بسم الله الرحمن الرحيم

Pharmaceutical Calculations
PHT (210)

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Course Outline:

Reference: Pharmaceutical Calculations 13th and 14th editions. Howard C. Ansel

Week	Item	Source	Lecturer
1	Fundamentals of pharmaceutical calculations	Chapter 1	Dr. M. Altamimi
2	International System of Units	Chapter 2	
3	Density, specific gravity and specific volume	Chapter 5	
4	Interpretation of prescription and medication orders	Chapter 4	
5	Percentage, ratio strength and other expressions of concentrations	Chapter 6	
6	Calculation of Doses: general considerations	Chapter 7	
7	Calculation of Doses: patient parameter (1st Midterm exam)	Chapter 8	

Definition:

✧*Pharmaceutical calculations* is the area of study that applies basic mathematics to the preparation, safe , and effective use of pharmaceuticals.

✧This is an essential course for any pharmacist and its principles are going to be used no matter what kind of pharmacy practice are being conducted.

Lecture 1

Introduction and basic mathematics review

Numerals and Numbers

1, 3, 6, 9, 15

I, III, VI, IX, XV

NUMBERS AND NUMERALS

A number is a total quantity or amount, whereas a numeral is a word, sign, or group of words and signs representing a number.

Arabic Numerals

Arabic numerals, such a 1, 2, 3, etc., are used universally to indicate quantities. These numerals, which are represented by a zero and nine digits, are easy to read and less likely to be confused.

Roman Numerals

Roman numerals are used with the apothecary's system of measurement to designate quantities on prescription. In the Roman system of counting, letters of the alphabet (both uppercase and lowercase) such as I or i, V or v, and X or x are used to designate numbers. A few commonly used Roman numerals and their Arabic equivalents are given in Table 1.1.

TABLE 1.1. Roman Numerals and Their Arabic Equivalents.

Roman Numeral	Arabic Numeral
I (or i)	1
II (or ii)	2
III or (iii)	3
IV (or iv)	4
V (or v)	5
VI (or vi)	6
VII (or vii)	7
VIII (or viii)	8
IX (or ix)	9
X (or x)	10
XX (or xx)	20
XXX (or xxx)	30
L (or l)	50
C (or c)	100
D (or d)	500
M (or m)	1000

In the usage of Roman numerals, the following set of rules apply:

(1) When a Roman numeral is repeated, it doubles its value; when a Roman numeral is repeated three times, it triples its value.

Examples:

I = 1, II = 2, III = 3

X = 10, XX = 20, XXX = 30

(2) When Roman numeral(s) of lesser value follows one of a greater value, they are added.

Examples:

VII = 5 + 1 + 1 = 7

XVI = 10 + 5 + 1 = 16

(3) When Roman numeral(s) of lesser value precedes one of a greater value, they are subtracted from the greater value numeral.

Examples:

IV = 5 − 1 = 4

IX = 10 − 1 = 9

(4) When Roman numeral of a lesser value is placed between two greater values, it is first subtracted from the greater numeral placed after it, and then that value is added to the other numeral(s) (i.e., subtraction rule applies first, then the addition rule).

Examples:

XXIX = 10 + 10 + (10 − 1) = 29

XIV = 10 + (5 − 1) = 14

(5) Roman numerals may not be repeated more than three times in succession.

Example: 4 is written as IV but not as IIII

(6) When possible, largest value numerals should be used.

Example: 15 is written as XV but not as VVV

Roman numerals are sometimes combined with the abbreviation for one half, ss. The abbreviation should always be at the end of a Roman numeral. Generally, Roman numerals are written in lowercase when used with ss, such as iss to indicate 1½.

iv	=	4	xxiv	=	24	xliv	=	44	cdi	=	401	cm	=	900
ix	=	9	xxxix	=	39	xc	=	90	cdxl	=	440	cmxcix	=	999
xiv	=	14	xl	=	40	xcix	=	99	cdxliv	=	444	MCDXCII	=	1492
xix	=	19	xli	=	41	cd	=	400	cdxc	=	490	MMIV	=	2004

FRACTIONS

A *fraction* is a portion of a whole number. Fractions contain two numbers: the bottom number (referred to as *denominator*) and the top number (referred to as *numerator*). The denominator in the fraction is the total number of parts into which the whole number is divided. The numerator in the fraction is the number of parts we have.

A *proper fraction* should always be less than 1, i.e., the numerator is smaller than the denominator.

Examples:

5/8, 7/8, 3/8

A proper fraction such as 3/8 may be read as ''3 of 8 parts'' or as ''3 divided by 8.''

An *improper fraction* has a numerator that is equal to or greater than the denominator. It is therefore equal to or greater than one.

