



## American Medical Technologists Medical Laboratory Scientist (MLS) Certification Competencies and Examination Specifications

*Summary Table*

|       | Work Area                              | Number of Questions | Percentage of Exam |
|-------|----------------------------------------|---------------------|--------------------|
| I.    | General Laboratory                     | 30                  | 14.3%              |
| II.   | Chemistry                              | 45                  | 21.4%              |
| III.  | Hematology                             | 32                  | 15.2%              |
| IV.   | Coagulation and Hemostasis             | 15                  | 7.1%               |
| V.    | Immunology and Serology                | 8                   | 3.8%               |
| VI.   | Immunohematology                       | 22                  | 10.5%              |
| VII.  | Blood Banking and Transfusion Services | 17                  | 8.1%               |
| VIII. | Microbiology                           | 31                  | 14.8%              |
| IX.   | Urinalysis and Body Fluids             | 10                  | 4.8%               |
| Total |                                        | 210                 | 100%               |

### *Question Weightings, Work Areas, Task Areas, and Competencies*

**Number  
of items**

#### **[30] I. General Laboratory (14.3% of exam)**

##### **Laboratory quality**

- Demonstrate knowledge of quality control for all laboratory procedures and the acceptance or rejection of an analysis based on quality control rules
- Demonstrate knowledge of quality control terminology to include:
 

|             |                          |                                |
|-------------|--------------------------|--------------------------------|
| linearity   | coefficient of variation | pre-/postanalytical            |
| accuracy    | skewness                 | confidence limit               |
| precision   | mean value               | normal distribution            |
| reliability | standard deviation       | standard deviation index (SDI) |
| delta OD    | shift, trend             | Levey-Jennings charts          |
- Understand the differences between accuracy and precision
- Review all kit/procedure package inserts to assure that accurate and up-to-date testing

procedures are being executed

- Employ quality improvement (TQM, CQI, PIC)
- Demonstrate knowledge of proficiency testing

### **Laboratory laws and regulations**

- Know laws and regulations governing the laboratory (OSHA, CLIA, HIPAA)

### **Laboratory safety**

- Employ laboratory safety
- Employ Universal / Standard precautions
- Employ equipment safety to include sharps for needle disposal
- Employ chemical hazard safety and Safety Data Sheets (SDS)
- Employ proper infection control

### **Laboratory instrumentation, maintenance, and principles of operation**

- Employ manual laboratory instrumentation, including the use of glassware and pipettes, and the cleaning and maintenance of instruments
- Calibrate instruments knowing the difference between testing technologies requiring calibration and those requiring only quality control checks
- Balance centrifuge and know centrifugation durations
- Employ automated laboratory instrumentation

### **Laboratory mathematics**

- Apply laboratory mathematics; understand and calculate essential indices such as mean, standard deviation, and coefficient of variation
- Demonstrate understanding of designations/abbreviations used for weights and measures
- Demonstrate understanding of normal solutions, molar solutions, percentage solutions (w/w, w/v, and v/v), calculate equivalent weight and dilutions used most frequently in the clinical laboratory

### **General microscopy**

- Demonstrate knowledge of microscopy, including types of microscopes and parts of binocular microscope
- Use and clean binocular microscope and calibrate ocular micrometer

### **Phlebotomy and specimen collection, including specimen handling and integrity**

- Collect, handle, and process all specimens for analysis (including infant collection)
- Understand the differences between serum, plasma, and whole blood
- Employ safety precautions when collecting blood samples
- Employ procedures to prevent hemolysis
- Collect blood in collecting tubes for analysis (clotted blood and anticoagulated blood)
- Employ proper order of draw when collecting blood in multiple types of vacuum tubes

- Employ proper anticoagulants for each analysis and know effects of improper anticoagulant use
- Know procedure for blood culture collection
- Know the proper labeling of blood tubes including sentinel event with blood bank armbands
- Perform infant blood collection through heel puncture
- Perform glucose tolerance test
- Know length of time in which samples clot
- Handle and preserve body fluids for chemical analysis
- Preserve urine specimens
- Process irretrievable specimens (CSF, tissue, etc.)
- Determine the suitability of specimens for analysis
- Determine preanalytical, analytical, and/or postanalytical causes of erroneous results

#### **Patient identification**

- Assure continual accuracy of patient identification (including STAT, call reports for inpatient and outpatient, etc.)
- Match name, MR, DOB, registration number, and other identifiers with tests and orders to confirm positive patient identification

