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DOSAGES AND SOLUTIONS

A PROGRAMMED PRESENTATION

Laura K. Hart

Fourth edition

The C. V. Mosby Company

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Preface

This text has been compiled primarily to guide student nurses in the study of the arithmetic of dosages and solutions. The technique of programmed instruction used in this text offers students two main advantages: it requires that students become actively involved in the learning process, and it allows them to proceed at their own speed. The programs have been designed so that this course in the arithmetic of dosages and solutions can be completely self-directed. Students are given information in easy-to-digest pieces, a sentence or short paragraph at a time. The information is arranged in logical order, with each step building on the previous one and with the correct answer shown immediately.

The programs were developed on the assumption that all students at the beginning of this course possess the basic mathematical skills of addition, subtraction, multiplication, and division. However, for those who need to brush up on fractions, decimals, percentages, and ratios, a brief review has been included. The programs have been written to ensure that practically all students will get 95% of the answers correct.

Laura K. Hart

Contents

Introduction

A BRIEF ARITHMETIC REVIEW

This section has been included for those who may need a quick review of the basic rules for fractions, decimals, proportions, and ratios. Examples of how these rules are used to calculate dosages have been included in the programmed text where pertinent.

A fraction is a part of any object, quantity, or digit.

1 numerator
/ division line
4 denominator

To change a fraction to its lowest term, divide the numerator and the denominator by the same number. 2/4 = 1/2

To change a mixed number to a fraction, multiply the denominator by the whole number, add the numerator, and place over the denominator. 3 1/3 = 10/3

To change an improper fraction to a mixed number, divide the numerator by the denominator. 10/3 = 3 1/3

To multiply a fraction, multiply the numerator by the numerator and the denominator by the denominator. 1/2 × 6 = 1/2 × 6/1 = 6/2 = 3

To divide a fraction, invert the divisor and multiply. 1/2 ÷ 6 = 1/2 ÷ 6/1 = 1/2 × 1/6 = 1/12

To change a fraction to a decimal, divide the numerator by the denominator.

$$1/2 = \begin{array}{r} .5 \\ 2\overline{)1.00} \end{array}$$

A decimal refers to ten. Any fraction whose denominator is 10 or a multiple of 10 may be written as a decimal fraction.

Ten millions	Millions	Hundred thousands	Ten thousands	Thousands	Hundreds	Tens	Unit of one	Decimal point	Tenths	Hundredths	Thousandths	Ten thousandths	Hundred thousandths	Millionths	Ten millionths
8	7	6	5	4	3	2	1	·	1	2	3	4	5	6	7

Whole numbers — Decimal numbers

To multiply decimals, multiply as with whole numbers, but in the product, beginning at the right, point off as many places as there are in the multiplier and in the multiplicand.

```
 2.4 multiplicand
 1.2 multiplier
 ---
 48
24
----
2.88 product
```

To divide a decimal by a decimal, move the decimal point of the divisor to the right until it becomes a whole number, and then move the decimal point of the dividend the same number of places to the right, adding zeros if necessary.

$$.002\overline{)4.} = 002.\overline{)4000.}\quad \text{quotient } 2000.$$

To change a decimal to a fraction, use the number expressed as the numerator and the number represented by the decimal place as the denominator. .4 = 4/10 .44 = 44/100

To change a decimal to a ratio, change the decimal to a fraction and then to a ratio. .4 = 4/10 = 4:10 or 2:5 .5 = 5/10 = 5:10 or 1:2

A percent is a fraction whose numerator is expressed and whose denominator is understood to be 100.

To change a percent to a decimal, remove the percent sign and move the decimal point two places left. 30% = .30 2.5% = .025

To change a percent to a fraction, divide the percent by 100 and reduce to lowest terms. 50% = 50/100 = 1/2 25% = 25/100 = 1/4

To change a percent to a ratio, use the expressed numerator as the first term and the understood denominator (100) as the second. Reduce to lowest terms. 50% = 50:100 = 1:2

A proportion shows the relationship between two equal ratios. In a proportion the product of the means equals the product of the extremes.

```
extremes
↓       ↓
1:2::2:4          1 × 4 = 4 extremes
  ↑  ↑            2 × 2 = 4 means
  means
```

If one of the means is unknown, divide the product of the extremes by the known mean.

