Medical Mathematics and Dosage Calculations for Veterinary Technicians

Third Edition

Robert Bill

with website

WILEY Blackwell

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About the Companion Website

This book is accompanied by a companion website:

www.wiley.com/go/bill/calculations

The website includes:

- Answer keys to problems
- PowerPoint files of all figures from the book for downloading

Section I

Review of Math Fundamentals

1

Math Fundamentals

Self-assessment

OBJECTIVES
The student will be able to: 1) conduct a self-assessment, and 2) identify areas needed for review.

In a medical situation the most beneficial drug can be rendered worthless or dangerous if the veterinarian or veterinary technician does not accurately calculate the dose. As many veterinary professionals can testify, it is not enough to just have a superficial understanding of dosage calculation because superficial knowledge often fails during an emergency situation. The skill of accurately calculating drug dosages or making correct medical math calculations must be deeply ingrained and practiced to be consistently reliable.

Another obligation of professionals is to recognize and accurately identify the limits of their knowledge and to strengthen the weaker areas of their skills or knowledge. To help you define the areas of math and dosage calculation that you need to refresh or review, complete the following self-assessment exercises. Note that some of the exercises require you to perform the tasks *without a calculator*. Although a calculator should be used to carry out most dosage calculations, it is also important that the veterinary professional understands how to perform the basic operations manually. They will thereby be able to recognize when an answer to a problem is obviously not accurate (e.g. when the decimal point is misplaced by 1 or 2 places).

For those sections of the self-assessment that you identify as areas where a review would be useful, work through the chapters and sections of the book to which that section of the self-assessment exercise refers.

Self-assessment Exercises

1 Write each of the following numbers in scientific notation:

A) 23
B) 132
C) 522 178
D) 0.2
E) 0.0452

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F) 0.000 067
G) 94.0023
H) 897.010 00

2 Add or subtract the following decimal numbers, without a calculator:

A) 1.5 + 4 =
B) 9.7 + 1.9 =
C) 6.55 + 7.43 =
D) 0.42 + 0.09 =
E) 0.009 + 4.0 =
F) 7.5 − 2.5 =
G) 9.0 − 3.9 =
H) 23.125 − 1.50 =
I) 0.551 − 0.095 =
J) 0.003 52 − 0.0009 =
K) The veterinarian needs a mixture of the following three drugs to be administered as an anesthetic cocktail: 0.4 mL Drug A, 0.35 mL Drug B, and 1.24 mL of Drug C. What is the final volume of combined drug to be given?
L) Four gerbils are weighed individually. Their masses are 82.0 g, 76.5 g, 92.8 g, and 81.9 g. What is the total weight of all four gerbils?
M) The normal dose for an animal is calculated as 48.7 mg. However, the veterinarian wants to adjust the dose because of changes in the animal's physiology due to the disease being treated. The dose needs to be decreased by 10% (4.87 mg). What is the new dose need for this patient?
N) The veterinarian gives an oral drug order to be added to a bag of IV fluids as follows: "Give twenty-three point four mL of Drug A and three point one two five mL of Drug B." What is the total volume (mL) of drugs being added to this bag of IV fluids?

3 Multiply or divide the following decimal numbers, without a calculator:

A) 2.5 × 5 =
B) 3.0 × 8.35 =
C) 24.75 × 12.35 =
D) 0.02 × 15.5 =
E) 0.003 × 0.0125 =
F) 15 ÷ 2.5 =
G) 2.5 ÷ 1.5 =
H) 35 ÷ 0.5 =
I) 0.25 ÷ 0.125 =
J) 0.010 ÷ 0.0025 =
K) An animal is dispensed 2.5 mg tablets to be given twice daily for six days. What is the total mass of drug that has been dispensed? Give your answer in mg.
L) The veterinarian dispenses 1200 mL of medication to be given equally to 8 calves. How much does each calf get?
M) A laboratory animal colony needs to treat a parasite problem by giving 2.3 mg of a drug to each of the 94 rats in the colony. How many mg of drug is needed to do this?
N) A total of 560 mg of drug needs to be equally divided into two doses per day for a period of one week. How much drug is given in each dose?

O) The veterinarian gives the following drug order: "Dispense one and one-tenth mL per day for ten days." What total volume (mL) is to be dispensed?
P) A veterinarian gives the following oral drug order: "42.75 mL of drug needs to be divided into equal doses for these three cats." How much does each cat get?

4 Round the following decimal numbers to the nearest 1/100th and the nearest 1/10th, without a calculator:

A) 20.394 =
B) 9.682 =
C) 3.233 =
D) 29.452 =
E) 413.675 =
F) 5.956 =
G) 36.789 22 =
H) 0.255 =
I) 0.093 =
J) 1200.019 22 =
K) The veterinarian gives the following oral drug order: "Give fifteen point seven five mg but round it to the nearest tenth." How much do you give?
L) The dose calculation for a patient is 37.56 mg. What would the dose be, correctly rounded to a whole number? Is this dose closer to the 40 mg tablet size or the 35 mg tablet size?

