DOSAGE CALCULATIONS

FIFTH CANADIAN EDITION

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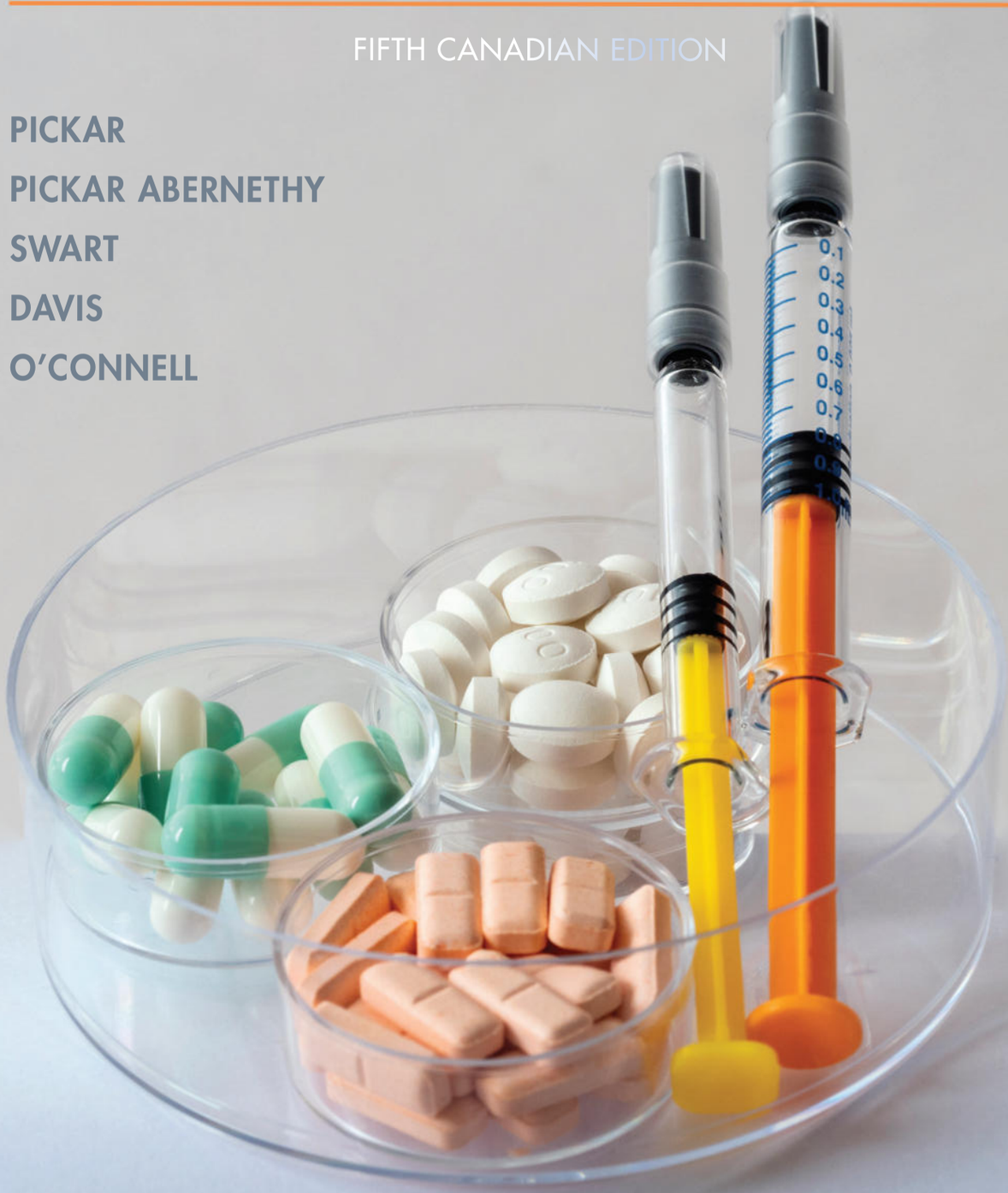

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BRIEF CONTENTS

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PREFACE

Dosage Calculations, Fifth Canadian Edition, offers a clear and concise method of calculating drug dosages. The text is directed to students who want to improve their comfort level with mathematic calculations, and to faculty members who prefer the formula method for calculating dosages. The previous four Canadian and nine U.S. editions have been classroom tested and reviewed by well over 1 million faculty and students, who report that this textbook helped decrease math anxiety and promote confidence in their ability to perform accurate medication calculations. As one reviewer noted, "I have looked at others [textbooks] and I don't feel they can compare."

The only math prerequisite is the ability to do basic arithmetic. For those who need a review, Chapters 1 and 2 offer an overview of basic arithmetic calculations with extensive exercises for practice.

The text teaches the Three-Step Approach for calculating dosages:

1. Convert measurements to the same unit;
2. Consider what dosage is reasonable; and
3. Calculate using the formula method.

Dosage Calculations, Fifth Canadian Edition, is based on feedback from users of the previous editions and users of other dosage calculation texts. The new edition also responds to changes in the healthcare system by introducing new drugs, replacing outdated drugs, and discussing new or refined ways of administering medications. This revision was designed with the beginning Canadian healthcare provider in mind. The metric system (International System (SI) of units) is used almost exclusively. The medication examples have been cross-referenced with the current Health Canada drug database so that beginning professionals will be able to recognize names and dosages. The importance of avoiding patient safety incidents, previously referred to as medication errors, is highlighted by the incorporation of applied clinical reasoning scenarios based on patient care situations.

