DIMENSIONAL ANALYSIS FOR MEDS

Refocusing on Essential Metric Calculations

Anna M. Curren

Sixth Edition

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Dedication

This edition is dedicated to nurses globally, whose courage and expertise is critical in the COVID-19 pandemic.

The Pedagogy

Dimensional Analysis for Meds: Refocusing on Essential Metric Calculations, Sixth Edition has been carefully written and thoroughly tested to allow all dosage content and considerations to proceed from simple to complex. This text takes an interactive approach and addresses different learning styles, thereby ensuring that all students can successfully master **all basic dosage calculations**. The following pedagogical aids help to reinforce key concepts and appear in most chapters.

OBJECTIVES

Each chapter opens with a list of Objectives, which provides instructors and students with a summary of the content and concepts to be presented in the chapter. These objectives serve as a checklist to help guide students and focus their study.

KEY POINTS

Key Points reinforce safety considerations related to dimensional analysis (DA) and the administration of prescription medications. Each Key Point is easily identified by a key icon.

EXAMPLES

Examples provide real-world scenarios related to solving calculations in a clinical setting.

PROBLEMS

Problems allow students to demonstrate their knowledge of key concepts presented throughout the text. Answers are provided after each problem set so they can check their work.

SUMMARY SELF-TESTS

Summary Self-Tests allow students to test their comprehension of key concepts at the end of each chapter. Answers are provided at the end of each self-test set so they can check their work.

Contents

Preface

A preface is an introduction written by an author to explain her or his text's content. I welcome the opportunity to do this for the sixth edition of *Dimensional Analysis for Meds*.

The most important content in this edition remains Chapter 1, *Introduction to the Metric System*, the system in which 98% of dosages are ordered. Concentrating heavily on common metric dosages, while not forgetting the other measures that are less frequently ordered, the text starts by providing many one-step dosages that can be calculated mentally. These include both oral and parenteral (injectable) solution dosages. Detailed instruction in hypodermic syringe measurements is provided to allow real-life measurement of calculated parenteral dosages.

The decision to teach dimensional analysis as the **ONLY calculation method** is deliberate, because it is the **only method** that reduces multiple-step clinical calculations to a single, easy-to-solve equation. Manual refresher math is limited to that which is specifically required for dimensional analysis. Calculator use throughout the text is recommended. The bulk of dosage-related calculations of necessity must and will be learned in clinical practice following graduation. In this edition everything necessary to make the transition to clinical learning has been covered.

This edition has a second dominating focus: the elimination of all content unrelated to the specific objectives of basic math instruction. As an author, I plead guilty to unrealistically seeking to include **everything** possible in clinical math concepts, even when it took the content beyond basic objectives. A primary example was to include dosage calculations that are the sole responsibility of pharmacists and physicians. The renewed focus on basic math instruction in this edition has resulted in a smaller text than the fifth edition, and we are proud of eliminating so much unnecessary content. Essential learnings in refresher math and clinical calculations do not require a 2- to 2.5-inch-thick text. Several such oversized texts are currently in publication, and we hope that other authors will follow our lead and reduce content to only that which is absolutely necessary.

Letter for the Learner

Welcome to our journey together through *Dimensional Analysis for Meds (DAFM), Sixth Edition*. Many students have written to me over the years to tell me how much they enjoyed learning from my text, and I anticipate that you will enjoy it, too.

First things first: **Put aside any worry** that you may have about your math skills. Your admission to your current nursing or technical program guarantees that you have the ability to succeed. **Clinical math is NOT complicated, and you WILL be successful**. While math lends itself best to a printed text, you can also successfully use an online instructional version.

HERE ARE YOUR IMPORTANT GUIDELINES FOR SUCCESS

1. Locate a clear writing surface and gather lots of scratch paper, pencils, pens, and **a calculator**.
2. Record your answers **both in the text and on paper**, which will **make checking multiple answers much easier**.
3. Programmed learning **proceeds in small steps**. Do **exactly** what the text instructs you to do, and **no more**. Jumping ahead may cause confusion.
4. All chapters allow you to **proceed at your own speed**, and you may be surprised at how quickly you move ahead.
5. Keep *DAFM, Sixth Edition* in your professional library. **You will** move to different clinical areas in your career, and a quick refresher of these contents may be helpful.

There is nothing quite like finishing a lesson and feeling like you've nailed it, and you are going to do just that using this text! So settle down, and enjoy your clinical dosage journey with me.

—Anna M. Curren

Instructor Guidelines

The content of *Dimensional Analysis for Meds (DAFM), Sixth Edition* has been carefully organized from simple to complex, concentrating most heavily on essential metric system concepts and calculations. This is reflected in our new subtitle: *Refocusing on Essential Metric Calculations*. *DAFM* has moved much faster than most texts to keep pace with clinical reality, and all the essentials have been covered in this edition. Its chapters have been designed for assignment in chronological order, 1 through 15.

The obvious problem in all learning is: How do I get students to do their homework? The author recommends administering a short, **graded quiz** at the start of the lecture following the first chapter assignment. Tell the students **in advance** that you will give this quiz. It takes only minutes to do, and you can have the students self-correct it, or hand off their test paper to someone in front, behind, or to one side to correct it as you give the answers. Collect the **already graded papers**, and you have established a winning learning curve.

Most importantly, you can use **any** of the examples or problems in the text for testing, because it is **impossible** for students to memorize them. Once established, this routine is effective and enjoyable for all.

DAFM has been and is used extensively in programs ranging from Practical Nurse (PN)/Licensed Practical Nurse (LPN) to Bachelor of Science in Nursing (BSN), and its content has been specifically tailored to relate to both student audiences. It is easily understandable by beginner learners, and respectful of the need of advanced learners to move more quickly. Educator and student feedback on their use of *DAFM* has been particularly helpful to the author over its years of publication, and once again we solicit your participation in this evaluation process. All emails to info@jblearning.com will be promptly forwarded to the author for her consideration and/or comment.

Pretest

You will be using a calculator in this text for calculations, and you may also use one where it's appropriate to answer the following Pretest questions.

Special math areas such as decimal fractions, which are common in dosages, will be covered to bring your skills up to date.

Regardless of your math proficiency, it's important that you complete the entire refresher math section, Section 2. It includes memory cues and shortcuts for simplifying and solving many of the clinical calculations that are included in the entire text, and you will need to be familiar with these strategies.

Identify the decimal fraction with the greatest value in each set.

1. (a) 4.4 (b) 2.85 (c) 5.3 ____________
2. (a) 6.3 (b) 5.73 (c) 4.4 ____________
3. (a) 0.18 (b) 0.62 (c) 0.35 ____________
4. (a) 0.2 (b) 0.125 (c) 0.3 ____________
5. (a) 0.15 (b) 0.11 (c) 0.14 ____________
6. (a) 4.27 (b) 4.31 (c) 4.09 ____________
7. If tablets with a strength of 0.2 mg are available and 0.6 mg is ordered, how many tablets must you give? ____________
8. If tablets are labeled 0.3 mg and 0.6 mg are ordered, how many tablets must you give? ____________
9. If the available tablets have a strength of 1.25 mg and 2.5 mg is ordered, how many tablets must you give? ____________
10. If 0.25 mg is ordered and tablets available are 0.125 mg, how many tablets will you need? ____________

Express these numbers to the nearest tenth.

11. 2.17 = ____________
12. 0.15 = ____________
13. 3.77 = ____________
14. 4.62 = ____________
15. 11.74 = ____________
16. 5.26 = ____________

Express these numbers to the nearest hundredth.

17. 1.357 = ____________
18. 7.413 = ____________
19. 10.105 = ____________
20. 3.775 = ____________
21. 0.176 = ____________

Multiply these decimals. Express your answers to the nearest tenth.

22. 0.7×1.2 = ____________
23. 1.8×2.6 = ____________
24. $5.1 \times 0.25 \times 1.1$ = ____________
25. 3.3×3.75 = ____________

Divide these fractions. Express your answers to the nearest hundredth.

26. $16.3 \div 3.2$ = ____________
27. $15.1 \div 1.1$ = ____________
28. $2 \div 0.75$ = ____________
29. $4.17 \div 2.7$ = ____________

Define the following terms.

30. Numerator

____

____

31. Denominator

____

____

32. Common-fraction

____

____

Solve these equations. Express your answers to the nearest tenth.