#### **Waived testing**

- Demonstrate knowledge of waived testing in the clinical laboratory

### **[45] II. Chemistry (21.4% of exam)**

#### **General knowledge**

- Define clinical chemistry terminology:
 

|                   |                                              |
|-------------------|----------------------------------------------|
| spectrophotometry | densitometry                                 |
| refractometry     | electrophoresis                              |
| turbidimetry      | nephelometry                                 |
| osmometry         | mass spectrometry                            |
| chromatography    | enzyme linked immunoassay (ELISA)            |
| chemiluminescence | fluorescence polarization immunoassay (FPIA) |
- Define terminology related to principles of clinical laboratory instrumentation:
 

|                        |                            |
|------------------------|----------------------------|
| radiant energy         | visual spectrum/wavelength |
| end point reactions    | diffraction grating        |
| kinetic/rate reactions | random access              |

 Beer-Lambert Law

#### **Instrumentation**

- Demonstrate knowledge of the components of a spectrophotometer
- Demonstrate understanding of the visual spectrum and wavelength
- Perform spectrophotometric procedure
- Demonstrate understanding of the Beer-Lambert Law
- Demonstrate the ability to operate and describe the principles of operation of osmometer,

nephelometer, random access analyzers, blood gas analyzers, discrete analysis

- Demonstrate the ability to perform and describe the principles of immunoassay
- Describe the principles of electrophoresis
- Describe the importance of preventative maintenance; chemistry analyzer maintenance

### **Renal function tests**

- Describe physiology and know anatomy of the kidneys
- Perform common renal function tests (non-protein nitrogens), clearance tests, and estimated glomerular filtration rate
- Perform renal function tests and correlate results to pathological conditions affecting kidney function; know reference limits

### **Hepatic function tests**

- Demonstrate understanding of the anatomy and physiology of the liver
- Describe types of bilirubin and types of jaundice, and understand the formation of bilirubin and urobilinogen
- Understand and perform common hepatic function tests
- Correlate test elevations to the different types of jaundice (hemolytic/prehepatic, hepatic, posthepatic)

### **Carbohydrate metabolism**

- Define carbohydrate metabolism terminology  
carbohydrate                      ketones                      lipogenesis  
monosaccharide                  insulin                      renal threshold  
disaccharide                      glycolysis                  diabetes mellitus  
polysaccharide                  glycogenesis              A<sub>1</sub>C hemoglobin  
glycogen                          glycogenolysis
- Describe insulin and carbohydrate metabolism, carbohydrate digestion, and types of diabetes
- Describe the principles of tests for carbohydrate metabolism in body fluids, including tests for glucose in blood, urine, and cerebrospinal fluid, glucose tolerance tests, gestational diabetes screening tests, and A<sub>1</sub>C hemoglobin
- Perform and interpret tests for glucose analysis to include all tests for carbohydrates and reducing substances, and those performed on blood, urine, and spinal fluid
- Perform oral glucose tolerance test; recognize and differentiate normal glucose tolerance and diabetic glucose tolerance, and hypoglycemic (flat) curves
- Describe the significance of A<sub>1</sub>C and the treatment of diabetes

### **Protein analysis**

- Describe the structure and function of plasma proteins; synthesis, distribution, catabolism, and excretion of proteins; protein classification
- Describe principles of protein electrophoresis; recognize and interpret normal and disease patterns in serum protein electrophoresis
- Perform tests measuring total protein, albumin, and globulin

- Demonstrate knowledge of clinical protein analysis and correlate test results with disease states

## Enzymology

- Demonstrate understanding of enzymology concepts:
  - Clinically-significant enzymes (CP, ALT, GGT, ALP, AST, CK, LD, amylase, lipase)
  - Isoenzymes (CK, ALP, LD)
  - Cardiac enzymes and related cardiac markers (troponin and myoglobin)
  - Pancreatic enzymes
  - Enzymes associated with the liver
- Demonstrate knowledge of the methodology for measuring enzyme activity
- Perform enzyme analyses
- Describe enzymes that are elevated in liver disease; correlate with liver disease, including types of jaundice
- Describe enzymes of the pancreas; correlate amylase and lipase with pancreatic disease
- Demonstrate knowledge of cardiac marker tests: troponin T and I, myoglobin, B natriuretic peptide (BNP), and C-reactive protein (CRP)
- Describe cardiac enzymes and interpret test results; correlate elevations of cardiac markers including their rise and fall with cardiac events
- Demonstrate knowledge of the phosphatases; correlate elevations with disease states

## Endocrinology

- Demonstrate understanding of endocrinology concepts:
  - Glands and hormones of the endocrine system
  - Function of hormones
  - Feedback mechanisms
  - Conditions associated with hypo- and hypersecretion of hormones
- Demonstrate knowledge of thyroid function tests (thyroxine, TBG, free T<sub>3</sub>, free T<sub>4</sub>, TSH)
- Demonstrate knowledge of growth hormones; correlate test results with disease states
- Demonstrate knowledge of reproductive hormones (FSH, LH, estriol, estradiol, estrogen, testosterone, 17-ketosteroids); correlate test results with disease states
- Demonstrate knowledge of hormones secreted during pregnancy (HPL, HCG, prolactin)
- Demonstrate knowledge of 24-hour urine endocrinology testing (SHIAA); correlate test results with disease states
- Perform endocrine function tests

