

# To The Student

## Math and Dosage Calculations

Accurate math and dosage calculations play a large role in ensuring that medication errors do not occur. Medication errors affect the health and safety of patients and are of great concern for the medical community. As a health care employee, you must carefully perform math and dosage calculations to prevent these errors. This *Math and Dosage Calculations for Medical Careers* textbook and student CD-ROM are designed to help you do just that.

This course teaches you the skills and techniques to calculate the amount of medication that a patient should receive or you should administer. You will also learn to interpret physician's orders, medication records, and drug labels. This textbook is written for any student who plans to enter the health care field and will be working with medications. Right now you may be pursuing a career as a medical assistant, nurse, pharmacy technician, or other health care worker.

This textbook and CD-ROM will guide you through all the steps to find the correct amount of medication to administer to patients. The early chapters provide detailed review of the basic arithmetic and algebra skills that are needed. The later chapters provide options for calculating dosages of medications administered by different routes and to different-age patients.

Since your math backgrounds may be different, this book provides various approaches for calculating dosages, so you can build upon what you already know. You may pick the dosage calculations technique that you understand the best and feel most comfortable with performing. These four methods are introduced: fraction proportion, ratio proportion, dimensional analysis, and the formula method. Once you have determined the method you prefer, read the color-coded material throughout the book.



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## How Can I Succeed in this Class, a First Step Toward My Goals?

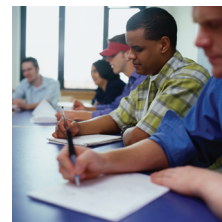
If you're reading this, you're on the right track.

*You are the same today that you are going to be 5 years from now except for two things: the people with whom you associate and the books you read. —Charles Jones*

Right now, you're probably leafing through this book, feeling just a little overwhelmed. You're trying to juggle several other classes (which probably are equally intimidating), possibly a job, and, on top of it all, a life.

It's true—you are what you put into your studies. You have a lot of time and money invested in your education. Don't blow it now by only putting in half of the effort that this class requires. Succeeding in this class (and life) requires

- Making a commitment—of time and perseverance.
- Knowing and motivating yourself.
- Getting organized.
- Managing your time.



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This special introduction has been designed specifically to help you focus. It's here to help you learn how to manage your time and your studies to succeed. It will help you learn how to be effective in these areas as well as offer guidance in

- Getting the most out of your lecture.
- Thinking through—and applying—the material.
- Getting the most out of your textbook and CD-ROM.
- Finding extra help when you need it.



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## Making a Commitment—of Time and Perseverance

Learning—and mastering—takes time. And patience. Nothing worthwhile comes easily. Be committed to your studies, and you will reap the benefits in the long run.

Consider this: Your math and dosage calculations course is building the foundation for your future—a future in your chosen health care profession. Sloppy and hurried craftsmanship now will only lead to ruin later.

*Study Tip: A good rule of thumb is to allow 2 hours of study time for every hour you spend in class.*

## Knowing and Motivating Yourself

What type of a learner are you? When are you most productive? Know yourself and your limits, and work within them. Know how to motivate yourself to give your all to your studies and achieve your goals. Quite bluntly, you are the one who benefits most from your success. If you lack self-motivation and drive, you are the first person who suffers.

Knowing yourself—there are many types of learners, and there is no right or wrong way of learning. Which category do you fall into?

1. *Visual learner.* You respond best to “seeing” processes and information. Particularly focus on the text’s rules, examples, figures, and tables.
2. *Auditory learner.* You work best by listening to—and possibly tape-recording—the lecture and by talking information through with a study partner. Don’t miss any lectures. Be sure to listen to the key terms on the audio Glossary and review all the rules on the CD-ROM.
3. *Tactile / kinesthetic learner.* You learn best by being “hands on.” You’ll benefit by applying what you’ve learned during lab time. Think of how to apply your critical thinking skills. Work through the Critical Thinking on the Job sections, and be sure to complete all the practice problems and games on the CD-ROM.

Identify your own personal preferences for learning, and seek out the resources that will best help you with your studies. Also, learn by recognizing your weaknesses and try to compensate or work to improve them.

## Getting Organized

It’s simple, yet it’s fundamental. It seems the more organized you are, the more easily things come. Take the time before your course begins to look around and analyze your life and your study habits. Get organized now, and you’ll find you have a little more time—and a lot less stress.