33. $\frac{1}{4} \times \frac{2}{3}$ = ____________
34. $\frac{240}{170} \times \frac{135}{300}$ = ____________

35. $\dfrac{0.2}{1.75} \times \dfrac{1.5}{0.2}$ = ____________

36. $\dfrac{2.1}{3.6} \times \dfrac{1.7}{1.3}$ = ____________

37. $\dfrac{0.26}{0.2} \times \dfrac{3.3}{1.2}$ = ____________

38. $\dfrac{50}{1} \times \dfrac{60}{240} \times \dfrac{1}{900} \times \dfrac{400}{1}$ = ____________

39. $\dfrac{50}{40} \times \dfrac{450}{40} \times \dfrac{1}{900} \times \dfrac{114}{1}$ = ____________

ANSWERS

1. c
2. a
3. b
4. c
5. a
6. b
7. 3 tablets
8. 2 tablets
9. 2 tablets
10. 2 tablets
11. 2.2
12. 0.2
13. 3.8
14. 4.6
15. 11.7
16. 5.3
17. 1.36
18. 7.41
19. 10.11
20. 3.78
21. 0.18
22. 0.8
23. 4.7
24. 1.4
25. 12.4
26. 5.09
27. 13.73
28. 2.67
29. 1.54
30. The top number in a common fraction
31. The bottom number in a common fraction
32. One number on top of another, separated by a horizontal division line
33. 0.2
34. 0 6
35. 0.9
36. 0.8
37. 3.6
38. 5.6
39. 1.5

SECTION 1

The Metric System and Additional Drug Measures

CHAPTER 1

The Metric System in Clinical Medicine

OBJECTIVES

The learner will:

1. Identify the relative value of decimal numbers.
2. List the metric measures used in the clinical setting.
3. Write metric weights and volumes using correct notation rules.
4. Convert clinical weights and volumes within the metric system.

PREREQUISITE

Sixth-Grade Math

INTRODUCTION

The majority of drugs, both in the clinical hospital setting and at your local pharmacy, are measured in **metric dosages**. Milligrams, abbreviated **mg**, will be a familiar dosage strength.

The metric system was invented in France in 1875 as the **Systeme International (SI)**. Both the U.S. and Canada **legislated the metric system in 1975**, but **only Canada went totally metric**. The result is that the U.S. still uses **gallons for volume, miles rather than kilometers for distance, and pounds and ounces instead of grams for weight**.

Thankfully, however, the metric system was **widely adopted very early in clinical medicine**, and it is such a logical system that you are going to find it very easy to learn and use.

The metric is a decimal system, in which all units of measure for weight, volume, and length relate to each other.

The fact that the metric is a **decimal** system is incredibly important in **dosage calculations** because **dosages can be changed from one measure to the next simply by moving a decimal point**. However, anything involving decimals raises a red flag for caution, and we will address that necessity.

Both the U.S. and Canadian monetary systems of dollars and cents are decimal systems.

So, since you know **how to count money**, you already know **how to recognize the value of decimal numbers in drug dosages**. That said, a quick refresher in the relative value of decimal numbers seen in dosages is the logical place to start your introduction to the metric system.

RELATIVE VALUE OF DECIMAL NUMBERS

The whole numbers in dosages have the same relative value as dollars, and decimal fractions have the same value as cents: **The greater the number, the greater the value.**

The range of drug dosages, which includes decimal fractions, stretches from millions on the whole number side to thousandths on the decimal side. Refer to the decimal scale in **Figure 1-1**, and locate the decimal point, which is slightly to the right on this scale. Notice the whole numbers on the left of the scale, which rise in value from ones to millions, which is the largest whole-number drug dosage in current use.

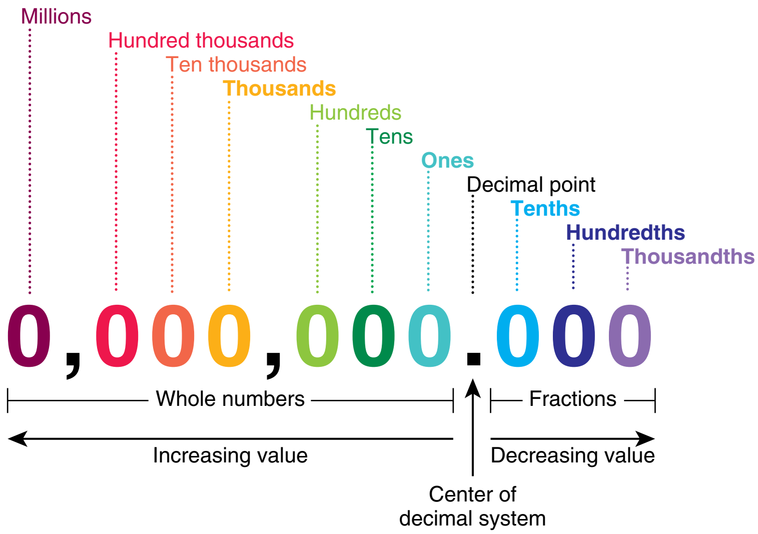


Figure 1-1

The first determiner of the relative value in numbers is the presence of a whole number. The greater the number, the greater the value.

EXAMPLE 1 10.1 is greater than 9.15.

EXAMPLE 2 3.2 is greater than 2.99.

EXAMPLE 3 7.01 is greater than 6.99.

PROBLEMS 1-1

Choose the greatest value in each of the following number sets.

1.	(a) 3.5	(b) 2.7	(c) 4.2	________
2.	(a) 6.15	(b) 5.95	(c) 4.54	________
3.	(a) 12.02	(b) 10.19	(c) 11.04	________
4.	(a) 2.5	(b) 1.75	(c) 0.75	________
5.	(a) 4.3	(b) 2.75	(c) 5.1	________
6.	(a) 6.15	(b) 7.4	(c) 5.95	________
7.	(a) 7.25	(b) 8.1	(c) 9.37	________
8.	(a) 4.25	(b) 5.1	(c) 3.75	________
9.	(a) 9.4	(b) 8.75	(c) 7.4	________
10.	(a) 5.1	(b) 6.33	(c) 4.2	________

Answers **1.** c **2.** a **3.** a **4.** a **5.** c **6.** b **7.** c **8.** b **9.** a **10.** b

If, however, the whole numbers are the same, for example, **10**.2 and **10**.7, or if there are no whole numbers, for example, **0**.25 and **0**.35, **then the fractions will determine the relative value**. Let's take a closer look at the fractional side of the scale in **Figure 1-2**.

It is necessary to **consider only three numbers after the decimal point** because drug dosages measured as decimal fractions do not contain more than three digits. An example is 0.125 mg. First, notice that a **zero is used to replace the whole number** in this decimal fraction and that will be the case in all dosages that do not contain a whole number.

If a decimal fraction is not preceded by a whole number, a zero, called a leading zero, is used in front of the decimal point to emphasize the fractional dosage.

EXAMPLE 4 **0**.125 **0**.1 **0**.45

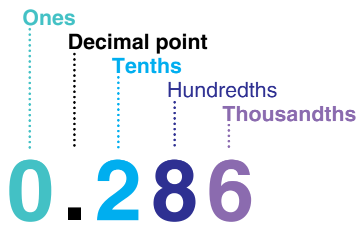


Figure 1-2

Look again at Figure 1-2. The numbers to the right of the decimal point represent **tenths**, **hundredths**, and **thousandths**, in that order. When you see a decimal fraction in which the **whole numbers are the same**, or if there are **no whole numbers**, stop and look first at the number representing **tenths**.

The fraction with the higher number representing tenths has the greater value.

EXAMPLE 5 0.3 is greater than 0.27.

EXAMPLE 6 0.4 is greater than 0.29.

EXAMPLE 7 1.2 is greater than 1.19.

EXAMPLE 8 3.5 is greater than 3.2.

PROBLEMS 1-2

Choose the greatest value in each of the following number sets.

1. (a) 0.4 (b) 0.2 (c) 0.5 ________
2. (a) 2.73 (b) 2.61 (c) 2.87 ________
3. (a) 0.19 (b) 0.61 (c) 0.34 ________
4. (a) 3.5 (b) 3.75 (c) 3.25 ________
5. (a) 0.3 (b) 0.25 (c) 0.4 ________
6. (a) 1.35 (b) 1.29 (c) 1.4 ________
7. (a) 2.5 (b) 2.7 (c) 2.35 ________
8. (a) 4.51 (b) 4.75 (c) 4.8 ________
9. (a) 0.8 (b) 0.3 (c) 0.4 ________
10. (a) 2.1 (b) 2.05 (c) 2.15 ________

Answers **1.** c **2.** c **3.** b **4.** b **5.** c **6.** c **7.** b **8.** c **9.** a **10.** c

If in decimal fractions, the numbers representing **the tenths are identical**, for example 0.25 and 0.27), then **the number representing the hundredths will determine the relative value**.

When the tenths in a decimal fraction are identical, the fraction with the greater number representing hundredths will have the greater value.

EXAMPLE 9 0.**27** is greater than 0.**25**.

EXAMPLE 10 0.**15** is greater than 0.1 (0.1 represents 0.**10**).

Extra zeros, called trailing zeros, are omitted on the end of decimal fractions in drug dosages, because they can easily be misread and lead to errors.

EXAMPLE 11 2.25 is greater than 2.2 (same as 2.20).

EXAMPLE 12 9.77 is greater than 9.7 (same as 9.70).

PROBLEMS 1-3

Choose the greatest value in each of the following number sets.

