PROGRAMMED MATHEMATICS OF DRUGS AND SOLUTIONS

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6TH EDITION

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PREFACE

It is essential that every individual involved in administering drugs to patients be aware of correct methods to calculate dosage. This book is designed both as a self-paced introductory program to the mathematics of drugs and solutions and as a refresher for knowledge previously learned. It provides a review of basic arithmetic and application of those concepts related to drugs and solutions. The book can be helpful to anyone responsible for administration of medications.

The reader's knowledge is tested at various points. A pretest is included to provide guidelines to areas of weakness in basic arithmetic. Numerous practice problems throughout the book provide an immediate measure of the reader's understanding of the concept presented. A comprehensive examination is included at the end of the book.

All drugs mentioned in the book have been reviewed for current use. Practice problems have been included directly after the concept discussed.

VIRGINIA POOLE ARCANGELO, PHD, FNP

TO THE READER

One important part of nursing practice is the correct administration of drugs and solutions to patients. In providing a person with the correct dosage, the nurse may need to do some mathematical calculations because the available drug may be stated in a different system of measurement or may be more or less than the amount that has been ordered. The goal of this book is to enable you to solve such problems.

To do this, mathematical concepts are presented in a practical way within the text. These concepts are then applied to the preparation of drugs and solutions. It is your responsibility to learn the mathematical skills necessary to administer medications accurately.

The names of drugs found in the problems and examples are currently used in practice. A section on proper selection and use of syringes is included.

This is a programmed textbook. It may be different from books you have used in the past in that the text is incomplete and broken down into small units called "frames." You will complete the text by filling in words or phrases or by answering the questions. The answers can be written in the frames. Check each answer as soon as you have written it by comparing it with the correct answer, which is found to the right of the frame you have just read. As you work through the program, use the included bookmark to cover the answer column. You need not be concerned if you make a mistake. The important thing is to go back and find your error and correct it.

This text will assist you in building on your mathematical skills and enable you to apply them to the clinical setting. Good luck.

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GLOSSARY

Ampule	small glass container for solutions; usually used for one dose then discarded
Compatible	able to mix with another substance without causing a harmful reaction
Concentration	content of contained substance in solution
Dilute	to make less concentrated
Diluent	agent used to make substance less concentrated
Electrolyte	compound that separates into charged particles when dissolved in water
Equivalent	equal in value
Generic	name of drug that identifies it by other than its trade name
Hyperalimentation	method for providing total caloric needs intra-venously for the undernourished individual
Hypertonic	greater concentration than that of a solution to which it is compared
Hypodermic	inserted under the skin
Hypotonic	lesser concentration than that of a solution to which it is compared
Isotonic	same concentration as that of a solution to which it is compared
Nomogram	representation by graph, diagram, or chart of relationship between values
Parenteral	not through the alimentary canal; i.e., subcutaneous, intramuscular, or intravenous

Precipitate	deposit separated from a solution
Proprietary	any chemical or drug used in the treatment of disease if protected against free competition by patent or copyright
	relation between two similar things
Saturated	holding all that can be absorbed
Solute	substance dissolved in solution
Solvent	liquid holding another substance in solution
Stock solution	that substance available
Unit	specifically denned amount of anything subject to measurement
U.S.P.	United States Pharmacopeia—a legally recognized compendium of standards for drugs

PRETEST

Knowledge Self-Assessment

This pretest is designed to help you assess your knowledge of and ability to work with fractions and decimals. As you proceed through the programmed text, you will need to apply this knowledge in the calculations to arrive at the proper dosage of medication to administer to your patient.

FRACTIONS

A Add the following and reduce all fractions to lowest terms:

1. $\frac{2}{3}+\frac{4}{5}=$	$\frac{10}{15}+\frac{12}{15}=\frac{22}{15}=1\frac{7}{15}$
2. $\frac{1}{3}+\frac{1}{2}+\frac{5}{6}=$	$\frac{2}{6}+\frac{3}{6}+\frac{5}{6}=1\frac{4}{6}=1\frac{2}{3}$
3. $5\frac{1}{2}+1\frac{1}{3}+4\frac{1}{4}=$	$5\frac{6}{12}+1\frac{4}{12}+4\frac{3}{12}=10\frac{13}{12}=11\frac{1}{12}$
4. $1\frac{3}{4}+5\frac{1}{2}+11\frac{1}{16}=$	$1\frac{12}{16}+5\frac{8}{16}+11\frac{1}{16}=17\frac{21}{16}=18\frac{5}{16}$
5. $\frac{3}{5}+\frac{4}{9}+\frac{7}{30}=$	$\frac{54}{90}+\frac{40}{90}+\frac{21}{90}=\frac{115}{90}=1\frac{25}{90}=1\frac{5}{18}$

B. Subtract the following and reduce all fractions to lowest terms:

1. $\frac{5}{8}-\frac{1}{3}=$	$\frac{15}{24}-\frac{8}{24}=\frac{7}{24}$
2. $2\frac{2}{3}-1\frac{3}{4}=$	$2\frac{8}{12}-1\frac{9}{12}=\frac{32}{12}-\frac{21}{12}=\frac{11}{12}$
3. $110\frac{3}{33}-35\frac{2}{3}=$	$109\frac{36}{33}-35\frac{22}{33}=74\frac{14}{33}$
4. $5\frac{3}{8}-2\frac{1}{6}=$	$5\frac{9}{24}-2\frac{4}{24}=3\frac{5}{24}$
5. $6\frac{4}{7}-2\frac{1}{3}=$	$6\frac{12}{21}-2\frac{7}{21}=4\frac{5}{21}$

C. Multiply the following and reduce all fractions to lowest terms:

1. $8 \times \frac{3}{4} =$	$\frac{8}{1} \times \frac{3}{4} = \frac{24}{4} = 6$
2. $\frac{11}{12} \times \frac{4}{5} \times 6\frac{1}{4} =$	$\frac{11}{12} \times \frac{4}{5} \times \frac{25}{4} = \frac{1100}{240} = 4\frac{7}{12}$
3. $6\frac{6}{11} \times 7\frac{1}{3} =$	$\frac{72}{11} \times \frac{22}{3} = \frac{1584}{33} = 48$
4. $36\frac{5}{6} \times \frac{5}{6} \times \frac{3}{8} =$	$\frac{36}{1} \times \frac{5}{6} \times \frac{3}{8} = \frac{540}{48} = 11\frac{1}{4}$
5. $6\frac{1}{4} \times 4 \times 3\frac{2}{5} =$	$\frac{25}{4} \times \frac{4}{1} \times \frac{17}{5} = \frac{1700}{20} = 85$

D. Divide the following and reduce all fractions to lowest terms:

1. $16 \div \frac{4}{5} =$	$\frac{16}{1} \times \frac{5}{4} = \frac{80}{4} = 20$
2. $8\frac{1}{8} \div \frac{3}{4} =$	$\frac{65}{8} \times \frac{4}{3} = \frac{260}{24} = 10\frac{20}{24} = 10\frac{5}{6}$
3. $8\frac{1}{2} \div \frac{9}{16} \div 8 =$	$\frac{7}{2} \times \frac{16}{9} \times \frac{1}{8} = \frac{272}{144} = 1\frac{128}{144} = 1\frac{8}{9}$
4. $3\frac{1}{7} \div 1\frac{7}{15} \div 2\frac{2}{7} =$	$\frac{22}{7} \times \frac{15}{22} \times \frac{7}{16} = \frac{2310}{2464} = \frac{15}{16}$
5. $50\frac{4}{5} \div 1\frac{2}{3} =$	$\frac{254}{5} \times \frac{3}{5} = \frac{762}{25} = 30\frac{12}{25}$

DECIMALS

A. Add the followings:

1. 2.8+3.4+6.0 =	12.2
2.21.35+7.06+0.03=	28.44
3. 0.002 + 31.6 + 8.6 +2.23 =	42.432
4.1.653 + 21 + 6.3 + 8.2 =	37.173
5. 200.62 + 9.4 + 0.003 + 20.1 =	230.123

B. Subtract the following:

1. 10.392 – 8.34 =	2.052

2. 20.432 – 16.66 =	3.772
3. 10.2 – 4.819 =	5.381
4.11.6 -5.078 =	6.522
5. 25.635 – 20.1 =	5.535

C. Multiply the following :

1. $8.2 \times 24.3 =$	199.26
2. $2.65 \times 0.03 =$	0.0795

3. $4.753 \times 2.564 =$	12.186692
4. $1.75 \times 0.002 =$	0.00350
5. $10.35 \times 0.41 =$	4.2435

D. Divide the following :

1. $20.3 \div 15 =$	1.3533
2. $50 \div 2.5 =$	20
3. $65 \div 2.5 =$	26

4. $80 \div 0.55 =$	145.4545
5. $2.1 \div 0.07 =$	30

PROPORTIONS

Solve for x:

1. $\frac{4}{5} = \frac{\times}{30}$	24
2. $\frac{13}{20} = \frac{\times}{5}$	3.25
3. $\frac{5}{6} = \frac{8}{\times}$	9.6

4. $\frac{1}{200} = \frac{\times}{50}$	0.25

1
Review of Arithmetic

Calculations of drugs and solutions require a basic understanding of whole numbers, fractions, and decimals. It is helpful to review this material. This section covers the basic rules for working with fractions, decimals, and percentages. It can be used as a review for those areas in which you were weak in the pretest.

1. A fraction is a part of a whole number. It consists of a numerator, which is the top number, and a denominator, which is the bottom number. In the fraction $\frac{3}{4}$, 3 is the ________________. and 4 is the _____________.	numerator denominator
2. Fractions should always be reduced to the lowest term. To do this, the numerator and the denominator are each divided by the largest number by which they are both divisible. In the fraction $\frac{8}{24}$, both the numerator and denominator are divisible by eight, so $\frac{8}{24}$ =_____________	$\frac{1}{3}$

3. To change a mixed number (a whole number and a fraction) to a fraction, the whole number is multiplied by the denominator of the fraction. This number is added to the numerator of the fraction and the sum is placed over the denominator. $2\frac{1}{6} = (2 \times \_\_\_\_) + 1.$ So $2\frac{1}{6} = \frac{}{6}$	6 13
4. To change an improper fraction (a fraction whose numerator is greater than its denominator is greater than its denominator and, therefore, whose value is greater than 1) to a mixed number, the numerator is divided by the denominator. Anything that is not further divisible is expressed as a fraction. $\frac{13}{6} = 6\sqrt{13} = \_\_\_\_\_$	$2\frac{1}{6}$
5.To add fractions with the same denominator, add the numerators and place that sum over the denominator. The answer is reduced to the lowest term if necessary. $\frac{4}{7} + \frac{2}{7} = \_\_\_\_\_$	$\frac{6}{7}$

6.To add fractions with different denominators, first find the lowest number evenly divisible by both. This is called the "lowest common denominator." Convert each fraction to the same terms by dividing the denominator into the lowest common denominator and multiplying that answer and the numerator. The answer to this is the new numerator. The numerators are then added together and placed over the lowest common denominator. In the problem $\frac{1}{6}+\frac{3}{4}$, the lowest common denominator of $\frac{1}{6}$ and $\frac{3}{4}$ is _______. Therefore, $\frac{1}{6}=\frac{\_\_}{12}$ and $\frac{3}{4}=\frac{\_\_}{12}$. So $\frac{1}{6}+\frac{3}{4}=$ _____. (The fraction should be reduced to the lowest term.)	12 2 9 $\frac{11}{12}$

7. To subtract fractions with the same denominator, subtract the numerators and place the answer over the denominator. The answer should be reduced to the lowest term. $\frac{3}{4} - \frac{1}{4} =$ ______	 $\frac{2}{4} = \frac{1}{2}$
8.To subtract fractions with different denominators, the lowest common denominator must first be found and the fractions must be converted as in frame 6. the numerators are then subtracted and placed over the lowest common denominator and reduced to the lowest term. In the problem $\frac{5}{7} - \frac{1}{3}$, the lowest common denominator of $\frac{5}{7}$ and $\frac{1}{3}$ is ______. $\frac{5}{7} = \frac{}{21}$. $\frac{1}{3} = \frac{}{21}$. So $\frac{5}{7}$ - $\frac{1}{3} =$ _____.	 21 15 7 $\frac{8}{21}$

9.To multiply fractions, multiply the numerators together. The answer is the new numerator. Then multiply the denominators; that number is the new denominator. In the problem $\frac{7}{8}\times\frac{1}{2}$, $7\times1=$ _____ $8\times2=$ ____. So $\frac{7}{8}\times\frac{1}{2}=$ ____ .	 7 16 $\frac{7}{16}$
10. To divide fractions, the division problem must be changed to a multiplication problem. Do this by inverting the divisor (the number to the right of the division sign) and then following the rule for multiplication. The answer should be reduced to the lowest term. In the problem $\frac{1}{8}\div3$, the 3 is changed to ____, and two fractions are multiplied. $\frac{1}{8}\times\frac{1}{3}=$ ____	 $\frac{1}{3}$ $\frac{1}{24}$

The following are practice problems with fractions.