Find a calendar system that works for you. The best kind is one that you can take with you everywhere. To be truly organized, you should integrate all aspects of your life into this one calendar—school, work, and leisure. Some people also find it helpful to have an additional monthly calendar posted by their desks for “at a glance” dates and to have a visual of what’s to come. If you do this, be sure you are consistently synchronizing both calendars so as not to miss anything. More tips for organizing your calendar can be found in the next section, “Managing Your Time”.

By the same token, keep everything for your course or courses in one place—and at your fingertips. A three-ring binder works well because it allows you to add or organize



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handouts and notes from class in any order you prefer. Incorporating your own custom tabs helps you flip to exactly what you need at a moment's notice.

Find your space. Find a place that helps you be organized and focused. If it's your desk in your dorm room or in your home, keep it clean. Clutter adds confusion and stress, and it wastes time. Or perhaps your "space" is at the library. If that's the case, keep a backpack or bag that's fully stocked with what you might need—your text, binder or notes, pens, highlighters, Post-Its, and phone numbers of study partners (*Hint*: a good place to keep phone numbers is in your "one place for everything calendar").

**Helpful Hint.** Add extra "padding" into your deadlines to yourself. If you have a report due on Friday, set a goal for yourself to have it done on Wednesday. Then take time on Thursday to look over your project again, with a fresh eye. Make any corrections or enhancements, and have it ready to turn in on Friday.

## Managing Your Time

Managing your time is the single most important thing you can do to help yourself. And it's probably one of the most difficult tasks to successfully master.

You are taking this course because you want to succeed in life. You are preparing for a career. You are expected to work much harder and to learn much more than you ever have before. To be successful, you need to invest in your education with a commitment of time.

**How time slips away.** People tend to let an enormous amount of time slip away from them, mainly in three ways:

1. *Procrastination*—putting off chores simply because we don't feel in the mood to do them right away.
2. *Distraction*—getting sidetracked by the endless variety of other things that seem easier or more fun to do, often not realizing how much time they eat up.
3. *Underestimating the value of small bits of time*—thinking it's not worth doing any work because we have something else to do or somewhere else to be in 20 minutes or so.

We all lead busy lives. But we all choose how to spend our time. Choose wisely and make the most of every minute you have by implementing these tips.

**Know yourself and when you'll be able to study most efficiently.** When are you most productive? Are you a late nighter? Or an early bird? Plan to study when you are most alert and can have uninterrupted segments. This could include a quick 5-minute review before class or a 1-hour problem-solving study session with a friend.

**Create a set study time for yourself daily.** Having a set schedule for yourself helps you commit to studying and helps you plan instead of cram. Find—and use—a planner that is small enough to take with you—everywhere. This can be a \$2.50 paper calendar or a more expensive electronic version. They all work on the same premise—*organize all your activities in one place.*

Make sure you log your projects and homework deadlines in your personal calendar.

Less is more. Schedule study time using shorter, focused blocks with small breaks. Doing this offers two benefits:

1. You will be less fatigued and will gain more from your effort.
2. Studying will seem less overwhelming, and you will be less likely to procrastinate.

**Plan time for leisure, friends, exercise, and sleep.** Studying should be your main focus, but you need to balance your time—and your life. Try to complete tasks ahead of schedule. This will give you a chance to carefully review your work before you hand it in (instead of at 1 a.m. when you are half awake). You'll feel less stressed in the end.



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**Prioritize!** In your calendar or planner, highlight or number key projects; do them first, and then cross them off when you've completed them. Give yourself a pat on the back for getting them done! Review your calendar and reprioritize daily.

Try to resist distractions by setting and sticking to a designated study time (remember your commitment and perseverance!). Distractions may include friends and surfing the Internet.

**Multitask when possible.** You may find a lot of extra time you didn't think you had. Review material or organize your term paper in your head while walking to class or doing laundry, or during "mental downtime." (*Note:* Mental downtime does *not* mean in the middle of a lecture.)

## Getting the Most Out of Lectures

Believe it or not instructors want you to succeed. They put a lot of effort into helping you learn and into preparing their lectures. Attending class is one of the simplest, most valuable things you can do to help yourself. But it doesn't end there—getting the most out of your lectures means being organized. Here's how:



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**Prepare before you go to class.** Really! You'll be amazed at how much more comprehensible the material will be when you preview the chapter before you go to class. Don't feel overwhelmed by this already. One tip may help you: Plan to arrive at class 5 to 15 minutes before the lecture. Bring your text with you, and skim the chapter before the lecture begins. At the very least, this will give you an overview of what may be discussed.