1. (a) 0.12 (b) 0.15 (c) 0.17 ________
2. (a) 1.2 (b) 1.24 (c) 1.23 ________
3. (a) 0.37 (b) 0.3 (c) 0.36 ________
4. (a) 3.27 (b) 3.25 (c) 3.21 ________
5. (a) 0.16 (b) 0.11 (c) 0.19 ________
6. (a) 4.23 (b) 4.2 (c) 4.09 ________
7. (a) 3.27 (b) 3.21 (c) 3.29 ________
8. (a) 2.75 (b) 2.73 (c) 2.78 ________
9. (a) 0.31 (b) 0.37 (c) 0.33 ________
10. (a) 0.43 (b) 0.45 (c) 0.44 ________

Answers **1.** c **2.** b **3.** a **4.** a **5.** c **6.** a **7.** c **8.** c **9.** b **10.** b

PROBLEMS 1-4

Which fraction has the greater value?

(a) 0.125 (b) 0.25 ________

Answer: If you chose 0.125, you have just made a serious drug dosage error. Look again at the numbers representing the tenths, and you will see that 0.**2**5 is greater than 0.**1**25. In this fraction, 0.25 is the same as 0.250, which is exactly double the value of 0.125. **Check the tenths carefully, regardless of the total number of figures after the decimal point**.

EXAMPLE 13 0.15 (same as 0.150) is greater than 0.125.

EXAMPLE 14 0.3 (same as 0.30) is greater than 0.15.

EXAMPLE 15 0.75 (same as 0.750) is greater than 0.325.

EXAMPLE 16 0.8 (same as 0.80) is greater than 0.16.

The number of figures on the right of the decimal point is not an indication of relative value. Always look at the figure representing the tenths first, and if these are identical, check the hundredths to determine the greater value.

This completes your introduction to the relative value of decimal numbers. The key points just reviewed will cover all situations in dosage calculations in which you have to recognize greater and lesser values.

PROBLEMS 1-5

Choose the greatest value in each of the following number sets.

1. (a) 0.4 (b) 0.5 (c) 0.125 ________
2. (a) 0.4 (b) 0.45 (c) 0.5 ________
3. (a) 7.5 (b) 6.25 (c) 4.75 ________
4. (a) 0.3 (b) 0.25 (c) 0.35 ________
5. (a) 1.125 (b) 1.75 (c) 1.5 ________
6. (a) 4.5 (b) 4.75 (c) 4.25 ________
7. (a) 0.1 (b) 0.01 (c) 0.04 ________
8. (a) 5.75 (b) 6.25 (c) 6.5 ________
9. (a) 0.6 (b) 0.16 (c) 0.06 ________
10. (a) 3.55 (b) 2.95 (c) 3.7 ________

Answers **1.** b **2.** c **3.** a **4.** c **5.** b **6.** b **7.** a **8.** c **9.** a **10.** c

BASIC UNITS OF THE METRIC SYSTEM

The basic measures of the metric system are those for **length**, **volume**, and **weight**.

Length: meter

Volume: liter

Weight: gram

Memorize the basic units if you do not already know them.

In addition to the basic units, **there are both larger and smaller measures** for the basics. In the metric system, however, there is one very important advantage: **All other measures, whether larger or smaller than the basic, have the name of the basic measure incorporated in them**. So, when you see a metric measure, there is no doubt what it is measuring: **meter–length**, **liter–volume**, and **gram–weight**.

PROBLEMS 1-6

Identify the metric measures with their appropriate category of weight, length, or volume.

1. milligram ________
2. centimeter ________
3. milliliter ________
4. millimeter ________
5. kilogram ________
6. microgram ________
7. kilometer ________
8. kiloliter ________

Answers **1.** weight **2.** length **3.** volume **4.** length **5.** weight **6.** weight **7.** length **8.** volume

METRIC PREFIXES

Prefixes are used in **combination** with the basic meter, liter, and gram to identify **larger and smaller metric measures**. Prefixes also **change the value of the basic measures by the same amount**. For example, the prefix "kilo" identifies a measure that is larger than the basic by 1000. The same prefixes are used with all three measures. Therefore, there is a kilo**meter**, kilo**gram**, and a kilo**liter**.

Identical prefixes are used to identify larger and smaller metric measures.

Prefixes also change the value of each of the basic units by the same amount. For example, the prefix "kilo" identifies a unit of measure that is larger than (or multiplies) the basic unit by 1000.

1 kilometer = 1000 meters

1 kilogram = 1000 grams

1 kiloliter = 1000 liters

Kilo is the **only** prefix that you will be using in the clinical setting that identifies a measure **larger** than the basic. Kilograms are frequently **used as a measure for body weight**, especially for infants and children.

You will see only two measures **smaller** than the basic in drug dosages. These are:

milli (as in milligram) for weight

micro (as in microgram) for weight

Therefore, you will actually be working with only **three prefixes**: **kilo**, which identifies a larger measure than the basic, and **milli** and **micro**, which are smaller measures.

METRIC ABBREVIATIONS

In clinical use, metric measures are abbreviated.

The basic metric measures are abbreviated to their first initial and printed in small (lowercase) letters, with the exception of liter, which is capitalized (uppercase).

meter is abbreviated **m**

gram is abbreviated **g**

liter is abbreviated **L**

The abbreviations for prefixes used in combination with the basic measures are also printed in lower case.

kilo is **k** (as in kilogram, kg)

milli is **m** (as in milligram, mg)

micro is **mc** (as in microgram, mcg)

In combination, liter remains capitalized. Therefore, milliliter is **mL** and kiloliter is **kL**.

PROBLEMS 1-7

Abbreviate the following metric measures.

1. microgram ________
2. liter ________
3. kilogram ________
4. milliliter ________
5. milligram ________
6. meter ________
7. kiloliter ________
8. gram ________

Answers **1.** mcg **2.** L **3.** kg **4.** mL **5.** mg **6.** m **7.** kL **8.** g

METRIC NOTATION RULES

To remember the rules of metric **notation**, in which **a unit of measure is expressed with a quantity**, it is helpful to memorize some prototypes (examples) that incorporate all the rules. For the metric system, the notations for one-half, one, and one and one-half milliliters incorporate all the official notation rules.

Prototype notations: **0.5 mL** **1 mL** **1.5 mL**

RULE 1: The quantity is written in Arabic numerals: 1, 2, 3, 4, and so forth.

Example 1 0.5 1 1.5

RULE 2: The numerals representing the quantity are placed in front of the abbreviations.

Example 2 0.5 mL 1 mL 1.5 mL (**not** mL 0.5, mL 1, mL 1.5)

RULE 3: A full space is used between the numeral and the abbreviation.

Example 3 0.5 mL 1 mL 1.5 mL (**not** 0.5mL, 1mL, 1.5mL)

RULE 4: Fractional parts of a measure are expressed as decimal fractions.

Example 4 0.5 mL 1.5 mL (**not** ½ mL, 1½ mL)

RULE 5: A zero, called a leading zero, is placed in front of the decimal fraction to emphasize the fractional value,

Example 5 0.5 mL (**not** .5 mL)

RULE 6: Excess zeros following a decimal fraction, called trailing zeros, are eliminated.

Example 6 0.5 mL 1 mL 1.5 mL (**not** 0.50 mL, 1.0 mL, 1.50 mL)

PROBLEMS 1-8

Write the following metric measures using official abbreviation and notation rules.

1. two grams ____________
2. five hundred milliliters ____________
3. five-tenths of a liter ____________
4. two-tenths of a milligram ____________
5. five-hundredths of a gram ____________
6. two and five-tenths kilograms ____________
7. one hundred micrograms ____________
8. two and three-tenths milliliters ____________
9. seven-tenths of a milliliter ____________
10. three-tenths of a milligram ____________
11. two and four-tenths liters ____________
12. seventeen and five-tenths kilograms ____________

13. nine-hundredths of a milligram ____________
14. ten and two-tenths micrograms ____________
15. four-hundredths of a gram ____________

Answers **1.** 2 g **2.** 500 mL **3.** 0.5 L **4.** 0.2 mg **5.** 0.05 g **6.** 2.5 kg **7.** 100 mcg **8.** 2.3 mL **9.** 0.7 mL **10.** 0.3 mg **11.** 2.4 L **12.** 17.5 kg **13.** 0.09 mg **14.** 10.2 mcg **15.** 0.04 g

CONVERSION BETWEEN METRIC MEASURES

There are only four metric **weight measures** used in dosages. From **greater** to **lesser** value, these are:

kg = kilogram

g = gram

mg = milligram

mcg = microgram

Memorizing the relative value of the four metric weights you will be working with is the first prerequisite for learning conversions.

Only **two volume measures** are frequently used. From **greater** to **lesser** value, these are:

L = liter

mL = milliliter

Each of these clinical measures differs from the next by 1000.

1 kg = 1000 g

1 g = 1000 mg

1 mg = 1000 mcg

1 L = 1000 mL

Once again, from greater to lesser value, the measures are for weight: kg, g, mg, and mcg, and for volume L and mL. Each measure differs from the next by 1000, and **all conversions will be between touching measures:** kg to g, g to mg, mg to mcg, and L to mL.

PROBLEMS 1-9

Choose true (T) or false (F) for each conversion.

