frac{\quad}{300}$$
$$\frac{\quad}{300}$$

Subtracting Mixed Numbers

Subtract the fractions first, and then subtract the whole numbers.

EXAMPLE

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

Answer

$$4\frac{1}{4} = 3\frac{5}{4}$$

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

(Note: You cannot subtract $\frac{3}{4}$ from $\frac{1}{4}$; therefore, borrow 1 [which equals $\frac{4}{4}$] from the whole numbers, and then add $\frac{4}{4} + \frac{1}{4} = \frac{5}{4}$.)

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

(Subtract the numerators, then place the answer over the denominator [4]. Reduce to lowest terms, and then subtract the whole numbers.)

When the denominators are unlike, change the fractions to equivalent fractions by finding the lowest common denominator.

EXAMPLE

$$2\frac{5}{8} - 1\frac{1}{4} = \_\_\_\_$$

Answer

1. Determine the lowest common denominator. (Use 8 as the common denominator.)
2. Divide the denominator of the fraction being changed into the common denominator, and then multiply the product (answer) by the numerator.

$$2\frac{5}{8} = 2\frac{5}{8}$$

(Divide 8 into 8, and then multiply the answer [1] by 5.)

$$-1\frac{1}{4} = 1\frac{2}{8}$$

(Divide 4 into 8, and then multiply the answer [2] by 1.)

$$1\frac{3}{8}$$

(Subtract the numerators, and then place the total [3] over the denominator [8]. Reduce to lowest terms, and then subtract the whole numbers.)

Subtract the following:

a. $\frac{7}{8} = \frac{\_\_}{24}$

$-\frac{3}{6} = \frac{\_\_}{24}$

$\frac{\_\_}{24}$

b. $6\frac{7}{8} = \frac{\_\_}{16}$

$-3\frac{1}{16} = \frac{\_\_}{16}$

$\frac{\_\_}{16}$

Multiplication

Multiplying a Whole Number by a Fraction

EXAMPLE

$$3 \times \frac{5}{8} = \_\_\_\_$$

Answer

1. Place the whole number over 1 ($\frac{3}{1}$).
2. Multiply the numerators (top numbers), and then multiply the denominators (bottom numbers).

$$\frac{3}{1} \times \frac{5}{8} = \frac{15}{8}$$

3. Change the improper fraction to a mixed number.

$$\frac{15}{8} = 1\frac{7}{8}$$

Multiply the following:

a. $2 \times \frac{3}{4} = \_\_\_\_\_$

b. $15 \times \frac{3}{5} = \_\_\_\_\_$

Multiplying Two Fractions

EXAMPLE

$$\frac{1}{4} \times \frac{2}{3} = \_\_\_\_$$

1. Use cancellation to speed the process:

$$\frac{1}{\cancel{4}_{2}} \times \frac{\cancel{2}^{1}}{3} = \frac{1}{6}$$

2. Multiply the numerators (top numbers), and then multiply the denominators: $\frac{1}{2} \times \frac{1}{3} = \frac{1}{6}$

Multiplying Mixed Numbers

EXAMPLE

$$3\frac{1}{2} \times 2\frac{1}{5} = \_\_\_\_$$

Answer: Change the mixed numbers (i.e., a whole number and a fraction) to improper fractions (i.e., the numerator is larger than the denominator).

1. Multiply the denominator by the whole number, then add the numerator:

$3\frac{1}{2}$ becomes $3 \times 2 = 6 + 1 = \frac{7}{2}$

$2\frac{1}{5}$ becomes $2 \times 5 = 10 + 1 = \frac{11}{5}$

$$\frac{7}{2}\times\frac{11}{5}=\_\_\_\_$$

2. Multiply the numerators, and then multiply the denominators.

$$\frac{7}{2}\times\frac{11}{5}=\frac{77}{10}$$

3. Change the product (answer), which is an improper fraction, to a mixed number by dividing the denominator into the numerator, and then reduce to lowest terms.

$$\frac{7}{2}\times\frac{11}{5}=\frac{77}{10}=7\frac{7}{10}$$

Multiply the following:

a. $1\frac{2}{3}\times\frac{3}{6}=\_\_\_\_\_$

b. $1\frac{7}{8}\times 1\frac{1}{4}=\_\_\_\_\_$

Division

Dividing Fractions

1. Change the division sign to a multiplication sign.
2. Invert the divisor, which is the number after the division sign.
3. Reduce the fractions with the use of cancellation.
4. Multiply the numerators and the denominators.

EXAMPLE

$$4\div\frac{1}{2}=\_\_\_\_$$

$$4\div\frac{1}{2}=\frac{4}{1}\times\frac{2}{1}=\frac{8}{1}=8$$

Dividing With a Mixed Number

1. Change the mixed number to an improper fraction.
2. Change the division sign to a multiplication sign.
3. Invert the divisor.
4. Reduce whenever possible.

EXAMPLE

$$4\frac{1}{2}\div\frac{3}{4}=\frac{9}{2}\div\frac{3}{4}=\frac{\overset{3}{\cancel{9}}}{\underset{1}{\cancel{2}}}\times\frac{\overset{3}{\cancel{4}}}{\underset{1}{\cancel{3}}}=\frac{6}{1}\text{ or }6$$

$$6\frac{1}{4}\div1\frac{1}{4}=\frac{25}{4}\div\frac{5}{4}=\frac{\overset{5}{\cancel{25}}}{\underset{1}{\cancel{4}}}\times\frac{\overset{1}{\cancel{4}}}{\underset{1}{\cancel{5}}}=\frac{5}{1}\text{ or }5$$

Fractions as Decimals

A fraction can be changed to a decimal form by dividing the numerator by the denominator.

EXAMPLE

$$\frac{1}{2}=2\overline{)1.0}\quad(0.5)$$

Change the following fractions to decimals:

a. $\frac{1}{100}=\_\_\_\_\_$

b. $\frac{5}{8}=\_\_\_\_\_$

c. $\frac{1}{2}=\_\_\_\_\_$

Using Cancellation to Speed Your Work

1. Determine a number that will divide evenly into both the numerator and the denominator.
2. Continue the process of dividing both the numerator and the denominator by the same number until all numbers are reduced to lowest terms.
3. Complete the multiplication of the problem.

EXAMPLE

$$\frac{\overset{1}{\cancel{3}}}{\underset{2}{\cancel{6}}}\times\frac{\overset{3}{\cancel{9}}}{\underset{2}{\cancel{10}}}=\_\_\_\_$$

$$\frac{1}{2}\times\frac{3}{2}=\frac{3}{4}$$

4. Complete the division of the problem.

EXAMPLE

$$\frac{6}{9}\div\frac{5}{8}=\_\_\_\_$$

(Change the division sign to a multiplication sign, invert the divisor, reduce, and then complete the multiplication of the problem.)

$$\frac{2}{3}\times\frac{8}{5}=\frac{16}{15}=1\frac{1}{15}$$

DECIMAL FRACTIONS

Objectives

2. Demonstrate proficiency performing mathematic problems that involve the addition, subtraction, multiplication, and division of decimals.

3. Convert decimals to fractions and fractions to decimals.

When fractions are written in decimal form, the denominators are not written. The word *decimal* means "10." When reading decimals, the numbers to the left of the decimal point are whole numbers. It may help to think of them as whole dollars. Numbers to the right of the decimal are fractions of the whole number and may be thought of as cents.

EXAMPLE

1.0 = one

11.0 = eleven

111.0 = one hundred eleven

1111.0 = one thousand one hundred eleven

Numbers to the right of the decimal point are read as follows:

EXAMPLE

Decimals	***Fractions***
0.1 = one tenth	$\frac{1}{10}$
0.01 = one hundredth	$\frac{1}{100}$
0.465 = four hundred sixty-five thousandths	$\frac{465}{1000}$
0.0007 = seven ten thousandths	$\frac{7}{10,000}$

Here is another way to view the reading of decimals:

Ten Thousands	Thousands	Hundreds	One	DECIMAL POINT	Tenths	Hundredths	Thousandths	Ten Thousandths	
Whole Numbers					Fractions				
				.	1				equals one-tenth (1/10)
				.	2	2			equals twenty-two hundredths (22/100)
				.	1	1	2		equals one hundred twelve thousandths (112/1000)
				.	0	1	1	2	equals one hundred twelve ten thousandths (112/10,000)
			1	.					equals number one
		1	0	.					equals number ten
	1	0	0	.					equals number one hundred
1	0	0	0	.					equals number one thousand

EXAMPLE

(NOTE: Hospital policy now recommends that 1.000 g be written as "1 g" to avoid error. Often, the decimal point is not recognized, and very large doses have been accidentally administered. The rule is as follows: "Don't use trailing 0s to the right of decimal points.")

250 mg = 0.250 g

MULTIPLYING DECIMALS

Multiplying Whole Numbers and Decimals

1. Count as many places in the answer, starting from the right, as there are places in the decimal that is involved in the multiplication.
2. The multiplier is the bottom number with the × (i.e., the multiplication sign) in front of it.
3. The multiplicand is the top number.

