Preparing for the American Board of Pathology (ABPath) Examination of Fundamental Knowledge and Skills

# Chemical Pathology

*Content Specifications*

# Overview:

Chemical Pathology Content Specifications

This guide outlines the content that may appear on the American Board of Pathology Chemical Pathology Subspecialty exam. It provides a framework based on the knowledge and skills typically covered in Fellow-level training, along with applicable Core and Advanced Resident topics from residency training that the trainee is expected to know or be able to perform.

**Key to Designations:**

C = Core/Foundational Knowledge

AR = Advanced Resident Knowledge

F = Fellow/Advanced Practitioner Knowledge

The exam assesses the knowledge, judgment, skills, and abilities necessary to identify specific entities, properly process specimens, and diagnose and monitor diseases using methods common in the practice of Chemical Pathology. The specific diseases, tests, and concepts listed in this document are important for candidates to know, but it is not possible to create a fully comprehensive list of all the material needed for certification and effective practice. Candidates should use this guide as a reference for preparing for certification and professional practice.

# Contents

## 1. Analytical Techniques and Safety

a. Concept of Solute and Solvent
   i. Expressing Concentrations of Solutions C
b. Units of Measurement

- i. International Units, Decimal Multiples, and Submultiples of SI units — C
- ii. Problem Areas in the Use of SI Units — C
- iii. Standardized Reporting of Test Results — C

c. Safety — C

d. Basic Measurement Techniques and Procedures
- i. Centrifugation — C
- ii. Controlling Hydrogen Ion Concentration (Buffer Solution) — C
- iii. Procedures for Processing Solutions (Dilution, Evaporation, Filtration) — AR
- iv. Viscosity — AR
- v. Extraction — F
- vi. Gravimetry — F
- vii. Measurement of Radioactivity — F

e. Interference with Testing, General — AR

f. Chemicals
- i. Reagent Grade and Analytical Reagent Grade Water — AR
- ii. Ultrapure Reagents — F

g. Reference Materials (Primary, Secondary, Standard, Certified) — F

## 2. Specimen Collection and Processing

a. Patient Preparation — C

b. Handling of Specimens for Testing — C
- i. Maintenance of Specimen Identification — C
- ii. Preservation of Specimens in Transit — C
- iii. Separation and Storage of Specimens — C
- iv. Transport of Specimens — C

c. Specimens
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  3. Infant (Heel Stick, Small Needles) — C
  4. Hemolysis — C
- ii. Urine (Timed, Random, Preservatives) — C
- iii. Cerebrospinal Fluid — C
- iv. Pleural, Pericardial, and Ascitic Fluids — C

d. Feces (Timed, Random) — AR

e. Synovial Fluid — AR

f. Amniotic Fluid (Amniocentesis) — AR

g. Saliva — AR

h. Solid Tissue — F

i. Hair and Finger Nails — F

## 3. Optical Techniques

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| b. | Spectrophotometry | |
| | (Beer's Law, Wavelengths, Calibration, Performance Checks) | C |
| c. | Fluorometry | AR |
| d. | Chemiluminescence, Bioluminescence, Electrochemiluminescence | AR |
| e. | Nephelometry and Turbidimetry | AR |
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## 4. Electrochemistry and Chemical Sensors

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| b. | Voltammetry/Amperometry | AR |
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| d. | Coulometry | F |
| e. | Optical Chemical Sensors | F |
| f. | Biosensors | F |

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| b. | Conventional Electrophoresis (Slab Gel, IEF, 2-D) | C |
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| | ii. Partition Chromatography | AR |
| | iii. Adsorption Chromatography | AR |
| | iv. Affinity Chromatography | AR |
| | v. Size-Exclusion Chromatography | AR |
| b. | Column Chromatography | AR |
| | i. Gas Chromatography | AR |
| | ii. Liquid Chromatography | AR |
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| | ii. Analyte Quantification | AR |

