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Remington: Practice of

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Chairman of the Editorial Board and Editor

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analysis, and if the student finds a procedure that is more logical to him and gives the correct answer, he should use it. The solutions to sample problems used here should, therefore, generally be considered suggestive rather than the only way to solve a given type of problem.

Before the student reads this part of the chapter and attempts to solve the problems, he should be thoroughly familiar with, and understand, the information in the preceding part of this chapter.

Mathematical Principles

A few mathematical principles (eg, common decimal fractions, exponents, powers and roots, significant figures and logarithms) will be reviewed: these are areas where students often become careless or have forgotten skills. Following this, various types of practical pharmaceutical problems that the pharmacist may be required to solve are discussed and solutions are given. Where practical, rules for solving these problems are given. No attempt is made to elaborate on any mathematical theory.

The problems generally consist in determining the quantity or quantities of material(s) required to compound prescriptions properly and make products used to aid the compounding of prescriptions. The materials used to compound prescription orders may be pure or mixtures of substances in varying strengths. The strengths of mixtures may be denoted in different ways. Conversions may be necessary between systems of varying strengths or between different measuring systems. At the end of each section, sample problems are given for the student to solve, the answers to which appear on page 90.

Because of the decreasing importance of the apothecary system, the metric system will be emphasized. Chemicals and preparations most likely will be purchased using the avoirdupois or metric systems. Prescription orders are filled in the system indicated on the order, usually the apothecary or metric systems.

The student should become familiar with the terminology used in writing prescription orders such as Latin words and abbreviations used in giving directions to the pharmacist and patient. The prescriber occasionally may use Roman numerals instead of Arabic numerals. Students, therefore, must be familiar with these even if the practice is declining.

Significant Figures

Weighings and measurements can be carried out with only a certain maximum degree of accuracy; the result always is approximate due to the many sources of error such as temperature, limitations of the instruments employed, personal factors, etc. The pharmacist must achieve the greatest accuracy possible with his equipment, but it would be erroneous to claim that he has weighed 1 mg of a solid on a Class III prescription balance, which has a sensibility reciprocal of 10 mg, or that he has measured 76.32 mL of a liquid in a 100-mL graduate, which can be read only to 1 mL. When quantities are written, the numbers should contain only those digits which are "significant" within the precision of the instrument.

Significant figures are digits which have practical meaning. In some instances zeros are significant; in other instances they merely indicate the order of magnitude of the other digits by locating the decimal point. For example, in the measurement 473 mL all the digits are significant, but in the measurement 4730 mL the zero may or may not be significant. In the weight 0.0316 g the zeros are not significant but only locate the decimal point. In any result the last significant figure is only approximate, but all preceding figures are accurate. When 473 mL is recorded, it is understood that the measurement had been made within ±0.5 mL or somewhere between 472.5 and 473.5 mL. The student should stop to consider the full implications of this, specifically that the measurement is subject to a maximum error of

$$\frac{0.5}{473} \times 100 = \text{(approx) } 0.1\% \text{ or 1 part in 1000}$$

A zero in a quantity such as 473.0 mL is a significant figure and implies that the measurement has been made within the limits 472.95 mL and 473.05 mL or with a possible error of

$$\frac{0.05}{473} \times 100 = \text{(approx) } 0.01\% \text{ or 1 part in 10,000}$$

Thus, 473 is correct to the nearest mL and 473.0 is correct to the nearest 0.1 mL.

Rules

1. *When adding or subtracting, retain in the sum or remainder no more decimal places than the least number entering into the calculations.* For example

	11.5 g		11.50 g
	2.65 g		2.65 g
	3.49 g		3.49 g
	17.64 g		17.64 g
Answer:	17.6 g	*Answer:*	17.64 g

In the first column 11.5 g was weighed to 0.1 g or with an accuracy of ±0.05 g. Although the other two weighings were made with an accuracy of ±0.005 g, the sum can be expressed properly only to one decimal place.

In the second column 11.50 g was weighed to the nearest 0.10 g or with an accuracy of ±0.005 g. Since all weighings were made with this degree of accuracy, the sum may be stated as in the example, 17.64 g.

Retain all figures possible until all the calculations are completed and then retain only the significant figures for the answer. Additions or subtractions involving both large and small quantities, each expressed with maximum significance, are often useless. For example, if one were to add 1.2 and 0.041 g, the physical sum would be 1.2 g. regardless of the fact that the two numbers add numerically to 1.241. To express the physical sum as 1.241 g would convey an erroneous degree of accuracy with which the quantity was known.

2. *When multiplying or dividing, retain in the answer no more significant figures than the least number entering into the calculation.*

The meaning of this rule may be illustrated by the use of equivalents during conversions from one measuring system to another. Table 12 gives different equivalent values and the number of significant figures to which the answer is correct. Always use an equivalent which will give the desired degree of accuracy. Repeated multiplication of an approximation increases the error progressively; therefore, retain all figures during calculations and drop insignificant figures as the final step.

Fractions

Common Fractions

An example of a common fraction is ⅜. It is read as "three-eighths" and indicates three parts divided by eight parts of the same thing. The units with both numbers must be the same. If a pharmacist measures ⅜ of a fluidounce into a graduate, he measures 3 fluidrams, out of 8 fluidrams (a fluidounce contains 8 fluidrams).

The following principles should be applied when using common fractions:

1. The value of a fraction is not altered by multiplying or dividing both numerator and denominator by the same number.
2. Multiplying the numerator or dividing the denominator by a number, multiplies the fraction by that number.
3. Dividing the numerator or multiplying the denominator by a number divides the fraction by that number.
4. To add or subtract fractions, form fractions with the *lowest common denominator,* perform the arithmetical operation and reduce to the lowest common denominator.

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