

# TECHNOLOGIST AND INTERNATIONAL TECHNOLOGIST IN CHEMISTRY, C(ASCP) AND C(ASCP)<sup>i</sup> SPECIALIST AND INTERNATIONAL SPECIALIST IN CHEMISTRY, SC(ASCP) AND SC(ASCP)<sup>i</sup> EXAMINATION CONTENT GUIDELINE

## EXAMINATION MODEL

The C(ASCP), C(ASCP)<sup>i</sup>, SC(ASCP), and SC(ASCP)<sup>i</sup> certification examinations are composed of 100 examination questions given in a 2 hour 30 minute time frame. All examination questions are multiple-choice with one best answer. The certification examinations are administered using the format of computer adaptive testing (CAT).

With CAT, when a person answers a question correctly, the next test question has a slightly higher level of difficulty. The difficulty level of the questions presented to the examinee continues to increase until a question is answered incorrectly. Then a slightly easier question is presented. In this way, the test is tailored to the individual's ability level.

Each question in the test bank is calibrated for level of difficulty and is assigned a content area that matches with the subtest area of the content outline for a particular examination. The weight (value) given to each question is determined by the level of difficulty. Therefore, the examinee must answer enough difficult questions to achieve a score above the pass point in order to successfully pass the certification examination.

## EXAMINATION SUBTESTS

The C(ASCP), C(ASCP)<sup>i</sup>, SC(ASCP), and SC(ASCP)<sup>i</sup> certification examination questions encompass different subtests within the area of Chemistry: General Chemistry, Proteins and Enzymes, Acid-Base, Blood Gases, and Electrolytes, Hormones and Vitamins, Toxicology and Therapeutic Drug Monitoring, Instrumentation and Analytical Techniques and Laboratory Operations. Each of these subtests comprises a specific percentage of the overall 100-question certification examination. The subtests for the C and SC examinations are described in the following table:

SUBTESTS	DESCRIPTION	EXAM PERCENTAGES
GENERAL CHEMISTRY	Biochemical theory and physiology, test procedures, and test result interpretation for carbohydrates, lipids and heme derivatives	C: 15% – 20%
		SC: 10 – 15%
PROTEINS AND ENZYMES	Biochemical theory and physiology, test procedures, and test result interpretation for enzymes, proteins and other nitrogen containing compounds	20% – 25%
ACID-BASE, BLOOD GASES AND ELECTROLYTES	Biochemical theory and physiology, test procedures, and test result interpretation for acid-base determinations and electrolytes	10% – 15%
HORMONES AND VITAMINS	Biochemical theory and physiology, test procedures, and test result interpretation for endocrinology, vitamins and nutrition	10% – 15%
TOXICOLOGY AND THERAPEUTIC DRUG MONITORING	Pharmacokinetics/Toxicokinetics, chemical/physical properties, test procedures, and test result interpretation for TDM and toxicology	5% – 10%
INSTRUMENTATION AND ANALYTICAL TECHNIQUES	Principles, usage, and troubleshooting of equipment and methods used	5% – 10%
LABORATORY OPERATIONS	C: Calculations, QC/QA, guidelines/regulations, safety	C: 15% – 20%
	SC: Management, QC/QA, safety, research and development, education, LIS, calculations, guidelines/regulations	SC: 20% – 25%

For a more specific overview of the seven subtest areas on the C(ASCP), C(ASCP)<sup>i</sup>, SC(ASCP), and SC(ASCP)<sup>i</sup> certification examinations, please refer to the **CONTENT OUTLINE** on pages 2 – 3.

**TECHNOLOGIST AND INTERNATIONAL TECHNOLOGIST IN CHEMISTRY,  
C(ASCP) AND C(ASCP)<sup>i</sup>  
SPECIALIST AND INTERNATIONAL SPECIALIST IN CHEMISTRY,  
SC(ASCP) AND SC(ASCP)<sup>i</sup>  
EXAMINATION CONTENT OUTLINE**

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**IMPORTANT:** Examination questions, which are related to the subtest areas outlined below, may be both theoretical and procedural. Theoretical questions measure skills necessary to apply knowledge, calculate results, and correlate patient results to disease states. Procedural questions measure skills necessary to perform laboratory techniques, evaluate laboratory data, and follow quality assurance protocols

**I. GENERAL CHEMISTRY**

**(C: 15% – 20%; SC: 10 – 15%)**

**A. Carbohydrates**

1. Biochemical theory and physiology
  - a. Metabolic pathways
  - b. Normal and abnormal states
  - c. Physical and chemical properties
2. Test procedures
  - a. Principles
  - b. Special precautions, specimen collection and processing, troubleshooting and interfering substances
  - c. Tolerance testing
  - d. Glycated proteins
3. Test result interpretation

**B. Lipids**

1. Biochemical theory and physiology
  - a. Metabolic pathways
  - b. Normal and abnormal states
  - c. Physical and chemical properties
    - 1) lipoproteins
    - 2) phospholipids
    - 3) triglycerides
    - 4) cholesterol
    - 5) apolipoproteins
2. Test procedures
  - a. Principles
  - b. Special precautions, specimen collection and processing, troubleshooting and interfering substances
3. Test result interpretation