1. T F 1000 mL = 1000 L
2. T F 1000 mg = 1 g
3. T F 1000 g = 1 kg

4.	T	F	1000 mg	=	1 mcg
5.	T	F	1000 mcg	=	1 g
6.	T	F	1 kg	=	1000 g
7.	T	F	1 mg	=	1000 g
8.	T	F	1000 mcg	=	1 mg
9.	T	F	1 g	=	100 mcg
10.	T	F	1000 L	=	1 kL

Answers **1.** F **2.** T **3.** T **4.** F **5.** F **6.** T **7.** F **8.** T **9.** F **10.** T

CONVERTING METRIC MEASURES

All **conversions between the measures are accomplished simply by moving the decimal point**. Also, because each measure in clinical use differs from the next by 1000, if you know one conversion, you know them all.

How far do you move the decimal point? There is an **unforgettable memory cue** that you can use with **all metric conversions**. There are **three zeros in 1000**. The decimal point moves **three places**, the **same number of places as the zeros** in the conversion.

In metric conversions between touching units of clinical measures differing by 1000, the decimal point is moved three places, the same as the number of zeros in 1000.

CONVERTING TO A SMALLER METRIC MEASURE

If you are converting to a **smaller** measure, for example, g to mg or L to mL, the decimal point moves **three places to the** right, and the **quantity will be larger**.

EXAMPLE 1 0.5 g = ____________ mg

You are converting to a smaller measure, from **g to mg**, so the quantity will be **larger**. Move the decimal point **three places to the right**. To do this, you must **add two zeros** to the end of the quantity and **eliminate the zero in front** of it. The larger 500 mg quantity indicates that you have moved the decimal point in the correct direction.

0.5 g = .500. mg Move the decimal three places to the right

Answer: 0.5 g = 500 mg

EXAMPLE 2 2.5 L = ____________ mL

You are converting to a smaller measure, so the quantity will be **larger**. Move the decimal point **three places to the right**. To do this, you must **add two zeros**. The larger 2500 mL quantity indicates that you have moved the decimal point in the correct direction.

2.5 L = 2.500. mL

Answer: 2.5 L = 2500 mL

PROBLEMS 1-10

Convert the following metric measures.

1. 7 mg = ________ mcg
2. 1.7 L = ________ mL
3. 3.2 g = ________ mg
4. 0.03 kg = ________ g
5. 0.4 mg = ________ mcg
6. 1.5 mg = ________ mcg
7. 0.7 g = ________ mg
8. 0.3 L = ________ mL
9. 7 kg = ________ g
10. 0.01 mg = ________ mcg

Answers **1.** 7000 mcg **2.** 1700 mL **3.** 3200 mg **4.** 30 g **5.** 400 mcg **6.** 1500 mcg **7.** 700 mg **8.** 300 mL **9.** 7000 g **10.** 10 mcg

CONVERTING TO A LARGER METRIC MEASURE

In metric conversions from **smaller to larger measures**, such as mL to L and mcg to mg, the quantity will be **smaller**. The decimal point is moved **three places to the left**.

EXAMPLE 1 200 mL = ________ L

You are converting to a larger measure, **mL** to **L**, so the quantity will be **smaller**. Move the decimal point **three places to the left**.

.200. mL = .200 L

Eliminate the two unnecessary zeros at the end of the quantity to make it .2, then add a zero in front of the decimal point.

Answer: 200 mL = 0.2 L

EXAMPLE 2 1500 mcg = ________ mg

You are converting to a larger measure, so the quantity will be smaller. Move the decimal point **three places to the left**. **Place a decimal point in front of** the 5 and **eliminate the two zeros** after 5.

1.500. mcg = 1.500 mg

Answer: 1500 mcg = 1.5 mg

EXAMPLE 3 300 mcg = __________ mg

You are converting to a larger measure, **mcg** to **mg**, so the quantity will be **smaller**. Move the decimal point **three places to the left**.

.300. mcg = .300 mg

Eliminate two zeros from the end to make it .3 and place a zero in front of the decimal point to complete the conversion.

Answer: 300 mcg = 0.3 mg

PROBLEMS 1-11

Convert the metric measures.

1. 3500 mL = __________ L
2. 520 mg = __________ g
3. 1800 mcg = __________ mg
4. 750 mL = __________ L
5. 150 mg = __________ g
6. 250 mcg = __________ mg
7. 1200 mg = __________ g
8. 600 mL = __________ L
9. 100 mg = __________ g
10. 950 mcg = __________ mg

Answers **1.** 3.5 L **2.** 0.52 g **3.** 1.8 mg **4.** 0.75 L **5.** 0.15 g **6.** 0.25 mg **7.** 1.2 g **8.** 0.6 L **9.** 0.1 g **10.** 0.95 mg

SUMMARY

This concludes your introduction to the metric system. The important points to remember from this chapter are:

- The basic measures of the metric system are meter for length, liter for volume, and gram for weight.
- The meter (m), liter (L), and gram (g) are the basic units of metric measure.
- The basic measures are abbreviated to their first initial: m for meter, L for liter, and g for gram.
- Larger and smaller measures than the basics are identified by the use of prefixes.
- The prefixes are printed using small (lowercase) letters. Only the abbreviation for liter, L, is capitalized.

- Conversions within the metric system are made by moving the decimal point.
- Only four metric measures are used in clinical dosages and measures: g, mg, mcg, and L.
- All differ from each other by 1000.
- All dosage conversions are made by moving the decimal point three places (right or left).
- If a dosage contains a whole number, this will be the first determiner of value.
- If a dosage does not include a whole number, a zero, called a leading zero, is placed in front of the decimal point to emphasize that it is a fractional dosage.
- If there is no whole number, or if the whole numbers are the same, the number representing the tenths in the decimal fraction will be the next determiner of relative value.
- If the tenths in decimal fractions are identical, the number representing hundredths will determine relative value.
- Extra zeros, called trailing zeros, must be eliminated from dosages to prevent misreading errors.
- The one larger measure you will be seeing is the kilo, whose prefix is k.
- The smaller measures you will see are milli (m) and micro (mc).
- Each prefix changes the value of a basic measure by the same amount.
- Conversions within the metric system are accomplished by moving the decimal point.
- To convert from smaller to larger measures, move the decimal point to the left.
- Conversions from g to mg, mg to mcg, and mL to L all require moving the decimal point three places.

SUMMARY SELF-TEST

List the three basic measures of the metric system and identify what they measure.

1. ______________________ ______________________

______________________ ______________________

______________________ ______________________

Identify the official metric abbreviations in the following.

2. (a) L
(a) g
(b) kL
(c) mgm
(d) mg
(e) kg
(f) ml
(g) G

____

Use official metric abbreviations and notation rules to express these metric measures.

3. six-hundredths of a milligram ____________
4. three hundred and ten milliliters ____________
5. three-tenths of a kilogram ____________
6. four-tenths of a milliliter ____________
7. one and five-tenths grams ____________
8. one-hundredth of a gram ____________
9. four thousand milliliters ____________
10. one and two-tenths milligrams ____________

List the four commonly used clinical measures of weight, and the two of volume, from greater to lesser value.

11. Weight ____________ ____________ ____________ ____________

    Volume ____________ ____________

Convert the following metric measures.

12. 160 mg = ____________ g
13. 10 kg = ____________ g
14. 1500 mcg = ____________ mg
15. 750 mg = ____________ g
16. 200 mL = ____________ L
17. 0.3 g = ____________ mg
18. 0.05 g = ____________ mg
19. 0.15 g = ____________ mg
20. 1.2 L = ____________ mL
21. 1800 mL = ____________ L
22. 2 mg = ____________ mcg
23. 900 mcg = ____________ mg
24. 2.1 L = ____________ mL
25. 475 mL = ____________ L
26. 0.9 L = ____________ mL
27. 300 mg = ____________ g
28. 2.5 mg = ____________ mcg

29. 1 kL = ___________ L

30. 3 L = ___________ mL

31. 2 L = ___________ mL

32. 0.7 mg = ___________ mcg

33. 4 g = ___________ mg

34. 1000 mL = ___________ L

35. 2500 mL = ___________ L

36. 1000 mg = ___________ g

37. 0.2 mg = ___________ mcg

38. 2000 g = ___________ kg

39. 1.4 g = ___________ mg

40. 2.5 L = ___________ mL

Answers

1. gram, weight; liter, volume; meter, length
2. a, b, c, e, f
3. 0.06 mg
4. 310 mL
5. 0.3 kg
6. 0.4 mL
7. 1.5 g
8. 0.01 g
9. 4000 mL
10. 1.2 mg
11. kg, g, mg, mcg; L, mL
12. 0.16 g
13. 10,000 g
14. 1.5 mg
15. 0.75 g
16. 0.2 L
17. 300 mg
18. 50 mg
19. 150 mg
20. 1200 mL
21. 1.8 L
22. 2000 mcg
23. 0.9 mg
24. 2100 mL
25. 0.475 L
26. 900 mL
27. 0.3 g
28. 2500 mcg
29. 1000 L
30. 3000 mL
31. 2000 mL
32. 700 mcg
33. 4000 mg
34. 1 L
35. 2.5 L
36. 1 g
37. 200 mcg
38. 2 kg
39. 1400 mg
40. 2500 mL

CHAPTER 2

Additional Drug Measures: Units, Percentage, Milliequivalent, Ratio, and Household Measures

OBJECTIVES

The learner will recognize dosages:

1. Measured in units
2. Measured as percentages
3. Using ratio strengths
4. In milliequivalents
5. In household measures

INTRODUCTION

Although metric measures predominate in medications, several other measures are frequently used, particularly in parenteral (injectable) solutions and ointments, that are important for you to know.