11. $\frac{5}{6}+\frac{6}{6}=$	$\frac{11}{6}=1\frac{5}{6}$
12. $\frac{3}{14}+\frac{13}{14}=$	$\frac{16}{14}=1\frac{2}{14}=1\frac{1}{7}$
13. $3\frac{1}{4}+\frac{5}{6}=$	$\frac{39}{12}+\frac{10}{12}=\frac{49}{12}=4\frac{1}{12}$
14. $2\frac{5}{16}+4\frac{1}{5}=$	$\frac{185}{80}+\frac{336}{80}=\frac{521}{80}=6\frac{41}{80}$
15. $2\frac{2}{5}-\frac{3}{4}=$	$\frac{48}{20}-\frac{15}{20}=\frac{33}{20}=1\frac{13}{20}$

16. $\frac{14}{15} - \frac{2}{3} =$	$\frac{14}{15} - \frac{10}{15} = \frac{4}{15}$
17. $\frac{1}{12} \times \frac{3}{5} =$	$\frac{3}{60} = \frac{1}{20}$
18. $\frac{8}{9} \times \frac{3}{4} =$	$\frac{24}{36} = \frac{2}{3}$
19. $\frac{9}{10} \div 4 =$	$\frac{9}{10} \times \frac{1}{4} = \frac{9}{40}$
20. $\frac{7}{8} \div \frac{2}{3} =$	$\frac{7}{8} \times \frac{3}{2} = \frac{21}{16} = 1\frac{5}{16}$

21. A decimal represents a fraction whose denominator is a multiple of 10. 0.10 is the same as the fraction $\frac{1}{10}$. 0.01 is the same as the fraction ______.	$\frac{1}{100}$
22. When multiplying decimals, the two numbers are treated as whole numbers. The answer must have as many numbers to the right of the decimal point as the *total* number of decimal points in the numbers being multiplied. $3.4 \times 1.31 =$ ______ numbers to the right of the decimal point. $3.4 \times 13.31 =$ _____	3 4.454
23. To divide two decimals, the decimal point of the divisor is moved to the right until the number is a whole number. The decimal point of the dividend (the number to the left of the division sign) must be moved an equal number of places $3 \div .02 = .02\overline{)3.00}$ $2\overline{)300} =$ ____	150

The following are practice problems with decimals.

24. $3.25 \times 7.03 =$	22.8475
25. $9.12 \times 1.25 =$	11.4000
26. $12 \div 3.2 =$	$32 \overline{)120} = 3.75$
27. $4.25 \div 3.1 =$	$31 \overline{)42.5} = 1.371$
28. The term percent (%) means parts per hundred. To change a percent to a decimal, the % symbol is dropped and the number is divided by 100. 20% is the same as the decimal _______.	.20

29. When calculating with percentages, the % sign is dropped, the number is changed to a decimal, and rules pertaining to decimals are followed.

The following are practice problems using percentage.

30. 13 X 20% =	13 X .20 = 2.60
31. $6.2 \times 31\% =$	$6.2 \times .31 = 1.922$
32. $24 \div 8\% =$	$8\ \overline{)2400} = 300$

33. A ratio expresses the comparison of one number with another. A ratio expressing the relationship of three to four is written with a colon between the two numbers (3:4) or as fraction ($\frac{3}{4}$) . The ratio expressing the relationship of 7 to 8 can be written ____or _______.	7:8 $\frac{7}{8}$
34. A proportion is a statement of two ratios that are equal. An example is $\frac{1}{5}=\frac{20}{100}$. It is read, _____ is equal to 20 to 100.	1 to 5

35. One number in a proportion may be missing. The missing number is replaced by an x. For example, $\frac{2}{3}=\frac{x}{12}$. It is necessary to find the value of x. To find the value of x, cross multiply. $\frac{2}{3}=\frac{x}{12}$ $2\times 12=3x$ ____=3x x = 24 ÷ 3 x=_____	 24 8
36. Solve for x in the following problem. $\frac{3}{7}=\frac{12}{x}$ 3x=7×12 3x=____ x=____	 84 28

\

The following are practice problems for proportions

37. $\frac{1}{6} = \frac{x}{24}$	x=4
38. $\frac{4}{9} = \frac{8}{x}$	x=18
39. $\frac{3}{5} = \frac{x}{25}$	x=15

.

2
Using the Metric System

The first step in learning about the mathematics of drugs and solutions is to become familiar with the various systems and units used in measuring drugs and solutions. The first of these systems is the *metric* system of weights and measures. The metric system was developed in France in the latter part of the eighteenth century and is used in most European countries. Today, the metric system is utilized in hospitals throughout the United States. In the metric system, fractional quantities (i.e., less than one) are expressed as decimals. For example, one-half is written as 0.5. In this system, the unit of length is the meter (hence "metric").

The units used in measuring medication are (1) weight—the kilogram, the gram, and the milligram; and (2) volume—the liter and the milliliter or the cubic centimeter. (Although the milliliter and the cubic centimeter are not exactly equal, the difference is so slight that the terms are used interchangeably).

This chapter will examine the relationships between these units for weight and volume and will show how quantities are expressed within the framework of the metric system.

1. When administering medications to the patient, one of hree systems of measurements will be used. The first of these that we will discuss is the international decimal system called the <u>metric system.</u> The ________ ________ metric system is the international decimal system of weights and measures.	metric system
2. In the metric system, fractions are expressed as decimals. In the decimal system, the fraction one-half is written as 0.5. Four-tenths is written as __________.	0.4
3. The unit of weight in the metric systme is expressed in terms of the gram (g). The _________ is said to be the unit of weight in the metric system.	gram
4. In the metric system, five grams is written 5.0 ghrams or 5.0g. Ten grams is written as 10.0 g or __________ __________.	10.0 grams

5. The prefix "kilo" indicates 1,000.0. A kilogram (kg) is ___________grams.	 1,000.0
6. To change kilograms to grams, multiply the number of kilograms by 1,000 or move the decimal three places to the right. Thus: 5.0 kilograms (kg) x 1,000 = 5,000.0 grams (g) or 5.0 kilograms (kg) = 5.000 = 5,000.0 grams (g) 10.0 kg =___________g	10,000.0
7. 400.0 kg = 400,000.0 g 25.0kg=____________g	25,000.0
8. 2.0 kg = ___________g	2,000.0

9. To change grams to kilograms, divide the number of grams by 1.000 or move the decimal three places to the left. Thus: 1,000.0 g - 1,000 = 1.0 kg or 1,000.0 g=l 000.0 =1.0 kg 4,000.0 g=___________kg	4.0
10. 60.0 g = 0.006 kg 75.0 g = __________kg	0.075
11. 750.0g = __________kg	0.75
12. 3.5 kg = __________g	3500
13. 1800 g = __________kg	1.8
14. 0.5 kg = __________g	500
15. 750 g = __________kg	0.75

16. The prefix <u>mill!</u> indicates one one-thousandth of the unit. A milligram (mg) is __________ g.	one one-thousandth
17. One one-thousandth gram may also be written __________ g.	0.001
18. 4.0 mg = 0.004 g 13.0 mg = __________g	0.013
19. 230.0 mg = __________g	0.23
20. To change grams to milligrams, <u>multiply</u> the nur grains by <u>1.000</u> or move the decimal three places to <u>right.</u> 3.0 g x 1,000 = 3,000.0 mg or 3.Og= 3.000= 3,000.0 mg 2.0 g = _________mg	 2,000.0

21. 15.0 g = 15,000.0 mg	35,000.0
22. 1.5 g = __________mg	1,500.0
23. To change grams to milligrams, <u>multiply</u> the number of grains by <u>1.000</u> or move the decimal three places to the <u>left.</u> Thus : 1,200.0 mg ÷1,000=,1.2 g or 1,200.0 mg = 1 200.0 = 1.2 g 50.0 mg = ___________g	0.05
24. 14.0 mg = 0.014 g 100.0 mg = ___________g	0.10
25. 250.0 mg = ___________g	0.25
26. 8.0 mg = ___________g	0.008

27. 750.0 mg = __________g	0.75
28. 10.0 g = __________ mg	10,000.0
29. 3.0 g = __________mg	3,000.0
30. Volume in the metric system is expressed in terms of the liter. The __________ is the unit of volume in the metric system.	Liter
31. The liter and the milliliter (ml) are most frequently used. You will recall that the prefix milli means one one-thousandth of a unit. Here the prefix milli indicates __________ __________ of a liter.	one one-thousandth
32. One milliliter (ml) and one cubic centimeter (cc) are considered equivalent. Therefore, 10.0 ml and _______ cc can be used interchangeably.	10.0

33. To change liters to milliliters (ml) multiply the number of liters by 1.000 or move the decimal three places to the right. Thus: 2.0 liters x 1,000 = 2,000.0 ml (or cc) or 2.0 liters = 2.000 = 2,000.0 ml (or cc) 10.0 liters = _______ ml (or cc)	10,000.0
34. 15.0 liters = 15,000.0 ml (or cc) 33.0 liters = __________ml (orcc)	33,000.0
35. 4.0 liters = __________ml (or cc)	4,000.0
36. To change milliliters (or cubic centimeters) to liters, divide the number of milliliters by 1.000 or move the decimal three places to the left. Thus: 1,500.0 ml ÷ 1,000 = 1.5 liters or 1,500.0 ml = 1 500.0 = 1.5 liters 15.0 cc=___________liters	0.015

37. 18.0 cc = 0.018 liters 250.0 cc = ___________liters	0.25
38. 965.0 cc = ___________liters	0.965
39. 0.25 liters = ___________ ml	250.0
40. 4.0 liters = ___________ ml	4,000.0
41. 500.0 ml = ___________liters	0.5
42. 1,320.0 ml = ___________liters	1.32
43. 154.0 cc = ___________ liters	0.154
44. 1.75 liters = ___________ cc	1,750.0

3
Using Household Measurements

Household measurements are those commonly used in everyday home situations. You will recognize these measurements as those used in recipes and on supermarket items. Household measurements are not as accurate as those of the metric and the apothecaries' systems and, therefore, are not used to pour medications when either of the other systems is available. If you examine spoons, cups, and glasses in your own home, it will be evident to you that there is considerable variation in capacity. It may be that the household measurement is the only one you have available when working in a home situation or that it is the easiest system to use in patient teaching. These household measurements are familiar to the patient, and there are situations in which the measurements can be used with safety, such as "normal saline solution" for a gargle.

1. Household measurements are not as accurate as metric or apothecaries' system measurements and therefore are not used as frequently in medicine. However, the home-care nurse often will find accurate measures not available and must use what is available. Household measures are not as desirable as metric or pothecaries' measures because they are less __________.	accurate
2. Sixty drops (gtt) are considered one teaspoonful (t).60 gtt (drops) = 1 t (teaspoonful). (t). 60 gtt (drops) = 1 t (teaspoonful). Therefore, 120 gtt = _____ t	2
3. 5 t = 300 gtt 3 t = ___________ gtt	180
4. 30 gtt = ______ t	$\frac{1}{2}$
5. 4 t = __________gtt	240

6. 240 gtt = __________t	4
7. 90 gtt = __________t	$1\frac{1}{2}$
8. 2 t = __________gtt	120
9. Three teaspoonfuls (t) equal one tablespoonful (T). 3 t (teaspoonfuls) = 1 T (tablespoonful) 9t = __________T	3
10. 6 T = 18 t 4 T = __________t	12
11. 6 t = __________T	2
12. 3 T = __________t	9

13.9 t = __________T	3
14.2 T = __________t	6
15. Two tablespoonfuls (T) equal one fluid ounce. 2 T = 1 ounce (the word fluid is usually omitted) 4 T = ______ ounces	2
16. 5 ounces = 10 T 4 ounces = __________T	8
17. 12 T = __________ounces	6
18. 3 T = __________ ounces	$1\frac{1}{2}$
19. 6 ounces = __________ T	12
20. 12 T = __________ ounces	6

21. 2 ounces = ___________ T	4
22. Eight fluid ounces equal one cupful. 8 ounces = 1 cupful 16 ounces = ______ cupfuls.	2
23. 10 cupfuls = 80 ounces. 3 cupfuls = ___________ ounces.	24
24. 48 ounces = ___________ cupfuls	6
25. 12 pimces = ___________ cupfuls	$1\frac{1}{2}$
26. 3 cupfuls = ___________ ounces	24
27. 6 cupfuls = ___________ ounces	48
28. 48 ounces = ___________ cupfuls	6

29. Two pints (pt) equal one quart (qt). 2 pt (pints) = 1 qt (quart) Therefore, 4 pt = _____ qt	2
30. 5 qt = 10 pt 3 qt = __________ pt	6
31. 10 qt = __________ pt	20
32. 4 quarts = __________ pints	8
33. 12 pints = __________ quarts	6
34. 2 quarts = ___________ pints	4
35. 1 pint = __________ quart (s)	$\frac{1}{2}$

4
Mastering Equivalents

By definition, an equivalent is a given quantity that is considered to be of equal value to a quantity expressed in a different system. In comparing the metric, the apothecaries', and the household systems, a unit of one system never exactly equals a unit of another system. For example, while 1 ounce is exactly 29.5729 grams, in working dosage problems, you will round off to the nearest whole number. Hence, 30 grams is the approximate equivalent of 1 ounce.