Approach

This text is organized in a natural progression of basic to more complex information. Learners gain self-confidence as they master content in small increments with ample review and reinforcement.

Dosage Calculations has 14 chapters, divided into four sections that each end with a ***Self-Evaluation*** test, and two full post-tests at the end of the book.

Preceding *Section 1* is a ***Mathematics Diagnostic Evaluation***, which allows learners to determine their computational strengths and weaknesses.

In ***Section 1***, *Chapters 1* and *2* provide a review of basic arithmetic skills, including fractions, decimals, ratios, percents, and simple equations, with numerous examples and practice problems to ensure that students can apply the skills. *Chapter 3* introduces systems of measurement with a focus on the metric system. The household system is included briefly because of its applications for care at home. This chapter introduces conversion from one unit of measurement to another. The metric system, or SI system of measurement, is emphasized because of its exclusive use in Canada's healthcare sector. However, to challenge students and prepare them for real life, a small number of questions require students to convert imperial values to metric. Even though metric is used in Canada, many individuals still give their weight in pounds and height in feet and inches, which require conversion to metric. The use of the apothecary and household system is de-emphasized in the chapter, so only limited information is provided. The ratio and proportion method of performing conversions is also included; however, in this edition, ratio and proportion is not a major focus because research has shown that using this approach may be more prone to errors in calculations. International or 24-hour time, along with Fahrenheit and Celsius temperature conversions, is also included. *Chapter 4* is an overview of the three calculation methods used in determining drug dosages. This overview is accompanied by numerous examples and practice problems to ensure that students can apply the procedures.

Section 2 includes *Chapters 5* to *7*. The information in this section forms the foundation for measuring drug dosages and understanding drug orders and labels.

In *Chapter 5*, users learn to recognize and select appropriate equipment for the administration of medications based on the drug, dosage, and method of administration. Emphasis is placed on interpreting syringe calibrations to ensure that the dosage to be administered is accurate. All photos and drawings have been enhanced to improve clarity, and state-of-the-art

technology and information systems have also been updated.

Chapter 6 presents common abbreviations used in healthcare so that learners can become proficient in interpreting medical orders. Generic medication administration records have been used, as appropriate, for examples. In addition, the content on computerized medication administration records has been updated.

It is essential that learners be able to read medication labels to accurately calculate dosages. This skill is developed by having readers interpret the medication labels provided beginning in *Chapter 7*. These labels are from current commonly prescribed medications and are presented in full colour and actual size wherever possible.

In ***Section 3***, the reader learns and practices the skill of dosage calculations applied to patients across the lifespan. *Chapters 8* and *9* guide the reader to apply all the skills mastered to achieve accurate oral and injectable drug dosage calculations. Students learn to think through each problem logically for the right answer, and then to apply a simple formula to double-check their thinking. Experience has shown that when this logical but unique system is applied every time to every problem, math anxiety decreases and accuracy increases.

High-alert medications such as parenteral insulin and heparin sodium are thoroughly presented. Heparin and insulin types, species, and manufacturers have been updated.

Chapter 10 introduces the preparation of therapeutic solutions. Students learn the calculations associated with diluting solutions and reconstituting injectable drugs. This chapter leads to intravenous calculations by fully describing the preparation and administration of solutions.

Chapter 11 covers the calculation of pediatric and adult dosages and concentrates on the body weight method. Emphasis is placed on verifying safe dosages and applying concepts across the lifespan.

Section 4 presents advanced clinical calculations applicable to both adults and children. Intravenous administration calculations are presented in *Chapters 12* through *14*. Coverage reflects the greater application of IVs in drug therapy. Shortcut calculation methods are presented and explained fully. More infusion devices are included. Heparin and saline locks, types of IV solutions, IV monitoring, IV administration records, and direct IV drugs are presented in *Chapter 12*. Pediatric IV calculations are presented in *Chapter 13*, and obstetric, heparin sodium, insulin, and critical care IV calculations are covered in *Chapter 14*. Ample examples and practice problems help students master the necessary calculations.

Self-Evaluations at the end of each section provide learners with an opportunity to test their mastery of chapter objectives prior to proceeding to the next section. Presented in workbook format, students can write answers directly into the *Self-Evaluation*s. Two posttests at the conclusion of the text evaluate the learner's overall skill in dosage calculations. The ***Essential Skills Evaluation*** covers essential skills commonly tested by employers. The ***Comprehensive Skills Evaluation*** serves as a comprehensive evaluation of all 14 chapters. Both are presented in a case study format to simulate actual clinical calculations.

Additional Features

- More than 1000 problems reflecting current drugs and protocols are included for learners to practise their skills and reinforce their learning.
- Most syringes and measuring devices are drawn with relative sizing to provide accurate scale renderings to help learners master the measurement and reading of dosages.
- Many problems involving the interpretation of syringe scales are included to ensure that the proper dosage is administered. Once the dosage is calculated, the learner is directed to draw an arrow on a syringe at the proper value.
- Canadian labels of current and commonly prescribed medications are included to help users learn how to select the proper information required to determine the correct dosage. More than 200 labels have been used in this text. The authors and publisher have made every effort to include only labels in use today.
- Numerous **Examples** demonstrate the $\frac{D}{H} \times Q = X$ formula method of calculating dosages.
- The dimensional analysis and ratio and proportion methods are included in the beginning, giving instructors and students a choice of which method to use in calculating dosages.
- Clear instructions are included for calculating IV medications administered in milligrams per kilogram per minute.
- Clinical situations are simulated using actual medication labels, syringes, patient medication order forms, and medication administration records.
- NCLEX sample questions are included in each chapter.