INTERNATIONAL UNITS (units)

Units measure a drug by **its action, not its physical weight**. There is **no abbreviation** for units, and **dosages are written in lower case** using **Arabic numerals**, for example 10 units or 1,000,000 units.

Insulin, heparin, and antibiotics are measured in units, with penicillin having dosages measured in the hundreds of thousands to millions of units. Commas are not consistently used in large dosages unless they have five numbers, for example, 45,000 units.

PROBLEMS 2-1

Express the following dosages with numerals.

1. two hundred and fifty thousand units ________
2. ten units ________
3. five thousand units ________
4. forty-four units ________
5. forty thousand units ________
6. one million units ________
7. one thousand units ________
8. twenty-five hundred units ________
9. thirty-four units ________
10. one hundred units ________

Answers **1.** 250,000 units **2.** 10 units **3.** 5000 units **4.** 44 units **5.** 40,000 units **6.** 1,000,000 units **7.** 1000 units **8.** 2500 units **9.** 34 units **10.** 100 units

PERCENTAGE (%)

Percentage (%) means parts per hundred. The greater the percentage strength, the stronger the solution or ointment; for example, 3% is stronger than 1%. Fractional percentages are expressed as decimal fractions, for example, 0.45%. Notice that, unlike metric dosages, percentages are written with **no space between the quantity and percentage sign**. Percentage strengths are used extensively in intravenous (IV) solutions, and somewhat less commonly for a variety of other medications, including eye and topical (for external use) ointments. Percentage solutions and medications need to be taken seriously as dosages because they do contain significant amounts of a drug or, in IV solutions, a nutritive solute such as dextrose.

In solutions, percent represents the number of grams of a drug per 100 mL of solution.

EXAMPLE 1 100 mL of a 1% solution will contain 1 g of a drug.

EXAMPLE 2 1000 mL of a 2.5% solution will contain 25 g of a drug.

EXAMPLE 3 50 mL of a 10% solution will contain 5 g of a drug.

EXAMPLE 4 1000 mL of a 0.9% solution will contain 90 g of a drug.

Percentage solutions contain a significant amount of a drug or other solute, and reading percentage labels requires the same care as do other dosage measures.

MILLIEQUIVALENT (mEq)

Milliequivalents (**mEq**) is **an expression of the number of grams of a drug contained in 1 mL of a normal solution**. This is a definition that is quite understandable to a pharmacist or chemist, but you need not memorize it. Milliequivalent dosages are also written using **Arabic numerals**, with a space between the **abbreviation that follows**, for example, 30 mEq. You will see milliequivalents used in a variety of oral and parenteral solutions, potassium chloride being a common IV example.

PROBLEMS 2-2

Express the following milliequivalent dosages in numerals.

1. sixty milliequivalents ____________
2. fifteen milliequivalents ____________
3. forty milliequivalents ____________
4. one milliequivalent ____________
5. fifty milliequivalents ____________
6. eighty milliequivalents ____________
7. fifty-five milliequivalents ____________
8. seventy milliequivalents ____________
9. thirty milliequivalents ____________
10. twenty milliequivalents ____________

Answers **1.** 60 mEq **2.** 15 mEq **3.** 40 mEq **4.** 1 mEq **5.** 50 mEq **6.** 80 mEq **7.** 55 mEq **8.** 70 mEq **9.** 30 mEq **10.** 20 mEq

RATIO

Ratio strengths are used primarily in solutions. They represent **parts of drug per parts of solution**. They are written using Arabic numerals, for example, 1:1000 (one part drug to 1000 parts solution).

EXAMPLE 1 A 1:100 strength solution has 1 part drug in 100 parts solution.

EXAMPLE 2 A 1:5 solution contains 1 part drug in 5 parts solution.

EXAMPLE 3 A solution that is 1 part drug in 2 parts solution would be written 1:2.

The less solution a drug is dissolved in, the stronger the solution.

For example, a ratio strength of 1:10 (1 part drug in 10 parts solution) is much stronger than a 1:100 (1 part drug in 100 parts solution).

Ratio strengths are expressed in their **simplest terms**. For example, 2:10 would be incorrect because it can be reduced to 1:5. Dosages using ratio strengths are not common, but you do need to know what they represent.

PROBLEMS 2-3

Express the following as ratios.

1. 1 part drug to 200 parts solution ________
2. 1 part drug to 4 parts solution ________
3. 1 part drug to 7 parts solution ________

Identify the strongest solution in the following.

4. (a) 1:20 (b) 1:200 (c) 1:2
5. (a) 1:10 (b) 1:20 (c) 1:100
6. (a) 1:1000 (b) 1:5000 (c) 1:2000

Answers **1.** 1:200 **2.** 1:4 **3.** 1:7 **4.** c **5.** a **6.** a

HOUSEHOLD MEASURES

Household measures are not ordered in the clinical setting. They are mentioned here **only because** some **disposable clinical medication cups** may still contain them.

Accurate measurement of solution dosages using a calibrated medication cup requires that they be poured and read at eye level.

Read the household/metric equivalent measures in **Table 2-1**. You may be familiar with ounce, tablespoon, and teaspoon, but dram, dr, may also be on some disposable medication cups. There is no need to memorize the metric equivalents of these measures. The **important** thing to remember about household measures is that you **recognize and avoid them when pouring mL dosages into disposable medication cups**. A calibrated medication cup is illustrated in **Figure 2-1**.

A last household measure to address is the **drop, abbreviated gtt**. Medication dosages are now an **integral part of small-volume liquid medication preparations**. They may be **calibrated either by dosage**, or by **mL volume**, such as the dropper shown in **Figure 2-2**. Drops are used extensively for eye and ear treatments, and regularly for specific, small-volume pediatric medication dosages.

TABLE 2-1 Household Measures

Household Measure	Abbreviation	Metric Equivalent
Ounce	Oz	30 mL
Tablespoon	T, TBS, tbs	15 mL
Teaspoon	t, TSP, tsp	5 mL
Dram	Dr	4 mL
Drop	Gtt	

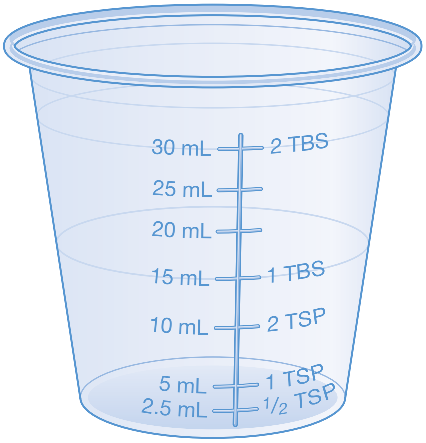


Figure 2-1 Calibrated medication cup

Figure 2-2 Calibrated medication dropper

SUMMARY

This concludes your introduction to the additional measures you will see used in dosages and in solutions. The important points to remember from this chapter are:

- International units measure a drug by its action, rather than by its weight.
- There is no abbreviation for units; it is written in full, in lowercase letters.
- Percentage (%) strengths are frequently used in solutions and ointments.
- Percent represents grams of a drug per 100 mL of solution.
- The greater the percentage strength, the stronger the solution.
- Milliequivalent is abbreviated as mEq and is frequently used in dosages.
- Ratio strengths represent parts of a drug per parts of solution.
- The abbreviation gtt is used in medications.

SUMMARY SELF-TEST

Express the following dosages using the official symbols/abbreviations.

1. three hundred thousand units __________
2. forty-five units __________
3. ten percent __________
4. two and a half percent __________

5. forty milliequivalents ____________
6. a one in two thousand ratio ____________
7. a one in ten ratio ____________
8. one percent ____________
9. one drop ____________
10. two thousand units ____________
11. five milliequivalents ____________
12. nine-tenths percent ____________
13. ten units ____________
14. a one in two ratio ____________
15. five percent ____________
16. twenty milliequivalents ____________
17. fourteen units ____________
18. twenty percent ____________
19. two million units ____________
20. one hundred thousand units ____________

Answers

1. 300,000 units
2. 45 units
3. 10%
4. 2.5%
5. 40 mEq
6. 1:2000
7. 1:10
8. 1%
9. 1 gtt
10. 2000 units
11. 5 mEq
12. 0.9%
13. 10 units
14. 1:2
15. 5%
16. 20 mEq
17. 14 units
18. 20%
19. 2,000,000 units
20. 100,000 units

SECTION 2

Oral Medications, Labels, One Step and Math Dosage Calculations

CHAPTER 3

Introduction to Oral Medications, Dosage Labels, and Calculations

OBJECTIVES

The learner will:

1. Identify scored, unscored, and enteric-coated tablets.
2. Identify regular and controlled-release capsules.
3. Differentiate generic and trade names on oral dosage and read oral dosage labels to mentally calculate simple dosages.
4. Discuss administration of oral medications.