EXAMPLES

$$\begin{array}{r}500\\ \times 0.02\\ \hline 10.00\,(10)\end{array}\qquad \begin{array}{r}1000\\ \times 0.04\\ \hline 40.00\,(40)\end{array}\qquad \begin{array}{r}1000\\ \times 0.009\\ \hline 9.000\,(9)\end{array}\qquad \begin{array}{r}7.25\\ \times 4\\ \hline 29.00\,(29)\end{array}\qquad \begin{array}{r}500\\ \times 0.009\\ \hline 4.500\,(5)\end{array}$$

Rounding the Answer

Note in the last example that the first number after the decimal point in the answer is 5. Instead of the answer remaining 4.5, it becomes the next whole number, which is 5. This would be true if the answer were 4.5, 4.6, 4.7, 4.8, or 4.9. In each case, the answer would become 5. If the answer were 4.1, 4.2, 4.3, or 4.4, the answer would remain 4.

When the first number after the decimal point is 5 or above, the answer becomes the next whole number. When the first number after the decimal point is less than 5, the answer becomes the whole number in the answer.

Multiply the following:

a. 1200 × 0.009 = ______

b. 575 × 0.02 = ______

c. 515 × 0.02 = ______

d. 510 × 0.04 = ______

Multiplying a Decimal by a Decimal

1. Multiply the problem as if the numbers were both whole numbers.
2. Count the decimal places in the answer, starting from the right, to equal the total of the decimal places in both of the numbers that are multiplied.

EXAMPLE

$$\begin{array}{r}3.75\\ \times\ 0.5\\ \hline 1.875\end{array}$$

There are two decimal places in 3.75 and one decimal place in 0.5, which means that the answer should have a total of three decimal places. Count three decimal places from the right.

Multiplying Numbers With Zero

EXAMPLES

1. Multiply 223 by 40.
   a. Multiply 223 by 0. Write the answer (0) in the unit column of the answer.
   b. Then multiply 223 by 4. Write this answer in front of the 0 in the product.

$$\begin{array}{r}223\\ \times\ 40\\ \hline 8920\end{array}$$

2. Multiply 124 by 304.
   a. First, multiply 124 by 4. The answer is 496.
   b. Now multiply 124 by 0. Write the answer (0) under the 9 in 496.

c. Multiply 124 by 3. Write this answer in front of the 0 in the product.

$$\begin{array}{r} 124 \\ \times\ 304 \\ \hline 496 \\ 3720 \\ \hline 37{,}696 \end{array}$$

DIVIDING DECIMALS

1. If the divisor (i.e., the number by which you divide) is a decimal, make it a whole number by moving the decimal point to the right of the last figure.
2. Move the decimal point in the dividend (i.e., the number inside the bracket) as many places to the right as you moved the decimal point in the divisor.
3. Place the decimal point for the quotient (i.e., the answer) directly above the new decimal point of the dividend.

EXAMPLES

$$0.25\overline{)10} = 25\overset{40.}{\overline{)1000.}}$$

$$0.3\overline{)99.3} = 3\overset{331.}{\overline{)993.}}$$

$$0.4\overline{)1.68} = 4\overset{4.2}{\overline{)16.8}}$$

CHANGING DECIMALS TO COMMON FRACTIONS

1. Remove the decimal point.
2. Place the appropriate denominator under the number.
3. Reduce to lowest terms.

EXAMPLES

$$0.2 = \frac{2}{10} = \frac{1}{5}$$

$$0.2 = \frac{20}{100} = \frac{1}{5}$$

Change the following:

a. 0.3 = _____

b. 0.4 = _____

c. 0.5 = _____

d. 0.05 = _____

e. 0.25 = _____

f. 0.50 = _____

g. 0.75 = _____

h. 0.002 = _____

CHANGING COMMON FRACTIONS TO DECIMAL FRACTIONS

Divide the numerator of the fraction by the denominator.

EXAMPLE

$$\frac{1}{4} \text{ means } 1 \div 4 \text{ or } 4\overset{0.25}{\overline{)1.00}}$$

Change the following:

a. ½ means ______

b. ⅙ means ______

c. ⅔ means ______

d. ¾ means ______

e. 1⁄50 means ______

PERCENTS

Objective

4. Convert percents to fractions, percents to decimals, decimal fractions to percents, and common fractions to percents.

DETERMINING THE PERCENT THAT ONE NUMBER IS OF ANOTHER

1. Divide the smaller number by the larger number.
2. Multiply the quotient by 100, and then add the percent sign.

EXAMPLE

A certain 1000-part solution is 10 parts drug. What percent of the solution is drug?

$$1000\overset{0.01}{\overline{)10.00}}$$

$0.01 \times 100 = 1.$ or 1%

CHANGING PERCENTS TO FRACTIONS

1. Omit the percent sign to form the numerator.
2. Use 100 for the denominator.
3. Reduce the fraction.

EXAMPLES

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

$$75\% = \frac{75}{100} = \frac{3}{4}$$

Change the following:

a. $25\% = \frac{25}{100} =$ _____

b. $15\% = \frac{15}{100} =$ _____

c. $10\% = \frac{10}{100} =$ _____

d. $20\% = \frac{20}{100} =$ _____

e. $50\% = \frac{50}{100} =$ _____

f. $2\% = \dfrac{2}{100} =$ _____

g. $12\frac{1}{2}\% = \dfrac{12.5}{100} =$ _____

h. $\frac{1}{4}\% = \dfrac{\frac{1}{4}}{100} =$ _____

i. $150\% = \dfrac{150}{100} =$ _____

j. $4\% = \dfrac{4}{100} =$ _____

CHANGING PERCENTS TO DECIMAL FRACTIONS

1. Omit the percent signs.
2. Insert a decimal point two places to the left of the last number, or express the number as hundredths as a decimal.

EXAMPLES

$5\% = 0.05$

$15\% = 0.15$

Change the following:

a. 4% = ______
b. 1% = ______
c. 2% = ______
d. 25% = ______
e. 50% = ______
f. 10% = ______

Note that, in these examples, those numbers that were already hundredths (i.e., 10%, 15%, 25%, 50%) merely need to have the decimal point placed in front of the first number, because they are already expressed in hundredths, whereas 1%, 2%, 4%, and 5% needed to have a zero placed in front of the number to express them as hundredths.

Change these percents to decimal fractions:

g. $12\frac{1}{2}\% =$ _____
h. $\frac{1}{4}\% =$ _____

If the percent is a mixed number, it should have the fraction expressed as a decimal. Then, change the percent to a decimal by moving the decimal point two places to the left.

CHANGING COMMON FRACTIONS TO PERCENTS

1. Divide the numerator by the denominator.
2. Multiply the quotient by 100, and then add the percent sign.

EXAMPLE

$$\frac{1}{50} = 50\overline{)1.00}^{\,0.02} = 0.02 \times 100 = 2\%$$

Change the following:

a. $\dfrac{1}{400} =$ _____

b. $\dfrac{1}{8} =$ _____

CHANGING DECIMAL FRACTIONS TO PERCENTS

1. Move the decimal point two places to the right.
2. Omit the decimal point if a whole number results.
3. Add the percent signs. (This is the same as multiplying the decimal fraction by 100 and then adding the percent sign.)

EXAMPLE

$$0.01 = 1.00 = 1\% \left(\text{or } \frac{1}{100}\right)$$

Change the following:

a. 0.05 = _____
b. 0.25 = _____
c. 0.15 = _____
d. 0.125 = _____
e. 0.0025 = _____

POINTS TO REMEMBER WHEN READING DECIMALS

1. Remember that "1." is the whole number 1. When it is written "1.0," it is still one or 1.
2. The whole number is usually written like this: 1, 2, 3, 4, and so on. (Remember, do not use trailing 0s.)
3. Can you read this one? 0.1. This is one tenth. There is one number after the decimal point.
4. Can you read this one? .1. This is also one tenth. The zero in front of the decimal point does not change its value. Thus, one tenth can be written in two ways: 0.1 and .1. (The leading 0 to the left of the decimal should be used to help prevent errors.)

RATIOS

Objective

5. Demonstrate proficiency with converting ratios to percentages and percentages to ratios, with simplifying ratios, and with the use of the proportion method for solving problems.

A ratio expresses the relationship that one quantity bears to another.

EXAMPLES

1:5 means 1 part of a drug to 5 parts of a solution.

1:100 means 1 part of a drug to 100 parts of a solution.

1:500 means 1 part of a drug to 500 parts of a solution.

A common fraction can be expressed as a ratio.

EXAMPLE

$\frac{1}{5}$ is the same as 1:5.

The ratio of one amount to an amount expressed in terms of the same unit is the number of units in the first divided by the number of units in the second. The ratio of 2 ounces of a disinfectant to 10 ounces of water is 2 to 10 or 1 to 5. This ratio may be written as 1:5.

