ESSENTIAL DRUG DOSAGE CALCULATIONS

ECOND EDITION

Lorrie N. Hegstad
Wilma Hayek

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Lorrie N. Hegstad, R.N., Ph.D.
Associate Professor
School of Nursing
The University of Texas at Arlington
Arlington, Texas

Wilma Hayek, R.N., M.S.N.
Assistant Professor
School of Nursing
The University of Texas Health Science Center at San Antonio
San Antonio, Texas

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PREFACE

The purpose of this book is to assist the learner in developing competence in the interpretation of medication orders and the calculation of correct dosages. It is written primarily for students enrolled in professional and technical schools of nursing. However, it can also serve as a reference for practicing nurses or as a part of inservice education refresher courses for inactive nurses. The book can be used as a self-paced independent learning module or within a planned course. Illustrations of measuring devices and drug forms are provided to aid the learner's understanding of the content.

Essential Drug Dosage Calculations presents the proportion method as a simple and practical approach to the calculating of dosages and solutions. Both generic and trade names of drugs are used throughout the text to help the learner become familiar with the current dosage forms and quantities.

The second edition contains more than 400 problems. The initial chapters on interpretation of medication orders and information needed to manipulate mathematically the various systems of measurement are retained from the first edition. The chapters on calculation of oral and parenteral dosages and reconstitution of drugs in powder and crystalline form are updated with new drugs and additional practice problems. Chapter 9 remains unique among dosage and solution books by including the use of blood and urine sliding scales for determining dosage and mixing insulins. Chapter 10 is updated to reflect the increased use of continuous and intermittent intravenous fluids and medications. All outdated material (Young's, Clark's, and Fried's Rules) has been removed from Chapter 11 (infant and children dosages). Practice with determining dosage by weight has received extensive attention.

Each chapter introduces the type of problem with a step-by-step procedure for solving the problem. Simple and complex examples are included, followed by a wide range of practice problems. To provide immediate feedback and to aid in reinforcing learning, each problem is set up in the appropriate proportion or formula and solved. Two comprehensive exams round out the edition to provide the learner with additional practice and an opportunity to have the experience of test-taking.

The following are acknowledged for providing information on specific drug dilution tables: *Physician's Desk Reference*, 1987 edition by Medical Economics Company, Inc., Burroughs Wellcome Co., Eli Lilly and Company, Pfizer Pharmaceuticals, Roerig, and Squibb.

We wish to express our appreciation to the students and faculty in schools of nursing who have used this book and provided us with feedback for this new edition.

Lorrie N. Hegstad
Wilma Hayek

OBJECTIVES

Upon completion of this book, the learner should be able to:

1. Identify abbreviations and symbols used in the preparation and administration of medications.
2. Interpret medication orders.
3. Identify units of measure appropriate to the household, metric, and apothecary systems.
4. Derive the approximate equivalent, convert from one system of measurement to another or from one unit of measurement to another within the same system.
5. Calculate the correct oral dosage in tablet or liquid form to be administered to the patient.
6. Given a parenteral drug in liquid form, calculate the correct volume to be administered to equal the dosage ordered.
7. Given a parenteral drug in its dry form, determine the correct:
   a. vial of medication to reconstitute
   b. amount of diluent to add to obtain the prescribed dosage
   c. total reconstituted volume
   d. volume of displacement
   e. volume of drug to administer to equal the prescribed dosage.
8. Label the reconstituted parenteral drug with the specific dosage for volume and the discard date.
9. Given a patient's weight in pounds or kilograms, determine a safe dose.
10. Given U-100 insulin and a U-100/1 cc or U-100/0.5 cc syringe, identify the quantity of insulin to be administered to equal the prescribed dosage.
11. Using U-100 insulin and a tuberculin syringe, compute the correct volume of insulin to be administered to equal the prescribed dosage.
12. Given a sliding scale prescribed by a physician and the urine or blood sugar results of the patient, compute the correct volume of insulin to be administered.
13. Given a specific IV administration set and the volume of solution to infuse per hour(s), calculate the correct:
    a. drop rate per minute
    b. length of time needed to infuse the total amount ordered
    c. total volume of fluid infused over a specified period of time.
14. Determine the IV drop rate needed to deliver a specified dosage of a medication in a limited period of time.

