

TECHNOLOGIST AND INTERNATIONAL TECHNOLOGIST IN CHEMISTRY, C(ASCP) AND C(ASCPⁱ) SPECIALIST AND INTERNATIONAL SPECIALIST IN CHEMISTRY, SC(ASCP) AND SC(ASCPⁱ) EXAMINATION CONTENT GUIDELINE

EXAMINATION MODEL

The C(ASCP), C(ASCPⁱ), SC(ASCP), and SC(ASCPⁱ) certification examinations are composed of 100 questions given in a 2 hour 30 minute time frame. All exam questions are multiple-choice with one best answer. The certification exams 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 classified by content area. The content area aligns with the examination specific content outline. The examinee must answer enough questions correctly to achieve a measure above the pass point in order to successfully pass the certification examination. There is no set number of questions one must answer to pass, nor is there a set percentage one must achieve to pass. If at the end of the exam the examinee's score is above the pass point, then he or she passes the exam.

EXAMINATION CONTENT AREAS

The C and SC exam questions encompass the following content areas within Chemistry: General Chemistry; Proteins and Enzymes; Acid-Base, Blood Gases, and Electrolytes; Special Chemistry; and Laboratory Operations. Each of these content areas comprises a specific percentage of the overall 100-question exam. The content areas and percentages are described below:

CONTENT AREA	DESCRIPTION	EXAM PERCENTAGE
GENERAL CHEMISTRY	Biochemical theory and physiology, test procedures, test result interpretation, and disease state correlation for carbohydrates, lipids, and heme derivatives	15% – 20%
PROTEINS AND ENZYMES	Biochemical theory and physiology, test procedures, test result interpretation, and disease state correlation for enzymes, proteins and other nitrogen-containing compounds	15% – 20%
ACID-BASE, BLOOD GASES AND ELECTROLYTES	Biochemical theory and physiology, test procedures, test result interpretation, and disease state correlation for acid-base determinations, blood gases, and electrolytes	15% – 20%
SPECIAL CHEMISTRY	Biochemical theory and physiology, test procedures, test result interpretation, and disease state correlation for endocrinology, vitamins, therapeutic drug monitoring, and toxicology	15% – 20%
LABORATORY OPERATIONS	Quality assessment/troubleshooting, compliance, regulations, safety, laboratory mathematics, instrumentation, and laboratory administration (SC EXAM ONLY)	C: 15% – 20% SC: 20% – 25%

For a more specific overview of the C and SC exams, please refer to the **CONTENT OUTLINE** starting on page 2.

TECHNOLOGIST AND INTERNATIONAL TECHNOLOGIST IN CHEMISTRY, C(ASCP) AND C(ASCPⁱ) SPECIALIST AND INTERNATIONAL SPECIALIST IN CHEMISTRY, SC(ASCP) AND SC(ASCPⁱ) EXAMINATION CONTENT OUTLINE

Examination questions, which are related to the subtest areas outlined below, may be both theoretical and/or 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 and follow quality assurance protocols. Additionally, regulatory questions are based on U.S. sources (e.g., AABB, FDA, CLIA, etc.).

I. GENERAL CHEMISTRY

(15% – 20% of total exam)

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
4. Disease state correlation

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
4. Disease state correlation

C. Heme Derivatives

1. Biochemical theory and physiology
 - a. Metabolic pathways
 - b. Normal and abnormal states
 - c. Physical and chemical properties
 - 1) Hemoglobin
 - 2) Bilirubin
 - 3) Urobilinogen
 - 4) Myoglobin
 - 5) Other porphyrins
2. Test procedures
 - a. Principles
 - b. Special precautions, specimen collection and processing, troubleshooting, and interfering substances
3. Test result interpretation
4. Disease state correlation

II. PROTEINS AND ENZYMES

(15% – 20% of total exam)

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
4. Disease state correlation

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
4. Disease state correlation

III. ACID-BASE, BLOOD GASES AND ELECTROLYTES

(15% – 20% of total exam)

A. Acid-Base Determinations (Including Blood Gases)

1. Biochemical theory and physiology
 - a. Henderson-Hasselbach equation
 - b. pH and H⁺ ion concentration
 - c. CO₂ and O₂ 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
4. Disease state correlation

B. Electrolytes

1. Biochemical theory and physiology
 - a. Sodium, potassium, chloride, CO₂, 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
5. Disease state correlation

IV. SPECIAL CHEMISTRY

(15% – 20% of total exam)

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 (e.g., cortisol, estrogen, hCG)
 - 2) Peptide hormones (e.g., insulin, prolactin)
 - 3) Thyroid hormones
 - 4) Other hormones
2. Test procedures
 - a. Principles
 - 1) Fluorescence
 - 2) Immunoassay
 - 3) Other methods
 - b. Special precautions, specimen collection and processing, troubleshooting, and interfering substances
 - c. Stimulation/suppression tests
3. Test result interpretation
4. Disease state correlation

B. Vitamins and Nutrition

1. Biochemical theory and physiology
 - a. Metabolism and action
 - b. Normal and abnormal states
 - c. Properties
 - 1) Vitamin D
 - 2) Vitamin B12/Folate
 - 3) Other vitamins
2. Test procedures
 - a. Principles
 - b. Special precautions, specimen collection and processing, troubleshooting, and interfering substances
3. Test result interpretation
4. Disease state correlation