1:?::2:4 1 × 4 = 2 × ?
4 ÷ 2 = 2 1:2::2:4

If one of the extremes is unknown, divide the product of the means by the known extreme.

1:2::2:? 1 × ? = 2 × 2
4 ÷ 1 = 4 1:2::2:4

To change a ratio to a decimal, change the ratio to a fraction and then divide the numerator by the denominator. 1:2 = 1/2 = $2\overline{)1.00}$ = .5

ABBREVIATIONS COMMONLY USED IN MEDICATION ORDERS

aa	of each (equal parts)
ac	before meals
ad lib	as much as desired
AM	morning
Aq	water
bid	twice a day
c	with
caps	capsules
dil	dilute
fl	fluid
h	hour
hs	hours of sleep (bedtime)
IM	intramuscular
IV	intravenous
OD	right eye
OS	left eye
os	mouth
OU	both eyes
pc	after meals
per	by
PO	by mouth
prn	when required
q	every
qd	every day
qh	every hour
q2h	every two hours
q3h	every three hours
q4h	every four hours
qid	four times a day
qod	every other day
$\bar{s}$	without
ss	a half
Sol	solution
Stat	immediately
SQ	subcutaneous
tab	tablet
tid	three times a day
tr or tinct	tincture
ung	ointment

UNIT I Metric system

In order to administer medications accurately a nurse must understand the systems used for weighing and measuring drugs. Although efforts are being made to have the metric system used exclusively, unfortunately many places in the United States still use the apothecaries' and metric systems interchangeably. For this reason a nurse must understand both of these systems.

10

1 The metric system, which employs the decimal scale, is composed of units measuring *length, volume,* and *weight*. Since the metric system employs the decimal scale would its numerical scale be based on units of 4, 10, or 22? ______

weight

2 Before considering the metric system's three units of measure, those of length, volume, and __________, let us first examine the use of the decimal scale in the metric system.

prefixes

3 A prefix (the first syllable or part of a word) is used to establish meaning. The prefixes utilized in the metric system indicate which unit of 10 applies to the measure in use. Since there are only six units of 10 utilized in the metric system, there likewise are only six __________ utilized to identify which unit of 10 is being used.

100

4 Three of the six prefixes are used to indicate multiples of 10, and three are used to indicate fractional units. The prefixes indicating multiples of 10 are deka, which refers to units of 10; hecto, which refers to units of 100; and kilo, which refers to units of 1000. A kilo indicates a unit that is ______ times larger than a deka.

kilo

5 Of the three prefixes used to indicate multiples of 10, the one most frequently used by the nurse is the prefix that refers to 1000 units. This prefix is ____________.

1000

6 Kilo is used in the word kiloliter to indicate a quantity _______ liters in volume.

1000

7 Kilo is used in the word kilometer to indicate a distance _______ meters in length.

kilogram

8 The quantity of 1000 grams in weight is usually referred to as a ____________.

fractions or divisions

9 The three prefixes that indicate the multiples of units are of Greek derivation; however, the prefixes that indicate the divisions or *fractions* of a unit are of Latin derivation. Prefixes are used not only to indicate multiples of a unit but _________________ of a unit of measure as well.

10

10 The three prefixes that indicate the divisions of the metric units are deci, referring to .1 of a unit; centi, referring to .01 of a unit; and milli, referring to .001 of a unit. Each is a division of _______. Note that since the metric system utilizes the decimal scale, fractional parts of metric units are always indicated with decimal numbers.

smaller

11 The divisional prefix of deci refers to .1 of a unit in medical measurements. The prefix deci is infrequently used in medical measurements. The prefix centi, referring to .01 of a unit, indicates a (smaller/larger) portion of the unit than the prefix deci.

.001

12 A deci is 10 times larger than a centi, and a centi of a unit is 10 times larger than a milli. Therefore, if a deci equals .1 of a unit, and a centi equals .01 of a unit, then a milli equals ______ of a unit.

centi
milli

13 The prefixes centi and milli are the two most commonly used in hospital terminology. If you have .01 of a unit, the prefix __________ is used; if you have .001 of a unit, the prefix __________ is used.