The two numbers being compared are referred to with the use of the term *ratio.* The first term of a true ratio is always one or 1. This is the simplest form of a ratio.

CHANGING RATIO TO PERCENT

1. Make the first term of the ratio the numerator of a fraction; the denominator is the second term of the ratio.
2. Divide the numerator by the denominator.
3. Multiply by 100, and then add the percent sign.

Change the following:

a. 1:5 = _____

CHANGING PERCENT TO RATIO

1. Change the percent to a fraction, and then reduce the fraction to lowest terms.
2. The numerator of the fraction is the first term of the ratio, and the denominator is the second term of the ratio.

EXAMPLE

$$\frac{1}{2}\% = \frac{\frac{1}{2}}{100} = \frac{1}{2} \div \frac{100}{1}$$
$$= \frac{1}{2} \times \frac{1}{100} = \frac{1}{200} = 1{:}200$$

Change the following:

a. 2% = _____

b. 50% = _____

c. 75% = _____

SIMPLIFYING RATIOS

Ratios can be simplified as ratios or as fractions.

EXAMPLE

$$25{:}100 = 1{:}4 \text{ or } \frac{25}{100} = \frac{1}{4}$$

Simplify the following:

a. 4:12 = _____

b. 5:10 = _____

c. 10:5 = _____

d. 75:100 = _____

e. ¼:100 = _____

f. 15:20 = _____

g. 3:9 = ______

PROPORTIONS

A proportion shows how two equal ratios are related. This method works well because it is possible to prove that your answer is correct, and it is especially useful when working with solution concentrations.

1. Three factors are known. The fourth unknown (i.e., what you are looking for) is represented by x.
2. The first and fourth terms of a proportion are called the *extremes;* the second and third are called the *means.* The product of the means equals the product of the extremes; in other words, multiplying the first and fourth terms produces a result that is equal to the result of multiplying the second and third terms.

EXAMPLE

multiply

extreme mean mean extreme

$$1 \times 2 = 2 \times 4$$

multiply

extreme mean

Proof: 1 × 4 = 4 and 2 × 2 = 4

If you did not know one number, you could solve for it as follows:

EXAMPLE

$1{:}2 = 2{:}x$

$1x = 4$

$x = 4 \times 1 = 4$

$x = 4$

Proof: 1 × 4 = 4 and 2 × 2 = 4

Solve the following:

a. 9:x : : 5:300 = _____

b. x:60 : : 4:120 = _____

c. 5:3000 : : 15:x = _____

d. 0.7:70 : : x:1000 = _____

e. $\frac{1}{400}$:x : : 2:1600 = _____

f. 0.2:8 : : x:20 = _____

g. 100,000:3 : : 1,000,000:x = _____

h. ¼:x : : 20:400 = _____

(NOTE: x is the unknown factor. It may be a mean or an extreme, and it may be in any of the four positions in any problem.)

SYSTEMS OF WEIGHTS AND MEASURES

Objectives

6. Memorize the basic equivalents of the household and metric systems.
7. Demonstrate proficiency performing conversion of medication problems with the use of the household and metric systems.

Key Terms

household measurements (HŎWS-hōld MĔ-zhŭr-mĕnts)

metric system (MĔT-rĭk)
meter (MĒ-tŭr)
liter (LĒ-tŭr)
gram (GRĂM)
milligrams (MĬL-ĭ-grămz)
kilograms (KĬL-ĭ-grămz)

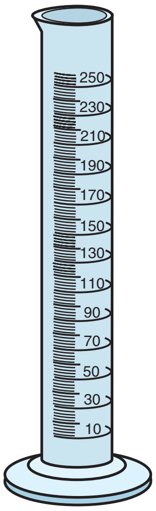


FIGURE 6-1 A graduated cylinder is used to measure the volume of liquids.

Two systems of measurement are used during the calculation, preparation, and administration of medicines: household and metric.

HOUSEHOLD MEASUREMENTS

Household measurements are often used to administer pharmacologic agents at home; however, they are less accurate. The patient has probably grown up using this system of measurement and therefore understands it best. Household measurements include drops, teaspoons, tablespoons, teacups, cups, glasses, pints, quarts, and gallons. The first three measurements—drops, teaspoons, and tablespoons—are used for medications, depending on the amount prescribed.

Common Household Equivalents

1 quart = 4 cups
1 pint = 2 cups
1 cup = 8 ounces
1 teacup = 6 ounces
1 tablespoon = 3 teaspoons
1 teaspoon = approximately 5 mL

METRIC SYSTEM

The **metric system** was invented in France during the late eighteenth century. A committee of the Academy of Sciences, working under government authority, recommended a standard unit of linear measure. For a basis of measurement, they chose a quarter of the earth's circumference as measured across the poles. One ten-millionth of this distance was accepted as the standard unit of linear measure. The committee calculated the distance from the equator to the North Pole from surveys that had been made along the meridian that passes through Paris. The distance divided by 10,000,000 was chosen as the unit of length, and this was called the *meter.*

The metric standards were adopted in France in 1799. The International Metric Convention met in Paris in 1875, and, as a result of this meeting, the International Bureau of Weights and Measures was formed. The bureau's first task was to construct an international standard meter bar and an international standard kilogram weight. Duplicates of these were made for all countries that participated in the convention.

A measurement line was selected on the international standard meter bar. The distance between the two lines of measurement on the bar is the official unit of the metric system. The standards given to the United States are preserved at the National Institute of Standards and Technology in Gaithersburg, Md. There are 25.4 millimeters (mm) in 1 inch (2.5 centimeters [cm]).

The metric system uses the **meter** as the unit of length, the **liter** as the unit of volume (Figure 6-1), and the **gram** as the unit of weight.

Units of Length (Meter)

1 millimeter = 0.001	meaning $\frac{1}{1000}$
1 centimeter = 0.01	meaning $\frac{1}{100}$
1 decimeter = 0.1	meaning $\frac{1}{10}$
1 meter = 1	meter

Units of Volume (Liter)

1 milliliter = 0.001	meaning $\frac{1}{1000}$
1 centiliter = 0.01	meaning $\frac{1}{100}$
1 deciliter = 0.1	meaning $\frac{1}{10}$
1 liter = 1	liter

Units of Weight (Gram)

1 microgram = 0.000001	meaning $\frac{1}{1,000,000}$
1 milligram = 0.001	meaning $\frac{1}{1000}$
1 centigram = 0.01	meaning $\frac{1}{100}$
1 decigram = 0.1	meaning $\frac{1}{10}$
1 gram = 1	gram

Other Prefixes

Deca- means ten or 10 times as much. *Hecto-* means one hundred or 100 times as much. *Kilo-* means one thousand or 1000 times as much. These three prefixes can be combined with the words *meter, gram,* and *liter.*

EXAMPLES
1 decaliter = 10 liters
1 hectometer = 100 meters
1 kilogram = 1000 grams

EXAMPLES

500 milligrams, 5 grams, 15 milliliters

Prefixes that are added to units (i.e., meters, liters, grams) indicate smaller or larger units. All units are derived by dividing or multiplying by 10, 100, or 1000.

Common Metric Equivalents

1 milliliter (mL) = 1 cubic centimeter (cc)
1000 milliliters (mL) = 1 liter (L)
= 1000 cubic centimeters (cc)
1000 milligrams (mg) = 1 gram (g)
1000 micrograms (mcg) = 1 milligram (mg)
1,000,000 micrograms (mcg) = 1 gram (g)
1000 grams (g) = 1 kilogram (kg)

Differentiate between metric weight and metric volume. Mark each of the following; use *MW* for metric weight or *MV* for metric volume.

a. microgram = ______
b. milliliter = ______
c. liter = ______
d. gram = ______

CONVERSION OF METRIC UNITS

The first step in calculating a drug dosage is to make sure that the drug ordered and the drug source on hand are both in the same system of measurement (preferably the metric system) and in the same unit of weight (e.g., both milligrams or both grams).

Converting Milligrams (Metric) to Grams (Metric) (1000 mg = 1 g)

Divide the number of milligrams by 1000, or move the decimal point of the milligrams three places to the left.

EXAMPLES

200 mg = 0.2 g
0.6 mg = 0.0006 g

Convert the following milligrams to grams:

a. 0.4 mg = _____ g
b. 0.12 mg = _____ g
c. 0.2 mg = _____ g
d. 0.1 mg = _____ g
e. 500 mg = _____ g
f. 125 mg = _____ g
g. 100 mg = _____ g
h. 200 mg = _____ g
i. 50 mg = _____ g
j. 400 mg = _____ g

Convert the following grams (g) to milligrams (mg):

k. 0.2 g = _____ mg
l. 0.250 g = _____ mg
m. 0.125 g = _____ mg
n. 0.0006 g = _____ mg
o. 0.004 g = _____ mg

In the following example, both the health care provider's order and the medication available are in the metric system. However, they are not both in the same unit of weight of the metric system.