**Be a good listener.** Most people think they are good listeners, but few really are. Are you? Obvious, but important, points to remember include these:

1. You can't listen if you are talking.
2. You aren't listening if you are daydreaming.
3. Listening and comprehending are two different things. If you don't understand something your instructor is saying, ask a question or make a note and visit the instructor after hours. Don't feel dumb or intimidated; you probably aren't the only person who "doesn't get it."

### Take good notes

1. Use a standard-size notebook or, better yet, a three-ring binder with looseleaf notepaper. The binder will allow you to organize and integrate your notes and handouts, integrate easy-to-reference tabs, etc.
2. Use a standard black or blue ink pen to take your initial notes. You can annotate later, using a pencil, which can be erased if need be.
3. Start a new page with each lecture or note-taking session (yes, you can and should also take notes from your textbook).
4. Label each page with the date and a heading for each day.
5. Focus on main points, and try to use an outline format to take notes to capture key ideas and organize subpoints.
6. Review and edit your notes shortly after class—at least within 24 hours—to make sure they make sense and that you've recorded core thoughts. You may also want to compare your notes with those of a study partner later, to make sure neither of you missed anything.

**Get a study partner.** Having a study partner has so many benefits. First, he or she can help you keep your commitment to this class. By having set study dates, you can combine study and social time and maybe even make it fun! In addition, you now have two sets of eyes and ears and two minds to help digest the information from lectures and from the text. Talk through concepts, compare notes, and quiz each other.



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An obvious note: Don't take advantage of your study partner by skipping class or skipping study dates. You obviously won't have a study partner—or a friend—much longer if it's not a mutually beneficial arrangement!

**Helpful Hint.** Take your text to the lecture, and keep it open to the topics being discussed. You can take brief notes in your textbook margin or reference textbook pages in your notebook to help you study later.



## Getting the Most Out of Your Textbook

McGraw-Hill and the authors of this book, Kathryn Booth and James Whaley, have invested our time, research, and talents to help you succeed as well. Our goal is to make learning easier—for you.

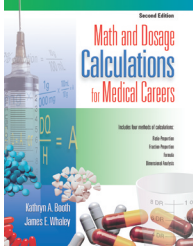
Here's how: The textbook has 12 chapters. Each opens with

1. *Objectives*, so you understand the key points you should master.
2. *Key Terms*, so you will know the terms necessary to perform math and dosage calculations.
3. *Introduction*, for you to understand why each chapter is important.

The text introduces techniques for math and dosage calculations by providing *Rules* to guide you. These rules introduce an important concept that must be followed while you are learning. After you read and study each rule and the examples that follow, you should open the student CD-ROM found in the back of the book and view the rule and complete the practice problems. Once you have mastered a rule, continue in the textbook.

Once you have completed a certain number of rules, you will come to the end of a section. Each section includes multiple Review and Practice problems to ensure your mastery of the content in that section. Check your answers against those in the back of the book.

Complete the chapter Checkup in the textbook for a final review, and take the Chapter Test on the CD-ROM for a final evaluation of your ability.



# The Learning System

Chapter openers feature **Objectives, Key Terms, Introduction**, and an insightful quote to introduce you to the chapter and help prepare you for the information presented. Take time to read and review these sections before you begin. **Key Terms and Introduction new to this edition!**

*“The Booth/Whaley text is the most appropriate to an entry level curriculum dealing with introducing the students to common mathematical calculations often found in the practice of allied health and nursing.”*

*Jim Downey, CEI Lowell Campus*

## 8 Oral Dosages

*If you want to achieve excellence, you can get there today. As of this second, quit doing less-than-excellent work.*  
—Thomas John Watson, Jr.

**Objectives** When you have completed Chapter 8, you will be able to

- Distinguish between different types of oral medications.
- Recognize the types of solid oral medications that may not be altered by crushing or opening them.
- List appropriate techniques for administering medication to patients with difficulty swallowing or with feeding tubes.
- Accurately calculate the amount of solid or liquid oral medication to administer to a patient.
- Identify common errors that occur in calculating and preparing dosages for oral administration or via a feeding tube.

**Key Terms**

Caplet	Scored
Capsule	Spansules
Enteric-coated	Sustained release
Gelcap	Tablet

**Introduction**

So far you have learned the fraction proportion, ratio proportion, formula, and dimensional analysis methods for simple calculations. In this chapter you will apply these methods to oral dosages including solids and liquids. By now you may have chosen one method with which you are most comfortable. If so, follow that method throughout this chapter, using the corresponding color coding in the examples given; then complete the practice problems, using your method of choice. While you are practicing these problems, remember that excellence is a *must* with dosage calculations.