5 Simplify the following fractions to their lowest form (e.g. 6/8 = 3/4), without a calculator:

A) $\frac{2}{10} =$

B) $\frac{4}{16} =$

C) $\frac{3}{12} =$

D) $1\frac{6}{8} =$

E) $5\frac{4}{32} =$

6 Add or subtract the following fractions, without a calculator:

A) $\frac{1}{4} + \frac{3}{4} =$

B) $\frac{1}{16} + \frac{3}{32} =$

C) $\frac{1}{6} + \frac{2}{5} =$

D) $1\frac{3}{4} + 2\frac{1}{2} =$

E) $5\frac{2}{3} + 4\frac{7}{8} =$

F) $\frac{1}{2} - \frac{1}{4} =$

G) $\frac{2}{3} - \frac{1}{6} =$

H) $1\frac{3}{4} - \frac{7}{8} =$

I) $3\frac{15}{16} - 2\frac{3}{8} =$

J) $45\frac{1}{5} - 33\frac{7}{8} =$

7 Multiply the following fractions, without a calculator:

A) $\frac{1}{2} \times \frac{1}{2} =$

B) $\frac{3}{4} \times \frac{1}{2} =$

C) $\frac{12}{16} \times \frac{3}{4} =$

D) $1\frac{1}{2} \times \frac{7}{8} =$

E) $\frac{11}{16} \times \frac{3}{4} =$

F) $2\frac{3}{4} \times 4\frac{1}{2} =$

G) $5\frac{4}{7} \times 1\frac{3}{4} =$

H) $10\frac{3}{8} \times 9\frac{1}{3} =$

8 Divide the following fractions:

A) $\frac{1}{4} \div \frac{1}{2} =$

B) $\frac{1}{3} \div \frac{1}{2} =$

C) $\frac{2}{4} \div \frac{3}{9} =$

D) $2 \div \frac{1}{4} =$

E) $2\frac{1}{2} \div \frac{1}{2} =$

F) $3\frac{3}{4} \div \frac{1}{16} =$

G) $22\frac{4}{8} \div \frac{2}{32} =$

H) $125\frac{1}{5} \div \frac{4}{25} =$

9 Convert the following fractions to decimal numbers (e.g. 1/2 = 0.5):

A) $\frac{2}{10} =$

B) $\frac{14}{28} =$

C) $\frac{3}{21} =$

D) $1\frac{1}{2} =$

E) $4\frac{5}{6} =$

F) $15\frac{7}{16} =$

10 Convert the following decimal numbers to the common fraction (e.g. 0.5 = 1/2):

A) 0.25 =
B) 0.333 =
C) 0.75 =
D) 0.125 =
E) 1.5 =
F) 2.500 =

11 Convert the following percentages to commonly used fractions (e.g. 50% = 1/2):

A) 25% =
B) 75% =
C) 33.3% =
D) 10% =
E) 80% =

12 Convert the following percentages to decimal numbers:

A) 25% =
B) 79% =

C) 100% =
D) 6% =
E) 0.2% =
F) 0.0087% =

13 Convert the following decimal numbers to percentages:

A) 0.5 =
B) 0.45 =
C) 1.00 =
D) 0.103 =
E) 0.900 23 =

14 Convert the following fractions to percentages (e.g. 1/2 = 50%):

A) $\frac{3}{4}$ =

B) $\frac{8}{10}$ =

C) $\frac{15}{45}$ =

D) $\frac{10}{10}$ =

E) $\frac{1}{1000}$ =

15 Answer the following percentage questions:

A) What is 25% of a 200 mg dose?
B) A veterinarian wants to use 50% of 25 mg calculated dose. How much drug (in milligrams) would they be giving?
C) What percentage is 80 pounds of 400 pounds?
D) A veterinary technician has drawn up 15 mg of the total 60 mg drug dose that they need to give an animal. What percentage of the total dose have they drawn up so far?