EXAMPLES

The health care provider orders that the patient receive 0.25 g of a drug. The label on the bottle of medicine says 250 mg, which means that each capsule contains 250 mg of the drug.

To change the gram dose into milligrams, multiply 0.25 by 1000, and then move the decimal point three places to the right (a milligram is one thousandth of a gram). When you do this, you find that 0.250 g = 250 mg, so you would give one capsule of the drug.

Try this one: The health care provider orders the patient to have 0.1 g of a drug. The label on the bottle states that the strength of the drug is 100 mg/capsule.

To change the gram dose into milligrams, move the decimal point three places to the right. You will see that 0.1 g = 100 mg, which is exactly what the bottle-label strength states.

Solid Dosage for Oral Administration

If the dosage on hand and the dosage ordered are both in the same system and in the same unit of weight, proceed to calculate the dosage with the use of one of these methods.

EXAMPLES

A health care provider orders that a patient receive 1 g of ampicillin. The ampicillin bottle states that each tablet in the bottle contains 0.5 g.

Problem: You do not have the 1 g as ordered. How many tablets will you give? (Both the amount ordered and the amount available are in the same system of measurement [metric] and the same unit of weight [grams]).

Solution: You may use two methods.

Method 1:

$$\frac{\text{Dose desired}}{\text{Dose on hand}} = \frac{1.0\text{ g}}{0.5\text{ g}} = 2$$

(You will give two 0.5-g tablets to give the patient the 1.0 g that was ordered.)

Method 2 (Proportional):
Metric dosage ordered: drug form
Metric dosage available: drug form

means

1.0 g : x tablets :: 0.5 g : 1 tablet

extremes

(means) = (extremes)

$0.5x = 1.0\text{g}$

$x = 2$ tablets

Proof:
Product of means: 2 (value of x) × 0.5 = 1
Product of extremes: 1 × 1 = 1

If the dosage on hand and the dosage ordered are both in the same system of measurement but if they are not in the same unit of weight within the system, then the units of weight must first be converted.

EXAMPLES

The health care provider orders 1000 milligrams (metric) of ampicillin. The medication on hand contains 0.25 g (metric) per tablet.

Rule: Convert grams (metric) to milligrams (metric) (1 g = 1000 mg): Multiply the number of grams by 1000, and then move the decimal point of the grams three places to the right: 0.25 g = 250 mg.

Solution:

$$\frac{\text{Dose desired}}{\text{Dose on hand}} = \frac{1000\text{ mg}}{250\text{ mg}} = 4 \quad \text{(Give four 0.25-g tablets.)}$$

$$\frac{\text{mg}}{250} : \frac{\text{tablet}}{1} :: \frac{\text{mg}}{1000} : \frac{\text{tablet}}{x}$$

$$x = \frac{1000}{250} = 4 \text{ tablets}$$

Proof:
Product of means: 1 × 1000 = 1000
Product of extremes: 250 × 4 = (value of x) = 1000

Conversion Problems

Some students understand problems that involve tablet or capsule dosage for oral administration if they are presented with their fractional equivalents.

EXAMPLES

1. A health care provider orders that a patient receive 2 g of a drug in oral tablet form. The label on the medicine bottle states that the strength on hand is 0.5 g. This means that each tablet in the bottle is 0.5-g strength. How many tablets would be given to the patient? 1, 2, 3, 4, or 5? *Answer:* 4

   What strength is ordered? 2 g

   What strength is on the bottle label? 0.5 g

   What is the fractional equivalent of 0.5 g? ½ g

   How many ½-g (0.5-g) tablets would equal 2 g? 4

   $$2 \div \frac{1}{2} = \frac{2}{1} \times \frac{2}{1} = 4 \text{ tablets}$$

2. A health care provider orders that a patient receive 0.2 mg of a drug in oral tablet form. The label on the medicine bottle states that the strength on hand is 0.1 mg. This means that each tablet in the bottle is 0.1-mg strength.

   How many tablets would be given to the patient? 1, 2, 3, or 4? *Answer:* 2 tablets

   What strength is ordered? 0.2 mg

   What is the fractional equivalent of 0.2 mg? $\frac{2}{10}$

   What strength is on the bottle label (on hand)? 0.1 mg

   What is the fractional equivalent of 0.1 mg? $\frac{1}{10}$

   How many $\frac{1}{10}$-mg (0.1-mg) tablets would equal $\frac{2}{10}$ mg (0.2 mg)? 2

   $$\begin{array}{r l} 0.1\text{ mg} = \frac{1}{10}\text{ mg or 1 tablet} \\ +0.1\text{ mg} = \frac{1}{10}\text{ mg or 1 tablet} \\ \hline 0.2\text{ mg} = \frac{2}{10}\text{ mg or 2 tablets} \end{array}$$

   Dosage desired ÷ Dosage on hand =

   $$\text{or } \frac{2}{10} \div \frac{1}{10} = \frac{2}{\cancel{10}_1} \times \frac{\cancel{10}^1}{1} = 2 \text{ tablets}$$

3. A health care provider orders a patient to receive 0.5 mg of a drug in oral capsule form. The label on the medicine bottle states that the strength on hand is 0.25 mg. This means that each capsule in the bottle is 0.25-mg strength. How many tablets would be given to the patient? 1, 2, 3, 4, or 5? *Answer:* 2 tablets

   What strength is ordered? 0.5 mg

   What fractional equivalent equals 0.5 mg? ½ mg

   What strength is on the bottle label? 0.25 mg

   What fractional equivalent equals the strength on hand? ¼ mg

   How many ¼-mg (0.25-mg) tablets would equal ½ mg (0.5 mg)? 2

   $$\begin{array}{r l} 0.25\text{ mg} = \frac{1}{4}\text{ mg or 1 tablet} \\ +\,0.25\text{ mg} = \frac{1}{4}\text{ mg or 1 tablet} \\ \hline 0.50\text{ mg} = \frac{1}{2}\text{ mg or 2 tablets} \end{array}$$

   Dosage desired ÷ dosage on hand =

   $$\text{or } \frac{1}{2} \div \frac{1}{4} = \frac{1}{2} \times \frac{4}{1} = 2 \text{ tablets}$$

4. A health care provider orders a patient to receive 0.25 mg of a drug in oral tablet form. The label on the medicine bottle states that the strength on hand is 0.5 mg. This means that every tablet in the bottle is 0.5-mg strength.

   How many tablets would be given? ½, 1, 1½, 2, 2½, 3, 4, or 5? *Answer:* ½ tablet

   What strength did the health care provider order? 0.25 mg

   What is the fractional equivalent of the strength that the health care provider ordered? ¼ mg

   What strength is on the bottle label? 0.5 mg

   What is the fractional equivalent of the strength on the bottle label (on hand)? ½ mg

   Which is less: 0.5 mg (½ mg) or 0.25 mg (¼ mg)? 0.25 mg (¼ mg)

   Was the amount ordered more or less than the strength on hand? Less

   $$0.5\text{ mg} = \frac{1}{2}\text{ mg or 1 tablet}$$

   $$0.25\text{ mg} = \frac{1}{4}\text{ mg or half as much or } \frac{1}{2} \text{ tablet}$$

   $$\text{or } \frac{1}{4} \div \frac{1}{2} = \frac{1}{4} \times \frac{2}{1} = \frac{1}{2} \text{ tablet}$$

If the medication is also available in 0.25-mg tablets, request that size from the pharmacy. A tablet should be divided only when it is scored; even then, the practice is not advised, because the tablet often fragments into unequal pieces.

Converting Pounds to Kilograms (1 kg = 2.2 lb)

Many health care providers request that the metric measure be used to record the body weight of the patient. Because the scales that are used in many hospitals are calibrated in pounds, conversion from pounds to **kilograms** is required.

1. To convert weight from kilograms to pounds, multiply the kilogram weight by 2.2.

EXAMPLE

25 kg × 2.2 lb/kg = 55 lb

Convert the following:

a. 35 kg = _____ lb

b. 16 kg = _____ lb

c. 65 kg = _____ lb

2. To convert weight from pounds to kilograms, divide the weight in pounds by 2.2.

EXAMPLE

140 lb ÷ 2.2 kg/lb = 63.6 kg

Convert the following:

d.125 lb = _____ kg

e. 9 lb = _____ kg

f.180 lb = _____ kg

The weight of a liter of water at 40° C is 2.2 pounds.

CALCULATING DOSAGE RANGES FOR MG/KG/DAY

Acceptable doses of medications are often published in a dosage range. It is the nurse's responsibility to confirm that a dosage ordered fits within the acceptable dosage range.

EXAMPLE

A health care provider gives the following order: Administer 3 mL of amoxicillin for oral suspension, 250 mg/5 mL every 8 hours, to a child weighing 40 pounds. (The amoxicillin dosage range is 20 to 40 mg/kg/day. This dosage is to be given in divided doses every 8 hours, which is a total of three doses per day.)

