# **Analytical Chemistry**

Sara Rasoul-Amini, Pharm D, PhD in Medicinal Chemistry; Department of Medicinal Chemistry, School of Pharmacy, Shiraz University of Medical Sciences(SUMS); Feb 2025

### **Pharmacy Curriculum**

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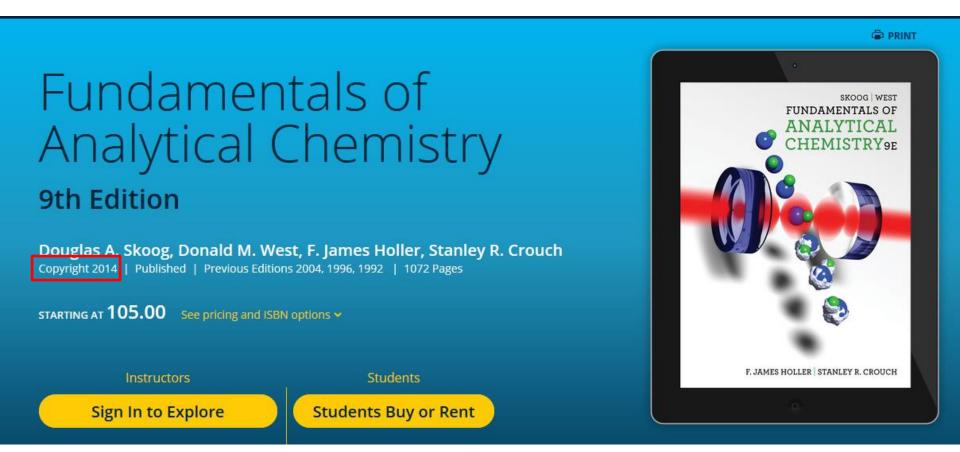
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# Application of Analytical Chemistry

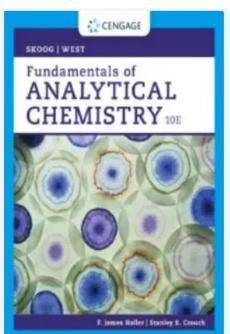
Sara Rasoul-Amini, Pharm D, PhD in Medicinal Chemistry; Department of Medicinal Chemistry, School of Pharmacy, Shiraz University of Medical Sciences(SUMS); Feb2025

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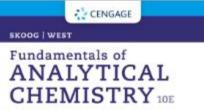
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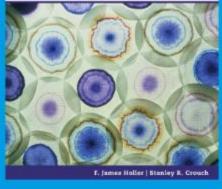
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SRAmini Feb 2025

### Contents in Brief

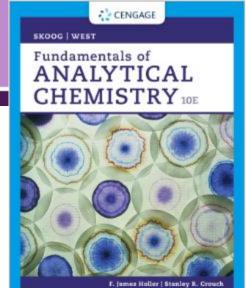
	Chapter 1	The Nature of Analytical Chemistry 1
PART I	QUALITY (	OF ANALYTICAL MEASUREMENTS 14
	Chapter 2	Calculations Used in Analytical Chemistry 15
	Chapter 3	Precision and Accuracy of Chemical Analyses 38
	Chapter 4	Random Errors in Chemical Analysis 51
	Chapter 5	Statistical Data Treatment and Evaluation 80
	Chapter 6	Sampling, Standardization, and Calibration 113
PART II	CHEMICAI	EQUILIBRIA 159
	Chapter 7	Aqueous Solutions and Chemical Equilibria 160
	Chapter 8	Effect of Electrolytes on Chemical Equilibria 199
	Chapter 9	Solving Equilibrium Problems for Complex Systems 214
PART III	CLASSICA	L METHODS OF ANALYSIS 243
	Chapter 10	Gravimetric Methods of Analysis 244
	Chapter 11	Titrations in Analytical Chemistry 267
	Chapter 12	Principles of Neutralization Titrations 288
	Chapter 13	Complex Acid-Base Systems 314
	Chapter 14	Applications of Neutralization Titrations 345
	Chapter 15	Complexation and Precipitation Reactions and Titrations 365





