Math For Meds 8th EDITION

DOSAGES AND SOLUTIONS

urren and Munday

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th edition

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All instructional information, including but not limited to examples, illustrations, and equations are offered here for the limited purposes of illustrating and explaining general techniques. Still, the facts and circumstances of every case inevitably require variations and unique medical knowledge.

The determination of amounts and proportions and the administration of prescription drugs is the rendering of medical services and no text can assume that responsibility. The responsibility ultimately rests with the individual medical practitioner.

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Preface

The updating of a text requires taking into account a number of factors: educator evaluations/requests, current clinical practice as observed by the authors on hospital visits, the input of experts in specific clinical areas, and, finally, author choice.

In making content decisions we begin by identifying student competency outcomes, and these become our guidelines for all changes. What exactly does the student need to know to meet identified objectives? How can this content be structured to make learning easy, enjoyable and lasting? At what point does "too much" instruction serve only to confuse? Given that different programs/instructors have different requirements, how do we structure content to please the majority? The last is an essential consideration if the text is to continue to be successful.

Philosophically we feel that content should be kept as simple as possible. We believe that our most important task is to give the student sound basics, and a sense of accomplishment to overcome the natural fear of such a major responsibility as clinical calculations. There is no point teaching to an "ideal" which is unrealistic, yet as educators we fall readily into the trap of trying to teach "everything".

On the subject of calculations we come immediately upon a point of contention: the use of calculators. Advanced clinical calculations are routinely done with calculators in the clinical setting. Indeed, it would be foolhardy not to use them, both from a time and accuracy standpoint. Yet students are barred from using calculators in licensing examinations. Should this policy not be reevaluated in the light of realistic clinical practice? As authors the calculator dichotomy has plagued us for years. So, we continue to teach the basic math required for simple calculations, most of which can be done mentally, and which we feel each practitioner should be competent to do. It is these skills which ***Math For Meds*** addresses first and forcefully in it's content. It is also the reason the use of ratio and proportion is not discussed until mid text, where more complicated calculations are introduced, and where it rightfully belongs.

All calculations in this text were checked with a calculator. If one is not used by students, or their calculator setting varies, an occasional discrepancy at the hundredth or tenth may be experienced, and should be considered correct. This is clearly explained in "Directions To The Student" on page vii, but may need to be reinforced as instruction progresses.

Once again we wish to express our thanks to the hundreds of educators who completed and returned an evaluation of the previous edition of ***Math for Meds.*** We are very pleased with our landmark 8th edition, and trust you will be too.

Anna M. Curren
Laurie D. Munday

San Diego, CA. November 1999

Directions to the Student

Welcome, to what we anticipate will be one of the most enjoyable texts you have ever used. ***Math For Meds*** is about to reassure you that math is nothing to be afraid of; that even the most difficult clinical calculations you encounter will present no problem for you; and that, on completion of your instruction, you will have the calculation skills you need to practice safely in your profession. You don't have to be a math expert to use this text. All that is required is average ability and a desire to learn. If you have not used your math skills for a number of years you will still have no difficulty, because the refresher math section will quickly bring you up to date. ***Math For Meds*** lets you move at your own pace through the content, which ranges from easy to thought provoking. Hundreds of examples and problems will keep your learning on track. You will enjoy learning from ***Math For Meds***, and here are the tips you need to get started.

1. Gather a pencil or pen and plenty of scratch paper.

2. Record the answers to calculations in your text as well as on the scratch paper. It makes checking your answers against those we provide much easier.

3. As you work your way through the programs do exactly as you are instructed to do, and no more. Programmed learning proceeds in small steps, and jumping ahead may cause confusion. All chapters are designed to let you move at your own speed. If you already know some of the basics you will move through them more quickly than you can imagine.

4. The refresher math section must be completed without a calculator. **However, be aware that the multiple steps of ratio and proportion calculations will result in a variety of answers to some problems. Small differences should be considered negligible, and answers correct.** If your instructor allows the use of a calculator for advanced calculations set it, if possible, to round to hundredths. All calculations in the text were checked on a calculator at the hundredth setting. If you use a calculator that does not have optional settings, you may experience answers which vary at the hundredth, or tenth. This difference may be considered negligible, and your answers correct.

5. Once you have completed your instruction we suggest you keep ***Math For Meds*** in your personal library. As you move to different clinical areas during your career you will encounter different types of calculations. A quick refresher with ***Math For Meds*** will be invaluable when that occurs.

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REFRESHER MATH PRE-TEST

If you can complete the following pre-test with 100% accuracy you may wish to bypass the Refresher Math section of this text, as all the pertinent math concepts are covered in the test items included. You should be aware, however, that this section offers many memory cues and short cuts for solving clinical calculations without a calculator.