**C. Heme Derivatives**

1. Biochemical theory and physiology
  - a. Metabolic pathways
  - b. Normal and abnormal states
  - c. Physical and chemical properties
    - 1) porphyrins
    - 2) hemoglobin
    - 3) bilirubin
    - 4) urobilinogen
    - 5) myoglobin
2. Test procedures
  - a. Principles
  - b. Special precautions, specimen collection and processing, troubleshooting and interfering substances
3. Test result interpretation

**II. PROTEINS AND ENZYMES**

**(C & SC: 20% – 25%)**

**A. Enzymes**

1. Biochemical theory and physiology
  - a. Metabolic pathways
  - b. Normal and abnormal states
  - c. Physical and chemical properties
    - 1) LD
    - 2) CK
    - 3) AST/ALT
    - 4) GGT
    - 5) lipase
    - 6) amylase
    - 7) alkaline phosphatase
    - 8) other enzymes

2. Test procedures
  - a. Principles
  - b. Special precautions, specimen collection and processing, troubleshooting and interfering substances
3. Test result interpretation

**B. Proteins and Other Nitrogen Containing Compounds**

1. Biochemical theory and physiology
  - a. Metabolic pathways
  - b. Normal and abnormal states
  - c. Physical and chemical properties
    - 1) proteins
    - 2) amino acids
    - 3) urea
    - 4) uric acid
    - 5) creatinine
    - 6) ammonia
    - 7) tumor markers
    - 8) viral proteins
    - 9) cardiac markers
    - 10) other compounds
2. Test procedures
  - a. Principles
  - b. Special precautions, specimen collection and processing, troubleshooting and interfering substances
  - c. Clearances
3. Test result interpretation

**III. ACID-BASE, BLOOD GASES AND ELECTROLYTES (C & SC 10% – 15%)**

**A. Acid-Base Determinations (Including Blood Gases)**

1. Biochemical theory and physiology
  - a. Henderson-Hasselbach equation
  - b. pH and H<sup>+</sup> ion concentration
  - c. CO<sub>2</sub> and O<sub>2</sub> transport
  - d. Normal and abnormal states
2. Test procedures
  - a. Analytical principles
  - b. Special precautions, specimen collection and processing, troubleshooting and interfering substances
3. Test result interpretation

**B. Electrolytes**

1. Biochemical theory and physiology
  - a. Sodium, potassium, chloride, CO<sub>2</sub>, bicarbonate
  - b. Calcium, magnesium, phosphorus, iron, TIBC
  - c. Trace elements
  - d. Normal and abnormal states
2. Test procedures
  - a. Principles
  - b. Special precautions, specimen collection and processing, troubleshooting and interfering substances
3. Calculations (osmolality, anion gap)
4. Test result interpretation

**IV. HORMONES AND VITAMINS (C & SC: 10% – 15%)**

**A. Endocrinology**

1. Biochemical theory and physiology
  - a. Metabolic pathways
  - b. Normal and abnormal states
  - c. Mechanism of action
  - d. Physical and chemical properties
    - 1) steroid hormones
    - 2) peptide hormones
    - 3) thyroid hormones
    - 4) other hormones
2. Test procedures
  - a. Principles
    - 1) fluorescence
    - 2) immunoassay
    - 3) chromatography
    - 4) other methods
  - b. Special precautions, specimen collection and processing, troubleshooting and interfering substances
  - c. Stimulation/suppression tests
3. Test result interpretation

**B. Vitamins and Nutrition**

1. Biochemical theory and physiology
  - a. Metabolism and action
  - b. Normal and abnormal states
  - c. Properties
2. Test procedures
  - a. Principles

- b. Special precautions, specimen collection and processing, troubleshooting and interfering substances
3. Test result interpretation

- b. Special precautions, specimen collections and processing, troubleshooting and interfering substances
4. Test result interpretation

## **V. TOXICOLOGY AND THERAPEUTIC DRUG MONITORING (C & SC: 5% – 10%)**

### **A. Therapeutic Drug Monitoring**

1. Pharmacokinetics
  - a. Therapeutic states
  - b. Toxic states
  - c. Metabolism and excretion
2. Chemical and physical properties
  - a. Aminoglycosides
  - b. Cardioactive
  - c. Anti-convulsants
  - d. Anti-depressants
  - e. Immunosuppressants
  - f. Other drugs
3. Test procedures
  - a. Principles
    - 1) immunoassay
    - 2) chromatography
    - 3) other methods
  - b. Special precautions, specimen collection and processing, troubleshooting and interfering substances
4. Test result interpretation

### **B. Toxicology**

1. Toxicokinetics
  - a. Toxic effects, signs and symptoms
  - b. Metabolism and excretion
2. Chemical and physical properties
  - a. Alcohols
  - b. Heavy metals
  - c. Analgesics
  - d. Drugs of abuse
  - e. Other toxins
3. Test procedures
  - a. Principles
    - 1) immunoassay
    - 2) chromatography
    - 3) other assays