### Contents in Brief

	Glossary G-1
Appendix 1	The Literature of Analytical Chemistry A-1
Appendix 2	Solubility Product Constants at 25°C A-6
Appendix 3	Acid Dissociation Constants at 25°C A-8
Appendix 4	Formation Constants at 25°C A-10
Appendix 5	Standard and Formal Electrode Potentials A-12
Appendix 6	Use of Exponential Numbers and Logarithms A-15
Appendix 7	Volumetric Calculations Using Normality and Equivalent Weight A-19
Appendix 8	Compounds Recommended for the Preparation of Standard Solutions of Some Common Elements A-26
Appendix 9	Derivation of Error Propagation Equations A-28
	Answers to Selected Questions and Problems A-33
	Index I-1



### **Analytical Chemistry**

- What is the nature of analytical chemistry?
- What is the target field of analytical chemistry?
- What is the general types of analytical chemistry?
- ✓ qualitative: establishes the chemical identity of species
- ✓ quantitative: determines the relative amount of species
- What is the method types of analytical chemistry?

classic: modern:

- ✓ volumetric spectroscopy
- ✓ gravimetric
- ✓ electrical charge

# Fields which Can be Applied in Analytical Chemistry

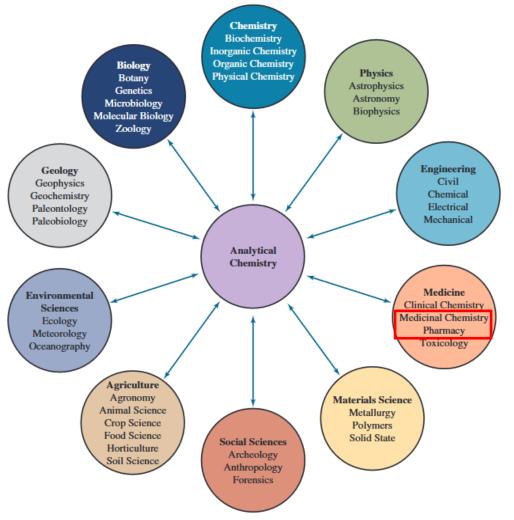


FIGURE 1-1

The relationship between analytical chemistry, other branches of chemistry, and the other sciences. The central location of analytical chemistry in the diagram signifies its importance and the breadth of its interactions with many

### **Keyword for the Goals of Analysis**

- Separation; isolation: sometimes includes extraction step
- Purification
- Identification
- Determination: qualitative & quantitative

### **Keywords in Analysis**

- To analyze: to do analysis
- Analyte: sample to be analyzed
- Assay: action of analysis mostly quantitative analysis
- Titrimetry

- Sampling: small mass/volume which is homogenous:
- ✓ represents the bulk sample
- ✓ in the same composition of the bulk sample

• Samples: Laboratory or Gross

11

# Types of Analyses by Sample Size (Scale)

### Types of Constituents in a Sample by Analyte Level

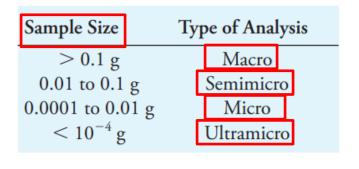
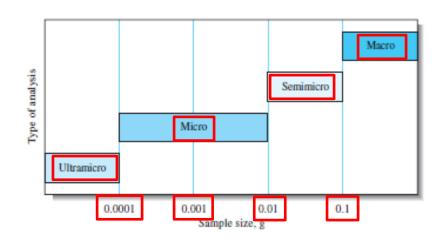


Figure 8-1 Classification of analyses by sample size.



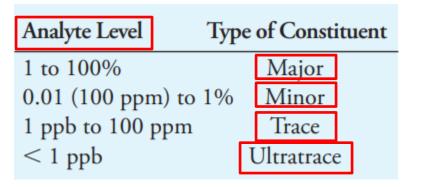
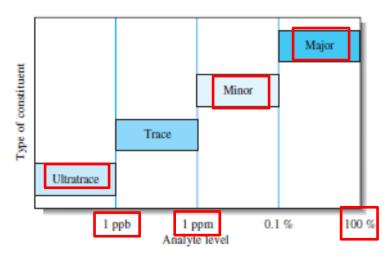


Figure 8-2 Classification of constituent types by analyte level.



