Pharmaceutical Calculations Chapters

2013 - 2014 (1434 - 1435):

Chapters: 1, 2, 3, 4, 6, 7, 8, 10, 11, 12, 13, 15, 16, 17, 21 and 22
Chapter 1

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Fundamentals of Pharmaceutical Calculations

Pharmaceutics I

PH 211
Objectives

Review basic mathematics:

• Convert common fractions, decimal fractions, and percentages to their corresponding equivalent.
• Utilize exponential notations in calculations.
• Review & apply the method of ratio and proportion in problem-solving.
Scope of Pharmaceutical Calculations

- Chemical purity, Physical and biological parameters
- Drug stability, rates of drug degradation and shelf life
- Rates of drug ADME (Pharmacokinetics)
- Prescriptions and medication orders
- Parameters of drug dynamics and clinical effectiveness
- Economic impact of drugs and drug therapy
Fractions

• When something is divided into parts, each part is considered a fraction of the whole.
• If a pie is cut into 8 slices, one slice can be expressed as 1/8, or one piece (1) of the whole (8).
• **Whole Numbers**: 10, 220, 5, 19

• **Fractions**: Parts of whole numbers (1/4, 2/7, 11/13) that have two parts:
  - **Numerator**, first or upper figure
  - **Denominator**, second or lower figure
• A fraction with the same numerator and same denominator has a value equivalent to 1.

• In other words, if you have 8 pieces of a pie that has been cut into 8 pieces, you have 1 pie.

\[
\frac{8}{8} = 1
\]
Proper fraction

- A fraction with a value of less than 1

- A fraction with a numerator value smaller than the denominator’s value

\[
\frac{1}{4} < 1
\]
Improper fraction

• A fraction with a value of larger than 1

• A fraction with a numerator value larger than the denominator’s value

\[ \frac{6}{5} > 1 \]
Mixed number

• A whole number and a fraction

\[ 5 \frac{1}{2} \]
Decimal fractions

- Decimal Numbers: another means of writing fractions:
  \[
  \frac{1}{2} = 0.5, \quad \frac{1}{2} = 0.5 = 50\%
  \]
  \[
  1\frac{3}{4} = 1.75
  \]

- Decimal fraction: 0.25, 0.10

**Example:**

- Reduce 36/2880 to its lowest terms

  Largest common divisor is 36

  \[
  \frac{36}{2880} = \frac{36 \div 36}{2880 \div 36} = \frac{1}{80}
  \]

  **answer**
Review basic mathematics on common and decimal fractions

- Adding fractions
- Subtracting fractions
- Multiplying fractions
- Dividing fractions
- Decimal fractions
- Percent
Adding or Subtracting Fractions

• When adding or subtracting fractions with unlike denominators, it is necessary to create a common denominator.

• *Common denominator:* a number into which each of the unlike denominators of two or more fractions can be divided evenly
Adding Fractions

* Calculate the following: \[ \frac{2}{5} + \frac{1}{5} = \frac{3}{5} \], answer

* \[ \frac{1}{4} + \frac{1}{12} + \frac{1}{8} + \frac{1}{6} \]

The lowest common denominator of the fraction is 24.

\[ \frac{1}{4} = \frac{6}{24}, \quad \frac{1}{12} = \frac{2}{24}, \quad \frac{1}{8} = \frac{3}{24}, \quad \text{and} \quad \frac{1}{6} = \frac{4}{24} \]

\[ \frac{6 + 2 + 3 + 4}{24} = \frac{15}{24} = \frac{5}{8} \]
Subtracting Fractions

\[
\frac{14}{24} - \frac{3}{24} = \frac{11}{24}
\]
**Multiplying Fractions**

- Multiply the numerators by numerators and denominators by denominators.
- In other words, multiply all numbers above the line; then multiply all numbers below the line.

\[
\frac{1}{4} \times \frac{2}{3} = \frac{2}{12} = \frac{1}{6}
\]

\[
\frac{2}{5} \times \frac{2}{1} = \frac{2}{5} = \frac{4}{5}
\]
Dividing Fractions

To divide by a fraction, multiply by its reciprocal, and then reduce it if necessary.

\[
\frac{1}{2} \div \frac{2}{3} = \frac{1}{2} \times \frac{3}{2} = \frac{3}{4}
\]
Decimal Fractions

\[ 0.125 = \frac{125}{1000} = \frac{1}{8} \]

\[ \frac{3}{8} = 3 \div 8 = 0.375 \]
Percent

• The percent term and its corresponding sign, %, mean “in a hundred” or “per 100”
• 50% means 50 parts in total of 100
  50:100, 0.50, or 50/100
• The number of parts per 100; can be written as a fraction, a decimal, or a ratio