By using the approximate equivalent in computation, you will obtain a slightly different answer than if you used the exact equivalent; however, a difference of 10% or less is considered legitimate.

Because these three systems of weights and measures are currently used in the United States, it is most important that you thoroughly understand each of the systems and be able to convert from one to another accurately and without hesitation.

1. There will be times when the three measurement systems will have to be used interchangeably. The order for the drug may be in metric terms, and the method of measurement available in __________ or __________ systems,	apothecaries' household
2. An equivalent is an amount in one system that may be substituted for a like amount in another system. However, the __________ may not be exactly equal to the original measure.	equivalent
3. For example, 1.0 g is exactly equal to 15.432 grains. In computing dosages of medications, however, you will substitute 15 grains for 1.0 grams when necessary. We can say that grains .15 is the __________ of 1.0 grams,	equivalent

4. When it is. necessary to convert from one system to another, it doesn't matter if the desired dose or the on-hand dose is the one that is converted. It is simpler to convert the desired dose to that on hand; therefore, in this text we will convert the __________ __________ to the dose on hand.	desired dose
5. In computing dosages of medications, 30.0 grams is considered the equivalent of one ounce (3i). Therefore, we can say _____ g is 3i	30.0
6. To change grams to ounces, divide the number of grams by 30. grams - 30 = __________	ounces

7. Example: In 60.0 grams there are how many ounces? grams $\div 30$ = ounces 60.0g $\div 30$=_____ounces	2
8. Example: How many ounces are in 150.0 grams? 150.0 g $\div 30$ = __________ ounces	5
9. How many ounces are in 30 grams? 30 g $\div 30$ =__________ ounces	1
10. How many ounces are in 135 grams? 135 g $\div 30$=_________ounces	$4\frac{1}{2}$
11. To change <u>ounces</u> to <u>grams,</u> multiply the number of ounces by 30. ounces x 30 = __________	grams

12. Example : How many grams are in 4 ounces? Ounces x 30 = grams $34 \times 30 =$ ___________	120.0
13. Example: How many grams are in $6\frac{1}{2}$ ounces? $36\frac{1}{2} \times 30 =$ ____________	195.0
14. How many grams are in 3 ounces? 33x30=__________	90.0
15. How many grams are in 20 ounces? 320x30=___________	600.0
16. 40.0 g= 3___________	$1\frac{1}{3}$
17. 70.0 g=3___________	$2\frac{1}{3}$

18. 38 = ___________g	240
19.310 = ___________ g	300
20. 561=____________g	1,830
21. 30.0 cc is considered the equivalent of 1 ounce. In converting from metric to apothecaries' systems you should consider ___________ cc as being equal to 3i.	30.0
22. To change <u>cc</u> to <u>ounces,</u> divide the number of cc by 30. cc÷ - 30 = ___________	ounces
23. Example: 240.0 cc is how many ounces? cc ÷- 30 = ounces 240.0 cc - 30 = 3 ___________	8

24. Example: How many ounces are there in 180.0 cc? 180.0 cc $\div$ 30 = 3 __________	6
25. How many ounces are in 60.0 cc? 60.0 cc-30 =3___________	2
26. How many ounces are in 1,000.0 cc? 1,000.0 cc $\div$ 30= 3 ____________	$33\frac{1}{3}$
27. To change <u>ounces</u> to <u>cc</u> multiply the number of ounces by 30. ounces x 30 = ___________	cc
28. Example: A four-ounce bottle holds how many cc? ounces x 30 = cc $34 \times 30 =$ ___________ *cc*	120.0

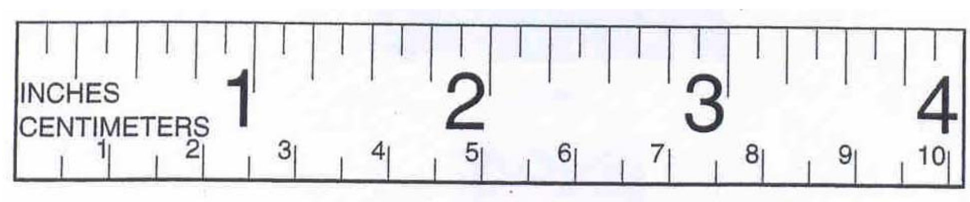
29. Example: How many cc are in 10 ounces? 310x30=__________ cc	300.0
30. How many cc are in 6 ounces? 36x30=___________cc	180.0
31. How many cc are in 2— ounces? $32\frac{1}{2} =$ __________ *cc*	75.0
32. 15.0cc=3__________	$\frac{1}{2}$
33. 10.5 cc = 3 __________	$3\frac{1}{2}$
34. 330 = __________ cc	900
35. $3 - 4\frac{1}{2} =$ __________ *cc*	135

36. 5 cc=___________3	0.167
37. 315=____________cc	0.5
38. In computing dosages for some medications, weight in kilograms is used. A kilogram is equivalent to 2.2 pounds. Therefore, we can say 2.2 pounds is equivalent to __________ kilogram (kg)	1
39. To change <u>pounds</u> to <u>kilograms,</u> divide the number of pounds by 2.2. pounds ÷2.2 =___________	kilograms
40. Example: How many kilograms are in 220 pounds? pounds - 2.2 = kg 220 pounds ÷2.2 =__________ kg	100.0

41. Example: How many kilograms are in 15 pounds? 15 pounds $\div$2.2 = ________ kg	6.8
42. How many kilograms are in 44 pounds? 44 pounds $\div$2.2 = _________ kg	20
43. How many kilograms are in 198 pounds? 198 pounds $\div$2.2 = _________kg	90
44. To change kilograms to pounds. multiply the number of kilograms by 2.2. kilograms x 2.2 = __________	pounds
45. Example: How many pounds are equivalent to 60 kilograms? kilograms x 2.2 = pounds 60 kg x 2.2 = _________ pounds	132

46. Example: How many pounds are equivalent to 20 kilograms? 20 kg x 2.2 = _____ pounds	44
47. How many pounds are equivalent to 500 kilograms? 500 kg x 2.2=_________pounds	1100
48. How many pounds are equivalent to 9 kilograms? 9 kg x 2.2=___________pounds	19.8
49. 132 pounds = _______ kg	60
50. 72kg=____________pounds	158.4
51. 78kg=____________pounds	171.6
52. 30 kg = _____ pounds	66

53. 84 pounds =__________kg	38.18
54. 100 pounds = __________ kg	45.45



55. The metric equivalent of 1 inch is 2.54 cm. To change inches to cm. multiply by __________.	2.54
56. To change cm to inches, you must __________by 2.54.	divide
57. How many cm is 3 $3\frac{1}{2}$ inches? $3\frac{1}{2} \times 2.54 =$ __________ 1 3- x 2.54 =	8.89 cm
58. How many cm is $\frac{1}{2}$ inch? $\frac{1}{2}$ x 2.54=__________	1.27cm

59. How many inches is 3 cm? 3 $\div$2.54 =___________	1.18 inches
60. How many inches is 12 cm? 12$\div$2.54=___________	4.72 inches
61. 3.25 inches =___________cm	8.26
62. 16 inches = ___________ cm	40.64
63. 21cm=___________inches	8.27
64. 1 cm = ___________ inches	0.39

65. It may be necessary to change a temperature from Celsius (°C) scale to Fahrenheit (°F) scale. To convert a Celsius (°C) reading to Fahrenheit (°F), use the formula: $°F = \frac{9}{5}\ °C + 32°$ If the °C reading is 37°, the °F is $\frac{9}{5}\ (37°)+32°=$___________.	98.6°F
66. A Celsius temperature of 50° is __________°F.	122
67. To change a temperature from Fahrenheit (°F) to Celsius (°C), use the formula: $°C = \frac{5}{9}(°F-32°)$ If the temperature is 100°F, the °C temperature is $\frac{5}{9}(100°-32°) =$_________.	38°C
68. A temperature of 160° F would be __________°C.	71.1

69. 94°F = ___________°C	34.4
70. 72°C=___________°F	161.6
71. 57°C=___________°F	134.6
72. 20°F=____________°C	-6.7
73. 98.6°F=____________°C	37

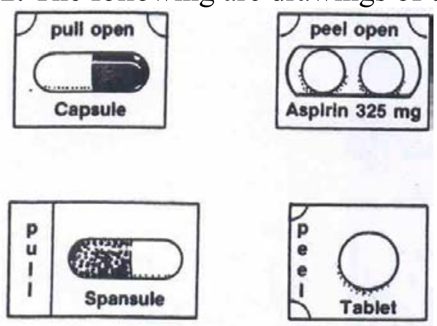
5
Reading Drug Labels

It is important when dispensing medications to **carefully** read and understand the drug label. Drugs are packaged in several forms: multidose packages and unit dose packages (one dose per package).

Two names generally appear on the label: the trade name and the generic name. The trade name is that name given to the drug by the pharmaceutical company that produces it. The generic name is the general name of a drug with a certain chemical composition. Drugs can be referred to by either the trade name or the generic name.

The label of the drug and the written order must be compared and determined to be a match before the drug is dispensed to the patient.

(Courtesy of Bristol-Myers Squibb Company. Used with permission.)

1. Drugs are packaged in several ways. These include __________ and __________.	Multiple dose; unit dose
2. The following are drawings of unit dose packages:  (Borrowed with permission from Henke G. Med-Math: Dosage Calculation, Preparation, and Administration, 3rd ed. Philadelphia: 1999:49.) In each package, there is __________ dose.	One

<table>
<tr>
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3. The following is an example of a label on a multiple dose package:

(Courtesy of Knoll Pharmaceutical Company. Used with permission.)

Each multiple dose container
contains __________ doses.
The important information on the drug label is circled and labeled.

</td>
<td>many</td>
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4. Drugs are labeled with the __________ name and the __________ name

</td>
<td>generic;
trade</td>
</tr>
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<td>

5. The trade name has an ® after it. The trade name of the drug is ___________.

</td>
<td>Synthroid</td>
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6. Also written on the label is the generic name. The generic name of the drug is _____________.	Levothyroine sodium
7. The strength of the drug is __________ mg.	0.1
8. Read the following label:  (Copyright Eli Lilly and Company. Used with permission.) The trade name is _________.	Keflex
9. The generic name is ————————.	Cephalexin
10. The strength is __________.	250 mg

11. Read the following label:  The generic name of the drug is __________.	Cefixime
12. The trade name of the drug is __________.	Suprax
13. The strength of the drug is ________________.	100 mg per 5 ml
14. The bottle contains __________ ml.	100

6
Calculating Oral Medication Dosage

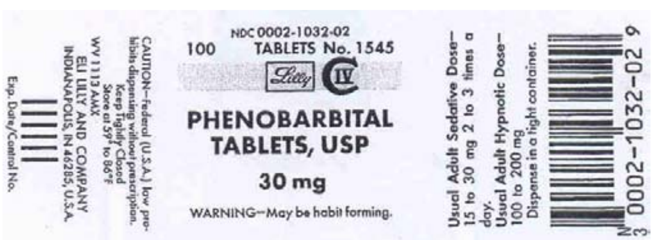
The most common method of administering medications is by mouth. This is considered the safest method and is usually the easiest for the patient. Medications that are given p.o. (Latin *per os*—by mouth) come in varied forms: pills, tablets, capsules, powders, and liquids.

The dose of medication that is available is frequently different from the dose to be given. Therefore, it is necessary to calculate how many or what part of the oral medication must be given in order to administer the correct dose. Many tablets are scored so that they can be easily broken into halves or quarters. Medications that are soluble in water may be dissolved to divide the dose.