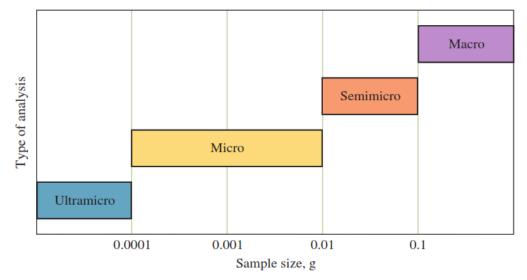
# Types of Analyses by Sample Size (Scale)



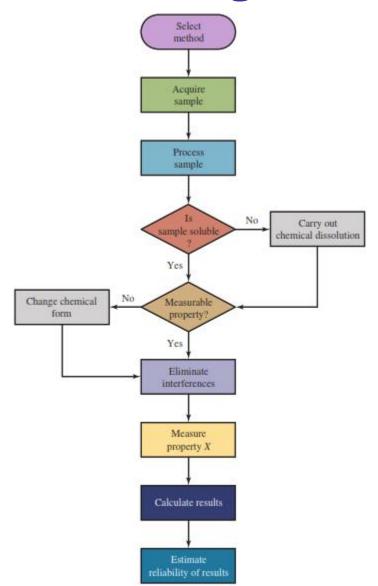
### Types of Constituents in a Sample by Analyte Level

### FIGURE 6-1

Classification of analyses by sample size.



### Flow Diagram for Quantitative Analysis



#### FIGURE 1-2

Flow diagram showing the steps in a quantitative analysis. There are a number of possible paths through these steps. In the simplest example represented by the central vertical pathway, we select a method, acquire and process the sample, dissolve the sample in a suitable solvent, measure a property of the analyte, calculate the results, and estimate the reliability of the results. Depending on the complexity of the sample and the chosen method, various other pathways may be necessary.

### Flow Diagram for Analysis

- Method: accuracy, time & money
- ✓ specific
- ✓ selective
- Acquiring the sample:
- ✓ providing accurate representative sampling
- Processing the sample:
- ✓ preparing lab samples: manner of analyte/ substance
- ✓ replicate samples
- Eliminating interferences
- Analysis step: determine substance: qualitative &/or quantitative
- Calibrating (standardization) & measurement of physical/chemical property of the analyte
- Calculating the results: significant digits & rounding data
- Evaluating the estimation of reliability of results

## Keywords to Introduce Reagents & Reactants Applied in Analysis

- Reagent grade
- ✓ specific-purpose reagent grade
- Standard grade:
- ✓ Primary Standard
- ✓ Reference Standard (RS)
- ✓ Secondary Standard

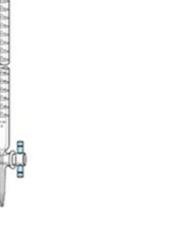
### **Major Labwares for Analysis**

• Volumetric flasks



Color

• Buret



• Volumetric pipette

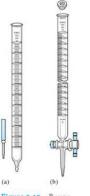


Figure 2-19 Burets: (a) glass-bead valve, (b) Teflon valve.



Figure 2-20 Typical volumetric flasks.

### Keywords for Chemical Techniques in Analysis

- Washing
- Transferring
- Decanting: decantation





Figure 2-12 (a) Washing by decantation. (b) Transferring the precipitate.

• Filtering: through filter paper or sintered glass





Figure 2-15 Ignition of a precipitate. Proper crucible position for preliminary charring is shown.