Examples:
• Convert 3/8 to percent.
  3/8 x 100= 37.5%, answer

• Convert 0.125 to percent.
  0.125 x 100 = 12.5%
<table>
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<tr>
<th>COMMON FRACTION</th>
<th>DECIMAL FRACTION</th>
<th>PERCENT (%)</th>
<th>COMMON FRACTION</th>
<th>DECIMAL FRACTION</th>
<th>PERCENT (%)</th>
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</table>
Exponential Notation “Power of 10”

- 121 could be expressed as 1.21 \times 10^2
- 1210 could be expressed as 1.21 \times 10^3
- 1^{st} part (1.21) called coefficient, 2^{nd} part is the exponential factor or power of 10.
- In the multiplication of exponentials, the exponents are added:
  - \((2.5 \times 10^2) \times (2.5 \times 10^4)= 6.25 \times 10^6\)
  - \((2.5 \times 10^2) \times (2.5 \times 10^{-4})= 6.25 \times 10^{-2}\)
  - \((5.4 \times 10^2) \times (4.5 \times 10^3)= 24.3 \times 10^5= 2.4 \times 10^6\)
- In the division of exponentials, the exponents are subtracted:
  - \(10^2 / 10^5=10^{-3}\)
Exponential Notation

• In the addition and subtraction of exponentials, the expressions must be changed (by moving the decimal points) and the coefficients only are added or subtracted

Example: $(1.4 \times 10^4) + (5.1 \times 10^3)$

\[
5.1 \times 10^3 = 0.51 \times 10^4
\]
\[
+ 1.4 \times 10^4
\]
Total $= 1.91 \times 10^4 \quad \text{answer}$
Ratio

- A numerical representation of the relationship between two parts of the whole or between one part and the whole
- 1:2
- All the rules governing common fractions equally apply to a ratio
- 20:4 = 10:2 = 5
- 20 grams : 4 grams
- “When two ratios have same value: equivalent”

\[
\frac{2}{4} = \frac{4}{8}
\]

\[2 \times 8 = 4 \times 4 = 16\]

Example: \[
\frac{6}{15} = \frac{2}{5}
\]

\[6 = \frac{15 \times 2}{5} = 6\]
Proportion

- Is the expression of the equality between two ratios
- It maybe noted by three standard forms

1) \( \frac{a}{b} = \frac{c}{d} \)
2) \( a:b :: c:d \)
3) \( \frac{a}{b} = \frac{c}{d} \).

If \( \frac{a}{b} = \frac{c}{d} \), then \( a = \frac{bc}{d}, \ b = \frac{ad}{c}, \ c = \frac{ad}{b}, \) and \( d = \frac{bc}{a} \).

Example: If 3 tablets contain 975 mg of aspirin, how many milligrams should be contained in 12 tablets?

\[
\frac{3 \text{ (tablets)}}{12 \text{ (tablets)}} = \frac{975 \text{ (milligrams)}}{X \text{ (milligrams)}} \quad \rightarrow \quad X = \frac{12 \times 975}{3} = 3900 \text{ milligrams, answer}
\]

Other example at pages 7
Variation

• Preceding examples (Proportional relationship) deals with twice the cause, double the effect and so on
• Occasionally, we have inverse relationships, half the effect, as when you decrease the strength of solution by increasing the amount of diluents

Example: If 10 pints of a 5% solution are diluted to 40 pints, what is the percentage strength of the solution?

\[
\frac{10 \text{ (p int s)}}{40 \text{ (p int s)}} = \frac{X \text{ (\%)} }{5 \text{ (\%)} }
\]

\[
X = \frac{10 \times 5}{40} \% = 1.25 \%, \text{ answer}
\]

• \( V_1 \times C_1 = V_2 \times C_2 \)
• \( 10 \times 5\% = 40 \times X \text{ (X)\%} = X = \frac{10 \times 5}{40} \% = 1.25 \%, \text{ answer} \)
Practice Problems: Chapter 1
“Fundamentals of Pharmaceutical Calculations”

Page 3: 1, 3 and 4.
Page 4: 5 and 6.
Page 5: 1, 3, 4, and 5.
Page 11: 1, 3, 5, 7, 9, 11 and 13.
Page 12: 15, 17, 19, 21, and 23.

Practice your calculations .... Guarantee your “A” Graduation