Convert the child's weight in pounds to kilograms:

40 lb/(2.2 kg/lb) = 18.2 kg

Calculate the lower dosage:

20 mg × 18.2 kg = 364 mg/day

Calculate the upper dosage:

40 mg × 18.2 kg = 728 mg/day

The recommended range for this child is 364 to 728 mg/day. The drug is to be given in three divided doses.

Lower dosage: 364 ÷ 3 = 121 mg per dose

Upper dosage: 728 ÷ 3 = 243 mg per dose

The per-dosage range is 121 to 243 mg per dose every 8 hours. Amoxicillin oral suspension is available as 250 mg/5 mL. Calculate the volume to be administered:

250 mg:5 mL = 121 mg:x

x = 2.4 mL

250 mg:5 mL = 243 mg:x

x = 4.9 mL

The dosage ordered (3 mL of amoxicillin at 250 mg/5 mL) is an acceptable dose because it fits within the range of 2.4 to 4.9 mL (or 121 to 243 mg per dose). Use an oral syringe to measure 3 mL for accurate administration.

CALCULATIONS WITH OTHER FORMS OF MEASURE THAT DO NOT REQUIRE CONVERSIONS

Other forms of measure that are often used in medicine are the "unit" and the "milliequivalent." There are no conversions used with units or milliequivalent (mEq), because the medication ordered and the medication available are expressed in the same system of measurement. Units and milliequivalent quantities are stated in Arabic numbers, with the terms *units* or *mEq* placed after them. Some medications (e.g., insulin, heparin, penicillin) are measured in units and are available as a standardized quantity of drug per volume (e.g., 100 units/mL of insulin, 1000 units/mL of heparin). It is important to read each medication label carefully, because the term *unit* can vary among drugs that are measured in this manner.

EXAMPLE 1

Heparin sodium injection, USP, can be supplied as 10 units, 100 units, 1000 units, 2500 units, 5000 units, 7500 units, 10,000 units, 20,000 units, 40,000 units/mL, and 25,000 units/500 mL.

Medication Problem: Health care provider's order: Heparin sodium, 8000 units subcut q12h

Available: Heparin sodium, 10,000 units/mL

What volume of heparin will you administer? (Remember to have all heparin dosages checked by a second qualified individual in accordance with clinical policy.)

Formula: Desired amount : x (desired volume) = Drug strength available : volume

8000 units:x (desired volume) = 10,000 units:1 mL

Multiply means: (10,000 units)(x) = 10,000 units-x

Multiply extremes: (8000 units)(1 mL) = 8000 units-mL

10,000 units-x = 8000 units-mL

$$\text{Reduce: } x = \frac{8000\ \cancel{\text{units}}\ \text{mL}}{10{,}\cancel{000\ \text{units}}} = \frac{8\ \text{mL}}{10} = 0.8\ \text{mL}$$

EXAMPLE 2

Insulins: Insulins (e.g., aspart, lispro, regular, NPH, 70/30, glargine) are supplied as 100 units/mL.

Medication Problem: Health care provider's order: Regular insulin 7 units subcut at 7 AM and 12 noon + regular insulin by sliding supplemental scale based on 6:45 AM and 11:45 AM blood glucose levels.

Sliding Supplemental Scale Insulin Dosage

- Blood glucose <60 = give two glasses of orange juice; call health care provider; repeat glucose monitoring 30 minutes after giving juice
- Blood glucose ≥100-150 = no additional insulin
- Blood glucose ≥151-200 = 1 unit regular insulin
- Blood glucose ≥201-250 = 2 units regular insulin
- Blood glucose ≥251-300 = 3 units regular insulin
- Blood glucose ≥301-350 = 4 units regular insulin
- Blood glucose >350 = 5 units regular insulin, subcut; call health care provider; order blood glucose to be drawn

EXAMPLE

If the blood glucose level at 6:45 AM is 258 mg/dL, how much sliding supplemental scale insulin would be required in addition to the prescribed dose of regular insulin of 7 units daily at 7 AM?

Answer: At 7 AM, the patient would receive 7 units (daily dose) plus 3 units (sliding scale) for a total of 10 units of regular insulin.

What volume of insulin will be administered? (Remember to have all insulin dosages checked by a second qualified individual in accordance with clinic policy.)

Available: Regular insulin, 100 units/mL

Formula: Desired amount : x (desired volume) = Drug strength available : volume

10 units : x (desired volume) = 100 units:1 mL

Multiply means: (100 units)(x) = 100 units-x

Multiply extremes: (10 units)(1 mL) = 10 units-mL

100 units-x = 10 units-mL

$$\text{Reduce}: x = \frac{10 \cancel{\text{ units}} \text{ mL}}{100 \cancel{\text{ units}}} = 0.1 \text{ mL regular insulin}$$

At 11:30 AM, before lunch, the patient's glucose meter reading is 321 mg/dL. According to the sliding scale given, how much regular insulin should be given?

Answer: 11 units of regular insulin (7 units ordered + 4 units from sliding supplemental scale)

What volume of insulin will you administer? (Remember to have all insulin dosages checked by a second qualified individual in accordance with clinic policy.)

Available: Regular insulin, 100 units/mL

Formula: Desired amount : x (desired volume) = Drug strength available : volume

11 units : x (desired volume) = 100 units:1 mL

Multiply means: (100 units)(x) = 100 units-x

Multiply extremes: (11 units)(1 mL) = 11 units-mL

100 units-x = 11 units-mL

$$\text{Reduce}: x = \frac{11 \cancel{\text{ units}} \text{ mL}}{100 \cancel{\text{ units}}} = 0.11 \text{ mL regular insulin}$$

EXAMPLE 3

Procaine penicillin is supplied as 300,000 units, 500,000 units, and 600,000 units/mL.

Medication Problem: Health care provider's order: Procaine penicillin, 400,000 units IM q12h

Available: Procaine penicillin, 600,000 units/mL

What volume will you administer?

Formula: Desired amount : x (desired volume) = Drug strength available : volume

400,000 units : x (desired volume) = 600,000 units:1 mL

Multiply means: (600,000 units)(x) = 600,000 units-x

Multiply extremes: (400,000 units)(1 mL) = 400,000 units-mL

600,000x = 400,000 units-mL

$$\text{Reduce}: x = \frac{\cancel{400{,}000} \cancel{\text{ units}} \text{ mL}}{\cancel{600{,}000} \cancel{\text{ units}}} = 0.66 \text{ mL procaine penicillin}$$

EXAMPLE 4

Potassium chloride is supplied as 6, 7, 8, 10, and 20 mEq per tablet.

Medication Problem: Health care provider's order: Potassium chloride, 40 mEq PO bid

Available: Potassium chloride, 20 mEq/tablet

How many tablets will be administered per dose?

Formula: Desired amount : x (desired quantity) = Drug strength available : 1 tablet

40 mEq:x (desired quantity) = 20 mEq:1 tablet

Multiply means: (20 mEq)(x) = 20 mEq-x

Multiply extremes: (40 mEq)(1 tablet) = 40 mEq-tablet

20 mEq-x = 40 mEq-tablet

$$\text{Reduce}: x = \frac{40 \cancel{\text{ mEq}}/\text{tablet}}{20 \cancel{\text{ mEq}}/\text{tablet}} = \text{2 tablets potassium chloride}$$

(NOTE: Potassium chloride is best given with or after meals with a full glass of water to decrease gastric upset. Remind the patient not to chew or crush tablets and to swallow them whole.)

CALCULATION OF INTRAVENOUS FLUID AND MEDICATION ADMINISTRATION RATES

Objective

8. Use formulas to calculate intravenous fluid and medicine administration rates.

Key Terms

administration sets (ăd-mĭn-ĭ-STRĀ-shŭn)
drip chamber (DRĬP CHĀM-bŭr)
macrodrip (MĂ-krō-drĭp)
microdrip (MĪ-krō-drĭp)
drop factor (DF)
round (RŎWND)

INTRAVENOUS FLUID ORDERS, DRIP RATES, PUMPS, AND ROUNDING

Intravenous (IV) solutions (fluids) consist of a liquid (solvent) that contains one or more dissolved substances (solutes). The health care provider orders a specific type and volume of solution to be infused over a specific time span. (See Chapter 12 for methods of IV administration, and see Table 12-1 for a listing of common IV solutions and abbreviations.)

The order can be written in any of the following three ways:

1. 1000 mL 5% dextrose and water (D5W) to infuse intravenously over the next 8 hours
2. 1 L D5W IV over next 8 hours
3. Infuse 5% dextrose intravenously at 125 mL/hr

Administration sets that are used to deliver a specified volume of solution are different, depending on the company that manufactured the set. The administration set can have different lengths and diameters of tubing, it may involve the presence or absence of inline filters, and it can have a differing number of Y ports (sites) (see Figure 12-1).

