

CALIFORNIA MEDICAL LABORATORY TECHNICIAN, CMLT

EXAMINATION CONTENT GUIDELINE

EXAMINATION MODEL

The CMLT(ASCP) examination is composed of 80 questions given in a 2 hour time frame. All exam questions are multiple-choice with one best answer. The certification exam is 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 CMLT exam questions encompass different content areas within Medical Laboratory Science: Urinalysis and Other Body Fluids, Chemistry, Hematology, Immunology, Microbiology, and Laboratory Operations. Each of these content areas comprise a specific percentage of the overall 80-question exam. The content areas and percentages are described below:

CONTENT AREA	DESCRIPTION	EXAM PERCENTAGE
URINALYSIS AND OTHER BODY FLUIDS	Physical and Chemical Testing, Microscopic Analysis (Urinalysis Only), Physiology, Disease States	10%
CHEMISTRY	Carbohydrates, Lipids, Heme Derivatives, Enzymes, Proteins & Other Nitrogen-Containing Compounds, Acid-Base Determinations (Including Blood Gases), Electrolytes, Endocrinology, Vitamins and Nutrition, Therapeutic Drug Monitoring, Toxicology	40%
HEMATOLOGY	Physiology, Disease States, Hematology Laboratory Testing, Hemostasis	20%
IMMUNOLOGY	Principles of Immunology, Diseases of the Immune System, Infectious Disease Serology, Serologic Procedures, Test Results	10%
MICROBIOLOGY	Preanalytic Procedures (Specimen Collection and Transport, Specimen Processing, and Gram Stain Procedure and Principle)	5%
LABORATORY OPERATIONS	Quality Assessment/Troubleshooting, Safety, Laboratory Mathematics, Manual/Automated Methodology, and Instrumentation	15%

For a more specific overview of the CMLT exam, please refer to the [CONTENT OUTLINE](#) starting on page 2.

CALIFORNIA MEDICAL LABORATORY TECHNICIAN, CMLT

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.).

URINALYSIS AND BODY FLUIDS

(10% of total exam)

I. URINALYSIS

A. Physical

1. Color and clarity
2. Specific gravity/osmolality

B. Chemical

1. Reagent strip
2. Confirmatory tests

C. Microscopic

1. Cells
2. Casts
3. Crystals
4. Microorganisms
5. Contaminants
6. Artifacts

D. Renal Physiology

E. Disease States

II. BODY FLUIDS (e.g., CSF, Amniotic, Synovial, Serous, Semen, and Feces)

A. Physical

B. Chemical

C. Physiology

D. Disease States

CHEMISTRY

(40% of total exam)

I. GENERAL CHEMISTRY

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

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

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

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

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) 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 collection and processing, troubleshooting, and interfering substances
4. Test result interpretation
5. Disease state correlation

HEMATOLOGY

(20% of total exam)

I. PHYSIOLOGY (to include blood, body fluids, and bone marrow)

- A. Production
- B. Destruction
- C. Function

II. DISEASE STATES

A. Erythrocytes

1. Anemia
 - a. Microcytic
 - 1) Iron deficiency
 - 2) Thalassemia
 - 3) Sideroblastic
 - 4) Chronic inflammation
 - b. Normocytic
 - 1) Hereditary hemolytic
 - 2) Acquired hemolytic
 - 3) Hypoproliferative
 - 4) Acute hemorrhage
 - c. Macrocytic
 - 1) Megaloblastic
 - 2) Non-megaloblastic
 - d. Hemoglobinopathies
2. Erythrocytosis
 - a. Relative
 - b. Absolute

B. Leukocytes (WHO classification)

1. Benign leukocyte disorders
 - a. Myeloid
 - b. Lymphoid
2. Myeloid neoplasia
 - a. Acute leukemia
 - b. Myelodysplastic syndromes
 - c. Myeloproliferative neoplasms
3. Lymphoid neoplasia
 - a. Acute leukemia
 - b. Chronic leukemia/lymphoma
 - c. Plasma cell dyscrasias
4. Hereditary anomalies

C. Platelets

1. Quantitative abnormalities
 - a. Thrombocytopenia
 - 1) Increased destruction (e.g., ITP, TTP, HIT)
 - 2) Decreased production
 - 3) Pseudothrombocytopenia
 - b. Thrombocytosis
2. Qualitative defects
 - a. von Willebrand disease
 - b. Bernard-Soulier syndrome
 - c. Glanzmann thrombasthenia