Note about Medication Labels

The authors have referred to Health Canada's Drug Product Database for the medication labels in this text (*https://health-products.canada.ca/dpd-bdpp*). There may be some discrepancies among Health Canada, drug monographs, and the *Compendium of Pharmaceuticals and Specialties (CPS)* in the dosage range requirements for drugs used as examples in this text. The purpose of this calculations text is to practise calculations. The authors have tried to be as accurate as possible; however, it is the responsibility of the individual administering the drug to ensure that the dosage administered is safe.

What's New in the Fifth Canadian Edition

Numerous updates have been made to the fifth Canadian edition to improve readability and address feedback from reviewers, users, and students. This edition is more streamlined and easier for students to use. Answers to all assessment material now directly follow the assessments. Students no longer need to flip to the end of the section or text for the answers. Fully worked solutions have been consolidated into a full Solutions Manual. Information previously found in appendices has been threaded directly into the appropriate chapters, and outdated content has been reduced where appropriate.

Section 1

- Addition of simplest method for adding and subtracting mixed fractions.
- Three calculation methods have been clearly outlined for conversions between different units of measure in Chapter 3 and for calculation of dosages in Chapter 4.
- Chapters 3 and 4 have been reorganized so all conversions are covered in Chapter 3 before moving onto Chapter 4, which is now dedicated to dosage calculations.

Section 2

- Addition of computerized medication orders, advantages and documentation.
- Labels have been updated where appropriate.

Section 3

- Chapter 10 has been revised to follow Canadian Malnutrition Taskforce best practice guidelines, which no longer recommend dilution of infant formulas or enteral feedings.

Section 4

- Revised IV heparin sodium calculation examples.
- Addition of clinical considerations for intermittent secondary minibag delivery.
- Addition of second method for calculating volume to administer per 15 seconds during direct IV administration.

Instructor Ancillaries

The following instructor resources have been created for *Dosage Calculations*, Fifth Canadian Edition. Access these ultimate tools for customizing lectures and presentations at login.cengage.com.

Test Bank

This resource was written by author Myrna Davis, Red River College. It includes over 250 multiple-choice questions written according to guidelines for effective construction and development of higher-order questions.

cognero® Full-Circle Assessment®

The test bank is available on a cloud-based platform. **Testing Powered by Cognero®** is a secure online testing system that allows instructors to author, edit, and manage test-bank content from anywhere Internet access is available. No special installations or downloads are needed, and the desktop-inspired interface, with its drop-down menus and familiar, intuitive tools, allows instructors to create and manage tests with ease. Multiple test versions can be created in an instant, and content can be imported or exported into other systems. Tests can be delivered from a learning management system, the classroom, or wherever an instructor chooses. Testing Powered by Cognero for *Dosage Calculations*, Fifth Canadian Edition, can be accessed through login.cengage.com.

PowerPoint

Microsoft® PowerPoint® lecture slides were revised and updated. There is an average of 15 slides per chapter, many featuring key figures, labels, tables, and photographs from *Dosage Calculations*, Fifth Canadian Edition.

Image Library

This resource consists of digital copies of figures, tables, photographs, and drug labels used in the book. Instructors may use these JPEGs to customize the PowerPoint or create their own PowerPoint presentations. The Image Library Key describes the images and lists the codes under which the JPEGs are saved.

Instructor's Solutions Manual

This manual, prepared by the authors, has been independently checked for accuracy by Heather LeBlanc, Oulton College. It contains complete worked-out solutions to Review Sets, Practice Problems, Self-Evaluations, Essential Skills Evaluation, and the Comprehensive Skills Evaluation. The Solutions Manual is available for instructors to download.

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- Sherry MacMillan, Dawson College
- Stephanie McGaffey, Western University

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Myrna originally started out as a diploma-prepared RN, then attended the University of Manitoba to complete a Baccalaureate Program for Registered Nurses and a Masters in Education specializing in adult and postsecondary education. She also completed the Winnipeg Critical Care Nursing Education Program. Myrna has worked in a variety of clinical areas such as medicine, surgery, the operating room, intensive care, and the emergency department. With extensive experience teaching and tutoring nursing students in dosage calculations, she has also been actively involved in developing strategies for assessing math readiness, reducing math anxiety, and math remediation. She is well known by nursing students for her "*Math with Myrna*" dosage calculation sessions offered in the nursing program at Red River College.

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Janet O'Connell, R.N., B.N., M.A.Ed. is a professor of Nursing and Coordinator at the Centennial College site of the Collaborative BScN program with Ryerson University, George Brown College, and Centennial College in Toronto. She received her Bachelor of Nursing degree from Dalhousie University in Halifax and her Master of Arts in Education from Central Michigan University. Her areas of clinical expertise are in adult medicine, surgery, and critical care.

Janet has taught nursing in both the Diploma RN and Baccalaureate Nursing programs for over 30 years, primarily in the areas of Clinical Practice in acute adult Medical Surgical units, Nursing Skills Labs, Nursing Theory including dosage calculation for medication administration and Pathotherapeutics, including Pharmacology. Janet has been extensively involved in Program Review and curriculum development, including NCLEX integration. Janet has been a reviewer and editor for OERs, journal articles and current nursing textbooks, including previous Canadian editions of *Dosage Calculations*.