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**Rule 2-2** To convert a decimal into a percent, multiply the decimal by 100 Then add the percent symbol.

**Example 1** Convert 1.42 to a percent.  
 $1.42 \times 100\% = 142.00\% = 142\%$   
 You can write this as  $1.42 = 142\%$ .

**Example 2** Convert 0.02 to a percent.  
 $0.02 \times 100\% = 2.00\% = 2\%$   
 You can write this as  $0.02 = 2\%$ .

**Example 3** When you move the decimal point to the right, you may need to insert zeros. Convert 0.8 to a percent.  
 $0.8 \times 100\% = 80.0\% = 80\%$   
 You can write this as  $0.8 = 80\%$ .

*Remember that when you multiply a number by 100, you move the decimal point two places to the right. When you divide a number by 100, you move the decimal point two places to the left.*

Abbreviation	Potential Problem	Preferred Term
U (for unit)	Mistaken as zero, four, or cc	Write <i>unit</i>
IU (for international unit)	Mistaken as IV (intravenous) or 10	Write <i>international unit</i>
Q.D., Q.I.D. (Latin abbreviations for once daily and every other day)	Mistaken for each other. The period after the Q can be mistaken for an I and the D can be mistaken for I.	Write <i>daily and every other day</i>
Trailing zero (X.0 mg) [Note: Prohibited only for medication-related notations] Lack of leading zero (X mg)	Decimal point is missed.	Never write a zero by itself after a decimal point (X mg), and always use a zero before a decimal point (0.X mg)
MS MSO <sub>4</sub> MgSO <sub>4</sub>	Confused for one another. Can mean morphine sulfate or magnesium sulfate.	Write <i>morphine sulfate or magnesium sulfate</i>

**GO TO . . .** Open the CD-ROM that accompanies your textbook, and select Chapter 5, Practice 5-3. Review the animation and example problems, then complete the practice problems. Continue to the next section of the book once you have mastered the rule presented. ■

**Rules** state important formulas and facts. They provide you with guidelines for calculating dosages. The examples illustrate the rules.

**Tables** summarize key information.

**CD-ROM references** direct you to CD exercises to help reinforce the concepts previously learned. **New to this edition!**

5. Cancel units.

$$A \text{ mL} = \frac{5 \text{ mL}}{250 \text{ } \mu\text{g}} \times \frac{125 \text{ } \mu\text{g}}{1}$$

6. Solve the equation.

$$A \text{ mL} = \frac{625 \text{ mL}}{250}$$

$$A = 2.5 \text{ mL}$$

### Using the Formula Method

Follow Procedure Checklist 7-4.

- The drug is ordered in milligram dose on hand. Therefore,
  - D = 125 mg
  - Q = 5 mL
  - H = 250 mg
- Fill in the formula.
 
$$\frac{D \times Q}{H} = A$$

$$\frac{125 \text{ mg} \times 5 \text{ mL}}{250 \text{ mg}} = A$$
- Cancel units.
 
$$\frac{125 \cancel{\text{ mg}} \times 5 \text{ mL}}{250 \cancel{\text{ mg}}} = A$$
- Solve for the unknown.
 
$$\frac{625 \text{ mL}}{250} = A$$

$$A = 2.5 \text{ mL}$$

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**GO TO** . . . Open the CD-R Chapter 8, Rule 8-5. Review the practice problems. Continue to the rule presented. ■

### Using the Fraction Proportion Method

Follow Procedure Checklist 7-1.

- Fill in the proportion.
 
$$\frac{Q}{H} = \frac{A}{D} \quad \text{or} \quad \frac{\text{dose on hand}}{\text{dose on hand}} = \frac{\text{amount to administer}}{\text{desired dose}}$$

$$\frac{5 \text{ mL}}{250 \text{ mg}} = \frac{A}{125 \text{ mg}}$$
- Cancel units.
 
$$\frac{5 \text{ mL}}{250 \cancel{\text{ mg}}} = \frac{A}{125 \cancel{\text{ mg}}}$$
- Cross-multiply and solve for the unknown.
 
$$250 \times A = 5 \text{ mL} \times 125$$

$$A = 5 \text{ mL} \times \frac{125}{250}$$

$$A = 2.5 \text{ mL}$$

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**GO TO** . . . Open the CD-R Chapter 8, Rule 8-5. Review the practice problems. Continue to the rule presented. ■

### Using the Ratio Proportion Method

Follow Procedure Checklist 7-2.