III. HEMATOLOGY LABORATORY TESTING

A. Cell Counts (to include blood and body fluids)

1. Automated
2. Reticulocytes
3. Spurious results

B. Differentials

C. Hemoglobin

1. Quantitative
2. Qualitative (e.g., sickle solubility)

D. Hematocrit

E. Indices

F. Hemolytic Indicators (e.g., haptoglobin, LD)

G. Other Studies (e.g., ESR)

IV. HEMOSTASIS

A. Physiology

1. Coagulation pathways
2. Fibrinolytic pathway
3. Vascular system

B. Disease States

1. Coagulation factor deficiencies
 - a. Acquired
 - b. Hereditary
2. Fibrinolytic system
3. Hypercoagulable states
4. DIC

C. Laboratory Determinations

1. PT/INR
2. APTT
3. Fibrinogen
4. D-dimer
5. Thrombin time
6. Mixing studies
7. Platelet function (e.g., PFA)
8. Hypercoagulability assays (e.g., protein S, protein C)

IMMUNOLOGY

(10% of total exam)

I. PRINCIPLES OF IMMUNOLOGY

A. Immune System Physiology

1. Primary and secondary response
2. B and T cells, macrophages
3. Genetics

B. Immunoglobulins

1. Classes and subclasses
2. Structure
3. Biologic and physical properties

C. Antigen-Antibody Interactions

1. Principles
2. Testing
 - a. Principles
 - b. Methods

D. Complement

1. Classical and alternative pathway mechanisms
2. Biologic properties

II. DISEASES OF THE IMMUNE SYSTEM

A. Autoimmunity

1. Systemic (e.g., SLE)
2. Organ-specific (e.g., Graves disease)

B. Hypersensitivity

1. I, II, III, IV

C. Immunoproliferative Diseases

1. Monoclonal gammopathies (e.g., multiple myeloma, Waldenström macroglobulinemia)

D. Immunodeficiency

1. Hereditary (e.g., SCID)
2. Acquired (e.g., HIV)

III. INFECTIOUS DISEASE SEROLOGY

- A. Clinical Significance and Epidemiology of Viral Pathogens (e.g., hepatitis (A, B, C), EBV, HIV, CMV, rubella, measles)**

IV. SEROLOGIC PROCEDURES

- A. Thyroid Antibodies**
- B. Rheumatoid Factor**
- C. Direct Detection Methods for Pathogens**
- D. Nontreponemal Syphilis Testing (RPR)**

V. TEST RESULTS

- A. Interpretation**
- B. Confirmatory Testing**
- C. Disease State Correlation**

MICROBIOLOGY

(5% of total exam)

I. PREANALYTIC PROCEDURES

A. Specimen Collection and Transport

1. Patient identification and specimen labeling
2. Specimen collection
3. Specimen transport systems and conditions for all organisms

B. Specimen Processing

1. Specimen prioritization and rejection criteria
2. Biosafety cabinet and personal protective equipment
3. Specimen preparation methods and applications
4. Media
5. Inoculation of media
6. Incubation conditions (e.g., temperature, atmosphere, duration)
7. Preparation methods for slides used for stains

C. Gram Stain: Procedure and Principle

LABORATORY OPERATIONS

(15% of total exam)

I. QUALITY ASSESSMENT/TROUBLESHOOTING

- A. Pre-analytical, Analytical, Post-analytical**
- B. Quality Control**
- C. Point-of-care Testing (POCT)**
- D. Compliance**
- E. Regulation (e.g., proficiency testing, competency assessment, accreditation standards)**

II. SAFETY

A. Safety Programs and Practices

1. Prevention of infection with bloodborne pathogens
2. Use of personal protective equipment (PPE)
3. Safe work practices
4. Safety data sheets (SDS) for chemicals and reagents

B. Emergency Procedures (e.g., needlesticks, splashes to mucous membranes, fire)

C. Packaging and Transportation of Specimens and Microorganisms

III. LABORATORY MATHEMATICS

- A. Concentration, Volume, and Dilutions
- B. Molarity, Normality
- C. Standard Curves
- D. Mean, Median, Mode, and Confidence Intervals
- E. Sensitivity, Specificity, and Predictive Value

IV. MANUAL/AUTOMATED METHODOLOGY AND INSTRUMENTATION

- A. Microscopy
- B. Centrifugation
- C. Spectrophotometry and Photometry
- D. Osmometry
- E. Electrochemistry
- F. Other Methods

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.

END OF CONTENT GUIDELINE