16 Solve for the missing X in each of the following:

A) $15 + X = 30 + 45$
B) $5 + 10 = 7 + X$
C) $X + 2.5 = 5.25 + 1.05$
D) $40 - X = 65 - 38$
E) $6.5 - 2.3 = 7.8 - X$
F) $X - 14.2 = 53.4 - 41.9$

17 Solve for the missing X in each of the following:

A) $2 \times 6 = 3 \times X$
B) $30 \times X = 120 \times 2$

C) $X \times 25.5 = 43.2 \times 12.25$
D) $25 \div 5 = 10 \div X$
E) $300 \div X = 12.5 \div 8.125$
F) $X \div 25 = 0.5 \div 0.75$

18 Solve for the missing X in the following proportions:

A) $\frac{2}{8} = \frac{X}{16}$

B) $\frac{4}{16} = \frac{3}{X}$

C) $\frac{X}{32} = \frac{18}{9}$

D) $\frac{12}{2} = \frac{X}{6}$

E) $\frac{9}{X} = \frac{36}{12}$

2

Review of Key Medical Math Fundamentals

Decimals

OBJECTIVES

The student will be able to:

1) accurately communicate decimal numbers in writing and speaking,
2) add and subtract decimals,
3) multiply and divide decimals,
4) apply scientific notation, and
5) round numbers.

Drug dosages, concentrations of drugs in vials, and drug units are commonly expressed as decimal numbers. Therefore, it is imperative that the veterinary professional be able to accurately add, subtract, multiply, and divide using decimal numbers. It is assumed the reader has a working knowledge of using decimals; therefore, this chapter will focus on a quick review with an emphasis on where common dosage calculation errors occur.

2.1 Relative Values of Decimal Numbers

The decimal point, or "point," orients the reader to the values of the decimal number. Each space to the *left* of the decimal point increases by a power of 10. Therefore, the first space to the left of the decimal point is "ones," the next space to the left is "tens," the next is "hundreds," and so on.

Each space to the *right* of the decimal point decreases by a power of 10 starting with "tenths." The second space to the right of the decimal point is the "hundredths," the next is "thousandths," and so on. Note that there are no "oneths" to the right of the decimal point and the first place to the right starts with "tenths." The numerals to the left of the decimal point are *whole numbers* (5, 62, 379) and the numerals to the right of the decimal point represent *decimal fractions* (e.g. one tenth, four hundredths).

Notice how all decimal fractions end in "th(s)," such as "four ten*ths*" or "one thousand*th*." Thus, the number 12.35 would contain the whole number "12" and the decimal fraction of "thirty-five hundredths."

The number shown in Figure 2.1 is 7842.125 and illustrates each of the places in the number.

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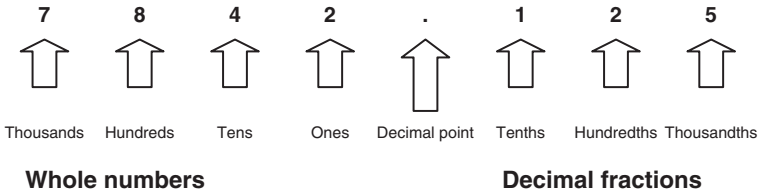

Figure 2.1 The location of whole numbers and decimal fractions in a decimal number

2.2 Properly Communicating Decimal Numbers

When reading a decimal number aloud, there are two ways to communicate the number. The number in Figure 2.1 can be read as either "seven thousand, eight hundred forty-two and one hundred twenty-five thousandths" or as "seven eight four two point one two five."

The first method is more formal and uses the word "and" to represent the decimal point. All units to the right of the decimal point are read as units of the *farthest right* place. Therefore, in the number above, there are "125 thousandths." For the number "1.12," the value to the right of the decimal point would be read aloud as "twelve hundredths" because the farthest right place that has a number is the hundredths place. When the value of a decimal number is less than 1, such as 0.5, the number would be read only as "five tenths" without stating the zero in the ones place.

The second method for communicating decimal numbers tends to convey the information in a shorter and more concise manner. The numbers are read left to right with the decimal point being spoken as "point." No place values (hundreds, tenths, thousandths, etc.) are stated in this method. Therefore, "234.56" would simply be read aloud as "two three four point five six." In contrast to the first method above, where the zero is not read for numbers with a value less than 1, in this second method the zero is communicated along with the "point." Thus 0.5 would be read as "zero point five." There are additional examples in Table 2.1.

Regardless of which method is used when a number is verbally communicated, it is essential that the number be communicated accurately. This can be a challenge when numbers are being communicated while masked for surgery or other procedures because the voice becomes muffled. It also becomes a challenge when communicating numbers by phone, particularly as cell phone reception can garble clear communication. In addition to the physical challenges with communicating numbers, some numbers sounds very similar to others, and the veterinary technician needs to be especially precise in communicating these numbers. It is a good practice to repeat any number that may be confusing, or to emphasize a key feature of the number, such as "One five POINT three," to make sure the recipient correctly receives the number. If there

Table 2.1 The correct way to read decimal numbers

36.89	"Thirty-six and eighty-nine hundredths" "Three six point eight nine"
0.9	"Nine tenths" "Zero point nine"
0.076	"Seventy-six thousandths" "Zero point zero seven six"
30.08	"Thirty and eight hundredths" "Three zero point zero eight"