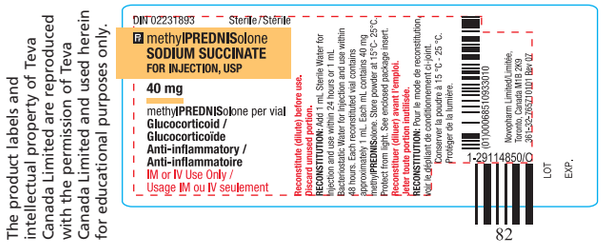
KEY FEATURES OF DOSAGE CALCULATIONS

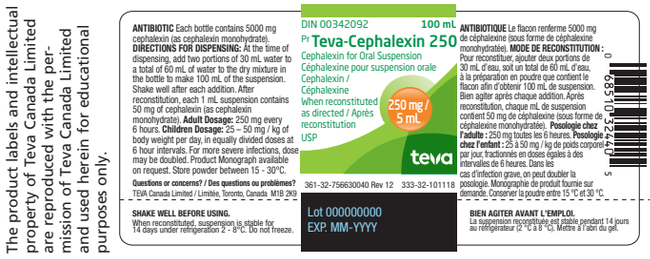
- Each chapter begins with **Objectives** that reflect clear expectations to help students focus on what they are expected to have achieved once each chapter is completed. The learning can be readily transferred from the classroom environment to the workplace environment.
- Concepts are presented from simple to complex, in small increments, followed by **Quick Review** boxes to reinforce learning.

QUICK REVIEW

- Some symbols and abbreviations are obsolete or can lead to patient safety incidents. Do not use U, IU, cc, and μg.
- No conversion is necessary for units, and mmoL or mEq, because the ordered dosage and supply dosage are in the same system.
- 1 unit = 1000 milliunits

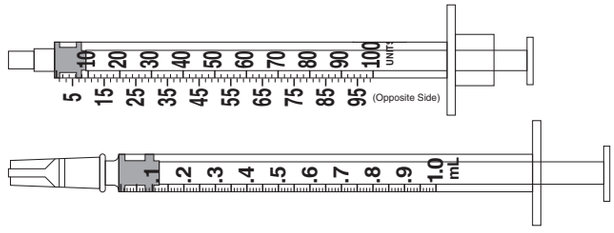
- Hundreds of **photos** and **drug labels** are presented to help students prepare themselves in practice.



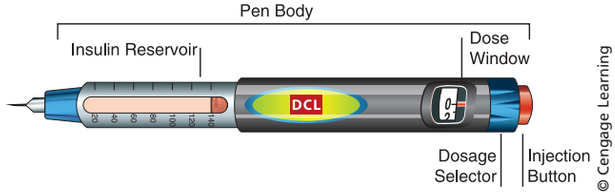


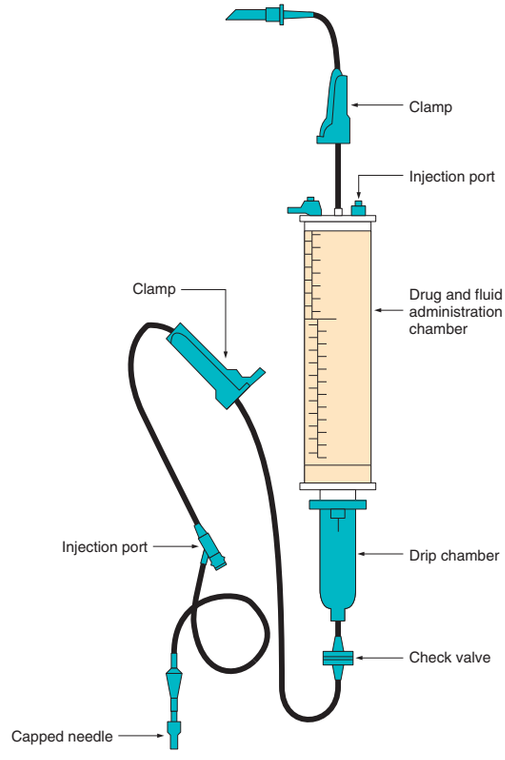
Capsa Healthcare

- **Syringes** are drawn full size, in most instances, to provide accurate scale renderings to help learners master the reading of injectable dosages.



- **Illustrations** simulate critical dosage calculations and dose preparation skills. In particular, colour is used to simulate a specific amount of medication.





- **Math Tip** boxes provide clues to essential computations, math shortcuts, and reminders throughout the text.

 # MATH TIP

If *both* the numerator and the denominator *cannot* be divided evenly by a nonzero number other than 1, then the fraction is already in its lowest terms.

- **Caution** boxes alert learners to critical information and safety concerns.

! CAUTION

Total volume or total quantity are not used when calculating dosages. Do not get the total volume or total quantity confused with a medication's strength or concentration.

- **Rule** boxes highlight and draw attention to important formulas and pertinent instructions.

✓ RULE

Step 3 Calculate Apply the dosage calculation formula: $\frac{D}{H} \times Q = X$

- **Remember** boxes highlight information that learners should memorize.

? REMEMBER

To avoid confusion,

- Always use the capitalized ***L*** to indicate litre. The lower case ***l*** is easily confused with the number one (1);
- Always use ***mcg*** to indicate microgram. The μ symbol is easily misunderstood.

- **Quick Review** boxes summarize critical information that students need to know before the Review Sets are completed.