## Lipids

- Demonstrate knowledge of concepts related to lipids:
 

|         |                               |             |
|---------|-------------------------------|-------------|
| lipid   | fatty acid                    | lipoprotein |
| Ester   | cholesterol (total, HDL, LDL) |             |
| alcohol | triglycerides                 |             |
- Describe the function of protein in the lipoprotein complex, and understand the metabolism of cholesterol and triglycerides
- Demonstrate knowledge of lipid analyses and correlate hyperlipidemia with coronary artery

disease; describe the classification of hyperlipidemias; know desirable limits for total cholesterol, LDL, and HDL

- Describe the digestion of fat
- Demonstrate understanding of lipid analyses

#### **Water and electrolytes**

- Demonstrate knowledge of electrolytes in body fluids (characteristics, fluid compartments and movements, electrolyte balance, reference limits for electrolyte profiles, expression of concentration of electrolytes) and understand common causes of electrolyte imbalances
- Define hyponatremia, hypernatremia, hypokalemia, and hyperkalemia
- Measure electrolytes; describe methodology for measurement and calculate osmolality

#### **Acid-base balance**

- Demonstrate understanding of concepts related to acid-base balance; hydrogen ion concentration (pH); regulation of acid-base balance by kidneys and lungs
- Demonstrate understanding of relationships between pH, bicarbonate, and carbonic acid (Henderson-Hasselbalch equation)
- Describe common acid-base imbalances
- Describe the measured and calculated parameters in an arterial blood gas analysis (ABG); relate abnormal ABG test results to causative conditions

#### **Cerebrospinal fluid (CSF)**

- Demonstrate understanding of cerebrospinal fluid (CSF) formation, characteristics, volume, function, and collection
- Demonstrate understanding of abnormal findings of CSF analysis

#### **Other chemistry procedures**

- Demonstrate understanding of tumor markers; discuss usage of B-HCG, CA 27-29, PSA, CEA, CA 125, CA 19, HER2
- Perform therapeutic drug monitoring and drugs of abuse testing; understand peak and trough, screening and confirmatory, methodologies used
- Understand the principles of fetal wellness (fibronectin, AFP, L/L ratio,  $\Delta 450$ )

### **[32] III. Hematology (15.2% of exam)**

#### **General knowledge**

- Apply knowledge of terminology related to hematology:

|               |                                      |                        |
|---------------|--------------------------------------|------------------------|
| leukocytes    | nucleated red blood cell (NRBC)      | hemoglobin (HGB)       |
| erythrocyte   | complete blood count (CBC)           | hematocrit (HCT)       |
| thrombocytes  | RBC, WBC, PLT morphology             | sodium citrate         |
| reticulocytes | RBC indices (MCV, MCH, MCHC)         | red blood cell (RBC)   |
| hematopoiesis | red cell distribution width (RDW)    | white blood cell (WBC) |
| anemia        | erythrocyte sedimentation rate (ESR) | plasma                 |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                        |                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|---------------------|
| leukemia                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | erythropoietin (EPO)                   | buffy coat          |
| serum                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | RBC, WBC inclusions                    | differential (DIFF) |
| platelet (PLT)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | ethylenediaminetetraacetic acid (EDTA) |                     |
| <ul style="list-style-type: none"> <li>• Know functions and cellular structures of blood (RBC, WBC, PLT)</li> <li>• Know maturation series of erythrocytes, leukocytes, and thrombocytes; erythrocyte production and destruction</li> <li>• Prepare and stain peripheral blood smear and bone marrow slides</li> <li>• Examine peripheral blood smear and correlate with CBC</li> <li>• Understand bone marrow aspiration procedure; touch preps from bone biopsies and bone marrow aspiration</li> </ul> |                                        |                     |

### **Erythrocyte procedures**

- Demonstrate knowledge of RBC count (manual and automated methods)
- Demonstrate knowledge of hemoglobin (manual and automated methods)
- Address interfering substances in hemoglobin measurement
- Demonstrate knowledge of hematocrit (manual and automated methods)
- Demonstrate knowledge of reticulocyte counts and calculations (relative count, ARC, CRC, RPI)
- Calculate red blood cell indices: MCV, MCH, MCHC
- Demonstrate knowledge of erythrocyte sedimentation rate (ESR) - Westergren
- Know types of specimens producing falsely-elevated ESR values