- Fill in the proportion.
 
$$Q : H :: A : D \quad \text{or} \quad \text{dose on hand} :: \text{amount to administer} : \text{desired dose}$$

$$5 \text{ mL} : 250 \text{ mg} :: A : 125 \text{ mg}$$
- Cancel units.
 
$$5 \text{ mL} : 250 \cancel{\text{ mg}} :: A : 125 \cancel{\text{ mg}}$$
- Multiply the means and extremes, then solve for the missing value.
 
$$250 \times A = 5 \text{ mL} \times 125$$

$$A = 5 \text{ mL} \times \frac{125}{250}$$

$$A = 2.5 \text{ mL}$$

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**GO TO** . . . Open the CD-R Chapter 8, Rule 8-5. Review the practice problems. Continue to the rule presented. ■

### Using Dimensional Analysis

Follow Procedure Checklist 7-3.

- The unit of measure for the amount to administer will be milliliters.
 
$$A \text{ mL} =$$
- Since the unit of measurement for the dosage ordered is the same as that for the dose on hand, this step is unnecessary.

Four different methods of **dosage calculations** are color-coded so you can easily find the method of problem solving that best fits your learning style. The methods are:

- Fraction Proportion**
- Ratio Proportion**
- Dimensional Analysis**
- Formula**

*“Students with a fear of math will not be intimidated by this text.”*

*Peggy Newton,  
Health Institute of Louisville*

**Patient Education** teaches you clear and accurate ways to communicate with patients.

### Patient Education

Review with patients who are taking medications in a home environment the steps for reconstituting liquid medications. Follow Rule 8-5. If necessary, copy the rule for them, then discuss. If you are dispensing medications, give the patients the same information that the pharmacist would, if you are allowed to do so. Give patients the following information about handling liquid medication:

- Read the label to learn how to store the medication.
- Use the measuring device provided or a device purchased specifically to measure medications. Household teaspoons and tablespoons do not measure liquid accurately.
- Do not store medication longer than the label indicates. Medication used after its expiration date may have lost potency, or its chemical composition may have changed.
- Wash the measuring device with hot water and a dishwashing detergent after each use. Dry it with a paper towel. Store it in a clean container such as a plastic bag.
- Keep liquid medication in original containers.

**Error Alert** brings attention to common medication mistakes and focuses on ways to avoid them.

### ERROR ALERT!

**Always be certain that you are dispensing the correct medication.**

Many drugs have names that are very similar. Read the order carefully and, when in doubt, contact the prescribing physician. The following list gives just a few examples of how similar the names of different drugs can look and sound. It is especially easy to confuse them when they are written rather than printed.

Acular—Ocular	Digitoxin—digoxin	Pavabid—Pavased
Benadryl—Bentyl	Eurax—Urex	Phenaphen—Phenergan
Cafergot—Carafate	Iodine—Lodine	Quinidine—quinine
Darvon—Diovan	Nicobid—Nitrobid	Uracil—uracil

**Critical Thinking on the Job** presents common problems that you may encounter in the healthcare field.

### Critical Thinking on the Job

## Critical Thinking Applications

require you to go beyond simple calculations.

### Critical Thinking Application

You are working in a clinic that serves many adult homeless people. Two forms of Erythromycin are available (see labels below). If the patient needs to take Erythromycin for 5 days, which form of the medication would be better and why?



**Case Study** exercises connect you to real-life situations.

**Internet Activities** help you learn how to use the Internet for research and information.

### Case Study

A drug order reads Dilaudid-HP 8 mg IM stat. You have available a drug with the following label:

1. What would you do to prepare for administering this drug?
  2. How would you administer the drug?
  3. What would you do with the vial after administering a dose of the drug?
- To check your answers, see page 494.



### Internet Activity

Mr. Liu is about to be discharged from the hospital with instructions to take Coumadin 1 mg bid. Mr. Liu is an elderly, easily confused man who will be cared for by his daughter. Although you have reviewed his medication instructions with him several times, you are not completely confident he understands that he should not drink alcohol or take any self-prescribed, over-the-counter medications or herbal cures while he is taking Coumadin.

**Assignment:** Conduct an Internet search to find information in plain language regarding the importance of not taking any over-the-counter medications while taking Coumadin.