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| | ii. Liquid Chromatography | AR |
| | iii. MALDI-TOF Mass Spectrometry | AR |

| | |
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| ii. Measurement of Enzyme Mass Concentration | AR |
| iii. Enzymes as Analytical Reagents | AR |
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| vii. Optimization, Standardization, and Quality Control of Enzymes | F |
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| b. Overview of General Principles of Immunoassay | |
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| ii. Competitive Immunoassays | C |
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| iv. Interferences in Immunoassays (HAMA, Macromolecules) | C |
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|---|---|
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| ii. Spectral Properties and Solubility | F |
| d. Heme Biosynthesis | |
| i. Enzymes of Heme Biosynthesis | F |
| e. Excretion of Heme Precursors | F |
| f. Regulation of Heme Biosynthesis | F |
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| iii. Analysis of Plasma Porphyrins | F |
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| ii. Pharmacokinetics | AR |
| iii. Drug Disposition | AR |
| iv. Clinical Utility | AR |
| v. Analytical Techniques | AR |
| vi. Pharmacogenetics | AR |
| b. Specific Drug Groups | |
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| iv. Cardioactive Drugs | AR |

| | | |
|---|---|---|
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## 22. Clinical Toxicology

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| ii. | High-Performance Liquid Chromatography | AR |
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| xi. | Cobalt | F |
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## 25. Kidney Disease

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iv. Glomerular Diseases C
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iv. Cystatin C C
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2. Specimen Collection for Total Protein and Albumin Measurement C
3. Measurement of Urine Total Protein C
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2. Markers Used for GFR C
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## 26. Physiology & Disorders of Water, Electrolyte, and Acid-Base Metabolism

- a. Water and Electrolytes-Composition of Body Fluids — C
- b. Acid-Base Disorders — C
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  - iv. Alcoholic Liver Disease — C
  - v. Hyperbilirubinemia of the Newborn — C
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  - iii. Prothrombin Time — C
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  - vi. Antimitochondrial Autoantibodies — AR
  - vii. Smooth Muscle Autoantibodies — F
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## 28. Gastric, Pancreatic, and Intestinal Function

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    2. IgG and IgA anti-deamidated gliadin — AR
  - ii. Ulcerative Colitis and Crohn Disease — AR
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- iii. Disaccharidase Deficiencies — F
- iv. Bacterial Overgrowth — F

b. Pancreatic Insufficiency — AR

c. Investigation of Maldigestion/Malabsorption
  - i. Evaluation of Fat Absorption
    1. Fecal Pancreatic Elastase — AR
    2. Fecal Fat — F

d. Investigation of Chronic Diarrhea (General Considerations)
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  - ii. Fecal Osmotic (Osmolal) Gap — F

e. Gastrointestinal Regulatory Peptides
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  - ii. Vasoactive Intestinal Polypeptide — F
  - iii. Glucose-Dependent Insulinotropic Peptide (GIP, Gastric Inhibitory Polypeptide) — F

## 29. Mineral and Bone Metabolism

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  - ii. Measurement of Calcium — C
  - iii. Patient Preparation and Sources of Preanalytical Error for Total and Free Calcium Measurements — AR
  - iv. Interpretation of Total and Free Calcium Results — AR
  - v. Urinary Calcium — F

b. Magnesium
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  - ii. Measurement of Total Magnesium — C

c. Hormones Regulating Mineral Metabolism
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  - ii. Vitamin D and its Metabolites — C
  - iii. Parathyroid Hormone-Related Protein — F

d. Phosphate
  - i. Measurement of Phosphate — AR

e. Biochemical Markers of Bone Turnover
  - i. Markers of Bone Resorption — AR
  - ii. Markers of Bone Formation — AR

## 30. Pituitary Function

a. Prolactin — C

b. Corticotropin (Adrenocorticotropin) and Related Peptides — C

c. Gonadotropins (Follicle-Stimulating Hormone and Luteinizing Hormone) — C

d. Thyrotropin — C

e. Growth Hormone and Insulin-Like Growth Factors AR
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## 31. The Adrenal Cortex

a. Adrenocortical Steroids
    i. General Biochemistry and Metabolism of Adrenocortical Steroids C
    ii. The Hypothalamic-Pituitary-Adrenal Cortical Axis C
    iii. Regulation of Adrenal Hormones C
b. Pre-Analytical Testing Issues
    i. Hypofunction of the Adrenal Cortex AR
    ii. Hyperfunction of the Adrenal Cortex AR
c. Disorders of the Adrenal Cortex
    i. Choice of Specimen (e.g., plasma, saliva) C
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## 32. Thyroid