Identify the decimal fraction with the highest value in each of the following.

1. a) 4.4 b) 2.85 c) 5.3 _____
2. a) 6.3 b) 5.73 c) 4.4 _____
3. a) 0.18 b) 0.62 c) 0.35 _____
4. a) 0.2 b) 0.125 c) 0.3 _____
5. a) 0.15 b) 0.11 c) 0.14 _____
6. a) 4.27 b) 4.31 c) 4.09 _____

Add the following decimals.

7. 0.2 + 2.23 = _____
8. 1.5 + 0.07 = _____
9. 6.45 + 12.1 + 9.54 = _____
10. 0.35 + 8.37 + 5.15 = _____

Subtract the following decimals.

11. 3.1 — 0.67 = _____
12. 12.41 — 2.11 = _____
13. 2.235 — 0.094 = _____
14. 4.65 — 0.7 = _____

15. If tablets with a strength of 0.2 mg are available and 0.6 mg is ordered you must give how many tablets? _____
16. If tablets are labeled 0.8 mg and 0.4 mg is ordered how many tablets must you give? _____
17. If the available tablets have a strength of 1.25 mg and 2.5 mg is ordered how many tablets must you give? _____
18. If 0.125 mg is ordered and the tablets available are labeled 0.25 mg how many must you give? _____

Express the following numbers to the nearest tenth.

19. 2.17 = _____
20. 0.15 = _____
21. 3.77 = _____
22. 4.62 = _____
23. 11.74 = _____
24. 5.26 = _____

Express the following to the nearest hundredth.

25. 1.357 = _____
26. 7.413 = _____
27. 10.105 = _____
28. 3.775 = _____
29. 0.176 = _____

30. Define "product."

_____

_____

Multiply the following decimals. Express answers to the nearest tenth.

31. 0.7 x 1.2 = _____
32. 1.8 x 2.6 = _____
33. 5.1 x 0.25 x 1.1 = _____
34. 3.3 x 3.75 = _____

Divide the following fractions. Express answers to the nearest hundredth.

35. 16.3 ÷ 3.2 = _____
36. 15.1 ÷ 1.1 = _____
37. 2 ÷ 0.75 = _____
38. 4.17 ÷ 2.7 = _____

39. Define "numerator."

_____

_____

40. Define "denominator."

_____

_____

41. Define "highest common denominator."

_____

_____

Solve the following equations. Express answers to the nearest tenth.

42. $\frac{1}{4} \times \frac{2}{3} =$ _____

43. $\frac{240}{170} \times \frac{135}{300} =$ _____

44. $\frac{0.2}{1.75} \times \frac{1.5}{0.2} =$ _____

45. $\frac{2.1}{3.6} \times \frac{1.7}{1.3} =$ _____

46. $\frac{0.26}{0.2} \times \frac{3.3}{1.2} =$ _____

47. $\frac{750}{1} \times \frac{300}{50} \times \frac{7}{2} =$ _____

48. $\frac{50}{1} \times \frac{60}{240} \times \frac{1}{900} \times \frac{400}{1} =$ _____

49. $\frac{35{,}000}{750} \times \frac{35}{1} =$ _____

50. $\frac{50}{2} \times \frac{450}{40} \times \frac{1}{900} \times \frac{114}{1} =$ _____

ANSWERS: 1. c 2. a 3. b 4. c 5. a 6. b 7. 2.43 8. 1.57 9. 28.09 10. 13.87 11. 2.43 12. 10.3 13. 2.141 14. 3.95 15. 3 tab 16. 1/2 tab 17. 2 tab 18. 1/2 tab 19. 2.2 20. 0.2 21. 3.8 22. 4.6 23. 11.7 24. 5.3 25. 1.36 26. 7.41 27. 10.11 28. 3.78 29. 0.18 30. the answer obtained from the multiplication of two or more numbers 31. 0.8 32. 4.7 33. 1.4 34. 12.4 35. 5.09 36. 13.73 37. 2.67 38. 1.54 39. the top number in a common fraction 40. the bottom number in a common fraction 41. the highest number which can be divided into two numbers to reduce them to their lowest terms (values) 42. 0.2 43. 0.6 44. 0.9 45. 0.8 46. 3.6 47. 15,750 48. 5.6 49. 1633.3 50. 35.6

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SECTION ONE

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CHAPTER

Relative Value, Addition and Subtraction of Decimals

In the course of administering medications you will be calculating drug dosages which contain decimals, for example 2.5 mg. The first two chapters of this text will provide a complete and easy refresher of everything that you must know about decimals. Let's begin with a review of the relative value of decimals, so that you will be able to recognize which of two or more numbers has the highest (and lowest) value.