15. Given a prescribed dose of medication to be administered IV push, determine the:
    a. amount of diluent to add to the medication
    b. volume of diluted drug to be administered in a specific time period.
16. Calculate the body surface area of a child, using the nomogram.
17. Calculate the safe pediatric dose using body weight and the body surface formula.

CONTENTS

39. 4.32 − 0.013 =

40. 1.37 − 0.26 =

41. 2.36 × 0.002 =

42. 1.06 × 1.13 =

43. 0.006 × 4.3 =

44. 0.25 × 100 =

45. 0.06 ÷ 0.02 =

46. 1.50 ÷ 0.30 =

47. 7.5 ÷ 0.035 =

48. 26.45 ÷ 3.60 =

Conversions: Convert the term given to its correct *percentage*, *fraction*, or *decimal* value. One value is given; calculate the other two equivalent values.

	Percent	*Common Fraction*	*Decimal*
49.	_____	$\frac{1}{2}$	50. _____
	25%	51. _____	52. _____
53.	_____	54. _____	0.10
	0.9%	55. _____	56. _____
57.	_____	$\frac{1}{3}$	58. _____
59.	_____	60. _____	0.001

Find the value of X in these proportion-type problems:

61. 3 : X :: 2 : 12 =

62. X : 6 :: 4 : 3 =

63. $\frac{1}{4}$: X :: 1 : 8 =

64. 48 : 12 :: $\frac{1}{10}$: X =

65. $\frac{2}{3}$: $\frac{3}{5}$ :: X : $\frac{9}{10}$ =

66. $\frac{1}{2}$: X :: 0.125 : 4 =

67. 0.25 : 500 :: X : 1000 =

68. $\frac{4}{5}$: 50 :: X : 100 =

69. $\frac{1}{150}$: $\frac{1}{200}$ :: 4 : X =

70. X : 12 :: 1.5 : 60 =

Solve the following word problems:

71. A student gets 3 credits for each course. If the student has a total of 30 credits, how many courses has the student taken?

72. If there are 2 ounces of a drug in 32 ounces of a solution, how many ounces of the drug are there in 16 ounces of the same solution?

73. Your salary is $125.00 per week. You plan to place at least 10% each week in savings. How much would you save each month (4 weeks)?

74. If one tablet contains gr. (grain) $\frac{1}{100}$ of a drug, how many grains would be in 3 tablets?

75. The doctor ordered 40 milligrams of a drug. The label on the bottle says that each tablet contains 5 milligrams. How many tablets are needed to equal the doctor's order?

Answers

Roman numerals in arabic numbers:

1. 5	3. 3	5. 10	7. 7
2. $\frac{1}{2}$	4. 1	6. 15	8. 20

Arabic numbers in roman numerals:

9. ii	11. v	13. xii	15. vi
10. iss	12. viii	14. iv	16. ix

Fractions		*Decimals*	
17. $\frac{3}{4}$	18. $\frac{7}{10}$	33. 2.8	34. 2.22
19. $\frac{1}{100}$	20. $\frac{13}{21}$	35. 27.97	36. 0.054
21. $\frac{3}{5}$	22. $\frac{5}{12}$	37. 0.04	38. 7.13
23. $\frac{1}{300}$	24. $\frac{7}{24}$	39. 4.307	40. 1.11
25. $\frac{8}{15}$	26. $\frac{1}{60}$	41. 0.00472	42. 1.1978
27. $\frac{1}{500}$	28. $\frac{5}{16}$	43. 0.0258	44. 25
29. 8	30. $\frac{1}{36}$	45. 3	46. 5
31. $\frac{1}{75}$	32. $1\frac{4}{5}$	47. 214.2857	48. 7.347