INTRODUCTION: TYPES OF ORAL MEDICATIONS

This chapter introduces you to the variety of oral medication preparations and discusses precautions in their use. It provides oral drug labels to instruct you in the information they contain and provides practice in calculating average oral dosages in tablet, capsule, and liquid medications.

TYPES OF TABLETS AND CAPSULES

Tablets and capsules are made in a wide variety of shapes, sizes, and colors. Refer to **Figure 3-1**, and notice that the tablets in photo **A** have a smooth surface. Compare this with the tablets in photo **B**, which have **an indentation**, called a **score line**, across the center. These particular scored tablets are termed **half-scored**, but tablets may also be **quarter-scored**, with crossing score lines. Color and scoring are mainly used by pharmaceutical companies for product identification.

The tablets in photo **C** have an **enteric coating**, added to delay absorption until they reach the small intestine. **Enteric-coated tablets must not be crushed**, since this would destroy their capacity to withstand destruction by stomach acid.

A. Tablets

© Ramon Espelt Photography/Shutterstock

B. Scored tablets

© MARCELODLT/Shutterstock

C. Enteric-coated tablets

© Juanmonino/E+/Getty Images

D. Capsules

© nokwalai/Shutterstock

E. Gelatin capsules

© Alexeysun/Shutterstock

F. Controlled-release capsules

© Lubov Vis/Shutterstock

Figure 3-1 Solid drug preparations

The three remaining photos, **D, E, and F** are **capsules**, drugs contained in gelatin covers. The capsules in photo **E** contain an **oily drug**, while those in photo **F** are **sustained or controlled release**, allowing for drug absorption over a period of time.

TABLET AND CAPSULE LABELS

Many oral drugs in the clinical setting may be packaged individually in single doses, called **unit dosages**, prepared by either drug manufacturers and/or hospital pharmacies. Unit dosage labels are quite small, with reduced labeling space, requiring careful reading of both the drug name and dosage. Consequently, throughout this text we have provided larger dosage labels, primarily using **generic names**, to aid in your instruction.

EXAMPLE 1

Look at the levothyroxine sodium label in **Figure 3-2**. This is the drug's **generic name**, which, in spite of its capitalization on this label, is normally written using **lowercase letters**. Underneath this is the **drug format, tablets**. Notice the **USP** that follows "Tablets," which refers to **United States Pharmacopeia**, one of several **national listings** of medications.

The **generic** is the **official international name** of a drug. Drug labels often contain **trade names**, each for the **exclusive use** of a drug's manufacturer. **Trade names** are **printed first** on labels and are **capitalized**. They will also have an ® **registration symbol** following their trade name. Levothyroxine sodium is the main drug used to treat hypothyroidism and is also marketed under the trade names Synthroid, Levoxyl, and Levothyroid. Drugs may be ordered by either name depending on hospital policy or prescriber preference, so recognizing this difference is necessary for accurate identification.

Next on the label is the **dosage strength**, 100 mcg and (0.1 mg). The prepared dosage is often representative of **the average dosage strength: the dosage given to the average patient at one time**. Notice that **100 TABLETS** is printed near the **top right** of the label. This is the **total number** of tablets in the bottle. Be careful not to confuse the quantity of tablets or capsules with the dosage strength. **The dosage strength always has a unit of measure associated with it**—in this case, mcg and mg.

EXAMPLE 2

The label in **Figure 3-3** is an example of a medication that contains not one but **two drugs**: oxycodone and acetaminophen, which is an analgesic. The dosages in this multiple-drug narcotic are written **separately** on the label, but **in the same order** as their generic names: **5 mg** is oxycodone; **325 mg** is acetaminophen.

The dosages in multiple-drug products are routinely written in the same order as the drugs listed in the product. Oxycodone and acetaminophen are generic names. Medications that contain more than one drug are usually **ordered by trade name and number of tablets or capsules**

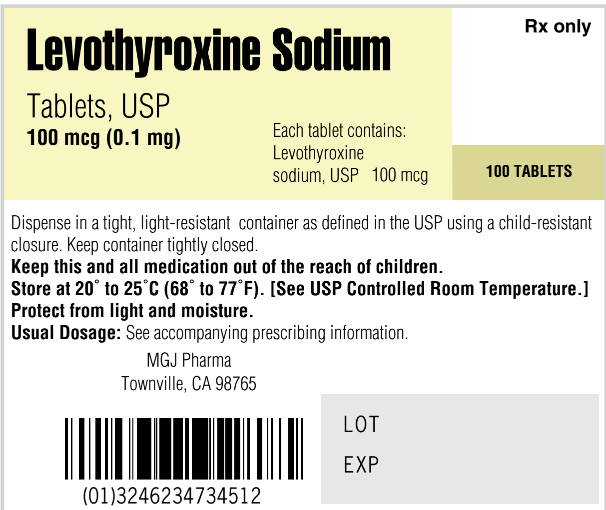


Figure 3-2

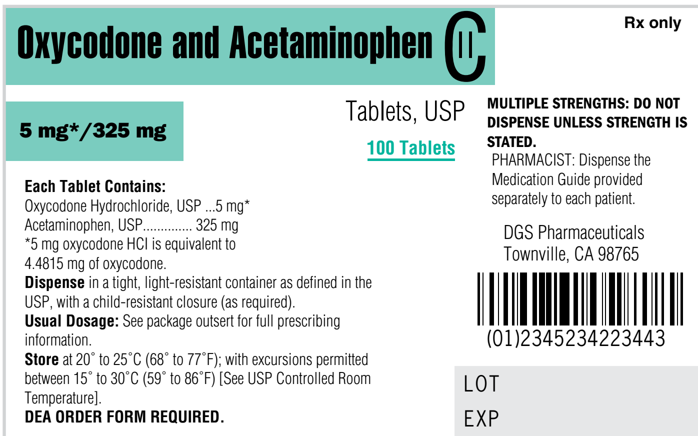


Figure 3-3

to be given rather than by dosage. Percocet and Endocet are two of the trade-named drugs used for this narcotic preparation. Given the addictive history of oxycodone, you may already be familiar with this generic name.

Tablets and capsules that contain more than one drug are usually ordered by trade name and number of tablets or capsules to be given.

PROBLEMS 3-1

Refer to the labels in Figures 3-4, 3-5, and 3-6 containing carbidopa and levodopa, major drugs used in the treatment of Parkinson's disease. All three of these labels are for different dosage combinations, and the next problems will ask you to identify these.

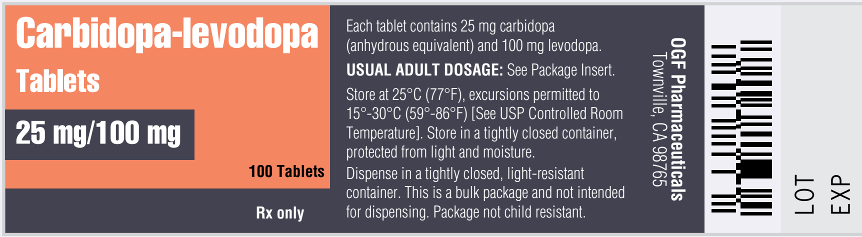


Figure 3-4

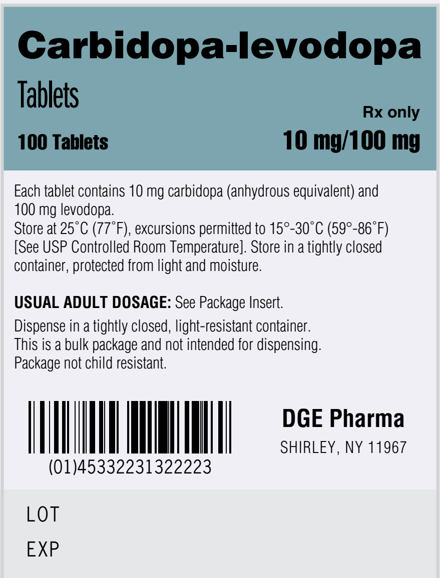


Figure 3-5

Figure 3-6

1. What is the dosage strength of carbidopa-levodopa in Figure 3-4? ____________
2. What is the dosage of carbidopa-levodopa in Figure 3-5? ____________
3. What is the dosage in Figure 3-6? ____________
4. What form are these medications prepared as? ____________
5. What different action does the preparation in Figure 3-6 have? ____________

Answers **1.** 25 mg/100 mg **2.** 10 mg/100 mg **3.** 50 mg/200 mg **4.** tablets **5.** extended release

This short question section was included to make you aware of the **multiple dosages** and **actions** that a particular medication may have, and you are now ready to calculate some simple dosages yourselves.