The **drip chamber** of the administration set is either a **macrodrip,** which delivers large drops, or a **microdrip,** which delivers small drops.

Macrodrip administration sets are not standardized in terms of drops per milliliter. Commonly used volumes are 10, 15, and 20 drops per milliliter (gtt/ml). The "drops per milliliter" is called the ***drop factor*** (DF).

All microdrip chambers deliver 60 drops (gtt) per mL. The microdrip administration set is used whenever a small volume of IV solution is ordered to be infused over a specified time (e.g., in neonatal and pediatric units). In some clinical settings, a microdrip administration set is used whenever the volume of solution to infuse is less than 100 mL per hour (Figure 6-2).

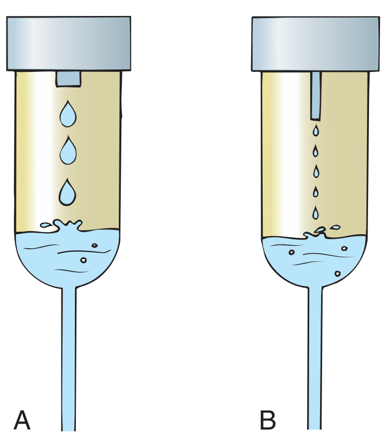


FIGURE 6-2 **A,** Macrodrip chamber. **B,** Microdrip chamber.

The box that contains the administration set always has the drop factor printed on the label.

ROUNDING

Not all calculations that are used to compute IV fluid administration rates divide out evenly; it is necessary to have a uniform way to **round** the answers to whole numbers. One method that is commonly used is to divide the numbers, carry the calculations to hundredths, and round to tenths. If the tenth is 0.5 or more, increase the answer to the next whole number. If the tenth is less than 0.5, leave the whole number at its current value.

EXAMPLES

$167.57 = 167.6 = 168$

$167.44 = 167.4 = 167$

$32.15 = 32.2 = 32$

$32.45 = 32.5 = 33$

The nurse must be able to calculate the rate for the prescribed infusion, whether it is being given as an additive in the primary IV fluid (using a secondary set called a *piggyback* or *rider setup* [see Chapter 12] with calibrated regulators) or infused by means of an electronic infusion pump.

VOLUMETRIC AND NONVOLUMETRIC PUMPS

When determining the flow rate for infusion pumps, the type of infusion pump must first be determined. Pumps are categorized as either volumetric or nonvolumetric. Volumetric pumps are set to measure the volume being infused in milliliters per hour, whereas nonvolumetric pumps are set in drops per minute. (Check the individual pump being used to see the type of calibration [mL/hr or gtt/min] printed on the display window of the pump.) (See Chapter 12 for a discussion of the types of infusion control devices.)

CALCULATION OF FLOW RATES

Milliliters per Hour (mL/hr)

To calculate flow rates, divide the total volume in milliliters (number of mL) of fluid ordered for infusion by the total number of hours that the infusion is to run. This will equal the milliliters per hour (mL/hr) that the infusion is to run.

$$\frac{\text{Number of mL}}{\text{Number of hours}} = \text{mL/hr}$$

EXAMPLE

Infuse 1000 mL lactated Ringer's (LR) solution over 10 hours

$$\frac{\text{Number of mL} = 1000\text{ mL}}{\text{Number of hours} = 10\text{ hr}} = 100\text{ mL/hr}$$

Calculate the following problems:

Health Care Provider's Order	***Duration of Infusion***	***Rate (mL/hr)***
a. 1000 mL 5% dextrose in water	12 hr	= _____ mL/hr
b. 1000 mL lactated Ringer's	6 hr	= _____ mL/hr
c. 500 mL 0.9% sodium chloride	4 hr	= _____ mL/hr

Calculating Rates of Infusion for Times Other Than 1 Hour

The nurse must be able to convert infusion rates given in minutes to milliliters per hour because volumetric pumps are calibrated in milliliters.

Using dimensional analysis, which is a technique that allows for the conversion from one unit to another, start with what is available, proceed with what is ordered, and then determine what will be calculated.

The volume to be infused that has been divided over the time is then converted to the desired rate by crossing out the units that you want to eliminate.

Calculate the following problems:

Health Care Provider's Order	***Duration of Infusion***	***Rate (mL/hr)***
a. 50 mL 0.9% NaCl with ampicillin 1 g	20 min	= _____ mL/hr
b. 150 mL D5W with gentamicin 80 mg	30 min	= _____ mL/hr
c. 50 mL 0.9% NaCl with ondansetron 32 mg	15 min	= _____ mL/hr

Drops per Minute (gtt/min)

The nurse must calculate drops per minute whenever a drug infusion is given with the use of a secondary administration set, a nonvolumetric infusion pump, or a calibrated cylinder. The formula is as follows:

$$\frac{\text{Total volume (milliliters) to infuse} \times \text{Drop factor}}{\text{Time (min)}} = \text{gtt/min}$$

$$\frac{\text{Total volume (milliliters) to infuse} \times \text{Drop factor (gtt/mL)}}{\text{Time (min)}} = \text{gtt/min}$$

$$\frac{\text{Total volume } \cancel{\text{(milliliters)}} \text{ to infuse} \times \text{Drop factor (gtt/}\cancel{\text{mL}}\text{)}}{\text{Time (min)}} = \text{gtt/min}$$

Remember that the answer, which is the number of *drops*, cannot be given as a fraction; as previously discussed, the answer must be rounded to a whole number.

EXAMPLE

31.4 gtt = 31 gtt

31.5 gtt = 32 gtt

Calculate the following problems.

Directions: Use a drop factor of 15 gtt/mL for volumes of 100 mL or more per hour; use a microdrip (60 gtt/mL) for volumes of less than 100/hr. (NOTE: Whenever a microdrip is used, milliliters per hour equals drops per minute, so no calculations are needed.)

Health Care Provider's Order	***Duration of Infusion***	***Rate (gtt/min)***
a. 125 mL D5W	60 min	= _____ gtt/min
b. 100 mL lactated Ringer's	60 min	= _____ gtt/min
c. 50 mL 0.9% NaCl	20 min	= _____ gtt/min

It is important to always label the numbers with appropriate units during the calculation to keep track of what the answer means. Cross out the values that are alike in the numerator and the denominator to end up with the desired answer.

DRUGS ORDERED IN UNITS PER HOUR OR MILLIGRAMS PER HOUR

Health care providers may order certain medicines to be administered in units per hour (units/hr) or in milligrams per hour (mg/hr). Drugs that are ordered in this way are administered by means of an electronic infusion pump. The formula is as follows.

Set up a proportion:

Total units or milligrams of drug added : Total volume of solution = Ordered amount of drugs in units or mg/hr : x (volume of solution)

EXAMPLE

Administered as units/hr

Approach 1: Health care provider's order: mix 10,000 units of heparin in 1000 mL D5W; infuse 80 units per hour. What volume of solution should be administered per hour?

10,000 units:1000 mL = 80 units/hr : x mL

Multiply the means:
1000 mL × 80 units/hr = 80,000 mL - units/hr.

Multiply the extremes: 10,000 units × x = 10,000 units-x.

10,000 units-x = 80,000 mL – units/hr

Divide both sides of equation by number with x.

$$\frac{10{,}000 \text{ units-}x}{10{,}000 \text{ units}} = \frac{80{,}000 \text{ mL} - \text{units/hr}}{10{,}000 \text{ units}}$$

$$\frac{\cancel{10{,}000 \text{ units}}\text{-}x}{\cancel{10{,}000 \text{ units}}} = \frac{\cancel{80{,}000} \text{ mL} - \cancel{\text{units}}\text{/hr}}{\cancel{10{,}000 \text{ units}}}$$

x = 8 mL/hr

Set infusion pump at 8 mL per hour to deliver 80 units of heparin per hour.

Approach 2: Health care provider's order: Mix 25,000 units of heparin in 250 mL D5W; infuse 800 units per hour. What volume of solution should be administered per hour?

25,000 units:250 mL : 800 units/hr:x mL

Multiply the means: 250 mL × 800 units/hr = 200,000 mL-units/hr

Multiply the extremes: 25,000 units × x = 25,000 units-x.

25,000 units-x = 200,000 mL-units/hr

Divide both sides of the equation by the number associated with x.

$$\frac{25{,}000 \text{ units-}x}{25{,}000 \text{ units}} = \frac{200{,}000 \text{ mL} - \text{units/hr}}{25{,}000 \text{ units}}$$

$$\frac{\cancel{25{,}000 \text{ units}}\text{-}x}{\cancel{25{,}000 \text{ units}}} = \frac{\cancel{200{,}000} \text{ mL} - \cancel{\text{units}}\text{/hr}}{25\cancel{,000 \text{ units}}}$$

x = 8 mL/hr

Set the infusion pump at 8 mL/hr to deliver 800 units of heparin per hour.

EXAMPLE

Administered as mL/hr.