### **Method of Folding a Filter Paper**

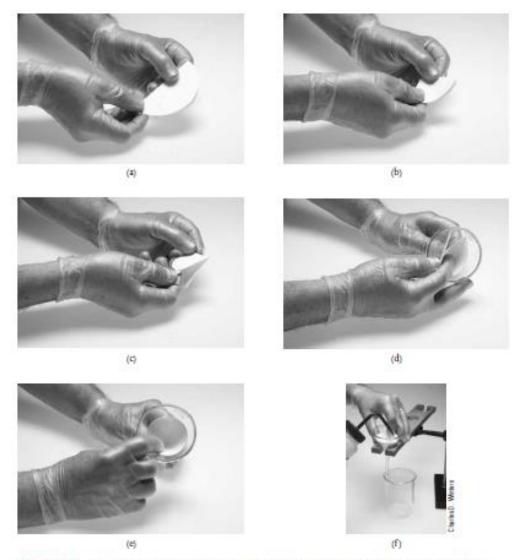
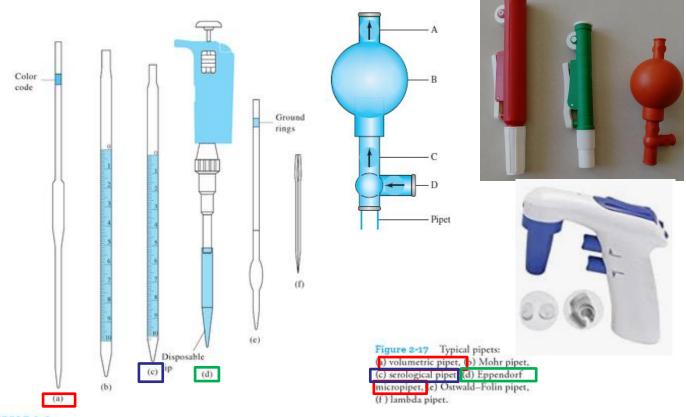


Figure 2-13 Folding and seating a filter paper. (a) Fold the paper exactly in half and crease it firmly. (b) Fold the paper a second time. (c) Tear off one of the corners on a line parallel to the second fold. (d) Open the untorn half of the folded paper to form a cone. (e) Seat the cone firmly into the funnel. (f) Moisten the paper slightly and gently pat the paper into place.

### Typical Pipets, Samplers and Pro-pipets



Tolerances,	Class	A	Transfer
Pipets			

Capacity, mL	Tolerances, mL		
0.5	±0.006		
1	±0.006		
2	±0.006		
5	±0.01		
10	±0.02		
20	±0.03		
25	±0.03		
50	±0.05		
100	±0.08		

#### Range and Precision of Typical Eppendorf Micropipets

Volume Range, µL	Standard Deviation, µL	
1-20	<0.04 @ 2 µL	
10-100	<0.06 @ 20 μL <0.10 @ 15 μL	
20-200	<0.15 @ 100 μL <0.15 @ 25 μL	
100-1000	<0.30 @ 200 μL <0.6 @ 250 μL	
500-5000	<1.3 @ 1000 μL <3 @ 1.0 mL	
	<8 @ 5.0 mL	