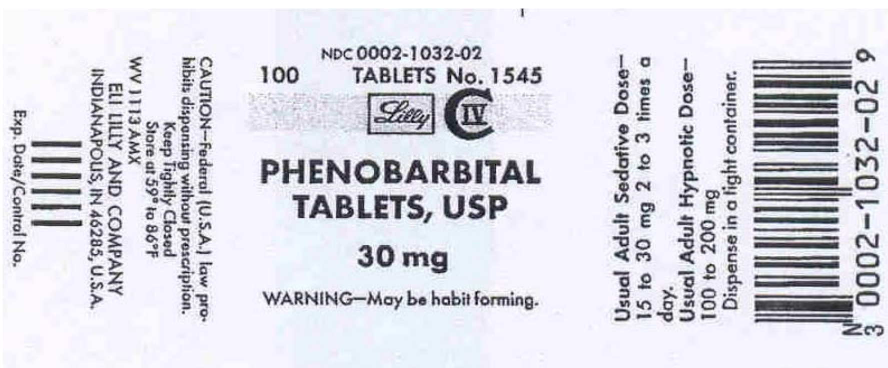
1. In preparing to administer oral medications, you may find that the prescribed dose is different from what is available. When the size of the prescribed ___________ and that of the medication on hand are not the same, you must determine how much of the available medication should be given.	dose
2. If the size of the tablet on hand is larger than the prescribed dose, less than one ___________ will be needed.	tablet
3. If the size of the tablet on hand is smaller than the prescribed dose, ___________ than one tablet will be used	more
4. To calculate the part of a tablet to be used or the ___________ ___________ ___________ you should use the formula given in frame 5.	number of tablets

5. Formula: <u>Desired dose</u> <u>D</u> On-hand dose H The desired dose (D) is the __________ of medication prescribed.	amount or quantity
6. To solve the formula $\frac{D}{H}$ the quantity D is __________ by the quantity H.	divided
7. Example: The order is for 10 rag of glipizide (Glucatrol). On hand is: glipizide (Glucatrol) 5 mg. How many of the tablet(s) would you use? Use the formula $\frac{D}{H}$ and substitute known values: $\frac{?mg}{?mg}$	$\frac{10mg}{5mg}$
8. $\frac{D}{H} =$ $\frac{10mg}{5mg} = 10mg \div 5mg =$__________ of the 5 mg tablets will be used.	2

9. Another way to solve the formula $\frac{D}{H}$ is to reduce the fraction to its lowest terms: $\frac{D}{H} = \frac{500mg}{250mg} = \frac{?}{?}$	2 mg 1 mg
10. $\frac{2}{1} =$ ____________ of the 250-mg tablets will be used.	2
11. You should use the method that you find easiest, or use the two __________ interchangeably.	methods
12. Example: The order is for furosemide (Lasix) 20 mg. On hand is: furosemide (Lasix) 40 mg tablet. $\frac{D}{H} = \frac{?mg}{?mg}$ Substitute the known values.	20 40

13. $\frac{D}{H} \_ 20\frac{20mg}{40mg} = \frac{1}{2}$ mg or __________ tablet of furosemide (Lasix) 40 mg will be used.	$\frac{1}{2}$
14. Using the alternative method: $\frac{D}{H}$ $\frac{20mg}{40mg} = 20mg \div 40mg =$ __________ tablet(s) of furosemide (Lasix) 40 mg will be used.	$\frac{1}{2}$
15. The order is for phenobarbital 60 mg.On hand is:  (Copyright Eli Lilly and Company. Used with permission.) $\frac{D}{H} = \frac{?\,mg}{?\,mg}$ (Substitute the known values)	60 30

16. $\frac{D}{H}\frac{60mg}{30mg} = 2$ or __________ tablets (s) of phenobarbital 30 mg wil be used	2
17. From the following container give 15 mg of phenobarbital. ____________________	$\frac{1}{2}$ tablet



(Copyright Eli Lilly and Company. Used with permission.)

18. From dipyridamole (Persantine) 25 mg, give 50 mg. __________	$\frac{D}{H} = \frac{50mg}{25mg} = 2tables$
19. From digoxin (Lanoxin) 0.25 mg, give 0.125 mg.	$\frac{D}{H} = \frac{0.125mg}{0.25mg} = \frac{1}{2}$ tablet

20. From propranolol hydrochloride (Inderal) 10 mg, give 40 mg.	$\frac{D}{H} = \frac{40mg}{10mg} = 4tables$
21. From the following container give  	$\frac{D}{H} = \frac{750mg}{250mg} = 3$ capsules
22. When liquids are ordered, use the formula: $\frac{Desireddose}{On - handdose} \times Volume$ $\frac{D}{H} \times V$. The container is labeled according to the amount of the drug in a given volume of the liquid. In this case the amount of drug in a given volume will be the _____ of the formula $\frac{D}{H} \times V$.	D

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23. This is the label for cefixime (Suprax):

Sample—For educational use only.

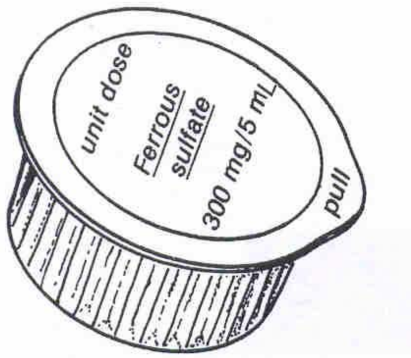
(Courtesy of Lederle Pharmaceutical Division of American Cyanamid Company. Used with permission.)

How will you give 250 mg ?

$$\frac{D}{H} \times V = \frac{250mg}{100mg} \times 5cc =$$

__________ cc v.
</td>
<td>12.5</td>
</tr>
<tr>
<td>
24. The label indicates that there are 125 mg of amoxicillin (Amox) per 5 cc. How will you give 250 mg?

$\frac{D}{H} \times V = \frac{250mg}{125mg} \times 5cc =$ __________ cc will be given.
</td>
<td>10</td>
</tr>
</table>

25. From:  (Borrowed with permission from Henke G Med-Math : Dosage Calculation, Preparation, and Administration, 3rd ed. Philadelphia : 1999: 49.) Give 450 mg.	$\frac{D}{H}\times V=\frac{450mg}{300mg}\times 5ml=7.5ml$
26. From:  (Courtesy of Lederle Pharmaceutical Division of American Cyanamid Company. Used with permission.) Give 250 mg	$\frac{D}{H}\times V=\frac{250mg}{100mg}\times 5ml=12.5ml$

7
Selecting a Syringe for Parenteral Injections

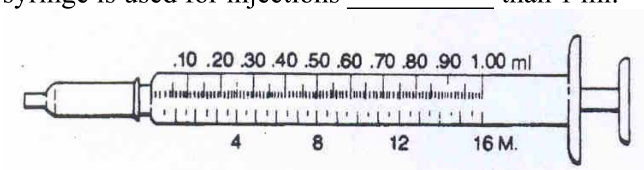
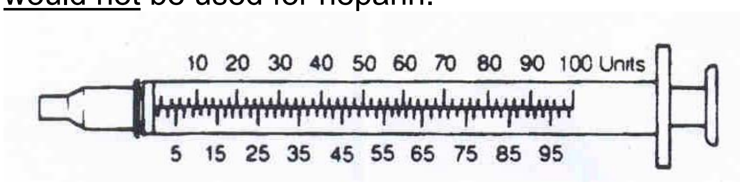
Many medications are given parenterally, that is, by injection— subcutaneously, intramuscularly, or intradermally. Three types of syringes are used: tuberculin, insulin, and hypodermic. The syringe selected is determined by the route and the amount of drug to be given.

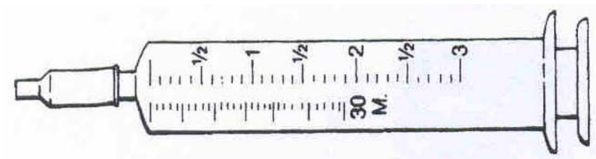
Insulin syringes are especially designed for use with U-100 insulin and are calibrated in 1-unit measures.

The tuberculin syringe is a narrow 1-ml syringe. It is calibrated in $\frac{1}{10}$ and $\frac{1}{100}$-ml units on one side and minims on the other side.

The hypodermic syringe comes in various sizes. The most commonly used size is a 3-ml syringe calibrated in $\frac{1}{10}$-ml increments on one side and minims on the other side.

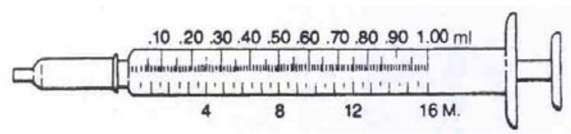
In this chapter, you will learn which syringe is appropriate to use to administer a given drug.

1. You should select a syringe to use depending on the quantity of solution to be given, the drug, the route, and the body size. To determine which syringe to use, you must calculate the ___________ of the solution.	quantity
2. The tuberculin syringe is a narrow 1-ml syringe. It is marked off in $\frac{1}{10}$ ml, $\frac{1}{100}$ ml, and minims. The tuberculin syringe is used for injections __________ than 1 ml. 	less
3. The insulin syringe is a narrow 1.0ml or 0.5-ml syringe marked off in single units. It is used <u>only</u> for insulin that contains 100 units/ml. The insulin syringe <u>would/ would not</u> be used for heparin. 	would not

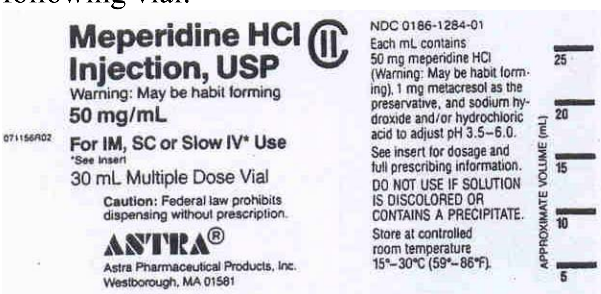
4. The hypodermic syringe most commonly used is a 3-ml syringe. It is marked off in $\frac{1}{5}$ ml, 10ml marked off in $\frac{1}{5}$ ml, 20 mlmarked off in 1-ml in crements, 30 ml marked off in increments of 1 ml, and 50 ml marked off in increments of 1 ml.  The hypodermic syringe also comes in sizes of 5 ml marked off in $\frac{1}{5}$ ml, 10 ml marked off in $\frac{1}{5}$ ml, 20 ml marked off in 1-ml increments, 30 ml marked off in increments of 1 ml, and 50 ml marked off in increments of 1 ml.	hypodermic
5. Needle gauges vary. The higher the gauge number, the smaller the needle. For instance, a 2 5-gauge needle is __________ than a 21-gauge needle.	smaller

6. The lengths of needles also vary, from $\frac{3}{8}$ inch to. A 25 – gauge needle, $\frac{1}{2}\, to\, \frac{5}{8}$ inch long, is used for a subcutaneous injection since only the subcutaneous layer is to be penetrated. To give a subcutaneous injection, the nurse would use a ____________ gauge, __________-inch needle.	25 $\frac{1}{2}\, or\, \frac{5}{8}$
7.The tuberculin syringe has a 26- to 2 7-gauge needle, $\frac{3}{8}\, to\, \frac{5}{8}$ inch long, for intradermal injections. The tuberculin syringe with its small needle would be used for __________ injections. The hypodermic syringe has a needle of 18 to 22 gauge and is 1 to $1\frac{1}{2}$ inches in length. The needle size to be used is determined by the viscosity of the medication and the size of the patient.	intradermal

8. If a medication for intramuscular injection is drawn up in a tuberculin syringe because it is a quantity less than 1 ml, the needle must be chan If it is for an intramuscular injection, the needle would be changed to a(n) ___________-gauge, __________-inch needle.	18- to 22 1 to $1\frac{1}{2}$
9. Some medications come in prefilled cartridges that are inserted into special holders in order to be able to inject them. These are called Tubex or Carpuject. If these are used, read the manufacturer's directions.	
10. Now let's determine which syringe to use for the following orders. Heparin 5,000 units SC is ordered. The vial contains 20,000 units per ml. How much would you need? $\frac{D}{H} \times V =$ __________ Fill in the proper numbers and complete the problem.	$\frac{5000units}{20000units} \times 1ml = .25ml$

11. In the preceding problem, a(n) __________ syringe would be used. The needle must be changed to a(n) _____ -gauge, __________ inch needle to give a subcutaneous injection	tuberculin 25 $\frac{1}{2} or \frac{5}{8}$
12. Mark the point to which the medicine amount in question 10 should be drawn up to in the syringe: 	

13. The order reads 25 units Humulin N insulin SC in A.M. The vial contains Humulin N 100 units/ml. A(n) __________ syringe would be used and __________ units of insulin drawn into the syringe.	insulin 25

14. Hydroxyzine 75 mg IM is ordered. The vial reads 100 mg/2 ml. A(n) _______________ syringe would be used and __________ ml drawn into the syringe.	3-ml hypodermic 1.5
15. Meperidine 25 mg IM is ordered. You have the following vial:  (Reproduced with permission of Astra Pharmaceuticals, L.P., 50 Otis St., Westborough, MA 01581-4500.) a (n) __________ syringe wih needle changed to __________ gauge would be used and __________ml given.	tuberculin 18- to 22- 1 to $1\frac{1}{2}$ inches long .50

16. The order reads: "Meperidine 75 mg IM." The vial contains 100 mg/ml. What syringe and needle would be used and how much medicine given?	Use a tuberculin syringe and change the needle to an 18 – to 22 gauge needle, 1 to $1\frac{1}{2}$ inches long $\frac{D}{H}\times V=\frac{75mg}{100mg}\times 1ml=\frac{3}{4}\times 1ml=\frac{3}{4}ml$
17. The order reads "Atropine sulfate 0.4 mg IM." The vial contains 1 mg/ml. What syringe and needle would be used and how much medicine given ?	Use a tuberculin syringe and change the needle to an 018- to 22- gauge needle, 1 to $1\frac{1}{2}$ inches long $\frac{D}{H}\times V=\frac{0.4mg}{1mg}\times 1ml=0.4ml$
18. The order reads hydroxyzine hydrochloride 50 mg. The vial contains 50 mg/ml. What syringe and needle would be used and how much medicine given?	Use a 3-ml hypodermic syringe with an 18- to 22- gauge needle , 1 to $1\frac{1}{2}$ inches long $\frac{D}{H}\times V=\frac{50mg}{50mg}\times 1ml=1ml$

19. The order reads: "Humulin regular insulin 20 units SC." On hand is a vial with Humulin regular 100 units/ml. What syringe would be used and how much medicine given?	Use an insulin syringe and draw 20 units of insulin
20. The order reads: "Cimetidine 300 mg IM." The drug comes 300 mg/2 ml. What syringe would be used and how much medicine given?	Use a 3-ml hypodermic syringe and draw 2 ml of medication

8
Calculating Injectable Liquid Dosage

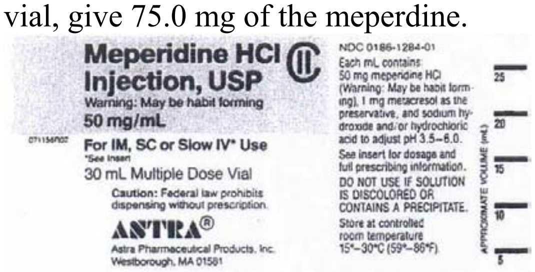
There are many drugs that can be stored safely in liquid form. These drugs are packaged in ampules (single-dose) or vials (single-dose or multiple-dose) and are labeled according to the amount of the drug in the ampule or in a fractional part of the vial; for example, meperidine hydrochloride 50 mg (ampule), or meperidine hydrochloride 50 mg/cc (multidose vial). These drugs are administered parenterally.