OBJECTIVES

The student will

1. identify the relative value of decimals
2. add decimals
3. subtract decimals

PREREQUISITE

Recognize the abbreviation mg, for milligram, as a drug measure.

Relative Value of Decimals

The easiest way to begin a review of decimal numbers is to visualize them on a scale which has a decimal point at its center. Look for a moment at Figure 1.

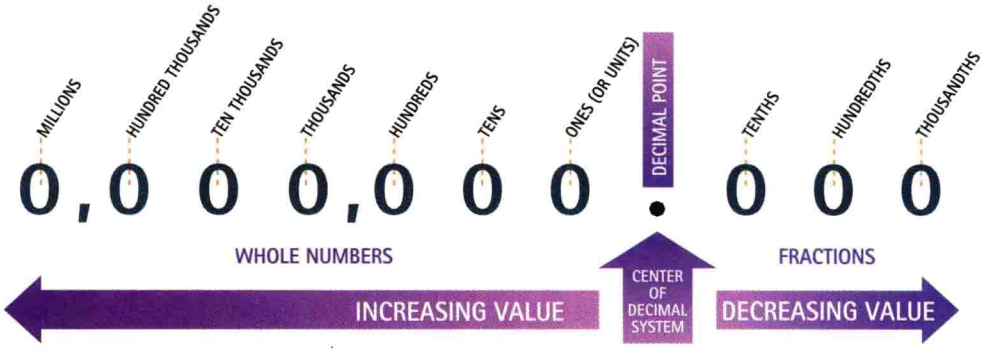

Figure 1

Notice that on the left of the decimal point are the whole numbers, and on the right the fractions. On the whole number (left) side of the scale, the measures rise increasingly in value, from ones, to tens, to hundreds, and so on to millions, which is the highest measure you will see in drug dosages. Our monetary system of dollars and cents is a decimal system, and the relative value of the whole numbers is exactly as you now know and use them: the higher the number, the higher the value.

The first key point in determining relative value of decimals is the presence of whole numbers. The higher the whole number, the higher the value.

EXAMPLE 1 10.1 is higher than 9.1

EXAMPLE 2 3.2 is higher than 2.9

EXAMPLE 3 7.01 is higher than 6.99

PROBLEM

Identify the number with the highest value in each of the following.

1.	a)	3.5	b)	2.7	c)	4.2 _____
2.	a)	6.15	b)	5.95	c)	4.54 _____
3.	a)	12.02	b)	10.19	c)	11.04 _____
4.	a)	2.5	b)	1.75	c)	0.75 _____
5.	a)	4.3	b)	2.75	c)	5.1 _____
6.	a)	6.15	b)	7.4	c)	6.95 _____

ANSWERS 1. c 2. a 3. a 4. a 5. c 6. b

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

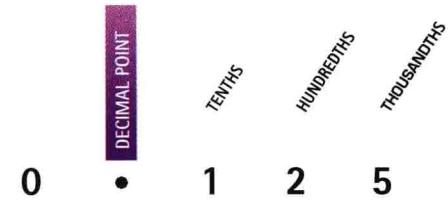

Figure 2

It is necessary to consider only three figures after the decimal point on the fractional side because drug dosages measured as decimal fractions do not contain more than three digits, for example 0.125 mg. First notice that a zero is used to replace the whole number in this decimal fraction.

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

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

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

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

EXAMPLE 1 0.3 is higher than 0.2

EXAMPLE 2 0.41 is higher than 0.29

EXAMPLE 3 1.21 is higher than 1.19

PROBLEM

Which of the following decimals has the highest value?

1.	a)	0.4	b)	0.2	c)	0.5 _____
2.	a)	2.73	b)	2.61	c)	2.87 _____
3.	a)	0.19	b)	0.61	c)	0.34 _____
4.	a)	3.5	b)	3.75	c)	3.25 _____
5.	a)	0.3	b)	0.25	c)	0.4 _____
6.	a)	1.35	b)	1.29	c)	1.4 _____

ANSWERS 1. c 2. c 3. b 4. b 5. c 6. c

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

The decimal fraction with the higher number representing hundredths will have the higher value when the tenths are identical.

EXAMPLE 1 0.27 is higher than 0.25

EXAMPLE 2 0.15 is higher than 0.1 (0.1 is the same as 0.10)

Extra zeros on the end of decimal fractions are omitted because they can cause confusion, although they do not alter the value of the fraction (0.10 is the same as 0.1).

EXAMPLE 3 2.25 is higher than 2.2 (same as 2.20)

EXAMPLE 4 9.77 is higher than 9.75

PROBLEM

Which of the following decimals has the highest value?