**Review and Practice** exercises follow each section of every chapter giving you the opportunity to apply new concepts.

## REVIEW AND PRACTICE

### 1-1 Fractions and Mixed Numbers

1. What is the numerator in  $\frac{17}{100}$ ?
2. What is the numerator in  $\frac{8}{5}$ ?
3. What is the denominator in  $\frac{4}{100}$ ?
4. What is the denominator in  $\frac{60}{17}$ ?
5. Twelve patients are in a hospital ward. Four have type A blood.
  - a. What fraction of the patients have type A blood?
  - b. What fraction of the patients do not have type A blood?
6. Twenty patients are in a hospital ward. Six have diabetes.
  - a. What fraction of the patients have diabetes?
  - b. What fraction of the patients do not have diabetes?
7. Write this expression as a fraction:  $16 \div 3$
8. Write this expression as a fraction:  $4 = 15$
9. Write this expression as a fraction:  $4 = 15$
10. Insert  $\frac{6}{7}$ ,  $\frac{7}{8}$ , or  $\frac{9}{10}$  to make means equal to.
  - a.  $\frac{11}{14} = 1$
11. Insert  $\frac{6}{7}$ ,  $\frac{7}{8}$ , or  $\frac{9}{10}$  to make means equal to.
  - a.  $\frac{24}{3} = 1$

your textbook, and complete a is presented for this chapter. print your results for your any of the chapter concepts. ■

Over 250 up-to-date full-color drug labels are presented along with common calculation problems that you will see on the job.

*"I really like the variety and quantity of drug labels that expose the students to the real thing."*

Cathy Kelley Arney,  
National College of Business & Technology

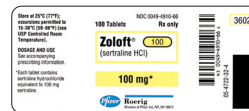
17. Ordered: Lipitor 30 mg, PO daily  
On hand: Refer to label H. Tablets are unscored.

Administer: \_\_\_\_\_



18. Ordered: Zoloff 50 mg PO daily  
On hand: Refer to label I. Tablets are scored.

Administer: \_\_\_\_\_



19. Ordered: Gleevec 200 mg PO daily  
On hand: Refer to label J. Tablets are not scored.

Administer: \_\_\_\_\_





### Conversion Factors

Conversion factors are expressions that allow you to switch from one unit of measurement to another.



**Learning Link** Recall from Chapter 3, Rule 3-7, when the numerator and denominator of a conversion factor are equivalent the factor itself equals 1, found on page 90.

In some cases, you convert between units in the same system of measurement; you will use conversion factors such as 1 mg/1000 mcg and 1000 mcg/1 mg. In other cases, you convert between systems, using conversion factors such as 1 tsp/5 mL and 5 mL/1 tsp.

## Glossary

**A**  
**Absorption** Movement of a drug from the site where it is given into the bloodstream  
**Alligation** One method for calculating dilutions  
**Amount to administer** The volume of liquid or number of solid dosage units that contains the desired dose  
**Ampule** Sealed container that usually holds 1 dose of liquid medication  
**Anticoagulant** A class of medication that reduces the blood's ability to clot  
**Apothecary system** An older system of measurement based upon a grain of wheat; other common units are the ounce, minim, and dram  
**B**  
**Biotransformation** Chemical changes of a drug in the body  
**BSA** Body surface area stated in square meters, or m<sup>2</sup>  
**C**  
**Calibrated spoons** Specially marked spoons used to administer oral medications with accuracy  
**Calibrations** Markings on medication equipment at various intervals  
**Cubic centimeter** Measure of volume that is the same as a milliliter (mL)  
**D**  
**DSW solution** Intravenous solution of 5% dextrose in water  
**Denominator** The bottom number of a fraction; represents the whole  
**Desired dose** Amount of drug to be given at a single time  
**Dilution** A solution created from an already prepared concentrated solution  
**Dimensional analysis** A method of dosage calculations that utilizes a series of factors to calculate dosages  
**Distribution** Movement of a drug from the bloodstream into other body tissues and fluids  
**DMFN** Daily maintenance fluid need, or the amount of fluids a patient needs over 24 hours both oral and parenteral  
**Dosage ordered** Amount of drug to give and how often it is to be given  
**Dosage strength** Dose on hand per dosage unit; the amount of drug over the form of the drug, for example, 500 mg/tablet or 250 mg/5 mL, ratio strength  
**Dosage unit** The unit by which the drug will be measured when administered  
**Dose on hand** Amount of drug contained in each dosage

**Learning Links** reference concepts taught in earlier chapters. **New to this edition!**

A **Glossary** has been added to enhance the learning of key terms in the text. **New to this edition!**

Pocket size **reference cards** found in the back of the book give you a convenient tool that displays the methods of calculations. **New to this edition!**