QUICK REVIEW

Percent (Part) = Percent × Whole Quantity

Example: What is 15% of 48?

$$15\% \times 48 = \frac{15}{100} \times 48$$

$$= \frac{15}{\cancel{100}_{25}} \times \overset{12}{\cancel{48}} = \frac{\overset{3}{\cancel{15}}}{\underset{5}{\cancel{25}}} \times 12 = \frac{3}{5} \times 12 = \frac{36}{5} = 7.2$$

OR

15 ÷ 100 = 0.15 x 48 = 7.2

- **Rationale for Practice** boxes provide the reasoning for a specific action or decision.

RATIONALE FOR PRACTICE

Some syringes may still be marked in cubic centimetres (cc), if an American product; however, most drugs in Canada are prepared and labelled with the strength given per millilitre (mL). The cubic centimetre and millilitre are equivalent measurements in dosage calculations (1 cc = 1 mL).

- **Understanding NCLEX Questions** appear near the end of Chapters 5 to 14, and provide students with an example of how a question would look as an NCLEX question. The answer is also provided.

UNDERSTANDING NCLEX QUESTIONS

The nurse is to administer 36 units of NPH and 12 units of regular insulin. Identify the steps the nurse would take in order of priority to prepare this dosage of insulin.

1. Inject air equal to NPH dose into NPH vial
2. Invert regular insulin bottle and withdraw regular insulin vial
3. Inject air equal to regular dose into regular insulin vial
4. Invert NPH vial and withdraw NPH dose.
   a. 1, 2, 3, 4
   b. 1, 4, 3, 2
   c. 1, 4, 2, 3
   d. 1, 3, 2, 4

Rationale: The regular insulin is withdrawn first to avoid accidental contamination of regular insulin with intermediate insulin.

Answer: d

Self-Assessment

- **Mathematics Diagnostic Evaluation:** The *Mathematics Diagnostic Evaluation*, a mini-chapter that precedes Section 1, allows learners to identify their computational strengths and weaknesses. Answers now directly follow the questions so students can easily check their knowledge.
- **Review Sets** are inserted after each major chapter topic to encourage learners to stop and check their understanding of the material just presented. The answers to Review Sets now directly follow the questions, so students can easily check their work. Fully worked solutions are available separately.

REVIEW SET 4-1

Use the formula method to calculate the quantity of drug to administer in the following:

1 A dosage of 0.8 g has been prescribed. The strength available is 1 g in 2.5 mL. _____

2. A dosage strength of 250 mg in 1.5 mL is available. The prescription is for 200 mg. _____

3. The strength available is 1 g in 5 mL. The prescription is for 0.2 g. _____

- **Practice Problems** round out each chapter. This is the students' opportunity to put their skills to the test, to identify their areas of strength and the areas in which they need additional study. Answers now directly follow the problems, so students can easily check their work. Fully worked solutions are available separately.

PRACTICE PROBLEMS

Calculate the dose of the following drug orders. The tablets are scored in half.

1. Order: *metformin 250 mg PO BID*
   Supply: metformin 500 mg tablets
   Give: _____ tablet(s)

2. Order: *codeine phosphate 30 mg PO q4h prn for pain*
   Supply: codeine phosphate 15 mg tablets
   Give: _____ tablet(s)

10. Order: *codeine phosphate 15 mg PO daily*
    Supply: codeine phosphate 30 mg tablets
    Give: _____ tablet(s)

11. Order: *propranolol hydrochloride 30 mg PO QID*
    Supply: propranolol hydrochloride 20 mg tablets
    Give: _____ tablet(s)

- **Application of Clinical Reasoning skills** are applied to realistic patient care situations to emphasize the importance of accurate dosage calculations and avoiding patient safety incidents. As an added benefit, clinical reasoning scenarios present prevention strategies so that the student can learn how to avoid these patient safety incidents in practice. Answers directly follow the questions.

APPLICATION OF CLINICAL REASONING

Errors in solution dilution of hygeol occur when the nurse fails to correctly calculate the amount of solute and solvent needed for the required solution strength.

Potential Patient Safety Incident
Incorrect calculation of solute and solvent

Possible Scenario
Suppose the prescriber orders $\frac{1}{3}$ *strength solution*

Potential Outcome
The nurse did not use the formula, so she may mix the wrong strength solution.

Prevention
The nurse should have thought through the meaning of the terms of a solution. If so, she would have recognized that $\frac{1}{3}$ strength means 1 part solute (30 mL) to 2 parts water (60 mL), not 1 part solute to 3 parts water. She should have applied the calculation formula to determine the amount of solute needed and the amount of solvent (water) to add. If she did not know how to prepare the product, she should have read the label carefully, or consulted another nurse to check the calculation. Never guess. Think and calculate with accuracy.
This could lead to potential harm to patients.

- **Self-Evaluations:** Self-evaluations at the end of each section provide learners with an opportunity to test their mastery of chapter objectives prior to proceeding to the next section. Answers to all questions in the self-evaluations now directly follow the self-evaluations. Fully worked solutions are provided separately.
- **Two Full Post-Tests:** Two tests at the end of the text evaluate the learner's overall skill in dosage calculations. The first test, **Essential Skills Evaluation**, covers essential skills commonly tested by employers. The second test is a **Comprehensive Skills Evaluation**. Answers to each of these are provided directly after the tests, so students can easily check their progress. Fully worked solutions are provided separately.

Mathematics Diagnostic Evaluation

To prepare for calculating dosages, it is important to know how to add, subtract, multiply, and divide whole numbers. It is also important to have a working knowledge of fractions, decimals, ratios, percents, and basic problem solving. This text reviews these important mathematical operations, which support all dosage calculations in healthcare.