Should the order for the medication and the drug that is available differ in dosage, you will use the formula discussed in this chapter to determine the quantity of solution to be given. Remember, as in working all dosage problems, two systems of weights and measures cannot be used in one problem without first converting the units to a common system.

1. Drugs for hypodermic injection are often kept in solutions of various strengths. These drugs are packaged in ampules or vials. An ampule holds a single dose, while a vial holds more than one dose. If you have four doses packaged together in one container, this container is called a __________.	vial
2. The container will be labeled with the amount of drug in the ampule or the fractional part of the vial. A vial labeled gr $\frac{1}{4}$ per cc would contain gr $\frac{1}{4}$ of the drug in each __________ of solution	cc
3. When the prescribed dose and the label on the ampule are the same, you should withdraw __________ of the solution in the ampule.	all

4. You are to give 50.0 mg of a drug in a vial labeled 50.0 mg per cc. You should withdraw __________ cc of solution from the vial.	1.0
5. When the prescribed dose differs from the label, you must determine how much of the ___________ must be used to give the prescribed dose.	solution
6. To determine the amount of solution required, use the following formula: $\frac{D}{H} \times V = x$ In this formula: D stands for _______________. H stands for _______________. V stands for the volume on hand *x* stands for the desired volume.	desired dose dose on hand

7. Example: The vial is labeled "Ceftriaxone 1 gm/4 ml." Give 125 mg. $\frac{D}{H} \times V = x$ $\frac{125mg}{1000mg} \times 4ml = x$ 0.125 x 4 ml =x x = ___________	0.5 ml of the ceftriazone will be given
8. Example: The vial is labeled " Prochlorperazine: 5.0 mg per ml." How would you give 8.0 mg of the drug? $\frac{D}{H} \times V = x$ $\frac{8.0mg}{?} \times ? = x$	5.0 mg 1.0 ml

9. $\frac{8.0mg}{5.0ng} \times 1.0ml =$ Finish the calculation and label the answer.	1.6 x 1 ml = 1.6 ml of prochlorperazine will be needed to give 8.0 mg
10. From a streptomycin solution containing 500.0 mg in 1.0 ml, give 400.0 mg.	$\frac{D}{H} \times V = x$ $\frac{400.0mg}{500.0mg} \times 1ml = \times$ 0.8 x 1.0 ml = x X = 0.8 ml of the streptomycin solution in 1.0 ml is needed to give streptomycin 400.0 mg
11. From a medication from the following vial, give 75.0 mg of the meperdine.  (Reproduced with permission of Astra Pharmaceuticals, L.P., 50 Otis St., Westborough, MA 01581-4500.)	$\frac{D}{H} \times V = x$ $\frac{75.0mg}{50.0mg} x1ml = x$ 1.5 X 1.0 ml = x x= 1.5 ml of meperdine solution 50.0 mg per 1 ml will be used to give meperdine 75.0 mg

12. Give chlorpromazine 0.050 g from a solution labeled 25.0 mg per ml.	0.050 g = 50.0 mg $\frac{D}{H} \times V = x$ $\frac{50.0mg}{25.0mg} \times 1.0ml = x$ 2 x 1.0 ml =x x = 2.0 ml of chlorpromazine solution labeled 25.0 mg/ml is needed to give 0.050 g
13. From hydroxyzine 100 mg per 2 ml, give 75 mg.	$\frac{D}{H} \times V = x$ $\frac{75mg}{100mg} \times 2ml = x$ 0.75 x 2 ml =x x = 1.5 ml of hydroxyzine solution of 100 mg per 2 ml is required to give 75 mg
14. From digitoxin 0.2 mg/ml, give 0.3 mg.	$\frac{D}{H} \times V = x$ $\frac{0.3mg}{0.2mg} \times 1.0ml = x$ 1.5 x 1.0 ml=x x = 1.5 ml of digitoxin 0.2 mg/ml equals 0.3 mg

9
Administering Drugs Measured in Units

The strength of certain medications is measured in units. A unit is a specifically denned amount of anything subject to measurement. The unit is denned for each drug and there is no *relationship* between the strength of a unit of one drug and a unit of another drug. A unit of heparin cannot be compared to a unit of penicillin. It is also important to note that cubic centimeters and units are not interchangeable.

Insulin is an example of a medication that is measured in units. It is supplied in vials with 100 units per ml. The least complicated and most accurate way to measure insulin is to use an insulin syringe. This is a special 1.0-ml syringe calibrated to measure units rather than cubic centimeters and minims.

When you do not have an insulin syringe to give insulin, you can measure the dose by using a tuberculin syringe or an ordinary 3.0-ml hypodermic syringe. The quantity of insulin to be given is calculated by using the formula presented in this chapter and is measured in minims or cubic centimeters.

The formula (which is the same basic formula you have used before) can be used to calculate the dose of any drug that is measured in units.

1. Many biologicals are supplied in vials containing a specified number of units per cubic centimeter of the solution. A vial labeled 1,500 units per cc would contain __________ units of the drug in each cc of the solution.	1,500
2. The potency of the unit of each product is denned by the United States Pharmacopeia. The unit may also be called a U.S.P. __________.	unit
3. These drugs are ordered according to the number of __________ to be given.	units
4. When the vial is labeled 1,500 U.S.P. units (or 1,500 units) per cc, _____ cc of solution will be withdrawn to give 1,500 units.	1.0

5. When the prescribed dose differs from what is on hand, the correct dose must be calculated as to how much of the __________ must be given	solution
6. Again use the basic formula: Desired dose $\frac{(D)}{(H)} \times V(Volume)$ On-hand dose Example: The order is for 4,500 units of tetanus antitoxin. The- label on the vial is "Tetanus Antitoxin: 1,500 units per milliliter." How much solution will be needed? We will work together step by step: $\frac{D}{H} \times V = \frac{4{,}500 units}{?} \times 1 ml$	1,500 units
7. $\frac{D}{H} \times V = \frac{4500 ml}{1500 unitsperml} \times 1 ml$ $\frac{45}{15} \times 1 ml =$ __________ of tetanus antitoxin solution containing 1,500 units per ml will be needed to give 4,500 units of tetanus antitoxin.	3.0 ml

8. Example: Using a penicillin solution containing 100,000 units in 1.0 cc, give 40,000 units of the drug. $\frac{D}{H} \times V =$ ___________ Substitute values and complete calculations. Label answer.	$\frac{40{,}000 units}{100{,}000 units} \times 1cc =$ $\frac{4}{10} \times 1cc = 0.4cc$ of penicillin solution containing 100,000 units in 1.0 cc will be needed to give 40,000 units of penicillin
9. Example: The order is for 25 units of Humulin N insulin. The label on the vial reads: "Humulin N: 100 units/cc." How many cc are needed? $\frac{D}{H} \times V =$ ___________	$\frac{25 units}{100 units} \times 1cc =$ .25 x 1 cc = .25 cc of Humulin N will be needed to give 25 units

10. Example: The order is for 7,500 units of heparin sodium. The label reads: "Heparin sodium: 5,000 units/ml." How many ml are needed? $\frac{D}{H} \times V =$ ___________	$\frac{7500 units}{5000 units} \times 1ml =$ will be needed to give 7,500 units heparin sodium
11. From a vial labeled "Heparin sodium 20,000 units per ml," give 5,000 units.	$\frac{D}{H} \times V = x$ $\frac{5{,}000 units}{20{,}000 units} \times 1ml = x$ x=0.25 ml of heparin sodium solution containing 20,000 units of heparin is needed

12. Give 50,000 units of sodium penicillin-G from a vial labeled 1,000,000 units/10 ml.	$\frac{D}{H} \times V = x$ $\frac{50{,}000 units}{1{,}000{,}000 units} \times 10 ml = x$ $\frac{5}{100} x 10 ml = x$ 0.5 x 10 ml =x x=0.5 ml of sodium penicillin G solution containg 1,000,000 units / 10 ml is needed
13. Give penicillin 600,000 units from a solution labeled 3,000,000 units/ 5.0 ml.	$\frac{D}{H} \times V = x$ $\frac{600{,}000}{3{,}000{,}000} x 5 ml = x$ $\frac{6}{30} \times 5 ml = x$ 0.2 X 5 ml = x x=1.0 ml of penicillin labeled 3,000,000 units/ 5 ml is needed

14. How many cc of NPH insulin (100 units/cc) will be needed to give 60 units? 60 units ?	$\frac{D}{H} xV = x$ $\frac{60 units}{100 unis} \times 1.0 cc = x$ $\frac{6}{10} \times 1 cc = x$ x=0.6 cc of NPH insulin is needed
15. From a vial labeled "Heparin sodium 5,000 units per ml," give 3,000 units. 3,000 units.	$\frac{3{,}000 units}{5{,}000 units} \times 1 ml = x$ $\frac{3}{5} \times 1 ml = x$ x=0.6 ml of heparin sodium labeled 5,000 units per ml will be needed

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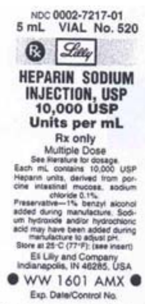
16. Give 2500 units of heparin from the following vial.



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$$\frac{D}{H} \times V = x$$

$$\frac{2500 units}{10{,}000 units} \times 1ml = x$$

$$\frac{25}{100} \times 1ml = x$$

x= 0.25 ml of heparin sodium will be needed.

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10
Preparing Drugs Packaged as Powders and Tablets

Drugs that are unstable in solution may also be packaged in dry form in ampules or vials. When you are ready to use the drug, it is dissolved in the correct diluent. Information concerning the correct diluent is packaged with the drug or can be obtained from the pharmacist or from pharmacology books. When a multi-dose vial is used, the vial must be relabeled stating the amount of drug contained in each cubic centimeter of the fluid and the date the fluid was prepared.

The formula needed to solve this type of conversion problem is presented here. This formula is used only when the amount of the drug does not increase the amount of the solution. When the drug increases the amount of the solution, specific directions as to the quantity of diluent are packaged with the drug and must be followed explicitly.