TABLET AND CAPSULE DOSAGE CALCULATION

When the time comes for you to administer medications, you will have to read a patient **Mediation Administration Record (MAR)** to prepare the dosage. The MAR will tell you the name and amount of drug to be given, but it will not tell you how many tablets or capsules contain this dosage. This you must calculate yourself. However, most tablets/capsules are prepared in average dosage strengths, and orders will usually involve giving one to three tablets or capsules.

As a general rule, **1 to 3 tablets** can be used as **a rough guideline** to correct oral dosage measurement. Orders calculated for more than three tablets or capsules require recalculation or should be questioned.

An unusual number of tablets or capsules should be a warning of an error in prescribing, transcribing, or calculation.

Let's now look at some sample orders and do some actual dosage calculations.

PROBLEMS 3-2

Refer to the label in Figure 3-7 to answer these questions.

1. What is the dosage strength? ____________
2. If you have an order for 120 mg, give ____________
3. If you have an order for 60 mg, give ____________
4. What is the generic name of this drug? ____________
5. What is the total number of capsules in this package? ____________

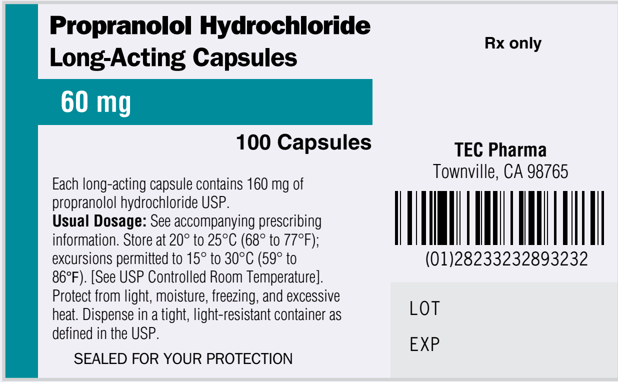


Figure 3-7

Answers **1.** 60 mg **2.** 2 caps **3.** 1 cap **4.** propranolol hydrochloride **5.** 100 capsules

PROBLEMS 3-3

Refer to the label in Figure 3-8 to answer these questions.

1. What is the dosage strength? ____________
2. If 10 mg is ordered, give ____________
3. If 20 mg is ordered, give ____________
4. What is the total number of tablets in this package? ____________

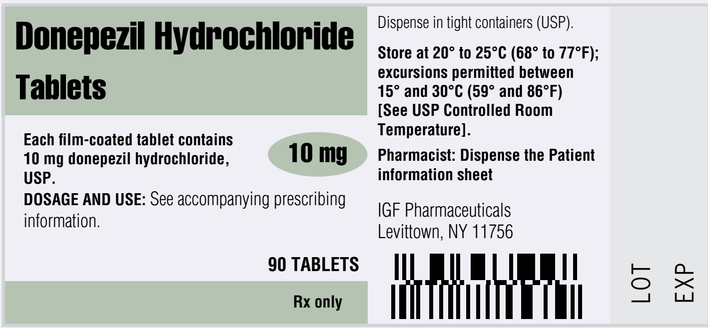


Figure 3-8

Answers **1.** 10 mg **2.** 1 tab **3.** 2 tabs **4.** 90

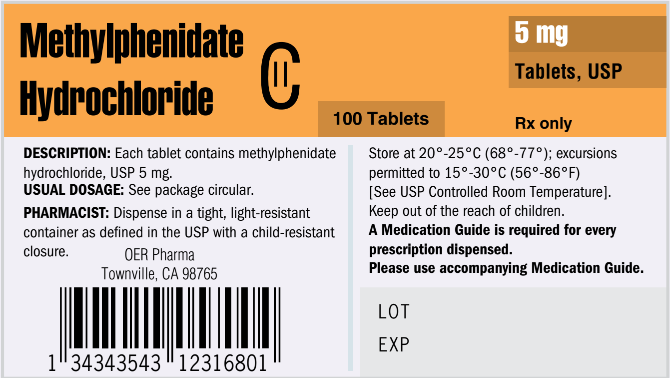
PROBLEMS 3-4

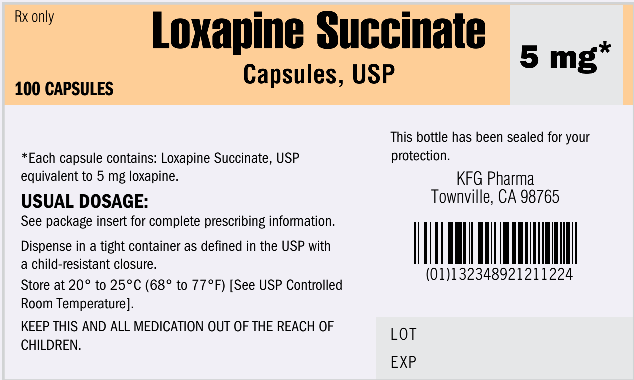
Locate the appropriate labels for the following dosages, and indicate how many tablets or capsules are needed to give them.

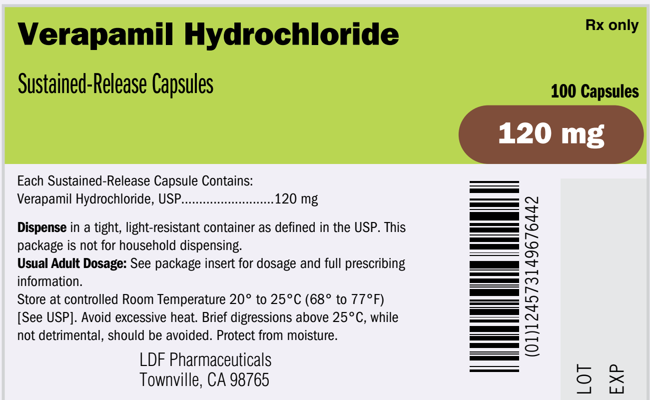
1. Verapamil HCl 0.12 g
2. Loxapine succinate 10 mg

3. Loxapine succinate 5000 mcg

4. Methylphenidate HCl 5000 mcg







Answers 1. 1 cap **2.** 2 caps **3.** 1 cap **4.** 1 tab

It is not uncommon for a drug to be **ordered** in one unit of metric measure—**such as, mg**—and discover that it is **labeled** in another measure—**such as, g**. It will then be necessary to **convert the metric units to calculate the dosage**. Conversions will always be between touching units of measure: g and mg or mg and mcg.

EXAMPLE 1

Refer to the triazolam label in **Figure 3-9**. A dosage of 250 mcg has been ordered. The label reads 0.25 mg. Convert the mg to mcg by moving the decimal point three places to the right, and you can mentally verify that these dosages are identical. Give 1 tablet.

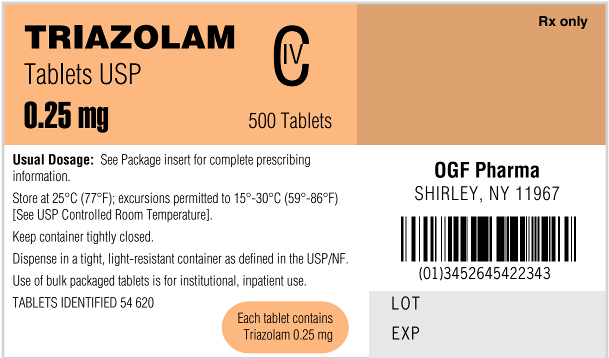


Figure 3-9

EXAMPLE 2

Refer to the clonazepam label in **Figure 3-10**. A dosage of 1000 mcg is ordered. The label reads 0.5 mg, so you must give 2 tablets (1 tab = 500 mcg, so 1000 mcg requires 2 tabs). The decimal moves three places to the right in this conversion.

