

MEDICAL LABORATORY SCIENTIST, MLS(ASCP) EXAMINATION CONTENT GUIDELINE

This document should serve as a useful guide for examination preparation. The Board of Certification criterion-referenced examinations are constructed to measure the competencies described in the Certification Levels Definitions. These competency statements are specified into task definitions, linked to each of the content outlines, and measured by the test items.

It should be noted that, for the Medical Laboratory Scientist, the Certification Levels Definitions refer to skills and abilities expected at career entry, not those that may be acquired with subsequent experience. Certification Levels are hierarchical and it is assumed that the technologist level encompasses knowledge and skills of the preceding technician level.

TECHNOLOGIST LEVEL

Knowledge

The technologist has an understanding of the underlying scientific principles of laboratory testing as well as the technical, procedural, and problem-solving aspects. The technologist has a general comprehension of the many factors that affect health and disease, and recognizes the importance of proper test selection, the numerous causes of discrepant test results (patient and laboratory), deviations of test results, and ethics including result confidentiality. The technologist correlates abnormal laboratory data with pathologic states, determines validity of test results, and need for additional tests. The technologist understands and enforces regulatory requirements, safety regulations, uses statistical methods and applies business and economic data in decision making. The technologist has an appreciation of the roles and interrelationships of paramedical and other health related fields and follows the ethical code of conduct for the profession.

Technical Skills

- *Performs full range of chemical, microbiologic, immunologic, hematologic, and immunohematologic laboratory procedures.*
- *Participates in the evaluation of new techniques and procedures in the laboratory.*

The technologist is capable of performing and interpreting standard, complex, and specialized tests. The technologist has an understanding of quality assurance sufficient to implement and monitor quality control programs. The technologist is able to participate in the introduction, investigation and implementation of new procedures and in the evaluation of new instruments. The technologist evaluates computer-generated data and troubleshoots problems. The technologist understands and uses troubleshooting, validation, statistical, computer, and preventive maintenance techniques to insure proper laboratory operation.

Problem Solving and Analytical Decision Making

- *Evaluates and solves problems related to collection and processing of biological specimens for analysis.*
- *Differentiates and resolves technical, instrument, physiologic causes of problems or unexpected test results.*

The technologist has the ability to exercise initiative and independent judgment in dealing with the broad scope of procedural and technical problems. The technologist is able to participate in, and may be delegated, the responsibility of decisions involving: quality control/quality assurance programs, instrument and methodology selection, preventive maintenance, safety procedures, reagent purchases, test selection/utilization, research procedures, and computer/statistical data.

Communication

- *Provides administrative and technical consulting services on laboratory testing.*

The technologist communicates technical information such as answering inquiries regarding test results, methodology, test specificity and sensitivity and specific factors that can influence test results to other health professionals and consumers. The technologist develops acceptable criteria, laboratory procedure manuals, reports, guidelines, and research protocols.

Teaching and Training Responsibilities

- *Incorporates principles of educational methodology in the instruction of laboratory personnel, other health care professionals and consumers.*

The technologist provides instruction in theory, technical skills, safety protocols, and application of laboratory test procedures. The technologist provides continuing education for laboratory personnel and maintains technical competence. The technologist may participate in the evaluation of the effectiveness of educational programs.

Supervision and Management

- *Gives direction and guidance to technical and support personnel.*

The technologist has an understanding of management theory, economic impact and management functions. The technologist participates in and takes responsibility for establishing technical and administrative procedures, quality control/quality assurance, standards of practice, safety and waste management procedures, information management and cost effective measures. The technologist supervises laboratory personnel.

THE EXAMINATION MODEL

The Board of Certification criterion-referenced examination model consists of three interrelated components:

COMPETENCY STATEMENTS describe the skills and tasks that Medical Laboratory Scientists should be able to perform.

CONTENT OUTLINE delineates general categories or subtest areas of the examination.

TAXONOMY levels describe the cognitive skills required to answer the question.

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|---------------------------------------|--|
| Level 1 - Recall: | Ability to recall or recognize previously learned (memorized) knowledge ranging from specific facts to complete theories. |
| Level 2 - Interpretive Skills: | Ability to utilize recalled knowledge to interpret or apply verbal, numeric or visual data. |
| Level 3 - Problem Solving: | Ability to utilize recalled knowledge and the interpretation/application of distinct criteria to resolve a problem or situation and/or make an appropriate decision. |

EXAMINATION REPORTING MECHANISMS

After the examination administration, preliminary test results (pass or fail) will appear on the computer screen. An official examination performance report will be mailed to the examinee within 10 business days of the examination administration, provided all official documents have been received.