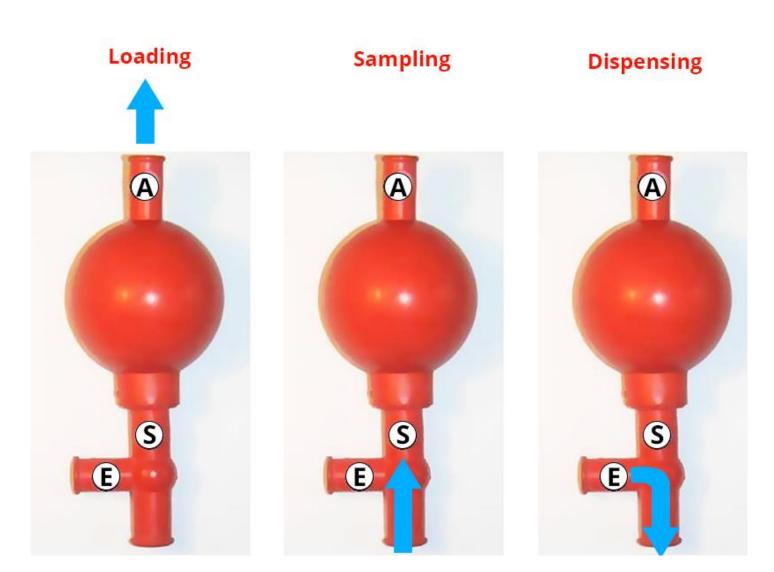
#### TABLE 2-2

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Characteristics of Pipets					
Name	Type of Calibration*	Function	Available Capacity, mL	Type of Drainage	
Volumetric	TD	Delivery of fixed volume	1-200	Free	
Mohr	TD	Delivery of variable volume	1-25	To lower calibration line	
Serological	TD	Delivery of variable volume	0.1-10	Blow out last drop**	
Serological	TD	Delivery of variable volume	0.1-10	To lower calibration line	
Ostwald-Folin	TD	Delivery of fixed volume	0.5-10	Blow out last drop**	
Lambda	TC	Containment of fixed volume	0.001-2	Wash out with suitable solvent	
Lambda	TD	Delivery of fixed volume	0.001-2	Blow out last drop**	
Eppendorf	TD	Delivery of variable or fixed volume	0.001-1	Tip emptied by air displacement	

<sup>\*</sup>TD, to deliver: TC, to contain.

<sup>&</sup>quot;A frosted ring near the top of pipets indicates that the last drop is to be blown out.

### **Pro-pipets**



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### **Automatic pipet: Sampler**

2G Measuring Volume 37





Figure 2-18 (a) Variable-volume automatic pipet, 100–1000 μL. At 100 μL, accuracy is 3.0%, and precision is 0.6%. At 1000 μL, accuracy is 0.6%, and precision is 0.2%. Volume is adjusted using the thumbwheel as shown. Volume shown is 525 μL.

# Typical Pipette/ Sampler/ Pro-Pipette





Figure 2-17 Typical pipets: (a) volumetric pipet, (b) Mohr pipet, (c) serological pipet, (d) Eppendorf micropipet, (e) Ostwald–Folin pipet, (f) lambda pipet.

#### Tolerances, Class A Transfer Pipets

Capacity, mL	Tolerances, mL		
0.5	±0.006		
1	±0.006		
2	±0.006		
5	±0.01		
10	±0.02		
20	±0.03		
25	±0.03		
50	±0.05		
100	±0.08		

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--------	-----------	-------	------

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Eppendorf	TD	Delivery of variable or fixed volume	0.001-1	Tip emptied by air displacement

<sup>\*</sup>TD, to deliver: TC, to contain.

<sup>&</sup>quot;A frosted ring near the top of pipets indicates that the last drop is to be blown out.

# Method of Manipulating a Buret Stopcock in Volumetric Analysis

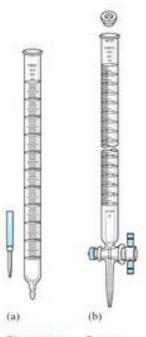


Figure 2-19 Burets: (a) glass-bead valve, (b) Teflon valve.



Figure 2-20 Typical volumetric flasks.



Figure 2-23 Recommended method for manipulating a buret stopcock.

### Method of Reading a Buret

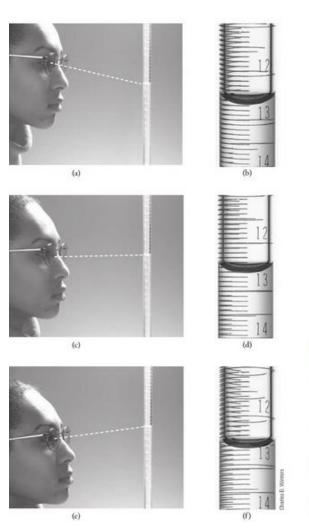


Figure 2-21 Reading a buret.

(a) The student reads the buret from a position above a line perpendicular to the buret and makes a reading

(b) of 12.58 m.L. (c) The student reads the buret from a position along a line perpendicular to the buret and makes a reading (d) of 12.62 m.L. (e) The student reads the buret from a position below a line perpendicular to the buret and makes a reading (f) of 12.67 m.L. To avoid the problem of parallax, buret readings should be made consistently along a line perpendicular to the buret, as shown in (c) and (d).