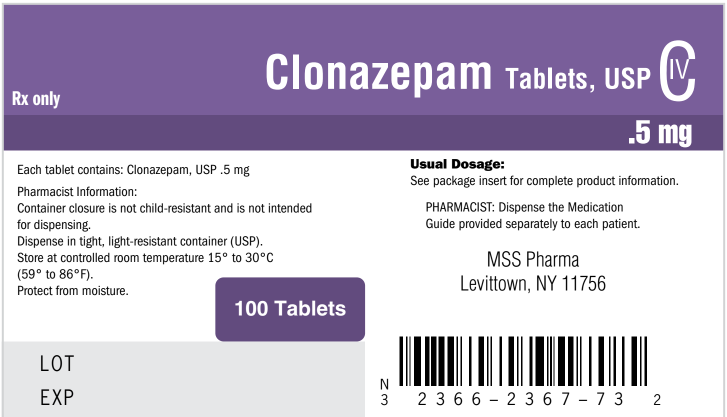


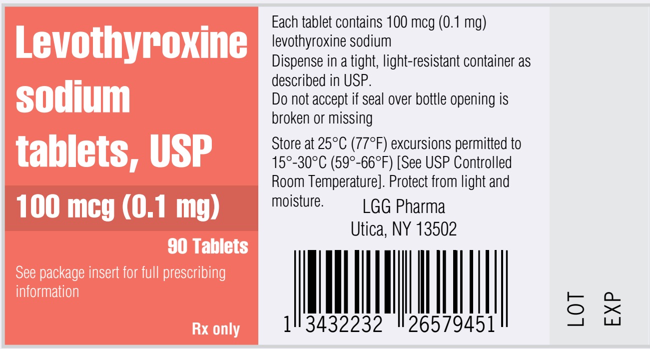
Figure 3-10

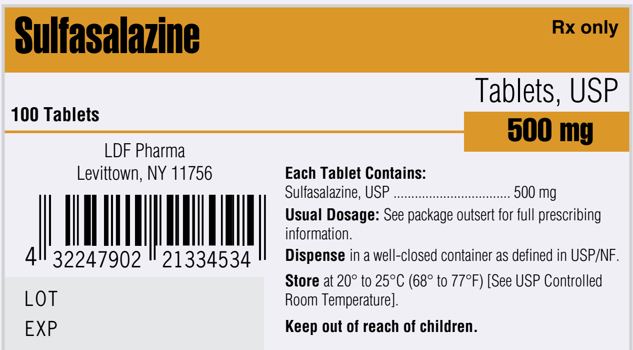
PROBLEMS 3-5

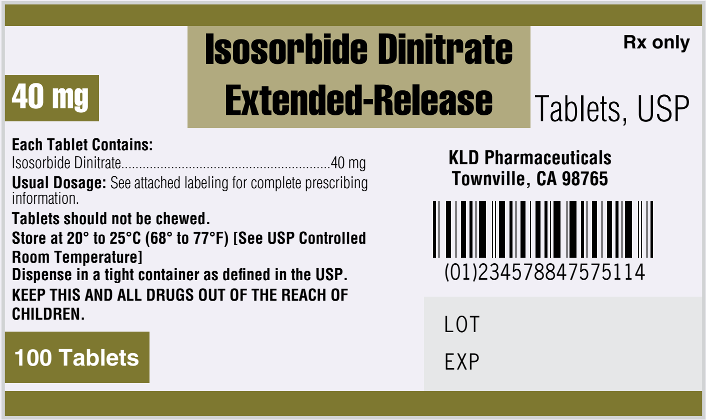
Locate the appropriate labels for the following drug orders, and indicate the number of tablets/capsules that will be required to administer the dosages ordered. A label may be used for more than one problem.

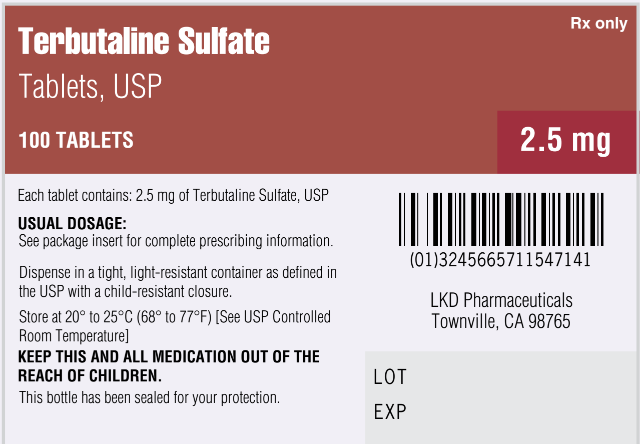
1. Isosorbide dinitrate 40 mg ____________ tab
2. Sulfasalazine 0.5 g ____________ tab
3. Sulfasalazine 1 g ____________ tab
4. Terbutaline sulfate 2500 mcg ____________ tab
5. Chlordiazepoxide HCl 50 mg ____________ cap

6. Chlordiazepoxide HCl 25 mg ________ cap
7. Isosorbide dinitrate 80 mg ________ tab
8. Levothyroxine 0.2 mg ________ tab
9. Levothyroxine Na 0.2 mg ________ tab
10. Terbutaline sulfate 2500 mcg ________ tab









Answers **1.** 1 tab **2.** 1 tab **3.** 2 tabs **4.** 1 tab **5.** 2 caps **6.** 1 cap **7.** 2 tabs **8.** 2 tabs **9.** 2 tabs **10.** 1 tab

ORAL SOLUTION DOSAGE CALCULATION

Solution medications are used most frequently in pediatrics, where many of the labels contain information on the following:

1. **Reconstitution of the solution** from its powdered form;
2. **Dosage based on body weight**; and
3. **Length of potency and storage** of the reconstituted solution.

The next set of questions will walk you through the important points to know about oral solutions.

PROBLEMS 3-6

Read the Cefaclor label in Figure 3-11 and answer the following questions.

1. What diluent is used to reconstitute this preparation? ____________
2. How much diluent must be added? ____________
3. How is the diluent to be added? ____________
4. How long will the reconstituted solution last? ____________
5. How must it be stored? ____________
6. What is the adult dosage? ____________
7. How often is the adult dosage to be administered? ____________
8. What is the pediatric dosage in otitis media? ____________
9. What precaution does administration of a suspension require? ____________
10. How many mL will a 187-mg adult dosage require? ____________

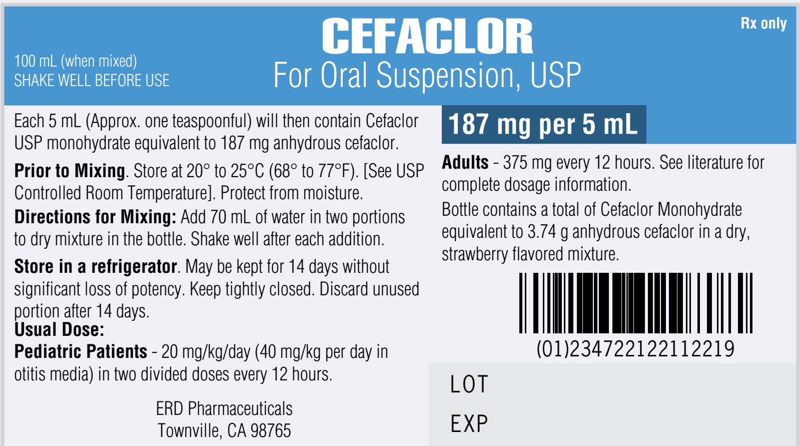


Figure 3-11

Answers **1.** water **2.** 70 mL **3.** In two portions **4.** 14 days **5.** Refrigerate **6.** 187 mg **7.** Every 12 hours **8.** 40 mg/kg/day **9.** Thorough mixing prior to pouring, immediate administration to prevent setting out **10.** 5 mL

In this exercise, you were introduced to **powdered oral drug reconstitution** and learned that reconstituted solutions **have a limited life span**, that they have specific **storage** requirements, that **average dosages** for **adults and children** are quite different, and that **reconstituted suspensions** have **expiration times** and **dates**.

Calculation of **dosages based on body weight** will be covered in a later chapter.

PROBLEMS 3-7

DIRECTIONS: Use the solution labels provided in Figures 3-12 through 3-16 to measure the following dosages. Indicate in the second column if these medications are suspensions.

1. Penicillin V potassium 0.25 g ________ ________
2. Valproic acid 0.5 g ________ ________
3. Amoxicillin 0.2 g ________ ________
4. Cefpodoxime proxetil 0.1 g ________ ________
5. Valproic acid 500 mg ________ ________
6. Fluoxetine 40 mg ________ ________
7. Amoxicillin 0.4 g ________ ________
8. Penicillin V potassium 500 mg ________ ________
9. Fluoxetine 20 mg ________ ________
10. Cefpodoxime proxetil 0.2 g ________ ________

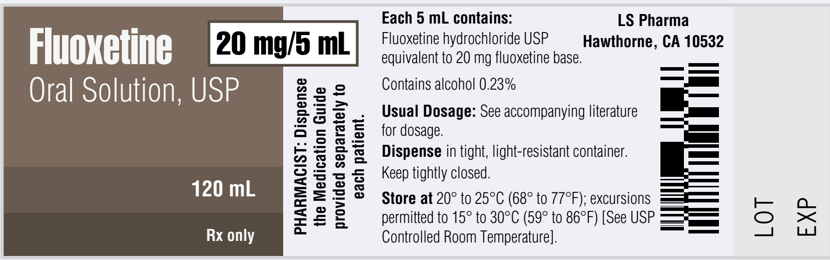


Figure 3-12

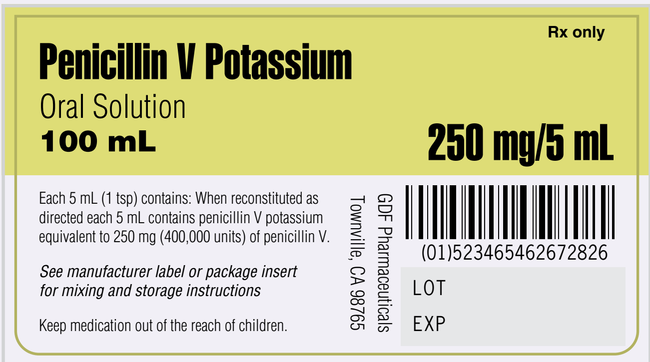


Figure 3-13