Conversions:

49. 50%
50. 0.50
51. $\frac{1}{4}$
52. 0.25
53. 10%
54. $\frac{1}{10}$
55. $\frac{9}{1000}$
56. 0.009
57. $33\frac{1}{3}\%$
58. 0.333
59. 0.1%
60. $\frac{1}{1000}$

Value of X:

61. 18
62. 8
63. 2
64. $\frac{1}{40}$
65. 1
66. 16
67. 0.5
68. 1.6
69. 3
70. 0.3

Word problems:

71. 10 courses
72. 1 ounce
73. $50.00 per month
74. $\frac{3}{100}$ grains
75. 8 tablets

Note to the Learner:

This test contained the basic math skills needed to compute most dosage and solution problems. If you incorrectly answered more than three (3) problems in each of the first sections or more than one (1) of the word problems, you might find it helpful to complete the Review of Basic Arithmetic section before continuing the book.

Review of Basic Arithmetic: Fractions

Definition: A fraction is a part of a whole.

$$\frac{4 \quad \text{NUMERATOR}}{6 \quad \text{DENOMINATOR}}$$

ADDING fractions with like denominators

1. Add the numerators.
2. Place the answer over the denominator.
3. Reduce the answer to the lowest term by dividing the numerator and the denominator by the largest number that can divide them both.

Example:

a. 1. $\frac{1}{4} + \frac{1}{4} = \frac{1+1}{4} = \frac{2}{4}$

2. $\frac{2}{4} > 2$ is divisible into both numbers

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

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

2. $\frac{6}{6} > 6$ is divisible into both numbers

3. $\frac{\cancel{6}^{1}}{\cancel{6}_{1}} = 1$

ADDING fractions with unlike denominators

1. Find the smallest number that the denominators of each fraction divide into evenly (least common denominator).
2. Divide the denominator into the least common denominator and multiply the results by the numerator.
3. Add the new numerators and place over the new denominator (least common denominator).
4. Reduce to lowest terms.

Example:

a. 1. $\frac{1}{4} + \frac{1}{3}$ (4 and 3 will divide into 12 evenly)

2. $12 \div 4 = 3 \times 1 = 3$

   $12 \div 3 = 4 \times 1 = 4$

3. $\frac{3+4}{12}$

4. $\frac{7}{12}$ is reduced to lowest terms

b. 1. $\frac{1}{6} + \frac{1}{2}$ (6 and 2 will divide into 6 evenly)

2. $6 \div 6 = 1 \times 1 = 1$

   $6 \div 2 = 3 \times 1 = 3$

3. $\frac{1 + 3}{6}$

4. $\frac{\cancel{4}^{2}}{\cancel{6}_{3}}$ > both numbers evenly divided by 2

$\frac{2}{3}$ is reduced to lowest terms

SUBTRACTING fractions with like denominators

1. Subtract the numerators.
2. Place the difference over the denominator.
3. Reduce to lowest terms.

Example:

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

2. $\frac{\cancel{2}^{1}}{\cancel{4}_{2}}$ > (both numbers evenly divisible by 2)

3. $\frac{1}{2}$ is reduced to lowest terms

b. 1. $\frac{8}{150} - \frac{3}{150} = \frac{8 - 3}{150}$

2. $\frac{\cancel{5}^{1}}{\cancel{150}_{30}}$ > (both numbers evenly divisible by 5)

3. $\frac{1}{30}$ is reduced to lowest terms

SUBTRACTING fractions with unlike denominators

1. Find the least common denominator and convert fractions.
2. Subtract the numerators.

3. Place the difference over the least common denominator.
4. Reduce to lowest terms.

Example:

a. 1. $\frac{3}{2} - \frac{3}{4}$ (both 2 and 4 divisible into 4)