a. Thyroid Hormones
    i. Chemistry, Biological Function, & Biochemistry of Thyroid Hormones C
    ii. Metabolism and Physiology of Thyroid Hormones C
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    ii. Hyperthyroidism (Graves Disease) C
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    ii. Thyroxine (T4) C
    iii. Triiodothyronine (T3) C
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## 33. Reproductive Related Disorder

a. Male Reproductive Biology
    i. Male Reproductive Development and Abnormalities AR
b. Female Reproductive Biology
    i. Female Reproductive Development C
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| | | |
|---|---|---|
| iii. | Normal Menstrual Cycle | C |
| iv. | Ovulation | C |
| v. | Irregular Menses | AR |
| c. | Reproductive Tests | |
| i. | Total Testosterone | C |
| ii. | Free Bound Testosterone | C |
| iii. | Estrogens (e.g., Estradiol, Estrone, Estriol) | C |
| iv. | Progesterone | C |
| v. | Anti-Mullerian Hormone | AR |
| vi. | Dehydroepiandrosterone Sulfate (DHEAS) | AR |
| vii. | Testosterone Precursors and Metabolites | F |
| viii. | Anabolic Steroids | F |

## 34. Clinical Chemistry of Pregnancy

| | | |
|---|---|---|
| a. | Human Pregnancy | |
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| b. | Maternal and Fetal Health Assessment | |
| i. | Detection and Dating of Pregnancy | C |
| c. | Complications of Pregnancy | |
| i. | Trophoblastic Disease | C |
| ii. | Abnormal Pregnancies (e.g., Preeclampsia, Ectopic, HELLP syndrome, Thyroid Disorders) | AR |
| iii. | Preterm Delivery | AR |
| d. | Maternal Serum Screening for Fetal Defects | |
| i. | Clinical Application or Prenatal Screening | AR |
| e. | Laboratory Tests | |
| i. | Chorionic Gonadotropin | C |
| ii. | Cell-Free Fetal DNA for Aneuploidy | C |
| iii. | Alpha Fetoprotein | AR |
| iv. | Unconjugated Estriol | AR |
| v. | Dimeric Inhibit A | AR |
| vi. | Placental Plasma Protein A | AR |
| vii. | Fetal Fibronectin | AR |
| viii. | Amniotic Fluid Bilirubin | F |

## 35. Inborn Errors of Amino Acid, Organic Acid, and Fatty Acid Metabolism

| | | |
|---|---|---|
| a. | Biochemical Diagnosis | |
| i. | Newborn Screening | C |
| ii. | Evaluation of Symptomatic Patients | AR |
| iii. | Prenatal Diagnosis | F |
| iv. | Postmortem Screening | F |
| b. | Disorders of Amino Acid Metabolism | |

| | |
|---|---|
| i. Classic Phenylketonuria and Other Hyperphenylalaninemias | F |
| ii. Tyrosinemia Type 1 | F |
| iii. Homocystinuria | F |
| iv. Maple Syrup Urine Disease | F |
| v. Urea Cycle Defects | F |
| vi. Nonketotic Hyperglycemia | F |
| c. Disorders of Organic Acid Metabolism | |
| i. Disorders of Propionate Metabolism | F |
| ii. Isovaleric Acidemia | F |
| iii. Glutaric Acidemia Type I | F |
| iv. Ethylmalonic Encephalopathy | F |
| d. Disorders of Fatty Acid Oxidation | |
| i. Very Long-Chain Acyl-CoA Dehydrogenase Deficiency | F |
| ii. Trifunctional Protein and Long-Chain 3-Hydroxy Acyl-CoA Dehydrogenase Deficiencies | F |
| iii. Medium-Chain Acyl-CoA Dehydrogenase Deficiency | F |
| iv. Short-Chain Acyl-CoA Dehydrogenase Deficiency | F |
| e. Disorders of Carbohydrates | |
| i. Galactosemia | F |