C. Therapeutic Drug Monitoring

1. Pharmacokinetics
 - a. Therapeutic states
 - b. Toxic states
 - c. Metabolism and excretion
2. Chemical and physical properties
 - a. Aminoglycosides (e.g., gentamicin)
 - b. Cardioactive (e.g., digoxin)
 - c. Anti-convulsants (e.g., phenobarbital)
 - d. Anti-depressants (e.g., lithium)
 - e. Immunosuppressants (e.g., tacrolimus)
 - 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
5. Disease state correlation

D. Toxicology

1. Toxicokinetics
 - a. Toxic effects, signs and symptoms
 - b. Metabolism and excretion
2. Chemical and physical properties
 - a. Alcohols
 - b. Heavy metals (e.g., lead)
 - c. Analgesics (e.g., acetaminophen)
 - d. Drugs of abuse
 - e. Other toxins

3. Test procedures
 - a. Principles
 - 1) Immunoassay
 - 2) Other methods
 - b. Special precautions, specimen collections and processing, troubleshooting, and interfering substances
4. Test result interpretation
5. Disease state correlation

V. LABORATORY OPERATIONS

(C: 15 – 20% of total exam)

(SC: 20 – 25% of total exam)

A. Quality Assessment/Troubleshooting

1. Pre-analytical, analytical, post-analytical
2. Quality control
3. Point-of-care testing (POCT)
4. Compliance
5. Regulation (e.g., proficiency testing, competency assessment, accreditation standards)

B. Safety

1. Safety programs and practices
 - a. Prevention of infection with blood-borne pathogens
 - b. Use of personal protective equipment (PPE)
 - c. Safe work practices
 - d. Safety data sheets (SDS) for chemicals and reagents
2. Emergency procedures (e.g., needlesticks, splashes to mucous membranes, fire)
3. Packaging and transportation of specimens

C. Laboratory Mathematics

1. Concentration, volume, and dilutions
2. Molarity, normality
3. Standard curves
4. Mean, median, mode, and confidence intervals
5. Sensitivity, specificity, and predictive value

D. Instrumentation

1. Manual/automated analytics
2. Spectrophotometry and photometry
3. Mass spectrometry
4. Osmometry
5. Electrophoresis
6. Chromatography
7. Electrochemistry
8. Centrifuges
9. Point-of-care testing (POCT)

E. Laboratory Administration (SC EXAM ONLY)

1. Financial
 - a. Budgets
 - b. Capital equipment acquisition
 - c. Cost analysis, reimbursement
 - d. Purchasing, inventory
2. Operations
 - a. Customer service
 - b. Facility management (e.g., laboratory design, utilities)
 - c. Information technology
 - d. Data management (e.g., research, outcomes)
 - e. Test verification/validation
3. Personnel
 - a. Staffing and productivity
 - b. Performance standards (e.g., training, competency assessment)
 - c. Counseling, disciplinary action, and conflict resolution
4. Quality Management
 - a. Continuous quality improvement
 - b. Individualized Quality Control Plan (IQCP)
 - c. Risk management/Medical-legal issues

Examples provided (as indicated by e.g.) are not limited to those listed.

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 THESE ADDITIONAL CALCULATIONS AND REFERENCE RANGES:

CALCULATIONS

- % Transferrin saturation/UIBC/TIBC
- Unconjugated/Indirect bilirubin
- LDL/Friedewald equation/non-HDL
- Timed urine calculations
- Beer’s Law

REFERENCE RANGES

FOR BOTH C AND SC EXAMS

<u>Analyte</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
Total Carbon Dioxide	23 – 29 mmol/L	23 – 29 mmol/L
Glucose (Fasting)	74 – 100 mg/dL	4.1 – 5.6 mmol/L
Hemoglobin A _{1c}	< 5.7%	< 39 mmol/mol
Blood Gases		
pH (Arterial)	7.35 – 7.45	7.35 – 7.45
pCO ₂	32 – 48 mmHg	4.26 – 6.38 kPa
pO ₂	> 80 mmHg	> 10.64 kPa
O ₂ Saturation	95 – 100%	95 – 100%
HCO ₃ ⁻ (Bicarbonate)	23 – 29 mmol/L	23 – 29 mmol/L
Blood Urea Nitrogen (BUN)	6 – 20 mg/dL	2.1 – 7.1 mmol/L
Creatinine	0.9 – 1.3 mg/dL	80 – 115 μmol/L

FOR SC EXAM ONLY

<u>Analyte</u>	<u>Conventional Units</u>	<u>SI Units</u>
Total Cholesterol	< 200 mg/dL	< 5.2 mmol/L
Triglycerides	< 150 mg/dL	< 1.7 mmol/L
HDL Cholesterol	> 40 mg/dL	> 1.0 mmol/L
LDL Cholesterol	< 100 mg/dL	< 2.6 mmol/L
Total Protein	6.0 – 8.0 g/dL	60 – 80 g/L
Calcium	8.6 – 10.2 mg/dL	2.15 – 2.55 mmol/L
Total Bilirubin	0.2 - 1.2 mg/dL	3.4 - 20.5 μmol/L
Direct/Conjugated Bilirubin	0.0 - 0.3 mg/dL	0 - 5.1 μmol/L
Indirect/Unconjugated Bilirubin	0.3 - 1.0 mg/dL	5.1 - 17.1 μmol/L

All values on the C and SC exams can be interpreted using the reference ranges above. These reference ranges will not be given on the exam. Other reference ranges will be provided as needed on the exam.

END OF CONTENT GUIDELINE