1. Certain drugs come from the pharmacy in dry powder form in a vial. The vial may contain the quantity of drug required for a single injection or may contain enough medication for several ___________.	doses
2. To determine the amount of diluent needed, a proportion must be used. The proportion formula to determine the amount of diluent needed is: $\frac{\text{Desired units}}{\text{On-hand units}} \quad \frac{\text{Desired volume}}{x\text{ volume}}$ *x* volume is the amount of diluent that will be added to the dry drug. Example: The label on a vial of powdered penicillin reads: "Penicillin: 1,000,000 U.S.P. units." The order reads penicillin 100,000 units stat and b.i.d. How many cubic centimeters of diluent will be needed to produce a solution containing 100,000 units per cc? Use the formula above: $\frac{DU}{HU} \quad \frac{V}{x}$ Substitute values: $\frac{100{,}000\,units}{1{,}000{,}000\,units} = \frac{?}{x}$	1.0cc

3. $\frac{100{,}000 \text{ units}}{} = \frac{1.0cc}{x}$ 100,000 : 1,000,000 : : 1.0 cc : x 100,000x = 1,000,000 cc x= ___________ ___________ ___________	10.0 cc of diluent will be needed to produce penicillin solution of 100,000 units/cc
4. After the diluent has been added to the vial, the vial must be labeled as to the number of units in each ___________.	cc
5. Another example: How much diluent will be needed to make a solution of 100,000 units per cc if the vial contains 2,000,000 units of dry drug? $\frac{DU}{HU} = \frac{V}{X}$ $\frac{?}{?} = \frac{1.0cc}{X}$	100,000 2,000,000

6. $\frac{100{,}000 units}{2{,}000{,}000 units} = \frac{1.0 cc}{x}$ 100,000: 2,000,000 : : 1.0 cc : x 100,000 x = 2,000,000 cc x= __________ __________ __________	20.0 cc of diluent will be needed to make a solution of 100,000 units/cc
7. Some drugs may increase the volume of the solution. The formula $\frac{DU}{HU} = \frac{V}{X}$ can be used only when the volume of the dry drug does not increase the volume of the ___________________.	solution
8. When the dry drug increases the volume of the solution, specific instructions are given by the manufacturer for the __________ of diluent to use.	amount

9. Example: Streptomycin sulfate for injection. The vial contains 1.0 g of the dry drug. Instructions: for 100 mg per cc, add 9.2 cc of diluent. 9.2 cc of diluent is added to the dry drug, which gives a total of 10.0 cc of solution, where each cc contains ___________ of the drug.	100.0 mg
10. How much diluent is required to prepare a solution of benzathine penicillin G of 500,000 units per cc when the vial contains 1,000,000 units of the dry drug?	$\frac{DU}{HU} = \frac{V}{x}$ $\frac{500{,}000 units}{1{,}000{,}000 units} = \frac{1.0 cc}{x}$ 500,000 : 1,000,000 : : 1.0 cc : x 500,000 x = 1,000,000 cc x=2.0 cc diluent is needed to prepare a solution of benzathine penicillin G 500,000 units per cc

11. Given a vial containing 750 units of a drug in dry form, how will you prepare a solution containing 150 units per cc?	$\frac{DU}{HU} = \frac{V}{x}$ $\frac{150 units}{750 units} = \frac{1.0 cc}{x}$ 150 : 750 : : 1.0 cc : x 150 x= 750.0 cc x=5.0 cc diluent is needed to prepare a solution containing 150 units of drug per cc
12. How much diluent is needed to give a solution of 25,000 units per cc if the vial contains 200,000 units of dry drug?	$\frac{DU}{HU} = \frac{V}{x}$ $\frac{25{,}000 units}{200{,}000 units} = \frac{1.0 cc}{x}$ 25,000 : 200,000 : : 1.0 cc : x 25,000 x = 200,000.0 cc x =8.0 cc diluent is needed to prepare a solultion containg 25,000 units of drug per cc

13. A vial of potassium penicillin G contains 2,000,000 units of the dry drug. How much diluent is needed to make a solution that contains 400,000 units per cc?	$\frac{DU}{HU} = \frac{V}{x}$ $\frac{400{,}000 units}{2{,}000{,}000 units} = \frac{1.0 cc}{x}$ 400,000 : 2,000,000 : : 1.0 cc: x 400,000 x = 2,000,000.0 cc x= 5.0 cc diluent is needed to prepare a solution containg 400,000 units of potassium penicillin G per cc

11
Mixing Parenteral Medications

Often, two drugs are mixed in a syringe to decrease the frequency of injection. The drugs mixed must be compatible; that is, they must not form a precipitate when mixed.

Mixing of drugs is common practice when two types of insulin are ordered or when preoperative medications are ordered.

Always check drug compatibility with the pharmacist or with a drug compatibility chart.

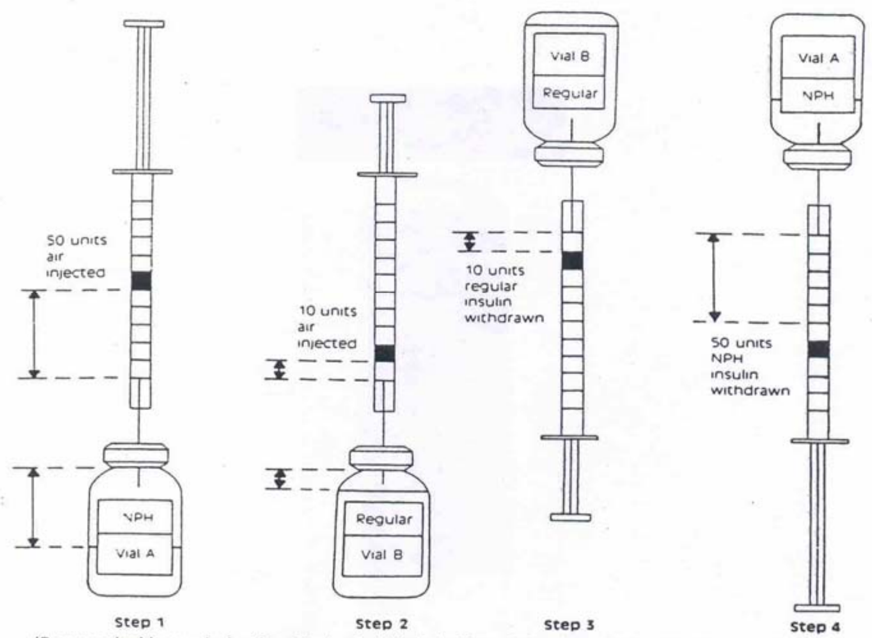
If the drugs form a precipitate when mixed, discard the mixed solution and inject each drug separately.

In this chapter, you will learn how to mix two drugs together in a syringe.

1. It is possible to mix more than one medication in the same syringe to inject into the patient. This can provide for patient comfort by <u>decreasing/increasing</u> the number of injections needed.	decreasing
2. The two medications must be checked to see that they are compatible—in other words, that they don't react to form a precipitate. If a precipitate forms, you __________ give the injection.	Cannot
3. When mixing two medications, it is important to not contaminate the medication left in one vial with the other medication. If contamination occurs, the contaminated drug must be __________.	Discarded

4. When withdrawing two drugs from two separate vials, draw air into a syringe in an amount equal to the solution being withdrawn into vial #1. Inject this air into________ _____, being careful to keep the needle out of the medication. Withdraw the needle and syringe from vial #1 without the medication.	vial 1
5.Draw air into the syringe equaling the amount of solution to be withdrawn from vial *#2* and inject this air into __________	vial 2
6. Withdraw the correct amount of solution from vial #2. Change the needle and insert the syringe with the new needle into vial #1. Withdraw the correct amount of solution and remove the needle and syringe from vial #1. The syringe has a ______________ of the medications from vials #1 and #2, but neither is contaminated.	mixture

The technique is demonstrated in the following diagram:



(Borrowed with permission from Taylor C, Lillis C, LeMone P. Fundamentals of Nursing: The Art and Science of Nursing Care. Philadelphia: Lippincott-Raven, 1997:622.)

7.If a multi-dose vial and a single dose vial first to prevent __________.	contamination

8. Example: The order reads : " Meperidine 50 mg IM, hydroxyzine 50 mg IM on call to O.R." Meperidine is packaged in a vial containing 100 mg/cc; hydroxyzine in a vial containing 50 mg/cc. Fill in the blanks. You will need __________ cc of meperidine and __________ cc of hydroxyzine	$\frac{D}{H} \times V = \frac{50mg}{100mg} \times 1cc$ = 0.5 cc meperidine $\frac{D}{H} \times V = \frac{50mg}{100mg} \times 1cc$ = 1 cc hydroxyzine
9. Use a __________________ syringe and draw up ________ cc of air and inject into the meperidine vial.	3-ml hypodermic 0.5
10. __________ the needle and syringe from the meperidine vial.	Remove

11. Draw up 1 cc of air and inject into the _______________ vial. Withdraw 1 cc of the medication and remove the needle and syringe from the hydroxyzine vial.	hydroxyzine
12. ___________ the needle and place the needle and syringe into the meperidine vial.	Change
13. Withdraw 0.5 cc of meperidine to a total of_____cc in the syringe.	1.5
14. Insulins vary in their duration of action. There are short-acting, intermediate-acting, and long-acting insulins. (Review in a pharmacology text.) Often, two insulins are ordered together. They can be mixed in the same ___________ syringe,	insulin

15. If the order reads 10 U regular insulin (short acting) and 25 U NPH (intermediate acting) SC before breakfast, and you have 100 units/cc insulin on hand, these two would be mixed in the following way: Draw 25 units of air into the syringe and inject 25 units of air into the _____ vial. Withdraw the needle and syringe from the NPH insulin vial.	NPH
16. Draw 10 units of air into the syringe and inject into the ___________ insulin vial.	Regular
17. Withdraw_____units of regular insulin from the vial and remove the needle and syringe from the regular insulin vial.	10
18. ___________ the needle.	Change

19. Insert the new needle and syringe into the NPH insulin vial and withdraw __________ units to a total of 35 units of insulin in the syringe (a mixture of 25 units NPH and 10 units regular).	25
20. *Always inject air in the longer-acting insulin vial first. Withdraw the shorter-acting insulin first, then the longer-acting insulin. If the shorter-acting insulin is accidentally injected into the vial containing the longer-acting insulin, the shorter-acting insulin will be absorbed. The longer-acting insulin cannot be absorbed by the shorter-acting insulin.* Example: The order reads 5 U regular insulin and 30 U NPH insulin in A.M. On hand is insulin with 100 units/cc. Fill in the blanks. Draw __________ units of air into the insulin syringe.	30
21. Inject the air into the ________ insulin vial and ____________ the needle and syringe from the vial.	NPH remove

22. Draw 5 units of air into the syringe and inject into the ___________ insulin vial	regular
23. Withdraw ___________units of regular insulin	5
24. Change the needle and insert the needle and syringe into the ___________ insulin vial.	NPH
25. Withdraw _____ units of NPH to a total of _____ units of insulin.	30 35

Here are a few practice problems. Go through all the steps of mixing medications in a syringe. Determine the amount of solution to be used and the type of syringe needed. Then explain how to mix the solution in the syringe. **26.** Order reads: "Meperidine 75 mg IM; hydroxyzine 25 mg IM." Meperidine comes 100 mg /ml. Hydroxyzine comes 100 mg / 2 ml.	 Use a 3 cc hypodermic syringe: Draw back $\frac{3}{4}$ ml (0.75 ml or M. 12). $\frac{D}{H} = \frac{75mg}{100mgml} = \frac{3}{4}ml$ Inject — ml into the meperidine vial and remove the needle and syringe. Draw back $\frac{1}{2}ml$. $\frac{D}{H} = \frac{x}{2ml}$ 25 mg : 100 mg : : x : 2 ml 50 ml = 100 x x=$\frac{1}{2}ml$ Insert the needle and syringe in the hydroxyzine vial and inject $\frac{1}{2}ml$ air. Withdraw $\frac{1}{2}ml$ hydroxyzine and remove the needle and syringe. Change the needle. Insert the new needle and syringe into the meperidine vial and remove 0.75 ml of meperidine to a total of $1\frac{1}{4}ml$ 1 of medication in the syringe.

27. Order reads: "Regular insulin 15 U, NPH insulin 35 U SC." On hand is regular insulin 100 U/ml and NPH insulin 100 U/ml.	Use an insulin syringe. Inject 35 units of air into the NPH insulin vial. Remove the needle and syringe from the NPH insulin vial. Inject 15 units of air into the regular insulin vial. Remove 15 units of regular insulin and remove the needle and syringe from the regular insulin vial. Change the needle. Insert the new needle and syringe into the NPH insulin vial and remove 35 units to a total of 50 units of insulin mixed in the syringe.

28. Order reads: "Morphine sulfate 10 mg IM and atropine sulfate 0.4 mg IM." On hand is morphine sulfate 10 mg/ml and atropine sulfate 1 mg/ml.	Use a 3 cc hypodermic syringe. Draw back 0.4 ml $\frac{D}{H} = \frac{10mg}{10mg/ml}$ Inject 1 ml of air into the morphine sulfate vial and remove the needle and syringe. Draw back 0.4 ml. $\frac{D}{H} = \frac{0.4mg}{1.0mg/ml} = 0.4ml$ Insert the needle and syringe in the atropine sulfate vial. Inject 0.4 ml of air into the atropine sulfate vial. Withdraw 0.4 ml of atropine sulfate and remove the needle and syringe. Change the needle. Insert the new needle and syringe into the morphine sulfate vial and remove 10 mg (1 ml) to a total of 1.4 ml medication in the syringe.

29. Order reads: "Regular insulin 5 units SC, NPH insulin 42 units SC." On hand is regular insulin 100 U/ml and NPH insulin 100 U/ml.	Use an insulin syringe. Inject 42 units of air into the NPH insulin vial. Remove th needle and syringe from th NPH insulin vial. Inject 5 units of air into the regular insulin vial. Remove 5 units of regular insulin and remove the needle and syringe grom the regular insulin vial. Change the needle. Insert the new needle and syringe into the NPH insulin vial and remove 42 units of NPH insulin to a total of 47 units.