The examinee Performance Report provides the scaled score on the total examination and pass/fail status for all candidates. In addition, failing candidates receive scaled scores for each subtest (see content outline for subtests). This information may help the examinee identify areas of strengths and weaknesses in order to develop a study plan for future examinations. A total scaled score of 400 is required to pass the examination.

SUBTEST	MLS
Blood Bank (BBNK)	17%
Chemistry (CHEM)	21%
Hematology (HEMA)	20%
Immunology (IMMU)	8%
Laboratory Operations (LO)	6%
Microbiology (MICR)	20%
Urinalysis and Other Body Fluids (UA)	8%

COMPETENCY STATEMENTS

MEDICAL LABORATORY SCIENTIST

For the laboratory areas of Body Fluids, Blood Bank, Chemistry, Hematology, Immunology and Microbiology, the following competencies are tested:

APPLIES KNOWLEDGE OF

- theory and principles related to:
 - anatomy (Body Fluids)
 - biochemistry (Chemistry and Hematology)
 - education
 - genetics (Blood Bank)
 - growth characteristics/diagnostic and infective forms (Microbiology)
 - immunology (Blood Bank and Immunology)
 - laboratory information systems
 - physiology (Body Fluids, Chemistry, Hematology, Immunology)
- data security/patient confidentiality
- fundamental biological characteristics related to laboratory testing
- medical terminology
- principles of performing basic/special laboratory procedures
- sources of error in laboratory testing
- standard operating procedures
- theory and practice related to laboratory operations (management/safety/education/R&D)

SELECTS APPROPRIATE

- controls for test performed
- course of action
- instruments for new laboratory procedures
- instruments to perform requested test
- quality control procedures
- reagents/media/blood products
- routine/special procedures to verify test results
- type of sample and method for test requested

PREPARES / PROCESSES

- controls
- equipment and instruments
- reagents/media/blood products
- specimens

CALCULATES RESULTS

ASSESSES TEST RESULTS BY CORRELATING LABORATORY DATA WITH

- clinical or other laboratory data
- physiologic processes to validate test results and procedures
- quality control data
- results obtained by alternate methodologies

EVALUATES

- appropriate actions and methods
- corrective actions
- patient-related requirements
- possible sources of error or inconsistencies
- quality control procedures
- specimen-related requirements

EVALUATES LABORATORY DATA TO

- assess test for procedural validity/accuracy
- assure personnel safety
- check for procedural/technical problems
- make identifications
- recognize and report abnormal test results and/or the need for additional testing
- recognize and resolve possible inconsistent results/sources of error
- recognize related disease states
- take corrective action
- verify test results for reporting

CONTENT OUTLINE

MEDICAL LABORATORY SCIENTIST

Refer to the MLS Competency Statements for the competencies tested in each subtest.

I. BLOOD BANK (17% of total exam)

1. ABO and Rh

- A. ABO
- B. Rh

2. Antibody Screen and Identification

- A. Antibody Screen
- B. Antibody Identification
 - 1) Duffy
 - 2) Ii
 - 3) Kell
 - 4) Kidd
 - 5) Lewis
 - 6) MNS
 - 7) P
 - 8) Rh
 - 9) Multiple antibodies

3. Crossmatch and Special Tests

- A. Crossmatch
- B. Special Tests
 - 1) DAT
 - 2) Phenotyping and genotyping
 - 3) Elution/adsorption
 - 4) Antibody titer
 - 5) Pre-warm technique
 - 6) Rosette and Kleihauer-Betke

4. Blood Donation, Transfusion Therapy, Transfusion Reactions and Hemolytic Disease of the Fetus and Newborn (HDFN)

- A. Blood Donation
 - 1) Donor requirements
 - 2) Donor testing
- B. Transfusion Therapy
 - 1) RBC
 - 2) PLT
 - 3) FFP
 - 4) Cryoprecipitated AHF
 - 5) RhIG
- C. Transfusion Reactions
- D. HDFN

II. URINALYSIS & OTHER BODY FLUIDS (8% of total exam)

1. Urinalysis

- A. Pre-Analytical
- B. Physical
 - 1) Color and clarity
 - 2) Specific gravity/osmolality