## 36. Laboratory Evaluation of Immunoglobulin Function and Humoral Immunity

| | |
|---|---|
| a. Immunoglobulins | |
| i. Immunoglobulin M, IgM | C |
| ii. Immunoglobulin G, IgG | C |
| 1. IgG Subclasses | AR |
| iii. Immunoglobulin A, IgA | C |
| iv. Free Light Chains, Serum | C |
| v. Immunoglobulin D, IgD | AR |
| vi. Immunoglobulin E, IgE | AR |
| b. Allergic Diseases | AR |
| c. Infectious Diseases | |
| i. Hepatitis A, B, and C | C |
| ii. HIV | C |
| iii. Syphilis | C |
| iv. EBV | C |
| v. Sepsis Evaluation (e.g., Lactate, Procalcitonin) | C |
| vi. Lyme Disease | AR |
| vii. Toxoplasma | AR |
| viii. MMR | AR |
| ix. SARS-CoV-2 | AR |
| x. HSV | AR |
| xi. Tuberculosis (Interferon Gamma Release Assays) | AR |
| xii. HTLV I/II | F |

| | | |
|---|---|---|
| xiii. | CMV | F |
| xiv. | *Bartonella* | F |
| xv. | *Coxiella* | F |

## 37. Mediators of Inflammation: Complement, Cytokines, and Adhesion Molecules

| | | |
|---|---|---|
| a. | Structure and Function of the Complement System | |
| i. | The Classical Pathway | AR |
| ii. | The Alternative Pathway | AR |
| iii. | The Mannan-Binding Lectin Pathway | F |
| iv. | Terminal Complement Components | F |
| v. | Anaphylatoxins | F |
| vi. | Regulation of Complement Activation | F |
| vii. | Complement Genetics | F |
| viii. | Complement and Acquired Immunity | F |
| b. | Complement in Disease States | |
| i. | Rheumatologic Diseases | AR |
| ii. | Hereditary Angioedema | AR |
| iii. | Infectious Diseases | AR |
| iv. | Renal Diseases | AR |
| v. | Hematologic Diseases | AR |
| c. | Assays of Complement | |
| i. | Functional Assays | AR |
| ii. | Antigenic Assays | AR |
| d. | Cytokines | |
| i. | General Information | AR |
| ii. | Interleukin-6 | F |

## 38. Immunodeficiency Disorders (e.g., Neutrophil Oxidative Burst Activity) **F**

## 39. Rheumatological Diseases

| | | |
|---|---|---|
| a. | Anti-Nuclear Antibody Methods and Interpretations | |
| i. | ANA by Indirect Immunofluorescence | C |
| ii. | ANA by EIA | C |
| iii. | ANA by Multiplex Bead Assays | C |
| b. | Specific Autoantibodies in Diseases | |
| i. | Systemic Lupus Erythematosus | C |
| ii. | Sjögren Syndrome | AR |
| iii. | Rheumatoid Arthritis (e.g., Rheumatoid Factor, Anti-CCP) | AR |
| iv. | Polymyositis and Dermatomyositis (Anti-Jo-1) | AR |
| v. | Antiphospholipid Syndrome (e.g., B2GP1, Cardiolipin, PS/PT) | AR |
| vi. | Mixed Connective Tissue Disease | AR |

## 40. Vasculitis

| | | |
|---|---|---|
| a. | Antineutrophil Cytoplasmic Antibody | C |
| i. | c-ANCA (PR3) | C |
| ii. | p-ANCA (Myeloperoxidase) | C |
| b. | Polyarteritis Nodosa | AR |
| c. | Churg-Strauss Syndrome | AR |
| d. | Microscopic Polyangiitis | AR |
| e. | Granulomatosis with Polyangiitis | AR |

## 41. Neurological Autoimmunity

| | | |
|---|---|---|
| a. | Myasthenia Gravis (e.g., ACHR) | C |
| b. | Multiple Sclerosis | |
| i. | Myelin Basic Protein | AR |
| ii. | Oligoclonal Bands on CSF IEF | AR |
| iii. | CSF IgG Synthesis Rate | F |

## 42. Chemical Pathology-Specific Administration and Laboratory Management

| | | |
|---|---|---|
| a. | Administration and Laboratory Management in Clinical Chemistry | C |
| i. | Laboratory Management | F |
| ii. | Rules and Regulations | F |
| iii. | Laboratory Inspections | F |
| iv. | QA/QC Issues | F |
| b. | Automation in the Clinical Laboratory | C |
| c. | Implementation and Management Considerations for POCT | |
| i. | General Considerations | C |
| ii. | Informatics and POCT | AR |