Set aside $1\frac{1}{2}$ hours in a quiet place to complete the 50 questions in the following diagnostic evaluation. Use a notepad and a pencil to work the problems.

Use the results to determine your current computational strengths and weaknesses and to guide your review. If you correctly answer all questions, then proceed directly to Chapter 3. If not, note any problems that are answered incorrectly, and use the related review materials in Chapters 1 and 2 to refresh your arithmetic skills.

This mathematics diagnostic evaluation is provided to enhance confidence and proficiency in arithmetic skills, thereby helping avoid careless mistakes later when you perform dosage calculations.

Good luck!

Directions:

1. Carry answers to three decimal places and round to two decimal places.

   (Examples: 5.175 = 5.18; 5.174 = 5.17)

2. Express fractions in their lowest terms.

   (Example: $\frac{6}{10} = \frac{3}{5}$)

Mathematics Diagnostic Evaluation

1. 1517 + 0.63 = _____
2. Express the value of 0.7 + 0.035 + 20.006 rounded to two decimal places. _____
3. 9.5 + 17.06 + 32 + 41.11 + 0.99 = _____
4. $19.69 + $304.03 = _____
5. 93.2 − 47.09 = _____
6. 1005 − 250.5 = _____
7. Express the value of 17.156 − 0.25 rounded to two decimal places. _____
8. 509 × 38.3 = _____
9. $4.12 × 42 = _____
10. 17.16 × 23.5 = _____
11. 972 ÷ 27 = _____
12. 2.5 ÷ 0.001 = _____
13. Express the value of $\frac{1}{4} \div \frac{3}{8}$ as a fraction reduced to its lowest terms. _____
14. Express $\frac{1500}{240}$ as a decimal. _____
15. Express 0.8 as a fraction. _____

16. Express $\frac{2}{5}$ as a percent. _____
17. Express 0.004 as a percent. _____
18. Express 5% as a decimal. _____
19. Express $33\frac{1}{3}\%$ as a ratio in lowest terms. _____
20. Express 1:50 as a decimal. _____
21. $\frac{1}{2} + \frac{3}{4} =$ _____
22. $1\frac{2}{3} + 4\frac{7}{8} =$ _____
23. $1\frac{5}{6} - \frac{2}{9} =$ _____
24. Express the value of $\frac{1}{100} \times 60$ as a fraction. _____
25. Express the value of $4\frac{1}{4} \times 3\frac{1}{2}$ as a mixed number. _____
26. Identify the fraction with the greatest value: $\frac{1}{150}, \frac{1}{200}, \frac{1}{100}$ _____
27. Identify the decimal with the least value: 0.009, 0.19, 0.9 _____
28. $\frac{6.4}{0.02} =$ _____
29. $\frac{0.02 + 0.16}{0.4 - 0.34} =$ _____
30. Express the value of $\frac{3}{12 + 3} \times 0.25$ as a decimal. _____
31. 8% of 50 = _____
32. $\frac{1}{2}\%$ of 18 = _____
33. 0.9% of 24 = _____

Find the value of "X." Express your answer as a decimal.

34. $\frac{1:1000}{1:100} \times 250 = X$ _____
35. $\frac{300}{150} \times 2 = X$ _____
36. $\frac{2.5}{5} \times 1.5 = X$ _____
37. $\frac{1000000}{250000} \times X = 12$ _____
38. $\frac{0.51}{1.7} \times X = 150$ _____
39. $X = (82.4 - 52)\frac{3}{5}$ _____

40. $\dfrac{\frac{1}{150}}{\frac{1}{300}} \times 1.2 = X$ _____

41. Express 2:10 as a fraction in its lowest terms. _____

42. Express 2% as a ratio in its lowest terms. _____

43. If 5 equal medication containers contain 25 tablets in total, how many tablets are in each container? _____

44. A patient is receiving 0.5 milligrams of a medication 4 times a day. What is the total amount of medication in milligrams given each day? _____

45. If 1 kilogram equals 2.2 pounds, how many kilograms does a 66-pound child weigh? _____

46. If 1 kilogram equals 2.2 pounds, how many pounds are in 1.5 kilograms? (Express your answer as a decimal.) _____

47. If 1 centimetre equals $\frac{2}{5}$ inch, how many centimetres are in $2\frac{1}{2}$ inches? (Express your answer as a decimal.) _____

48. If 2.5 centimetres equal 1 inch, how long in centimetres is a 3-inch wound? _____

49. This diagnostic test has a total of 50 problems. If you incorrectly answer 5 problems, what percentage will be answered correctly? _____

50. For every 5 female student nurses in a nursing class, there is 1 male student nurse. What is the ratio of female to male student nurses? _____

After completing these problems, check your answers. Give yourself 2 points for each correct answer.