1000
.01
.001

14 Of the six prefixes used to indicate multiples or fractions of a unit, only three are used with frequency in the hospital. The prefix kilo is used to indicate ______ times the unit; the prefix centi is used to indicate ______ part of a unit; and the prefix milli is used to indicate ______ part of a unit.

meter

15 The *meter* is the fundamental unit of the metric system. It is called the fundamental unit because it is from this standard of linear measure that the other two metric units of weight and volume are derived. As the name implies, the __________ is the fundamental unit of the metric system.

meter

16 An example of the use of this linear measure is the calibration of the sphygmomanometer, an instrument used to measure the blood pressure. Its scale is calibrated in millimeters. This indicates that each division of length represents .001 of a __________.

10

17 When very small or precise measurements are needed, the millimeter is used. However, for larger measures such as the length of a newborn infant the centimeter is the unit used. The centimeter (cm) is ______ times larger than the millimeter (mm). Note the abbreviations.

152 **18** Height is often measured in centimeters. A centimeter is $^2/_5$ or .3937 parts of an inch. If a person is 60 inches tall, he is also ________ cm tall. This problem can be solved via use of proportion. (See p. 2 for an explanation of how to solve a proportion problem.)

$$\frac{1\text{ cm}}{.3937\text{ in}} :: \frac{?\text{ cm}}{60\text{ in}}$$

Cross multiply: $.3937x = 60$

$$3937\overline{)600000.}\quad 152.4$$

$x = 152$ cm

20 **19** A 51-cm infant is ________ inches long.

$$\frac{1\text{ cm}}{.3937\text{ in}} :: \frac{51\text{ cm}}{?\text{ in}}$$

smaller **20** A centimeter is (larger/smaller) than an inch.

21 The metric unit of capacity or volume is the *liter* (L). It was decided that the volume of a liter should be that which could be contained in a cube measuring exactly 1 decimeter (dm) in length on all sides. This is how the standard for the metric unit of volume, the

liter ____________, was derived from the fundamental linear unit,

meter the ____________.

.1 **22** The prefix deci means .1; so a decimeter equals ________ of a meter.

23 If a centimeter is .01 meter and a decimeter is .1 meter, then there

10 are ________ cm in 1 dm.

24 If 10 cm equal 1 dm, and if a cube measuring 1 dm on all sides contains 1 L, then a cube measuring 10 cm on all sides would also hold

liter the volume of a ____________.

25 If you take one side measurement of 10 cm and cube it (take it to the third power), you will have the answer to how many cubes measuring a centimeter on all sides equal a liter. You can cube 10 cm in the following manner:

$$\frac{\text{1st power 2nd power}}{(10\text{ cm}) \times (10\text{ cm})} = 100\text{ cm} \times \frac{\text{3rd power}}{(10\text{ cm})} = \frac{1000}{\text{cubic cm}}$$

To determine the total volume, the side measure must be taken to the third power because a cube is three dimensional. Therefore, 1000 cubes measuring 1 cm on all sides would exactly fill the capacity of a ______________.

liter

26 If 1000 centimeter cubes equal a liter, then a liter contains ________ cubic centimeters (cc).

1000

27 As you recall, the prefix milli indicates .001 parts of a unit. Therefore, a milliliter is what part of a liter? ________

.001

28 The milliliter is the division of a liter that is most commonly used in the hospital, and it is abbreviated ml. Because a milliliter is .001 of a liter, there are ________ ml in a liter.

1000

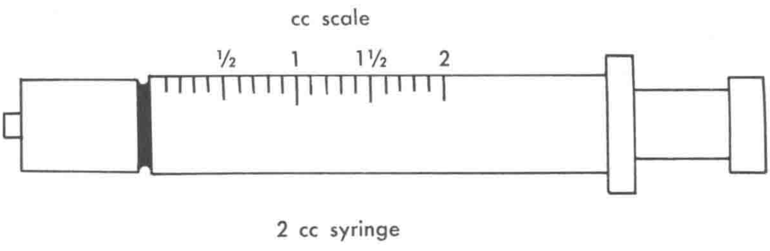
29 If there are 1000 ml in a liter and 1000 cc in a liter, then 1 cc could contain ________ ml of material.

1

30 1 L = ________ ml; 1 L = ________ cc; 1 ml = ________ cc.