C. Chemical

- 1) Reagent strip
- 2) Confirmatory tests

D. Microscopic

- 1) Cells
- 2) Casts
- 3) Crystals
- 4) Contaminants
- 5) Artifacts/microorganisms

E. Complete Urinalysis (includes physical, chemical, and microscopic)

F. Physiology

2. Other Body Fluids

- A. CSF
- B. Amniotic, Gastric, and Synovial Fluids, Serous Body Fluids, Sweat, Semen and Feces

III. CHEMISTRY (21% of total exam)

1. Carbohydrates, Acid Base and Electrolytes

- A. Carbohydrates
 - 1) Glucose
 - 2) Glycosylated hemoglobin
 - 3) Other carbohydrates (e.g. lactate)
- B. Acid Base
 - 1) pH, pCO₂, pO₂
 - 2) Osmolality, base excess
- C. Electrolytes
 - 1) Sodium, potassium, chloride, bicarbonate, anion gap
 - 2) Calcium, magnesium, phosphorus

2. Proteins and Other Nitrogen-Containing Compounds

- A. Protein and Other Nitrogen-Containing Compounds
 - 1) Total protein, albumin
 - 2) Globulins (alpha 1, alpha 2, beta, gamma)
 - 3) Ferritin, transferrin
 - 4) Iron and TIBC
 - 5) Ammonia
 - 6) Creatinine, BUN
 - 7) Uric acid
 - 8) Troponin
 - 9) Other (e.g., BNP)
- B. Heme Derivatives
 - 1) Hemoglobin (S, fetal, A₂, plasma)
 - 2) Bilirubin, urobilinogen
 - 3) Other (e.g., myoglobin)

3. Enzymes, Lipids and Lipoproteins

A. Enzymes

- 1) Amylase, lipase
- 2) AST, ALT
- 3) CK, LD
- 4) ALP
- 5) GGT
- 6) Other

B. Lipids and Lipoproteins

- 1) Cholesterol (total, HDL, LDL)
- 2) Triglycerides
- 3) Phospholipids (PG)
- 4) Other lipids and lipoproteins

4. Special Chemistry (Endocrinology, Tumor Markers, TDM, Toxicology)

A. Endocrinology and Tumor Markers

- 1) T₃, T₄, TBG, TSH
- 2) hCG, FSH, LH, estriol, estradiol
- 3) Other hormones (e.g. cortisol)
- 4) Tumor markers (alpha fetoprotein, CEA, hCG, PSA)

B. TDM and Toxicology

- 1) Therapeutic drug monitoring
- 2) Drugs of abuse
- 3) Other toxicology (e.g., lead)

IV. HEMATOLOGY (20% of total exam)

1. Erythrocytes and Leukocytes

A. Red Blood Cells and Indices

- 1) RBC count
- 2) Hemoglobin, hematocrit and indices

B. White Blood Cells

- 1) WBC count
- 2) Cytochemical stains

C. CBC (includes count, morphology and/or differential)

2. Other Tests

A. Reticulocyte Count and Other RBC Inclusions

B. ESR

C. Tests for Hemoglobin Defects

- 1) Sickle cell tests
- 2) Hemoglobin electrophoresis

D. Other

3. Morphology and Differentials

A. Red Blood Cell Morphology

B. White Blood Cell Morphology

C. Differential (Whole Blood and Bone Marrow)

D. Platelet Morphology

4. Platelets and Hemostasis

A. Platelets

- 1) Platelet count
- 2) Bleeding time and platelet function

B. Hemostasis

- 1) PT, aPTT, TT
- 2) Fibrinogen, FDP, D-dimer
- 3) Factor assays, antithrombin III
- 4) Circulating anticoagulants, plasminogen
- 5) Mixing studies
- 6) Anticoagulant therapy

7) Other

V. IMMUNOLOGY (8% of total exam)

1. Immunity

A. Autoimmunity

- 1) ANA, anti-DNA
- 2) CRP/RF
- 3) Thyroid antibodies
- 4) Other autoimmunes (e.g., extractable nuclear antigen)

B. Pre-Analytical, Test Principles

2. Infectious Diseases

A. Viral

- 1) EBV/infectious mononucleosis
- 2) Hepatitis
- 3) HIV/HTLV/CMV
- 4) Rubella/measles
- 5) Other viruses