Perfect score = 100 **My score = _____**

Answers to Mathematics Diagnostic Evaluation

1) 1517.63 **2)** 20.74 **3)** 100.66 **4)** $323.72 **5)** 46.11 **6)** 754.5 **7)** 16.91 **8)** 19 494.7 **9)** $173.04 **10)** 403.26

11) 36 **12)** 2500 **13)** $\frac{2}{3}$ **14)** 6.25 **15)** $\frac{4}{5}$ **16)** 40% **17)** 0.4% **18)** 0.05 **19)** 1:3 **20)** 0.02 **21)** $1\frac{1}{4}$ **22)** $6\frac{13}{24}$

23) $1\frac{11}{18}$ **24)** $\frac{3}{5}$ **25)** $14\frac{7}{8}$ **26)** $\frac{1}{100}$ **27)** 0.009 **28)** 320 **29)** 3 **30)** 0.05 **31)** 4 **32)** 0.09 **33)** 0.22 **34)** 25 **35)** 4

36) 0.75 **37)** 3 **38)** 500 **39)** 18.24 **40)** 2.4 **41)** $\frac{1}{5}$ **42)** 1:50 **43)** 5 tablets **44)** 2 milligrams **45)** 30 kilograms

46) 3.3 pounds **47)** $6\frac{1}{4}$ = 6.25 centimetres **48)** 7.5 centimetres **49)** 90% **50)** 5:1

CHAPTER 1

SECTION 1

Mathematics Review

Fractions and Decimals

OBJECTIVES

1. Differentiate between types of fractions.
2. Use fractions in a variety of calculations.
3. Discuss the significance of decimals in calculations.
4. Develop skill in using fractions and decimals in calculations.

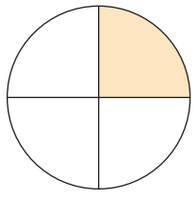
Healthcare providers need to understand fractions to be able to interpret and act on medical orders, read prescriptions, and understand patient records and information in healthcare literature. Fractions are also often used in household measures. Proficiency with fractions is essential to success in medication calculations.

FRACTIONS

A *fraction* is a part of a whole number. (See example below.) Fractions are composed of two parts: a *numerator,* the top number, and a *denominator,* the bottom number. The denominator refers to the total number of parts. The larger the number in the denominator, the smaller the value of the pieces (or fraction) of the whole. The numerator refers to a part of the whole that is being considered. The larger the number in the numerator, the more parts of the whole that are being considered. A fraction may also be read as the "numerator divided by the denominator."

Example:

$\frac{1}{4}$ $\frac{\text{numerator}}{\text{denominator}}$



The whole is divided into four equal parts (denominator), and one part (numerator) is being considered.

$\frac{1}{4}$ = 1 part of 4 parts, or $\frac{1}{4}$ of the whole.

The fraction $\frac{1}{4}$ may also be read as "1 divided by 4."

 # MATH TIP

The **d**enominator begins with **d** and is **d**own below the line in a fraction.

TYPES OF FRACTIONS

There are four types of fractions: proper, improper, mixed, and complex. Whole numbers can also be expressed as fractions.

Proper Fractions

Proper fractions are fractions in which the value of the numerator is less than the value of the denominator. The value of a proper fraction is less than 1.

RULE

Whenever the numerator is less than the denominator, the value of the proper fraction must be less than 1.

Example:

$\frac{5}{8}$ $\frac{\text{numerator}}{\text{denominator}}$ is less than 1

Improper Fractions

Improper fractions are fractions in which the value of the numerator is greater than or equal to the value of the denominator. The value of an improper fraction is greater than or equal to 1.

RULE

If the numerator is greater than the denominator, the value of the improper fraction must be greater than 1.

Example:

$\frac{8}{5}$ is greater than 1

RULE

If the numerator and the denominator are equal, the value of the improper fraction is always equal to 1.

Example:

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

Mixed Numbers

When a whole number and a proper fraction are combined, the result is called a *mixed number.* The value of a mixed number is always greater than 1.

RULE

If a fraction and a whole number are written together, the fraction value is always greater than 1.

Example:

$1\frac{5}{8} = 1 + \frac{5}{8}$; $1\frac{5}{8}$ is greater than 1

Complex Fractions

Complex fractions are fractions in which the numerator, the denominator, or both may be a proper fraction, an improper fraction, or a mixed number. The value may be less than, greater than, or equal to 1.

Examples:

$\frac{\frac{5}{8}}{\frac{1}{2}}$ is greater than 1 $\qquad \frac{\frac{5}{8}}{2}$ is less than 1 $\qquad \frac{1\frac{5}{8}}{\frac{1}{5}}$ is greater than 1 $\qquad \frac{\frac{1}{2}}{\frac{2}{4}} = 1$

Whole Numbers

Whole numbers have an unexpressed denominator of 1.

Examples:

$1 = \frac{1}{1} \qquad 3 = \frac{3}{1} \qquad 6 = \frac{6}{1} \qquad 100 = \frac{100}{1}$

FRACTIONS AT WORK

Being able to *convert* is a skill that must be mastered in order to become competent in medication calculations. In this chapter, you will learn to convert between the various types of fractions and to convert fractions to decimals and decimals to fractions. In later chapters, you will learn to convert between units of measurement. Conversion between the different types of fractions simplifies calculations.

Besides conversion, other requisite skills of mastery in fractions for use in medication calculations include comparing fractions, finding *equivalent fractions,* reducing fractions to their *lowest terms,* and finding *lowest common denominators* (LCDs).

Equivalent Fractions

Fractions of equal value can be expressed in several ways. If the numerator and the denominator of a fraction are either multiplied or divided by the same *nonzero* number, the fraction does not change in value. The resulting fraction has the same mathematical value as the original fraction and can be called an *equivalent fraction.*

 # MATH TIP

When changing a fraction, if you want to keep an equivalent value, you must do the same thing (multiply or divide by the same number) to the numerator and to the denominator.

Examples:

$\frac{2}{4} = \frac{2 \div 2}{4 \div 2} = \frac{1}{2} \qquad \frac{1}{3} = \frac{1 \times 3}{3 \times 3} = \frac{3}{9}$

Reducing Fractions to Their Lowest Terms

When calculating dosages, it is usually easier to work with fractions using the smallest numbers possible. Finding these equivalent fractions is called *reducing the fraction to its lowest terms* or *simplifying the fraction.*

RULE

To reduce a fraction to its lowest terms, *divide* both the numerator and the denominator by the *largest nonzero whole number* that will go evenly into both.