The health care provider could order the number of milliliters of heparin per hour rather than specifying the order in units per hour.

Mix 10,000 units heparin in 1000 mL D5W; infuse at 15 mL/hr. How many units of heparin are being delivered per hour?

10,000 units:1000 mL = x units:15 mL/hr

Multiply the means: 1000 mL × x = 1000 mL x

Multiply the extremes: 10,000 units × 15 mL/hr = 150,000 U-mL/hr.

1000 mL x = 150,000 units-mL/hr

Divide both sides of equation by number with x.

$$\frac{1000 \text{ mL-}x}{1000 \text{ mL}} = \frac{150{,}000 \text{ units-mL/hr}}{1000 \text{ mL}}$$

$$\frac{\cancel{1000 \text{ ml}}\text{-}x}{\cancel{1000 \text{ ml}}} = \frac{150\cancel{,000} \text{ units-}\cancel{\text{ml}}\text{/hr}}{1\cancel{000 \text{ ml}}}$$

Reduce: x = 150 units/hr

EXAMPLE

Administered as milligrams/hr

Health care provider's order: Mix 500 mg dopamine in 500 mL of D5W/0.45% NaCl to infuse at 30 mg/hr. What volume of solution should be administered per hour?

500 mg:500 mL = 30 mg/hr:x volume

Multiply the means: 500 mL × 30 mg/hr = 15,000 mL-mg/hr

Multiply the extremes: 500 mg × x = 500 mg-x

500 mg-x = 15,000 mL-mg/hr

Divide both sides of the equation by the number associated with x.

$$\frac{500 \text{ mg-}x}{500 \text{ mg}} = \frac{15{,}000 \text{ mL-mg/hr}}{500 \text{ mg}}$$

$$\frac{\cancel{500 \text{ mg}}\text{-}x}{\cancel{500 \text{ mg}}} = \frac{15\cancel{,000} \text{ mL-}\cancel{\text{mg}}\text{/hr}}{5\cancel{00 \text{ mg}}}$$

Reduce: x = 30 mL/hr

Set infusion pump at 30 mL/hr.

EXAMPLE

Administered as mcg/kg/hr

Health care provider's order: Mix 500 mg dopamine in 500 mL of D5W to infuse at 4 mcg/kg/min IV. The patient weighs 150 pounds. What volume of solution should be administered per hour?

Conversions: 150 pounds = 68.18 kg

Calculate the dosage per minute first: 4 mcg/kg/min × 68.18 kg = 272.73 mcg/min

Convert mcg/min to mcg/hr: 272.73 mcg/min × 60 min = 16,363.8 mcg/hr

Convert mcg/hr to mg/hr: 16,363.8 ÷ 1000 = 16.36 mg/hr

Calculate the flow rate: 500 mg:500 mL = 16.36 mg:x mL

x = 16.36 mL/hr

To infuse 4 mcg/kg/min, set the rate at 16.36 mL/hr.

Calculate the following problem:

a. Health care provider's order: Regular insulin 100 units in 100 mL normal saline (NS) infused at 15 units/hr = _____ mL/hr

FAHRENHEIT AND CENTIGRADE (CELSIUS) TEMPERATURES

Objective

9. Demonstrate proficiency performing conversions between the centigrade and Fahrenheit systems of temperature measurement.

Key Terms

centigrade (SĔN-tĭ-grād)
Celsius (SĔL-sē-ŭs)
Fahrenheit (FĂR-ĕn-hīt)

It is necessary for the nurse to be familiar with both the centigrade and the Fahrenheit scales of temperature measurement.

1. The centigrade and Fahrenheit scales differ from each other in the way that they are graduated.
   a. On the **centigrade (Celsius)** scale, the point at which water freezes is marked "0°."
   b. On the **Fahrenheit** scale, the point at which water freezes is marked "32°."
   c. The boiling point for water in centigrade is 100° C.
   d. The boiling point for water in Fahrenheit is 212° F.

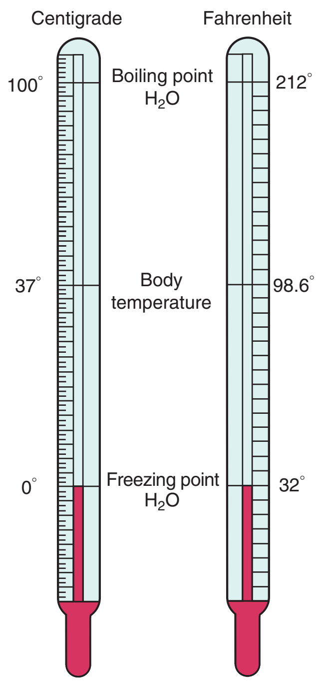


FIGURE 6-3 Clinical thermometers.

2. The value of graduations (degrees) on the centigrade thermometer differs from the value of degrees on the Fahrenheit thermometer (Figure 6-3).
   a. Using the centigrade scale, there are 100 increments (degrees) between the 0° point (i.e., the freezing point of water) and the 100° point (i.e., the boiling point of water).
   b. Using the Fahrenheit scale, there are 180 spaces (degrees) between the freezing and boiling points of water.
3. To convert readings from the centigrade scale to the Fahrenheit scale, the centigrade reading is multiplied by 180/100 or 9/5 and then added to 32.
4. To convert a Fahrenheit reading to the centigrade scale, subtract 32 from the Fahrenheit reading, and then multiply by 5/9 (100/180).

FORMULA FOR CONVERTING FAHRENHEIT TEMPERATURE TO CENTIGRADE TEMPERATURE

$$(\text{Fahrenheit}-32)\times\frac{5}{9}=\text{Centigrade}$$

$$(F-32)\times\frac{5}{9}=C$$

EXAMPLE

Change 212° F to ° C.

$$(F-32)\times\frac{5}{9}=C$$

$$212-32=180$$

$$180\times\frac{5}{9}=\frac{900}{9}=100°\text{ C.}$$

Convert the following Fahrenheit temperatures to centigrade:

a. 98.6° F = _____ ° C

b. 102.4° F = _____ ° C

c. 95.2° F = _____ ° C

FORMULA FOR CONVERTING CENTIGRADE TEMPERATURE TO FAHRENHEIT TEMPERATURE

$$\left(\text{Centigrade}\times\frac{9}{5}\right)+32=\text{Fahrenheit}$$

$$\left(C\times\frac{9}{5}\right)+32=F$$

EXAMPLE

Change 100° C to ° F.

$$\left(C\times\frac{9}{5}\right)+32=F$$

$$\left(100\times\frac{9}{5}\right)+\frac{900}{5}=180$$

$$180+32=212°\text{ F}$$

Convert the following centigrade temperatures to Fahrenheit:

a. 37° C = _____ ° F

b. 35° C = _____ ° F

c. 41° C = _____ ° F

Try these problems that involve converting centigrade to Fahrenheit and Fahrenheit to centigrade.

d. The nurse takes the following temperatures with Fahrenheit clinical thermometers: patient A, 104° F; patient B, 99° F; patient C, 101° F. The health care provider asks what the centigrade temperature is for each patient. Work your problems to convert Fahrenheit temperatures to centigrade temperature, and then check your answers.

e. The nurse takes the following temperatures with centigrade clinical thermometers: patient D, 37° C; patient E, 37.8° C; patient F, 38° C. The health care provider asks what the Fahrenheit temperature is for each patient. Work your problems to convert centigrade temperature to Fahrenheit temperatures, and then check your answers.

Most larger hospitals currently use electronic thermometers that give direct centigrade or Fahrenheit readings.

Get Ready for the NCLEX® Examination!

Additional Learning Resources

SG Go to your Study Guide for additional Review Questions for the NCLEX® Examination, Critical Thinking Clinical Situations, and other learning activities to help you to master this chapter's content.

evolve Go to your Evolve Web site (http://evolve.elsevier.com/Clayton) for the following FREE learning resources:

- Animations
- Appendices
- Drug dosage Calculators
- Drugs@FDA (catalog of FDA-approved drug products)
- Gold Standard Patient Teaching Handouts in English and Spanish
- Interactive Drug Flashcards
- Interactive Review Questions for the NCLEX® Examination and more!

