ASCP BOARD OF CERTIFICATION

TECHNOLOGIST AND INTERNATIONAL TECHNOLOGIST IN CHEMISTRY, C(ASCP) AND C(ASCP^{i})
SPECIALIST AND INTERNATIONAL SPECIALIST IN CHEMISTRY, SC(ASCP) AND SC(ASCP^{i})

EXAMINATION CONTENT GUIDELINE

EXAMINATION MODEL

The C and SC certification examinations are composed of 100 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 examination 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 examination 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 examination the examinee's score is above the pass point, then he or she passes the examination.

EXAMINATION CONTENT AREAS

The C and SC examination 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 examination. The content areas and percentages are described below:

CONTENT AREA	DESCRIPTION	EXAMINATION PERCENTAGE
GENERAL CHEMISTRY	Biochemical theory and physiology, test procedures, test result interpretation, and disease state correlation for carbohydrates, lipids, and heme derivatives	**15% – 25%**
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% – 25%**
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% – 25%**
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 EXAMINATION 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.

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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).

I. GENERAL CHEMISTRY (15% – 25% of total examination)

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) 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% – 25% of total examination)

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) Angiotensin converting enzyme

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) Cardiac markers
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% – 25% of total examination)

A. Acid-Base Determinations (Including Blood Gases)

1. Biochemical theory and physiology
   a. Henderson-Hasselbach equation
   b. pH and H^+ ion concentration
   c. CO_2 and O_2 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, CO_2, 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 examination)

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) Catecholamines
2. Test procedures
   a. Principles
      1) Fluorescence
      2) Immunoassay
   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
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. Anticonvulsants (e.g., phenobarbital)
   d. Antidepressants (e.g., lithium)
   e. Immunosuppressants (e.g., tacrolimus)
3. Test procedures
   a. Principles
      1) Immunoassay
      2) Chromatography
   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
3. Test procedures
   a. Principles
      1) Immunoassay
      2) Enzymatic methods
   b. Special precautions, specimen collection and processing, troubleshooting, and interfering substances
4. Test result interpretation
5. Disease state correlation

V. LABORATORY OPERATIONS (C: 15 – 20% of total examination) (SC: 20 – 25% of total examination)

A. Quality Assessment/Troubleshooting
1. Preanalytical, analytical, postanalytical
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 bloodborne 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 EXAMINATION 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 ASCP BOC examinations use conventional and SI units for results and reference ranges.

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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
- A/G ratio
- Timed urine calculations
- Creatinine clearance calculations
- Beer's law

REFERENCE RANGES

In support of effective examination preparation, the ASCP BOC provides the following composite reference ranges, inclusive of all genders and ethnic populations, as derived from published sources such as textbooks. These reference ranges are reviewed annually by the Chemistry Examination Committee. All corresponding laboratory values on the C and SC examinations can be interpreted using these reference ranges. These reference ranges are for examination purposes only and will not be provided during the C and SC examinations. Other reference ranges will be provided as needed during the C and SC examinations. These reference ranges should not be considered for clinical applications.

FOR BOTH C AND SC EXAMINATIONS

	Conventional Units	SI Units
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 CO_2	22 – 33 mmol/L	22 – 33 mmol/L
Creatinine	0.8 – 1.2 mg/dL	71 – 106 µmol/L
Blood urea nitrogen (BUN)	6 – 20 mg/dL	2.1 – 7.1 mmol/L
Glucose (fasting)	74 – 100 mg/dL	4.1 – 5.6 mmol/L
Hemoglobin A_{1C}	< 5.7%	< 39 mmol/mol
Arterial blood gases		
pH	7.35 – 7.45	7.35 – 7.45
pCO_2	35 – 44 mm Hg	4.7 – 5.9 kPa
pO_2	> 80 mm Hg	> 10.6 kPa
O_2 saturation	> 95%	> 95%
HCO_3^- (bicarbonate)	23 – 29 mmol/L	23 – 29 mmol/L

FOR SC EXAMINATION ONLY

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	2.2 – 2.6 mmol/L

Total bilirubin	0.2 - 1.2 mg/dL	3.4 - 20.5 µmol/L
Direct/conjugated bilirubin	< 0.2 mg/dL	< 3.4 µmol/L
Indirect/unconjugated bilirubin	0.3 - 1.0 mg/dL	5.1 - 17.1 µmol/L

END OF CONTENT GUIDELINE