1.	a)	0.12	b)	0.15	c)	0.17 _____
2.	a)	1.21	b)	1.24	c)	1.23 _____
3.	a)	0.37	b)	0.32	c)	0.36 _____
4.	a)	3.27	b)	3.25	c)	3.21 _____
5.	a)	0.16	b)	0.11	c)	0.19 _____
6.	a)	4.23	b)	4.2	c)	4.09 _____

ANSWERS 1. c 2. b 3. a 4. a 5. c 6. a

PROBLEM

Which decimal fraction has the higher value?

a) 0.125 b) 0.25

ANSWERS The correct answer is b) 0.25. The decimal fraction which has the higher number representing the **tenths** has the higher value. 2 is higher than 1; therefore 0.25 has a higher value than 0.125. Medication errors have been made in this **identical** decimal fraction; so remember it well.

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

This completes your introduction to the relative value of decimals. The key points just reviewed will cover all situations in dosage calculations where you will have to recognize high and low values. Therefore, you are now ready to test yourself more extensively on this information.

PROBLEM

Identify the decimal with the highest value in each of the following.

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

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

Addition and Subtraction of Decimals

There are several key points which will make addition and subtraction of decimal fractions easier and safer. Let's look at these.

When you first write the numbers down, line up the decimal points.

EXAMPLE To add 0.25 and 0.27

0.25	0.25
0.27 is safe	0.27 may be unsafe; it could lead to errors.

Always add or subtract from right to left.

If you found it necessary to write the numbers down, don't confuse yourself by trying to "eyeball" the answer. Also, write any numbers carried or rewrite those reduced by borrowing, if you find this helpful.

EXAMPLE 1 When adding 0.25 and 0.27

1	
0.25	
0.27	add the 5 and 7 first, then the 2, 2, and
0.52	the 1 you carried. Right to left.

EXAMPLE 2 When subtracting 0.63 from 0.71

6 1	
0.71	borrow 1 from 7 and rewrite as 6,
0.63	write the borrowed 1. Subtract 3 from 11.
0.08	Subtract 6 from 6. Work from right to left.

Add zeros as necessary to make the fractions of equal length.

This does not alter the value of the fractions and it helps prevent confusion and mistakes.

EXAMPLE When subtracting 0.125 from 0.25

0.25	becomes	0.250	
0.125		0.125	Answer = **0.125**

If you follow these simple rules and make them a habit, you will automatically reduce calculation errors. The problems on the following page will give you an excellent opportunity to practice them.

PROBLEM

Add the following decimals.

1. 0.25 + 0.5 = _____
2. 0.1 + 2.25 = _____
3. 1.7 + 0.75 = _____
4. 1.4 + 0.02 = _____
5. 2.3 + 1.45 = _____
6. 3.7 + 1.05 + 2.2 = _____
7. 6.42 + 13.3 + 9.55 = _____
8. 5.57 + 4.03 + 13.02 = _____
9. 0.33 + 8.41 + 6.09 = _____
10. 7.44 + 3.04 + 11.31 = _____

Subtract the following decimals.

11. 1.25 - 1.125 = _____
12. 3.2 - 0.65 = _____
13. 2.3 - 1.45 = _____
14. 0.02 - 0.01 = _____
15. 5 - 2.5 = _____
16. 7.33 - 4.04 = _____
17. 12.45 - 2.07 = _____
18. 0.07 - 0.035 = _____
19. 1.175 - 0.23 = _____
20. 5.75 - 0.95 = _____

ANSWERS 1. 0.75 2. 2.35 3. 2.45 4. 1.42 5. 3.75 6. 6.95 7. 29.27 8. 22.62 9. 14.83 10. 21.79
11. 0.125 12. 2.55 13. 0.85 14. 0.01 15. 2.5 16. 3.29 17. 10.38 18. 0.035 19. 0.945 20. 4.8

Summary

This concludes the refresher on relative value, addition and subtraction of decimals. The important points to remember from this chapter are:

- ➡ if the decimal fraction contains a whole number, the value of the whole number is the first determiner of relative value
- ➡ if the fraction does not include a whole number, a zero is placed in front of the decimal point to emphasize it
- ➡ the number representing the tenths in a decimal fraction is the first determiner of relative value
- ➡ if the tenths in decimal fractions are identical, the number representing hundredths will determine relative value
- ➡ when adding or subtracting decimal fractions, first line up the decimal points, then add or subtract from right to left

Summary Self Test

DIRECTIONS

Choose the decimal with the highest value from each of the following.

1. a) 2.45 b) 2.57 c) 2.19 _____
2. a) 3.07 b) 3.17 c) 3.71 _____
3. a) 0.12 b) 0.02 c) 0.01 _____
4. a) 5.31 b) 5.35 c) 6.01 _____
5. a) 4.5 b) 4.51 c) 4.15 _____
6. a) 0.015 b) 0.15 c) 0.1 _____
7. a) 1.3 b) 1.25 c) 1.35 _____

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