### PROCEDURE CHECKLIST 7-3

#### Calculating the Amount to Administer by Dimensional Analysis

- Do not calculate the desired dose and amount to administer separately. Place the unknown (amount to administer) on one side of the equation, and then multiply a series of factors on the right side of the equation. Cancel units to determine if the equation has been set up correctly.*
- Determine the unit of measure for the answer, and place it as the unknown on the left side of the equation. (In most cases this will be the amount to administer. The unit of measure will be the same unit of measure as that for the dosage unit.)
  - On the right side of the equation, write a conversion factor with the unit of measure for the desired dose on top and the unit of measure for the dose on hand on the bottom. (This is necessary if the dose ordered is in a different unit of measurement from that of the dose on hand.)
  - Multiply the conversion factor by a second factor—the dosage unit over the dose on hand.
  - Multiply by a third factor—the dose ordered over the number 1.
  - Cancel the units on the right side of the equation. The remaining unit of measure on the right side of the equation should match the unknown unit of measure on the left side of the equation.
  - Solve the equation.

**Conversion table** printed on inside back cover shows a quick and handy reference to common mathematical equivalents. **New to this edition!**

#### CONVERSIONS AND EQUIVALENTS FOR WEIGHTS AND MEASURES

##### METRIC WEIGHT MEASURE

1 kilogram kg<sub>2</sub> = 1000 grams g<sub>2</sub>  
 1 gram g<sub>2</sub> = 0.001 kilogram kg<sub>2</sub>  
 1 gram g<sub>2</sub> = 1000 milligrams mg<sub>2</sub>  
 1 milligram mg<sub>2</sub> = 0.001 gram g<sub>2</sub>  
 1 milligram mg<sub>2</sub> = 1000 micrograms mcg<sub>2</sub>  
 1 microgram mcg<sub>2</sub> = 0.001 milligram mg<sub>2</sub>

##### METRIC FLUID MEASURE

1 liter L<sub>2</sub> = 1000 milliliters mL<sub>2</sub>  
 1 milliliter mL<sub>2</sub> = 0.001 liter L<sub>2</sub>  
 1 milliliter mL<sub>2</sub> = 1 cubic centimeter

##### MEASURES FOR VOLUME APPROXIMATIONS

Metric System	Household System	Apothecary System
0.06 mL (droppers vary)	1 drop (gt)	1 drop (gt)
1 mL (droppers vary)	15 drops (gtt)	15 drops (gtt)
5 mL	1 tsp	1 dr (exact volume 3.7 mL)
15 mL	1 tbs	3 or 4 dr
30 mL	2 tbs or 1 oz	1 oz
240 mL	8 oz or 1 c	8 oz
480 mL	2 c = 1 pt	16 oz
960 mL (exact volume is 1000 mL)	1 qt or 2 pt or 4 c	32 oz

##### APOTHECARY-TO-METRIC SYSTEM WEIGHT APPROXIMATIONS

1 grain gr<sub>2</sub> = 0.065 grain gr<sub>2</sub> = 65 milligrams mg<sub>2</sub>  
 [Sometimes considered to be 1 grain gr<sub>2</sub> = 60 milligrams mg<sub>2</sub> or 0.06 gram (g)]

##### APOTHECARY-TO-HOUSEHOLD APPROXIMATIONS

1 drop = 1 minim  
 1 teaspoon tsp<sub>2</sub> = 60 drops gtt<sub>2</sub>  
 1 tablespoon tbs<sub>2</sub> = 3 teaspoons tsp<sub>2</sub>  
 1 ounce oz<sub>2</sub> = 2 tablespoons tbs<sub>2</sub>  
 1 cup c<sub>2</sub> = 8 ounces oz<sub>2</sub>

##### WEIGHT CONVERSION

1 kilogram kg<sub>2</sub> = 2.2 pounds lb<sub>2</sub>

##### LENGTH CONVERSION

1 inch in<sub>2</sub> = 2.5 centimeters cm<sub>2</sub>  
 1 yard yd<sub>2</sub> plus 3 inches in<sub>2</sub> = 1 meter m<sub>2</sub>

##### TEMPERATURE CONVERSION

Human body temperature  
 37°C = 98.6°F  
 5°F = 160 = 9°C  
 °F = 32 = °C  
 1.8 × °C + 32 = °F

*"The Pocket Reference Cards are a great idea. No more frantically shuffling through the text looking for the method."*

Michele Bach, Kansas City Community College

# Pretest

The following test covers basic mathematical concepts that you will need to understand and calculate dosages. This test will help you determine which concepts you need to review before continuing. You should already be able to perform basic operations—addition, subtraction, multiplication, and division—with whole numbers. The test covers fractions, decimals, percents, ratios, and proportions.