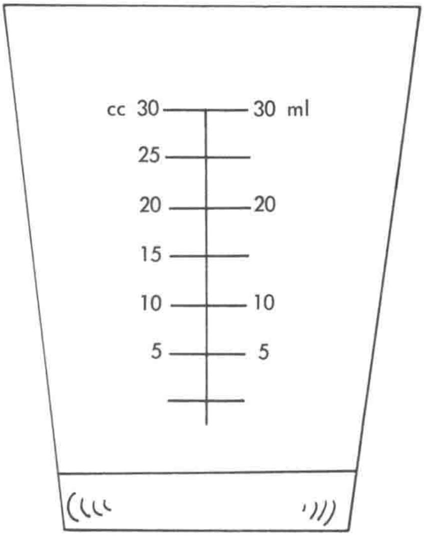
1000 1000 1

31 It is important to know this relationship between the volume and capacity measures in the metric system as liquid drugs are usually ordered in relation to their volume, but are measured according to the cc capacity of the container in which they will be distributed. Note the markings on the 2-cc syringe on p. 10.



1.5 If a patient is to receive an injection of 1.5 ml of a medication, this volume should be measured by filling a syringe to the _______ cc marking.

15 **32** Note that medicine glasses are also marked according to their cc capacity. As in the following example, some are marked with both the cc capacity scale and the ml volume scale. If you administer 15 ml of a medication, the medicine glass should be filled to the _______ cc marking.



250 **33** Usually in the hospital, fractional parts of a liter are expressed in milliliters. For example, a pitcher containing ½ L of fluid contains 500 ml of fluid. If you had a glass containing ¼ L of water, how many milliliters would it contain? _______

1750 ml | **34** Multiples of liters are also usually expressed in milliliters. For example, 1½ L of fluid would be referred to as 1500 ml of fluid. If you had 1¾ L of fluid, what would be the amount of fluid expressed in milliliters? ________________

1 | **35** In the hospital, fluid volumes are usually expressed in milliliters; however, it is necessary to know that 1 ml = ________ cc because syringe and medicine glass capacities are frequently expressed in cubic centimeters.

2
30 | **36** A 2-cc syringe when full contains ________ ml of drug, and a 30-cc medicine glass when full contains ________ ml of drug.

kilogram | **37** Using these two previously established standards, the meter and the liter, the original standard unit of weight was established. It was decided that a kilogram would be the weight of a liter of distilled water weighed at 4° C and 760 mm of pressure. The temperature had to be held constant because fluid will expand and contract with a change in temperature. The original standard unit of weight, the ____________, weighs approximately 2.2 pounds (lbs).

2.2 | **38** The kilogram, weighing approximately ________ lbs, is frequently used in hospitals to express body weights.

80 | **39** A person weighing 176 pounds weighs ________ kilograms (Kg):

$$\frac{2.2 \text{ lbs}}{1 \text{ Kg}} :: \frac{176 \text{ lbs}}{? \text{ Kg}}$$

132 | **40** A person weighing 60 Kg weighs ________ pounds.

.001 **41** The kilogram proved to be too large to meet the practical needs of pharmacists, so they decided to use the gram as their basic metric unit of weight. If the kilogram is 1000 grams, then the basic unit of weight, the gram, is _______ of a kilogram.

.001 .001 **42** Fractional parts of a gram are usually expressed in milligrams. As you remember, milli means _______ of a unit; so a milligram is _______ of a gram (g).

1000 100 **43** The milligram (mg), .001 of a gram, is as frequently used to express drug weights as is the gram. For example, a drug weighing 0.6 g could also be expressed as 600 mg. Since the milligram is _______ times smaller than the gram, it is very easy to change grams to milligrams. Simply multiply the number of grams by 1000, or move the decimal point three places to the right. For example: 1 g = 1000 mg; .5 g = 500 mg; .1 g = _______ mg.

44 Convert the following to milligrams.

900 mg .9 g = ___________

3 mg .003 g = ___________

70 mg .07 g = ___________

45 To change milligrams to grams the process is simply reversed. The number of milligrams is divided by 1000, or the decimal point is moved three places to the left. For example:

.2 600 mg = .6 g; 200 mg = _______ g.

46 Convert the following to grams.

.4 g 400 mg = ___________

.08 g 80 mg = ___________

1.5 g 1500 mg = ___________