B. Microbial

- 1) Cold agglutinins
- 2) Syphilis
- 3) Other microorganisms

VI. MICROBIOLOGY (20% of total exam)

1. General Microbiology, Preanalytical, and Aerobic Gram-positive Cocci

A. General Microbiology, Pre-Analytical and Susceptibility Testing

B. Aerobic Gram-positive Cocci:

Staphylococcus, *Streptococcus*, *Enterococcus*, other (e.g., *Gemella*, *Leuconostoc*, *Micrococcus*)

2. Gram-negative Bacilli

A. *Enterobacteriaceae*: *Citrobacter*, *Escherichia*, *Enterobacter*, *Klebsiella*, *Morganella*, *Proteus*, *Providencia*, *Salmonella*, *Serratia*, *Shigella*, *Yersinia*

B. Other Gram-negative Bacilli: *Acinetobacter*, *Aeromonas*, *Bordetella*, *Brucella*, *Campylobacter*, *Eikenella*, *Francisella*, *Haemophilus*, *Helicobacter*, *Legionella*, *Pasteurella*, *Plesiomonas*, *Pseudomonas*, *Burkholderia*, *Stenotrophomonas*, *Chryseobacterium*, *Vibrio*, *HACEK*, *Bartonella*, *Capnocytophaga*

3. Gram-negative Cocci, Gram-positive Bacilli and Anaerobes

A. Aerobic Gram-negative Cocci (e.g., *Neisseria*, *Moraxella*)

B. Aerobic or Facultative Gram-positive Bacilli: *Bacillus*, *Corynebacterium*, *Erysipelothrix*, *Gardnerella*, *Lactobacillus*, *Listeria*, *Nocardia*, *Streptomyces*

C. Anaerobes

- 1) Gram-positive: *Bifidobacterium*, *Clostridium*, *Eubacterium*, *Actinomyces*, *Peptostreptococcus*, *Propionibacterium*
- 2) Gram-negative: *Bacteroides*, *Fusobacterium*, *Porphyromonas*, *Prevotella*, *Veillonella*

4. Fungus, Viruses, Mycobacteria and Parasites

- A. Fungi
 - 1) Yeast (e.g., *Candida*, *Cryptococcus*, *Geotrichum*, *Malassezia*)
 - 2) Dimorphic fungi (e.g., *Blastomyces*, *Coccidioides*, *Histoplasma*, *Sporothrix*)
 - 3) Dermatophytes (e.g., *Epidermophyton*, *Microsporum*, *Trichophyton*)
 - 4) Zygomycetes (e.g., *Absidia*, *Mucor*, *Rhizopus*)
 - 5) Opportunistic molds/septate hyaline molds (e.g., *Aspergillus*, *Penicillium*)
 - 6) Dermatiaceous molds
- B. Mycobacteria
 - 1) *Mycobacterium tuberculosis* complex (e.g., *M. tuberculosis*)
 - 2) Other Mycobacteria (e.g., *M. avium*, *M. avium-intracellulare*, *M. fortuitum*, *M. gordonae*, *M. kansasii*, *M. leprae*, *M. marinum*, *M. scrofulaceum*)
- C. Viruses and Other Microorganisms
 - 1) Viruses (rapid antigen detection)
 - 2) Other microorganisms (e.g., *Chlamydia*, *Mycoplasma*)
- D. Parasites
 - 1) Blood and tissue protozoa (e.g., *Plasmodium*, *Pneumocystis*, *Trypanosoma*)
 - 2) Intestinal and urogenital protozoa (e.g., *Cryptosporidium*, *Entamoeba*, *Giardia*, *Trichomonas*)
 - 3) Intestinal and tissue helminths (e.g., *Ascaris*, *Enterobius*, hookworm, *Schistosoma*, *Strongyloides*, *Taenia*, *Trichinella*, *Trichuris*)

VII. LABORATORY OPERATIONS

(6% of total exam)

1. Quality Assessment

- A. Pre-Analytical
- B. Quality Control
- C. Compliance
- D. Regulation

2. Safety

3. Management

- A. Purchasing
- B. Inventory Control
- C. Competency

4. Laboratory Mathematics

5. Instrumentation and Analytical Techniques

- A. Molecular Techniques

6. Education and Communication

7. Laboratory Information Systems

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

END OF CONTENT GUIDELINE