Patience is required to reduce a fraction that has large numbers. Sometimes the procedure for reducing a fraction to its lowest terms seems like trial and error. It may need to be reduced several times. Guidelines for reducing fractions are as follows:

- Even numbers are divisible by 2 and sometimes by multiples of 2.
- Numbers ending in 5 or 0 are divisible by 5 and sometimes by multiples of 5.
- Certain numbers are called prime numbers because they cannot be reduced any further. Examples are 2, 3, 7, 11, 13, and 17. See if a prime number will divide evenly into the numerator and denominator.

Example:

Reduce $\frac{7}{28}$ to its lowest terms.

7 can evenly divide into both the numerator (7) and the denominator (28).

$$\frac{7 \div 7}{28 \div 7} = \frac{1}{4}$$

Example:

Reduce $\frac{6}{12}$ to its lowest terms.

6 is the largest number that will divide evenly into both 6 (numerator) and 12 (denominator).

$$\frac{6}{12} = \frac{6 \div 6}{12 \div 6} = \frac{1}{2} \text{ in its lowest terms}$$

MATH TIP

If *both* the numerator and the denominator *cannot* be divided evenly by a nonzero number other than 1, then the fraction is already in its lowest terms.

Finding Common Denominators for Two or More Fractions

To compare, add, or subtract fractions, the denominators must be the same. Such computations are made easier when the LCD is used. The LCD is the smallest whole number that can be divided equally by all denominators within the problem.

To find the LCD, first check to see if the largest denominator in the problem is evenly divisible by each of the other denominators. If so, this largest denominator is the LCD.

Example 1:

$\frac{1}{8}$ and $\frac{1}{4}$

The denominator 8 is evenly divisible by 4. Therefore, 8 is the LCD.

$\frac{2}{7}$ and $\frac{5}{14}$ and $\frac{1}{28}$

The denominator 28 is evenly divisible by 7 and 14. Therefore, 28 is the LCD.

If the largest denominator is not evenly divisible, find a common denominator by multiplying all the denominators together. This may not provide the LCD. Then try to reduce the fraction by following the rule described above for **reducing fractions to their lowest terms.**

Example 2:

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

The denominator 8 is *not* evenly divisible by 3. Therefore, multiply 8 by 3, which equals 24. The number 24 is a common denominator for these two fractions. In this case, the common denominator is the LCD.

$\frac{2}{3}$ and $\frac{1}{4}$ and $\frac{1}{6}$

The number 6 is evenly divisible by 3 but is not evenly divisible by 4. Multiply 3 by 4 by 6 (which equals 72), and reduce the fraction to its lowest terms, as described earlier. An alternative is to only multiply 4 by 6 (which equals 24) because the largest denominator is evenly divisible by the remaining denominator (3) in the example.

Converting Mixed Numbers to Improper Fractions

When calculating medication dosages, it is important to know how to convert a variety of fractions. Mixed numbers can be converted to improper fractions, and improper fractions can be converted to mixed numbers.

RULE

To change or convert a mixed number to an improper fraction, multiply the whole number by the denominator and add the numerator.

Example:

$$1\frac{5}{8} = \frac{(1 \times 8) + 5}{8} = \frac{13}{8}$$

Converting Improper Fractions to Mixed Numbers

RULE

To change or convert an improper fraction to a mixed number or a whole number, divide the numerator by the denominator.

Examples:

$\frac{8}{5} = 8 \div 5 = 1\frac{3}{5}$

$\frac{10}{4} = 10 \div 4 = 2\frac{2}{4} = 2\frac{1}{2}$

If the conversion cannot be performed mentally, it is also an option to use long division in order to change an improper fraction to a mixed number. When performing the long division, stop the calculation when you get a remainder. The quotient (answer) becomes the whole number, the remainder becomes the numerator, and the divisor becomes the denominator; then reduce the fraction to its lowest terms.

Using previous example:

$\frac{10}{4}$

$$\begin{array}{rl} & \textcircled{2} \text{ quotient (answer)} \\ \text{divisor } \textcircled{4}\overline{)10} & \text{dividend} \\ \underline{8} & \\ \textcircled{2} & \text{remainder} \end{array}$$

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

COMPARING FRACTIONS

Once the skills of finding equivalent fractions and LCDs, converting mixed numbers and improper fractions, and reducing fractions to their lowest terms have been mastered, comparing two fractions with the same numerators or the same denominators can be mastered. Fractions with different numerators and different denominators can also be compared.

RULE

If the numerators are the same, then the fraction with the smaller denominator has the greater value.

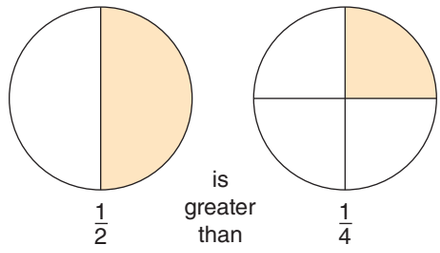
Example:

Compare $\frac{1}{2}$ and $\frac{1}{4}$.

Numerators are both 1.

Denominators: 2 is less than 4.

$\frac{1}{2}$ has a greater value.



RULE

If the denominators are both the same, then the fraction with the smaller numerator has the lesser value.