## **VI. INSTRUMENTATION AND ANALYTICAL TECHNIQUES (C & SC: 5% – 10%)**

### **A. Spectrophotometry and Photometry**

1. Photometry (ultraviolet to infrared)
2. Fluorescence
3. Nephelometry/turbidimetry
4. Reflectance

### **B. Mass Spectrometry**

### **C. Osmometry**

### **D. Manual/Automated Analytics**

1. General chemistry
2. Immunoassays
3. Other

### **E. Electrophoresis**

### **F. Chromatography**

### **G. Electrochemistry**

1. Potentiometry (including blood gas analyzers)
  - a. pH
  - b. pCO<sub>2</sub>
  - c. pO<sub>2</sub>
  - d. Ion selective electrodes
  - e. Other applications

### **H. Centrifuges and Balances**

### **I. Molecular Techniques**

### **J. Point-of-Care Testing (POCT)**

## **VII. LABORATORY OPERATIONS FOR TECHNOLOGIST IN CHEMISTRY ONLY (C: 15% – 20%)**

### **A. Mathematics**

1. Reagents
2. Graphs (Beers Law)
3. Statistics
4. Method evaluation/validation
5. Other calculations

### **B. Quality Assurance**

### **C. Safety**

### **D. Management**

### **E. Research and Development**

### **F. Education**

### **G. Laboratory Information Systems (LIS)**

**VIII. LABORATORY OPERATIONS FOR SPECIALIST  
IN CHEMISTRY ONLY (SC: 20% – 25%)**

**A. Mathematics**

1. Reagents
2. Graphs (Beers Law)
3. Statistics
4. Method evaluation/validation
5. Other calculations

**B. Management and Quality Assurance**

1. Planning
  - a. Setting goals and objectives
  - b. Budget development
  - c. Applied research and/or development
2. Organizing
  - a. Personnel
  - b. Work flow
  - c. Computer operations
  - d. Interpersonal relations
  - e. Interdepartmental relations
3. Staffing
  - a. Selection
  - b. Training
  - c. Evaluation
  - d. In-service education
4. Directing
  - a. Communication (internal and external)
  - b. Productivity
  - c. Leadership
  - d. Motivation
5. Controlling
  - a. Infection prevention and safety
  - b. Laboratory accreditation (including regulations)
  - c. Performance standards (QC)
  - d. Inventory and purchases

**C. Safety**

**D. Research and Development**

**E. Education**

**F. Laboratory Information Systems (LIS)**

**All Board of Certification examinations use conventional and SI units for results and reference ranges.**

**You will need to bring a non-programmable calculator with log function to the examination.**

**THE EXAMINEE IS EXPECTED TO KNOW HOW TO UTILIZE THE FOLLOWING CALCULATIONS AND REFERENCE INTERVALS:**

**CALCULATIONS**

- % TRANSFERRIN SATURATION/UIBC/TIBC
- ANION GAP (*Any commonly used formula is acceptable for examination purposes*)
- CREATININE CLEARANCE/GFR OSMOLALITY/ OSMOLAL GAP (*Any commonly used formula is acceptable for examination purposes*)
- UNCONJUGATED BILIRUBIN
- LDL/FRIEDEWALD EQUATION/non-HDL
- TIMED URINE CALCULATIONS
- BEER'S LAW
- HENDERSON-HASSELBACH EQUATION
- DILUTIONS (INDIVIDUAL AND SERIAL)
- REAGENT PREPARATION: MOLARITY, NORMALITY, AND PERCENT

**REFERENCE INTERVALS**

<u>Test</u>	<u>Conventional Units</u>	<u>SI Units</u>
Sodium	136-145 mmol/L	136-145 mmol/L
Potassium	3.5-5.1 mmol/L	3.5-5.1 mmol/L
Chloride	98-107 mmol/L	98-107 mmol/L
Carbon Dioxide (Total)	23-29 mmol/L	23-29 mmol/L
Magnesium	1.6-2.6 mg/dL	0.66-1.07 mmol/L
Calcium	8.6-10.2 mg/dL	2.15-2.55 mmol/L
Glucose (Fasting)	74-100 mg/dL	4.1-5.6 mmol/L
Blood Gases		
pH (Arterial)	7.35-7.45	7.35-7.45
pCO <sub>2</sub>	32-48 mmHg	4.26-6.38 kPa
pO <sub>2</sub>	>80 mmHg	>10.64 kPa
Urea Nitrogen, blood	6-20 mg/dL	2.1-7.1 mmol/L
Creatinine	0.9-1.3 mg/dL	80-115 μmol/L
Albumin	3.5-5.0 g/dL	35-50 g/L
Total Protein	6.0-8.0 g/dL	60-80 g/L

Unless otherwise stated, all values on the C and SC exams can be interpreted using the reference intervals above. These reference intervals will not be given on the exam. Other reference intervals will be provided as needed. These reference intervals are used for the C and SC exams only.

***END OF CONTENT GUIDELINE***