Answers to Practice Questions

Working With Fractions

a. $5/100 = 1/20$ (take out 5)
b. $3/21 = 1/7$ (take out 3)
c. $6/36 = 1/6$ (take out 6)
d. $12/44 = 3/11$ (take out 4)
e. $2/4 = 1/2$ (take out 2)

Adding Common Fractions

a. $5/8$
b. $1\,3/28$

Adding Mixed Numbers

a. $4/4 = 1$
b. $6/6 = 1$
c. $34/50 = 17/25$

Subtracting Fractions

a. $1/8$
b. $1/300$

Subtracting Mixed Numbers

a. $9/24 = 3/8$
b. $3\,13/16$

Multiplying a Whole Number by a Fraction

a. $3/2 = 1\,1/2$
b. $9/1 = 9$

Multiplying Mixed Numbers

a. $5/6$
b. $75/32 = 2\,11/32$

Fractions as Decimals

a. 0.01
b. 0.625
c. 0.5

Rounding the Answer

a. $1200 \times 0.009 = 10.8 = 11$
b. $575 \times 0.02 = 11.5 = 12$
c. $515 \times 0.02 = 10.3 = 10$
d. $510 \times 0.04 = 20.4 = 20$

Changing Decimals to Common Fractions

a. $0.3 = 3/10$
b. $0.4 = 4/10 = 2/5$
c. $0.5 = 5/10 = 1/2$
d. $0.05 = 5/100 = 1/20$
e. $0.25 = 25/100 = 1/4$
f. $0.50 = 50/100 = 1/2$
g. $0.75 = 75/100 = 3/4$
h. $0.002 = 2/1000 = 1/500$

Changing Common Fractions to Decimal Fractions

a. $1/2$ means $1 \div 2 = 0.5$
b. $1/6$ means $1 \div 6 = 0.166$ or 0.17
c. $2/3$ means $2 \div 3 = 0.66$ or 0.7
d. $3/4$ means $3 \div 4 = 0.75$ or 0.8
e. $1/50$ means $1 \div 50 = 0.02$

Changing Percents to Fractions

a. $25\% = 25/100 = 1/4$
b. $15\% = 15/100 = 3/20$
c. $10\% = 10/100 = 1/10$
d. $20\% = 20/100 = 1/5$
e. $50\% = 50/100 = 1/2$
f. $2\% = 2/100 = 1/50$
g. $12\,1/2\% = 12.5/100 = 125/1000 = 1/8$
h. $1/4\% = \frac{1}{4}/100 = 0.25/100 = 25/10{,}000 = 1/400$
i. $150\% = 150/100 = 1\,1/2$
j. $4\% = 4/100 = 1/25$

Changing Percents to Decimal Fractions

a. $4\% = 0.04$
b. $1\% = 0.01$
c. $2\% = 0.02$
d. $25\% = 0.25$
e. $50\% = 0.5$
f. $10\% = 0.1$
g. $12\,1/2\% = 12.5\%$ or 0.125
h. $1/4\% = 0.25\%$ or 0.0025

Changing Common Fractions to Percents

a. $1/400 = 0.0025 \times 100 = 0.25\%$
b. $1/8 = 0.125 \times 100 = 12.5\%$

Changing Decimal Fractions to Percents

a. $0.05 = 5\%$
b. $0.25 = 25\%$
c. $0.15 = 15\%$
d. $0.125 = 12.5\%$
e. $0.0025 = 0.25\%$

Changing Ratio to Percent
a. $1:5 = \frac{1}{5} = 0.2 \times 100 = 20\%$

Changing Percent to Ratio
a. $2\% = \frac{2}{100} = \frac{1}{50} = 1:50$
b. $50\% = \frac{50}{100} = \frac{1}{2} = 1:2$
c. $75\% = \frac{75}{100} = \frac{3}{4} = 3:4$

Simplifying Ratios
a. $4:12 = \frac{4}{12}$ or $\frac{1}{3}$
b. $5:10 = \frac{5}{10}$ or $\frac{1}{2}$
c. $10:5 = \frac{10}{5}$ or 2
d. $75:100 = \frac{75}{100}$ or $\frac{3}{4}$
e. $\frac{1}{4}:100 = \frac{\frac{1}{4}}{100}$ or $\frac{0.25}{100} = \frac{25}{10{,}000} = \frac{1}{400}$
f. $15:20 = \frac{15}{20}$ or $\frac{3}{4}$
g. $3:9 = \frac{3}{9}$ or $\frac{1}{3}$

Proportions
a. $9:x :: 5:300$
$5x = (9 \times 300)$
$5x = 2700$
$x = (2700 \div 5)$
$x = 540$

b. $x:60 :: 4:120$
$120x = (60 \times 4)$
$120x = 240$
$x = (240 \div 120)$
$x = 2$

c. $5:3000 :: 15:x$
$5x = (3000 \times 15)$
$5x = 45{,}000$
$x = (45{,}000 \div 5)$
$x = 9000$

d. $0.7:70 :: x:1000$
$70x = (0.7 \times 1000)$
$70x = 700$
$x = (700 \div 70)$
$x = 10$

e. $\frac{1}{400}:x :: 2:1600$
$2x = (\frac{1}{400} \times 1600)$
$2x = (1600 \div 400)$
$2x = 4$
$x = (4 \div 2)$
$x = 2$

f. $0.2:8 :: x:20$
$8x = (0.2 \times 20)$
$8x = 4$
$x = (4 \div 8)$
$x = 0.5$

g. $100{,}000:3 :: 1{,}000{,}000:x$
$100{,}000x = (3 \times 1{,}000{,}000)$
$100{,}000x = 3{,}000{,}000$
$x = (3{,}000{,}000 \div 100{,}000)$
$x = 30$

h. $\frac{1}{4}:x :: 20:400$
$20x = (\frac{1}{4} \times 400)$
$20x = (400 \div 4)$
$20x = 100$
$x = (100 \div 20)$
$x = 5$

Common Metric Equivalents
a. microgram = MW
b. milliliter = MV
c. liter = MV
d. gram = MW

Converting Milligrams (Metric) to Grams (Metric)
a. 0.4 mg = 0.0004 g
b. 0.12 mg = 0.00012 g
c. 0.2 mg = 0.0002 g
d. 0.1 mg = 0.0001 g
e. 500 mg = 0.5 g
f. 125 mg = 0.125 g
g. 100 mg = 0.1 g
h. 200 mg = 0.2 g
i. 50 mg = 0.05 g
j. 400 mg = 0.4 g
k. 0.2 g = 200 mg
l. 0.250 g = 250 mg
m. 0.125 g = 125 mg
n. 0.0006 g = 0.6 mg
o. 0.004 g = 4 mg

Converting Weight to Kilograms
a. 35 kg = 77 lb
b. 16 kg = 35.2 lb
c. 65 kg = 143 lb
d. 125 lb = 56.8 kg
e. 9 lb = 4.1 kg
f. 180 lb = 81.8 kg

Milliliters per Hour (mL/hr)

a. 1000 mL 5% dextrose in water	12 hr	= 83 mL/hr
b. 1000 mL lactated Ringer's	6 hr	= 167 mL/hr
c. 500 mL 0.9% sodium chloride	4 hr	= 125 mL/hr

Calculating Rates of Infusion for Times Other Than 1 Hour
a. 50 mL 0.9% NaCl with ampicillin 1 g = 50 mL/20 min = 2.5 mL/~~min~~ × 60 ~~min~~/hr = 150 mL/hr
b. 150 mL D5W with gentamicin 80 mg =150 mL/30 min = 5 mL/~~min~~ × 60 ~~min~~/hr = 300 mL/hr
c. 50 mL 0.9% NaCl with famotidine 40 mg 50 mL/15 min = 3.33 mL/~~min~~ × 60 ~~min~~/hr = 200 mL/hr

Drops per Minute
a. 125 mL/60 min = 2 ~~mL~~/min × 15 gtt/~~mL~~ = 31 gtt/min
b. 100 mL/60 min = 1.6 ~~mL~~/min × 15 gtt/~~mL~~ = 25 gtt/min
c. 50 mL/20 min = 2.5 ~~mL~~/min × 60 gtt/~~mL~~ = 150 gtt/min

Drugs Ordered in Units per Hour or Milligrams per Hour
a. 100 units/100 mL = 1 unit/mL × 15 units/hr = [because 1 unit/1 mL = 1 mL/1 unit, use the following:]
1 mL/1 ~~unit~~ × 15 ~~units~~/hr = 15 mL/hr

Formula for Converting Fahrenheit Temperature to Centigrade Temperature

a. 98.6° F = [(98.6 – 32) × $\frac{5}{9}$] = 66.6 × $\frac{5}{9}$ = 37° C
b. 102.4° F = [(102.4 – 32) × $\frac{5}{9}$] = 70.4 × $\frac{5}{9}$ = 39.1° C
c. 95.2° F = [(95.2 – 32) × $\frac{5}{9}$] = 63.2 × $\frac{5}{9}$ = 35.1° C

Formula for Converting Centigrade Temperature to Fahrenheit Temperature

a. 37° C = [37 × $\frac{9}{5}$ = $\frac{333}{5}$ = 66.6 + 32] = 98.6° F
b. 35° C = [35 × $\frac{9}{5}$ = $\frac{315}{5}$ = 63 + 32] = 95° F
c. 41° C = [41 × $\frac{9}{5}$ = $\frac{369}{5}$ = 73.8 + 32] = 105.8° F
d. patient A, 40° C; patient B, 37.2° C; patient C, 38.3° C.
e. patient D, 98.6° F; patient E, 100° F; patient F, 100.4° F.