12
Preparing Solutions

When providing care, you may need to prepare a solution or teach someone else how to do it. Solutions are commonly used for such purposes as irrigations or soaks and, depending on the situation, may be sterile or unsterile. A solution is a liquid containing a dissolved substance. It is made by dissolving one or more substances in a liquid (the solvent). These substances (solutes) may be in the form of a gas, a liquid, or a solid and may be the pure drug or the drug in a concentrated solution.

The strength of the solution is expressed as a percentage or as a ratio. Percentage indicates the amount of the drug present in 100 parts of the solution. It is a fraction, the numerator of which is expressed, and the denominator understood to be 100; for example, 25 percent is 25/100. Ratio is another way of indicating the relationship between the amount of the drug and the amount of the solution; for example, a 1:10 solution contains one part of the pure drug in ten parts of solution. Ratio and percentage really mean the same thing. For instance, a 25 percent solution also can be expressed as a 1:4 solution. It is important to remember when working problems in percentage and ratio that all measurements must be kept in the same system.

1. When caring for patients, you may be called on to prepare a liquid or solution for irrigations, soaks, or other treatments. A liquid, homogeneous mixture consisting of two or more components is called a __________.	solution
2. In most common solutions, one of the components is a liquid in which the other component is dissolved. This liquid portion is referred to as the solvent, and the component which is __________ in it is known as the solute. The solute may be either solid or liquid.	Dissolved
3. The most commonly used solvent is water. In a sodium chloride solution, the solvent would be __________.	water

4. The solute in a sodium chloride solution would be ___________________. To make a physiologic saline solution, two teaspoons of table salt are dissolved in 1,000 ml of water.	sodium chloride
5. For a solution that does need not to be sterile (e.g., mouth wash), ordinary tap water is the __________ most frequently used.	solvent
6. To make a sterile solution (for use on a wound) the most common solvent would be __________	sterile water
7. Solutions are made from pure drugs, tablets, or stock solutions. A pure drug is an unadulterated substance in solid or liquid form. Expressed in percentage, a pure drug is __________.	100%

8. Tablets containing a known quantity of the pure drug may be used to make a solution. The ___________ is essentially a preparation of the pure drug.	tablet
9. A stock solution is a relatively strong solution from which a weaker solution can be made. Stock solutions are usually ___________ to make a weaker solution.	diluted
10. The strength of a solution can be expressed by percentage or ratio. Percentage indicates: (a) the number of grains of the drug in 100 grains (b) the number of cc of the drug in 100.0 cc of the solution. Thus, a 1% solution of peroxide contains 1.0 cc of peroxide in ___________ of solution (peroxide is a liquid).	100.0 cc

11. In 200.0 cc of a 1% solution of peroxide, there are __________ of the pure drug.	2.0cc
12. Ratio (when used with solutions) denotes the relative amounts of solute and solvent. Here the metric system is almost always used. Thus: 1:1,000 indicates 1.0 g or 1.0 cc of pure drug in each 1,000.0 cc of solution. 2:1,000 therefore indicates 2.0 g (or 2.0 cc) of__________ ___________ in 1,000.0 cc of solution.	pure drug
13. A solution labeled 1.0 mg:l,000 ml contains __________ solute in __________ solution.	1.0 mg 1,000 ml

14. Now, let's work some problems in which the strength of the solution is expressed in percentage. The formula to be used is: $\frac{Desired}{On-hand} = \frac{Quantityofsolute(x)}{Quantityofsoluton(v)}$ or $\frac{D}{H} = \frac{x}{v}$ Example How many cc of pure drug will be needed to prepare 1 liter of a 40% solution? How will you prepare the solution? $\frac{D}{H} = \frac{x}{v}$ Substitute known values: $\frac{40\%}{?} = \frac{x}{1{,}000.0cc}(1.0liter)$	100%
15. $\frac{40\%}{100\%} = \frac{x}{?}$	1,000.0cc
16. 100x= 40,000.0 cc $x =$ ______________________	400.0 cc of pure drug will be needed

17. To prepare the 40% solution of drug, place the 400.0 cc of pure drug in a container and add water to make ________________.	1,000.0cc
18. Example: Prepare 250.0 cc of a 1% neomycin sulfate solution. How much neomycin sulfate will be needed? How will you prepare the solution? Use the formula: $\frac{D}{H} = \frac{x}{V}$ $\frac{1\%}{100\%} = \frac{?}{?}$	$\frac{x}{250.0cc}$
19. $\frac{1\%}{100\%} = \frac{x}{250.0cc}$ Finish calculations and label answer	100x= 250.0 cc x= 2.5 cc of neomycin sulfate will be needed. To this amount of drug add water to make 250.0 cc of solution. This is a 1% solution.

20. One more example: 5.0 g of boric acid for a sterile solution is dispensed. How much 5% solution can be made from one vial? Note: In this problem, the amount of solute is known rather than the amount of solution to be made. The same basic formula is used: $\frac{D}{H} = \frac{V(quantityofsolute)}{x(quantityofsolution)}$ $\frac{5\%}{100\%} = \frac{5.0gorcc}{x}$ Finish calculations and label answer.	5x= 500.0 cc x= 100.0 cc It is stated in the volume unit rather than solid unit. The 5.0 g of boric acid is dissolved in 100.0 cc of sterile water—100.0 cc of a 5% boric acid solution.

21. From a 3% hydrogen peroxide solution, how will you prepare 1 ounce of a 1% solution?	$\frac{D}{H}=\frac{x}{V}$ $\frac{1\%}{3\%}=\frac{x}{30.0cc}$ * * (equivalent of 1 fluid oounce) 3x=30.0 cc x=10.0 cc of 3 % hydrogen peroxide solution is needed. Add water to make 30.0 cc (1 fluid ounce). You now have 1 ounce of 1% hydrogen peroxide solution.
22. How will you make 1 quart of a 10% solution of neomycin sulfate?	$\frac{D}{H}=\frac{x}{V}$ $\frac{10\%}{100\%}=\frac{x}{1{,}000.0cc}$ * * (equivalent of 1 quart) 100x= 10,000.0 cc x= 100.0 cc neomycin sulfate is needed. Add water to make 1,000 cc (1 quart). You now have 1 quart of 10% neomycin sulfate solution.

23. How much hydrochloric acid will be needed to make 2 liters of a 2% solution?	$\frac{D}{H} = \frac{x}{V}$ $\frac{2\%}{100\%} = \frac{x}{2{,}000cc}$ 100x=4,000.0 cc x=40.0 cc of hydrochloric acid is needed. Add water to make 2,000.0 cc. You now have 2 liters of 2% hydrochloric acid solution.
24. How will you make 200.0 ml of a 1:40 acetic acid solution from a 1:20 acetic acid solution?	$\frac{D}{H} = \frac{x}{V}$ $\frac{1/40}{1/20} = \frac{x}{200.0ml}$ $\frac{1}{20}x = 200.0ml \times \frac{1}{40}$ x= 100.0 ml of 1:20 acetic acid solution is needed. Add water to make 200.0 ml of 1:40 acetic acid solution.

25. When the strength of the solution is expressed in ratio, this formula will be used: $\frac{\text{Desired ratio}}{\text{On-hand ratio}} = \frac{\text{Quantity of solute}}{\text{Quantity of solution}}$ or $\frac{D}{H} = \frac{?}{?}$	$\frac{x}{V}$
26. Example: How much solute is needed to make 2,000.0 ml of a 1:5,000 sodium bicarbonate solution from a 1:1,000 solution? $\frac{D}{H} = \frac{x}{V}$ $\frac{1:5{,}000}{1:1{,}000} = \frac{?}{?}$	$\frac{x}{2{,}000.0ml}$

27. $\frac{1/5,000}{1/1,000} = \frac{x}{2,000.0ml}$ $\frac{1}{1,000x} = 2,000.0ml \times \frac{1}{5,000}$ **x =** ________ Finish calculations and label answer	x=$\frac{2}{5} ml \div \frac{1}{1,000}$ x=400.0 ml of the $\frac{1}{1,000}$ sodium bicarbonate solution will be needed (Note: Here, the problem asks only how much drug will be needed)
28. Example: How will you prepare 1 quart of 1:20 solution of boric acid from the crystals? $\frac{D}{H} = \frac{x}{V}$ $\frac{1/20}{1/1} = \frac{x}{1,000.0cc}$ (This is the equivalent of one quart) lx=l,000.0 cc $cc \times \frac{1}{20}$ $x =$ _____ of boric acid crystals will be needed. Add water to make ________________ solution. You now have one quart of 1:20 solution of boric acid.	50g 1,000.0 cc (1 quart) (Note: This problem asks how you will prepare the solution.)

29. How much stock solution of benzalkonium chloride 1:1,000 is needed to make 1 liter of 1:10,000 solution?	$\frac{D}{H}=\frac{x}{V}$ $\frac{1/10{,}000}{1/1{,}000}=\frac{x}{1{,}000.0cc}$ $\frac{1}{1{,}000.0}x=1{,}000.0cc\times\frac{1}{10{,}000}$ x= 100.0 cc of 1:1,000 benzalkonium chloride solution is needed
30. Make 1 gallon of 5% boric acid solution from a 1:5 boric acid solution.	1 gallon = 4,000.0 cc Change 5% to its ratio equivalent 1:20 (5%=$\frac{5}{100}=\frac{1}{20}=1:20.$ Do you need to review this process?) $\frac{D}{H}=\frac{x}{V}$ $\frac{1/20}{1/5}=\frac{x}{4{,}000.0cc}$ $\frac{1}{5}x=4{,}000.0cc\times\frac{1}{20}$ x= 1,000.0 cc of 1:5 boric acid solution is needed to make 4,000.0 cc (1 gallon). You now have 1 gallon of 5% boric acid solution.

13
Administering Intravenous Medications

Fluids and electrolyte solutions are often administered by intravenous infusion. The safe and therapeutic administration of any solution is very important.

The purpose of this chapter is to help you develop the skills necessary to calculate proper flow rates and to determine the amount of fluid or drug the patient is receiving in a specific period of time. It will also acquaint you with your responsibility when medication is being given via a pump.

1. When an order for <u>fluid administration</u> is written it should include the solution to be administered and the rate of administration. Usually the order will be written thus: "1,000 cc D_5 W q 8 hours IV" indicating that 1,000 cc D_5 Wq 8 hours IV"indicaitng that 1,000 cc of D_5 W is to be infused over a period of __________ hours.	8
2. To further simplify, determine the amount of fluid to be administered in one hour using the following formula: Total amount ÷ total time = amount to be administered in one hour. In the above example: 1,000 cc ÷ 8 = _________ cc administered in 1 hour.	125
3. Parenteral administration sets deliver fluids by drops (via a drip chamber) that vary in size. The larger the size of the drop, the fewer the number of drops that will be needed to administer 1 cc. The smaller the size of the drop, the ________ the number of drops that will be needed to administer 1 cc.	greater

4. Information on drop size is available from the manufacturer of the equipment, and should be indicated on the set. This is called the drop factor. Example: A set labeled with a drop factor of 10 will need _____ drops to administer 1 cc of the solution.	10
5. A drop factor of 15 indicates the set will deliver 1 cc of fluid for every _____ drops.	15
6. When the drop factor is known, the drops per minute necessary to administer a specific amount of fluid in a prescribed time period is easily calculated by using the following formula: Drops / min = $\frac{Totalcc \times dropfactor}{\min utes}$ In the previous example, the number of cc to be administered IV in 1 hour was determined: 1,000 cc $\div 8 =$ ______________	125 cc per hour

7. Next, using a drop factor of 10, set up the formula: Drops /min $\frac{Total cc \times drop factor}{\min utes}$ x= $\frac{15cc \times ?}{60 \min utes}$	10
8. Solve for x	x= $\frac{125 \times 10}{60}$ x= $\frac{125}{6}$ x=20.8 or = 21 drops/ min to deliver 125 cc in 1 hour or 1,000 cc in 8 hours
9. Try another problem. The order reads "Administer by V 500 cc DgW in 8 hours." A check of your equipment indicates the drop factor to be 10. Now you have all the information necessary to determine the flow rate, or the _________ _________ _________ _________ _________	number of drops per minute

10. Take it step by step. First, determine the amount of solution to be delivered in one hour: Total amount ÷ total time = amount per minute. or 500 cc ÷ 8 hours = ___________.	62.5 cc
11. The drop factor given above is ________________.	10
12. The time (in minutes) is ________________.	60
13. Using the flow rate formula Drops/min = Amount in cc x drop factor time in minutes Substitute known values and solve for x.	x = 62.5cc x 10 60min x=62.5 ÷6 x= 10.4 or 10 drops / min to adminstrer 62.5 cc fluid in 1 hour or 500 cc in 8 hours.