Examples:

2/2 = 1, 5/4, 6/5

Common fractions and decimal fractions:

1- Common fractions written as ¾ , ½

2- Decimal fraction written as 0.12 , 0.004

- Addition

$$\frac{2}{4} + \frac{3}{4} = \frac{5}{4} = 1\frac{1}{4}$$

$$\frac{3}{4} + \frac{2}{3}$$

$$\frac{9}{12} + \frac{8}{12} = \frac{17}{12} = 1\frac{5}{12}$$

- Subtraction

$$\frac{2}{3} - \frac{1}{2} = \frac{4}{6} - \frac{3}{6} = \frac{1}{6}$$

- Multiplication

$$3 \times \frac{1}{4} = \frac{3}{4}$$

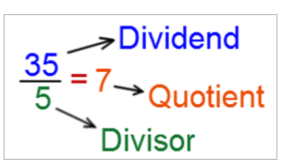
$$\frac{1}{3} \times \frac{1}{4} = \frac{1}{12}$$

$$\frac{5}{6} \times \frac{7}{8} = \frac{5 \times 7}{6 \times 8} = \frac{35}{48}$$

- Division

$$5 \div \frac{1}{2} = 5 \times \frac{2}{1} = 5 \times 2 = 10$$

$$\frac{2}{3} \div \frac{2}{5} = \frac{2}{3} \times \frac{5}{2} = \frac{10}{6} = \frac{5}{3}$$



Percent

The term *percent* and its corresponding sign, %, mean "in a hundred." So, *50 percent (50%)* means 50 parts in each one hundred of the same item.

Common fractions may be converted to percent by dividing the numerator by the denominator and multiplying by 100.

Example:

Convert $\frac{3}{8}$ to percent.

$$\frac{3}{8} \times 100 = 37.5\%, \textit{ answer.}$$

Decimal fractions may be converted to percent by multiplying by 100.

Example:

Convert 0.125 to percent.

$$0.125 \times 100 = 12.5\%, \textit{ answer.}$$

Percent weight-in-volume (w/v) expresses the number of *grams* of a constituent in *100 mL* of solution or liquid preparation and is used regardless of whether water or another liquid is the solvent or vehicle. Expressed as: _____ *% w/v.*

Percent volume-in-volume (v/v) expresses the number of *milliliters* of a constituent in *100 mL* of solution or liquid preparation. Expressed as: _____ *% v/v.*

Percent weight-in-weight (w/w) expresses the number of *grams* of a constituent in *100 g* of solution or preparation. Expressed as: _____ *% w/w.*

The term *percent*, or the symbol %, when used *without qualification* means:

- for solutions or suspensions of solids in liquids, *percent weight-in-volume*;
- for solutions of liquids in liquids, *percent volume-in-volume*;
- for mixtures of solids or semisolids, *percent weight-in-weight*; and
- for solutions of gases in liquids, *percent weight-in-volume*.

Ratios and Proportions:

- Rations relates the magnitudes of two quantities. For example:1:5 is the expression used and it is read as (one to five).

- The equality of two ratios is called proportion. For example: a:b = b:c or a/b = c/d. Also: If (a/b = c/d) then a = (b*c)/d and d = a/(b*c).

  Example: If 5 tablets contain 550 mg of aspirin, then how many mg should be in 15 tablets?

Dimensional Analysis:

- Four major steps that should be performed for successful dimensional analysis;
  1- Find the Final unite
  2- Identify the given unite
  3- Apply any conversion factors
  4- Set up ratios so that cancelations lead to the final unite.

  Example 1: How many ml in 300 *fluidounce* (*fl. oz*)?
  Example 2: If a patient is given 200 *fl. oz.* over 6 hour period, how many ml is given every minutes?

Significant Figures:

- Significant figures are *consecutive figures the express the value of a denominate numver accurately enough for a given purpose.* All the figures affect the accuracy and the last figure is called uncertain.
- ***Zero*** is significant only when:

1- Between digits, for example, 202, 101

2- One or more final zero to the right decimal point may be taken as significant.

Example 1: How many significant figures are in (0.25, 0.025, 0.205, 0.2050)?

* Always consider the sensitivity of your instrument before reporting your significant figures.

Rules of Rounding:

- Your last figure should be the only uncertain figure.
- When rounding a number add 1 to the last figure retained if the following figure is 5 or more.
  Example 1: $2.43 \approx 2.4$ and $2.46 \approx 2.5$
- However, the determining factor for rounding is the sensitivity of the used instrument.
- During a pharmaceutical calculation the resulting value should retain the same significant figures of those used in the calculations.

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