Take 90 minutes to answer the following 50 questions. Then check your answers on page 348. Review the questions you answered incorrectly to learn more about any basic math weaknesses. Then, as needed, review that content in Chapters 1 and 2.

1. Convert  $\frac{14}{3}$  to a mixed number.
2. Convert  $3\frac{7}{8}$  to a fraction.

Find the missing numerator in the following equations.

3.  $\frac{2}{7} = \frac{?}{21}$
4.  $1\frac{1}{8} = \frac{?}{16}$
5. Reduce  $\frac{40}{100}$  to lowest terms.
6. Which fraction has the greater value,  $\frac{3}{8}$  or  $\frac{2}{6}$ ?

Calculate the following. Reduce fractions to lowest terms and rewrite any fractions as mixed numbers.

7.  $\frac{4}{5} + \frac{3}{8}$
8.  $1\frac{1}{3} + \frac{5}{7}$
9.  $\frac{7}{10} - \frac{1}{4}$
10.  $8\frac{1}{4} - 2\frac{1}{3}$
11.  $\frac{3}{5} \times \frac{1}{9}$
12.  $3\frac{1}{5} \times 4\frac{3}{8}$
13.  $\frac{2}{3} \div \frac{4}{5}$
14.  $5\frac{1}{4} \div 2\frac{5}{8}$
15. Which number has the lesser value, 1.01 or 1.009?
16. Round 14.42 to the nearest whole number.
17. Round 6.05 to the nearest tenth.
18. Round 19.197 to the nearest hundredth.
19. Convert  $3\frac{4}{5}$  to a decimal number. If necessary, round to the nearest hundredth.
20. Convert 0.045 to a fraction or a mixed number. Reduce to lowest terms.

Calculate the following.

21.  $7.289 + 8.011$
22.  $0.012 + 0.9 + 4.2$
23.  $19.1 - 4.4$
24.  $100.03 - 0.6$
25.  $0.07 \times 3.2$
26.  $0.4 \div 0.02$
27. Convert 0.8 percent to a decimal number.

28. Convert 0.99 to a percent.
29. Convert 260 percent to a fraction or mixed number.
30. Convert  $1\frac{1}{8}$  to a percent.
31. Convert 7 : 12 to a fraction.
32. Convert  $\frac{10}{50}$  to a ratio. Reduce to lowest terms.
33. Convert 1 : 12 to a decimal. Round to the nearest hundredth, if necessary.
34. Convert 0.4 to a ratio. Reduce to lowest terms.
35. Convert 3 : 8 to a percent. Round to the nearest percent, if necessary.
36. Convert 0.5 percent to a ratio. Reduce to lowest terms.

Find the missing value in the following proportions.

37.  $8 : 16 :: ? : 8$

38.  $\frac{5}{9} = \frac{?}{27}$

39.  $8 : 12 :: ? : 9$

40.  $\frac{2}{7} = \frac{?}{28}$

41. A nurse is instructed to give a patient  $1\frac{1}{2}$  teaspoons of cough syrup 4 times a day. How many teaspoons of cough syrup will the nurse give each day?
42. A pharmacy technician tries to keep the equivalent of 12 bottles of a medication on hand. The hospital's first floor has  $1\frac{1}{2}$  bottles, the second floor has  $1\frac{3}{4}$  bottles, the third floor has  $3\frac{1}{4}$  bottles, and the supply closet has 3 bottles. Is there enough medication on hand? If not, how much should the technician order?
43. A bottle contains 75 milliliters (mL) of a liquid medication. Since the bottle was opened, one patient has received 3 doses of 2.5 mL. A second patient has received 4 doses of 2.2 mL. How much medication remains in the bottle?
44. A tablet contains 0.125 milligram (mg) of medication. A patient receives 3 tablets a day for 5 days. How many milligrams of medication does the patient receive over the 5 days?
45. An IV bag contained 1000 mL of a liquid. The liquid was administered to a patient, and now there is 400 mL left in the bag after 3 hours. How much IV fluid did the patient receive each hour?
46. The patient is taking 0.5 mg of medication 4 times a day. How many milligrams would the patient receive after  $1\frac{1}{2}$  days?
47. The patient took 0.88 microgram (mcg) every morning and 1.2 mcg each evening for 4 days. What was the total amount of medication taken?
48. Write a ratio that represents that 500 mL of solution contains 5 mg of drug.
49. Write a ratio that represents that every tablet in a bottle contains 25 mg of drug.
50. Write a ratio that represents that 3 mL of solution contains 125 mg of drug.