$4 \div 2 = 2 \times 3 = 6$
$4 \div 4 = 1 \times 3 = 3$

2. $\frac{6}{4} - \frac{3}{4} = \frac{6 - 3}{4}$

3. $\frac{3}{4}$

4. $\frac{3}{4}$ is reduced to lowest terms

b. 1. $\frac{1}{100} - \frac{1}{150}$ (both 100 and 150 divisible into 300)

$300 \div 100 = 3 \times 1 = 3$
$300 \div 150 = 2 \times 1 = 2$

2. $\frac{3}{300} - \frac{2}{300} = \frac{3 - 2}{300}$

3. $\frac{1}{300}$

4. $\frac{1}{300}$ is reduced to lowest terms

MULTIPLYING fractions

1. Multiply the numerators.
2. Multiply the denominators.
3. Reduce to lowest terms.

Example:

a. 1. & 2. $\frac{2}{3} \times \frac{3}{4} = \frac{2 \times 3}{3 \times 4} = \frac{6}{12} >$ (6 will divide evenly into 6 and 12)

3. $\frac{\cancel{6}^{1}}{\cancel{12}_{2}} = \frac{1}{2}$ (reduced to lowest terms)

b. 1. & 2. $\frac{1}{8} \times \frac{4}{9} = \frac{1 \times 4}{8 \times 9} = \frac{4}{72}$ (4 will divide evenly into both numbers)

3. $\frac{\cancel{4}^{1}}{\cancel{72}_{18}} = \frac{1}{18}$ (reduced to lowest terms)

c. 1. & 2. $\frac{1}{100} \times \frac{1}{3} = \frac{1 \times 1}{100 \times 3} = \frac{1}{300}$

3. $\frac{1}{300}$ is reduced to lowest terms

DIVIDING fractions

1. Invert the divisor ($\frac{1}{2}$ would become $\frac{2}{1}$)
2. Change the division sign ($\div$) to multiplication ($\times$).
3. Multiply the numerators.
4. Multiply the denominators.
5. Reduce to lowest terms.

Dividend		Divisor
$\frac{1}{4}$	$\div$	$\frac{1}{2}$

Example:

a. $\frac{1}{4} \div \frac{1}{2} = \frac{1}{4} \times \frac{2}{1} = \frac{1 \times 2}{4 \times 1} = \frac{2}{4} = \frac{1}{2}$

b. $\frac{1}{2} \div 100 = \frac{1}{2} \times \frac{1}{100} = \frac{1 \times 1}{2 \times 100} = \frac{1}{200}$

c. $\frac{1}{150} \div \frac{1}{300} = \frac{1}{150} \times \frac{300}{1} = \frac{300}{150} = 2$

Decimals

Definition: A fraction whose denominator is a power of 10 expressed by placing a point at the left of the numerator.

Example:

$$\frac{2}{10} = 0.2 \qquad \frac{25}{100} = 0.25$$

To CHANGE *fractions* to *decimals* divide the numerator by the denominator.

Example:

a. $\frac{1}{4} = 4\overline{)1.00}$ = 0.25

$$\begin{array}{r} 0 \\ \hline 10 \\ 8 \\ \hline 20 \\ 20 \end{array}$$

b. $\frac{2}{3} = 3\overline{)2.00}$ = 0.666 or 0.67

$$\begin{array}{r} 0 \\ \hline 20 \\ 18 \\ \hline 20 \\ 18 \\ \hline 20 \\ 18 \\ \hline 2 \end{array}$$

c. $\frac{1}{150} = 150\overline{)1.000}$ = 0.0066

$$\begin{array}{r} 0 \\ \hline 10 \\ 00 \\ \hline 100 \\ 000 \\ \hline 1000 \\ 900 \\ \hline 1000 \\ 900 \\ \hline 100 \end{array}$$