14. Order: "200 cc 0.9 NaCI IV in 2 hours." The drop factor is 15. What is the flow rate per minute?	200 cc $\div$2 hours = 100 cc in 1 hour $x = \frac{100 \times 15}{60}$ 100x15 x=100 $\div 4$ x= 25 drops / min to administer 100 cc 0.9 NaCl in 1 hour or 200 cc in 2 hours
15. It is frequently necessary to administer very small quantities of fluid over a period of time (for example, to infants or when very potent drugs are being given). To facilitate this, the flow is measured in microdrops per minute. Most of the sets used for this purpose have drop chambers that deliver 60 microdrops per cc. These sets are designated as Pedi-sets or Microdrip sets. The flow rate for a Microdrip set is __________•	60

16. Use the flow rate formula to implement the following order: "100 cc of 10% glucose in DgW by intravenous to a 10-month-old over 4 hours." 100 cc in 4 hours = _________ in 1 hour.	25cc
17. Using a Pedi-set, delivering 60 drops per cc, substitute known values in the formula and solve for *x*.	Microdrops/min = Total x drop Amount factor Time $x = \frac{25cc \times 60}{60 \min utes}$ x= 25 microdrops / min to deliver 25 cc in 1 hour or 100 cc in 4 hours.

18. Here is another order: "Give 500 cc 0.45 NaCI by IV in 10 hours." The Microdrop set has a drop factor of 60. You will regulate the set to run at what microdrops/min? Easy, isn't it? If you did make an error please go back to frame 6 and identiyfy the error .	500 cc $\div 10$ = 50 cc in one hour x= $\frac{50 cc x 60}{60 \min utes}$ x = 50 microdrops/min to administer 50 cc in 1 hour or 500 cc in 10 hours
19. You may have noted in the above examples that when using a Pedi-set or Micro-set delivering 60 drops/cc, the number of cc delivered each hour is equal to the number of drops per minute. Therefore, when using a set that delivers 60 drops per cc you will not need to calculate the flow rate by the previous formula. Instead, consider:Drops/min = cc/hour or 15 drops/min = _____ cc/hour REMEMBER: Before using this short-cut, be sure the set you are using delivers 60 drops/cc.	15

20. Give 800 cc lactated Ringer's solution IV in 4 hours using a drop factor of 10. What is the flow rate to be used?	800 cc $\div$ 4 hours = 200cc in 1 hour Flow rate = <u>Total cc x drop factor</u> 60 $x = 200 \div 6$ $x = 33\frac{1}{3}$ *or* 33 drops / min to adminster 200 cc lactated Ringer's solution IV in 1 hour or 800 cc in 4 hours.
21. Your postoperative hysterectomy client has an order for 2,500 cc D5 in $\frac{1}{2}$ NSS to be given IV every 12 hours. Your IV set has a drop factor of 15 . You will adjust the set to deliver ___________ drops per minute.	2,500 cc $\div$ 12 hours = 208 cc per 1 hour Flow rate = <u>Total cc x drop factor</u> Time in minutes $x = \frac{208 \times 15}{60}$ $x = 208 \div 4$ x= 52 drops / min to administer 208 cc D_5 in $\frac{1}{2}$ NSS IV in 1 hour or 2,500 cc in 12 hours.

22. Give 1,000 cc NSS by IV in 10 hours. The drop factor is 15. What is the flow rate?	1,000 cc ÷ 10 hours = 100 cc in 1 hour $x=\frac{100\times15}{60}$ 100x15 x=100 ÷ 4 x= 25 drops / min to administer 100 cc NSS by IV in 1 hour or 1,000 cc in 10 hours
23. Give an infant 120 cc physiologic saline IV n 6 hours. The drop factor is 60. What is the flow rate?	120 cc ÷ 6 hours = 20 cc in 1 hour $x=\frac{20\times60}{60}$ x=20 drops /min to administer 20 cc physiologic saline in 1 hour or 120 cc in 6 hours
24. Your postcholecystectomy client is to receive 250 cc packed cells in 2 hours. The blood administration set states "6 drops per cc." The flow rate will be :	250 cc ÷ 2 hours =125 cc in 1 hour $x=\frac{125\times6}{60}$ x=12.5 or 13drops / min to administer 125 cc packed cells in 1 hour or 250 cc in 2 hours

25. Sometimes an IV medication is ordered to be infused by a dose and you must calculate the flow rate. (To calculate the flow rate, a proportion must be used.) For example, an order reads: "Heparin 2,000 units/hr from an IV solution of 20,000 units of heparin in 1,000 cc NSS." How many ml/hr are to be infused? 20,000 units _ 2,000 units/hr ? cc xcc	1,000
26. 1,000 x 2,000 = ____________x 2,000,000 = 20,000 x 2,000,000 x 20,000 = *x* cc/hr x=___________cc/hr	20,000 100
27. Another example is: Pitocin is ordered to run at 0.02 units per minute from an IV solution of 10 units/1,000 ml PSS. How many ml/hr are to be infused? The first thing that must be done is to convert units/min to units/hr. 0.02U/min=__________U/hr	0.02x60=1.2

28. $\frac{10U}{1{,}000cc} = \frac{1.2U}{xcc}$ 1,200 $\div$___________=x cc/hr x= ___________ cc/hr	10 120
29. It may also be necessary to calculate hourly doses of medication when the hourly volume to be infused has been ordered. IT IS YOUR RESPONSIBILITY TO KNOW THE DOSAGE OF THE MEDICATION BEING ADMINISTERED. For example, an order reads: "IV 1,000 cc PSS with 20,000 units of heparin to infuse at 100 cc/hr." To calculate the dose that the patient receives every hour, a proportion is used. $\frac{20,.000U}{1{,}000cc} = \frac{xU}{100cc}$ x=___________	2,000 U/hr

30. Heparin 2,500 units an hour from an IV solution of 20,000 units in 1,000 cc NSS. How many cc per hour ar to be infused ?	$\frac{20{,}000U}{1{,}000cc} = \frac{2{,}500U}{xcc}$ 2,500,000 = 20,000x 250 $\div$ 2 = x $250 \div 2 = xcc / hr$ x=125cc/hr
31. The order reads: 500 mg of aminophylline in 250 cc D_5/W to run at 10 cc/hr. What is the dose that the patient receives in 1 hour?	$\frac{500\text{ mg}}{250\text{ cc}} = \frac{x\text{ mg}}{10\text{ cc}}$ 5,000=250x $5{,}000 \div 250$=x x=20 mg aminophylline in 1 hour
32. IV pumps and IV controllers are also available. These are used for IV medications that must be delivered at an exact rate at all times. These pumps or controllers would be used if a _________ must be given at a set rate. Examples are lidocaine, aminophylline, and heparin. Each manufacturer includes specific instructions with the machines. It is essential to acquaint yourself with the machine and the set-up before using it. Some IV medications are given through sets that control the volume. These volume-control sets are called Buretrol, Soluset, Volutrol, Peditrol. The manufacturer provides detailed instructions (usually included in the package). Read the directions carefully before using.	medication

33. Intravenous medications may be ordered to run with another medication. This is called piggyback. If an IV medication is run with another IV it is called __________	Piggyback
34. The medication that is piggybacked is usually dissolved in another 50 to 100 cc of a solution. The medication is dissolved in 50 to 100 cc of ___________.	Solution
35. The instructions usually tell you how long the medication should run. For example, the order reads: Amoxicillin 500 mg in 50 cc D5W to run for 30 minutes. The _____ cc would be infused in _____ minutes.	50 30

36. The calculation of the drops per minute would be done as previously explained. The formula is:	$\text{drops/min} = \frac{\text{total cc x drop factor}}{\text{minutes}}$
37. This set delivers 15 drops per cc. Calculate the drops per minute for the example in frame 35.	$\text{drops / min} = \frac{50\text{ cc X }15\text{ gtts / cc}}{30\text{ minutes}}$ $\frac{75\text{ gtts}}{30\text{min}}$ 25 gtts/min

14
Medications for Infants and Children

Medications can be administered to infants and children by any of the routes used for adults. When administering medications to infants and children, the dosage must be carefully calculated based on body weight in kilograms. While the dose of the medication will be specified on the prescription, it is important for the individual administering the medication to be certain that the correct dose has been prescribed. This requires calculating the body weight in kilograms and then calculating the correct dosage.

The pediatric dose is listed in various drug references and in package inserts. In addition to the listing of the dose per kilogram, an upper limit of the drug that can be administered to the child is stated.

In this chapter, you will learn how to calculate the amount of medication to be given to an infant or child. A child over 12 years of age is usually considered an adult and is given the adult dose.

1. While the dose of the drug will be ordered by the provider, it is important for the person administering the drug to recognize whether the dose is within safe ________________.	limits (or range)
2. In drug references, the correct pediatric dosage of the drug that can be administered is given along with the ________ ________ of the drug that can be safely administered.	upper limit
3. The correct dosage of the drug is calculated based on the ________ ______________ of the child	body weight
4. The body weight of the child is calculated in _____________.	kilograms

5. Ibuprofen (Motrin) suspension every 6 hours is ordered for a child who weighs 36 pounds. The bottle reads 100 mg/5 ml. The insert reads that the correct dose is 10 ing/kg every 6 hours to a maxium of 40/mg/kg/day. To determine the correct dose, the body weight of the child is calculated in kilograms. The body weight in kilograms is ________ _____________ kilograms.	36 $\div$ 2.2 = 16.3636 = 16.37
6. The next step is to calculate the correct dosage. dosage = weight (in kg) x mg/kg = _______ kg x _______ mg/kg	16.37 kg x 10 mg /kg
7. Correct dose = 16.37 kg x 10 mg / kg __________mg	163.7

8. The child would receive 164 mg. The medication comes 100 mg/5 ml so the correct volume must be calculated. To do this the formula, $\frac{D}{H} xV$ is used. The D (desired) dose is __________ mg.	164
9. The H (on-hand) medication is _____ mg/5 ml.	100
10. The dose per ml is then calculated. This is done by dividing the dose by the number of ml. The formula is:	$\frac{D}{H} xV$
11. The correct dose is:	$\frac{164 \text{ mg}}{100 \text{ mg}}$ x 5 ml = 8.2 ml

12. This means that the child should receive _________ ml of Motrin 100 mg/5 ml every 6 hours.	8.2
13. Another way that pediatric medication dosage may be presented is the amount per kilogram for 24 hours. A 22 pound infant is prescribed amoxicillin suspension t.i.d. The package insert reads 20 mg/kg/day in 3 divided doses. The medicine is dispensed as 125 mg/5 ml. The first step in calculating the correct dose is to determine the body weight in __________.	kilograms
14. The correct formula to calculate the body weight in kilograms is: pounds kilograms/pound	22 2.2
15. The child's weight is ________ kilograms.	10

16. The next step is to calculate the correct dose per day. The recommended dose is 20 mg/kg/day. Since the child weighs 10 kilograms, he should receive ____________ 20 mg/kg x 10 kg = 200 mg ___________ mg in 24 hours.	20mg /kg x 10 kg = 200 mg
17. Since 200 mg is to be given over an entire day and the child is to receive 3 doses a day, the correct amount for each dose must be calculated. This is done by using the equation ____________.	$\frac{200 \text{ mg}}{3}$
18. The correct dose at each administration is ________ mg.	66.67 = 67
19. Since the medication comes in 125 mg/5 ml, the correct volume must be calculated. The formula ___________ is used.	$\frac{D}{H} xV$

20. When substituting the numbers, the formula is	$\frac{67\ mg}{125\ mg}$ x 5 ml
21. The correct volume of medication is _______ ml for each administration.	2.68 = 2.7
22. Tyienol (acetaminophen) is ordered every 6 hours for a child weighing 36 pounds. The bottle reads 240 mg every 4—6 hours for a child 30-40 Ibs. The strength of the medicine is 160 mg/5 ml. How much would you give?	$\frac{D}{H} xV \quad \frac{240mg}{160mg} \times 5ml = 7.5ml$
23. Zithromax (azythromycin) is ordered for a child weighing 30 pounds. The recommended dose is 12 mg/kg/day. The medication comes 200 mg/ 5 ml. How much would you give daily?	30 pounds = 13.64 kg 13.64 kg x 12 mg /Kg / day = 163.68 mg / day $\frac{D}{H} xV = \frac{163.68mg}{200mg} \times 5ml = 4.0$ (round off)

24. Slo-phyllin (theophylline) is ordered for a 6-month-old weighing 19 pounds. The recommended dose is 4 mg/kg/dose. It comes 80 mg/15 ml. What dose would you give?	19 pounds = 8.64 kg 8.64 kg x 4 mg/kg = 34.5 mg $\frac{D}{H} xV = \frac{34.5mg}{80mg} \times 15ml = 6.5ml$
25. Ceclor (cefaclor) is ordered for a 40-pound child. The recommended dose is 40 mg/kg/day in 3 divided doses. It comes 250 mg/5 ml. How much would you give at each dose?	40 pounds = 18.18 kg 18.18 kg x40 mg /kg /day = 727.2 mg /day $\frac{727.2 \text{ mg/day}}{3}$ = 242.4 mg / dose $\frac{D}{H} xV = \frac{242.4mg}{250mg} x5ml$ =.97 x 5 ml = 43.85 ml = 5 ml (round off)