### **Leukocyte procedures**

- Demonstrate knowledge of WBC differentials
- Demonstrate knowledge of maturation series of the granulocytes (neutrophils, eosinophils, and basophils) and nongranulocytes (lymphocytes, monocytes)
- Understand leukocyte disorders and correlation with WBC differential
- Demonstrate knowledge of WBC count (manual and automated methods)
- Calculate absolute WBC counts
- Calculate corrected leukocyte counts for nucleated red blood cells
- Perform cytogenetic and molecular assays
- Perform cytochemical staining
- Demonstrate knowledge of cytogenic abnormalities associated with hematologic neoplasms
- Demonstrate knowledge of molecular diagnostic tests relevant to the diagnosis of hematologic neoplasms

### **Thrombocyte procedures**

- Demonstrate knowledge of blood smear evaluation of platelets; know thrombocyte (platelet) maturation series
- Perform platelet count (manual and automated methods)
- Identify sources of error and corrective actions for plate counts

### **Special procedures**

- Demonstrate knowledge of eosinophil count
- Demonstrate knowledge of body fluid analysis, counts, and related morphology (synovial fluid, CSF, serous fluid)
- Demonstrate knowledge of body fluid cytospin preparation and morphology
- Demonstrate knowledge of sickle cell screen
- Demonstrate knowledge of semen analyses
- Demonstrate knowledge of hemoglobinopathy evaluation; hemoglobin electrophoresis
- Demonstrate knowledge of molecular assays (malaria slide preparation and evaluation)

### **Automated instrumentation**

- Demonstrate knowledge of CBC/Diff using automated hematology instrumentation; know cell counter principles (impedance, flow cytometry)
- Know which CBC parameters are measured directly
- Interpret patient data using WBC/RBC histogram or cytogram
- Perform QC and investigate QC failures
- Perform maintenance protocols
- Identify sources of error and perform corrective action for hematological tests
- Demonstrate knowledge of flow cytometry

## **[15] IV. Coagulation and Hemostasis (7.1% of exam)**

### **General knowledge**

- Define terminology associated with coagulation:  
hemostasis      prothrombin time (PT)  
coagulation      activated partial thromboplastin time (APTT)  
factors          International Normalized Ratio (INR)  
thrombin        fibrin degradation products (FDP)  
fibrinogen      platelet function test  
heparin        Coumadin® (warfarin)  
sodium citrate
- Collect and process coagulation specimens
- Adjust anticoagulant-to-blood ratio when indicated
- Describe the coagulation cascade and list coagulation factors (Roman numerals and common name)
- Understand principles of hemostasis (primary, secondary, and fibrinolysis)
- Understand intrinsic, extrinsic, common pathways, and associated factors
- Correlate hemostatic disorders with laboratory evaluation (coagulation, thrombocyte, and vasculature disorders)
- Perform molecular testing and understand molecular assays in coagulation

### **Coagulation procedures**

- Perform prothrombin time, partial thromboplastin time (PTT or APTT), fibrinogen, and D-dimer

tests

- Perform fibrin degradation and fibrin split product tests (FDP or FSP)
- Perform heparin assay
- Perform mixing studies; factor testing
- Perform platelet function testing

#### [8] V. Immunology and Serology (3.8% of exam)

##### General knowledge

- Define terminology related to immunology and serology:

|           |              |                           |
|-----------|--------------|---------------------------|
| reagin    | thermostable | anticomplementary         |
| antigen   | thermolabile | serum vs. plasma          |
| antibody  | physiologic  | amboceptor or hemolysin   |
| hemolysis | hypertonic   | <i>Treponema pallidum</i> |
| VDRL      | hypotonic    | inactivation              |
| PCT       | cardiolipin  | monoclonal                |
| RPR       | complement   | polyclonal                |
- Know principles of immunologic examination (antibody production, antigen-antibody reaction); know the relationship of T and B cells to antibody production; know the definition of syphilis and the stages of infection
- Know factors affecting antigen/antibody reactions {temperature, pH, incubation time, ionic strength, antibody or antigen excess, enhancement media and technology used in blood banking (LISS, PEG, enzymes, albumin, microplates, gel)}

##### Serological tests for syphilis

- Demonstrate knowledge of qualitative and quantitative tests for syphilis (VDRL and RPR)
- Test VDRL and RPR delivery needles for accuracy
- Demonstrate knowledge of and know the principles of the MHA-TP test (microhemagglutination test for *Treponema pallidum*)

##### Analytic procedures

- Demonstrate knowledge of heterophile agglutination (mono) tests
- Demonstrate knowledge of febrile agglutination tests
- Demonstrate knowledge of C-reactive protein (CRP) slide tests
- Demonstrate knowledge of antistreptolysin screen and titer (ASO)
- Demonstrate knowledge of rheumatoid arthritis tests
- Demonstrate knowledge of systematic lupus erythematosus (SLE or LE) tests
- Demonstrate knowledge of antinuclear antibody (ANA) tests
- Demonstrate knowledge of antigen detection
- Demonstrate knowledge of pregnancy tests

##### Special procedures

- Demonstrate knowledge of cytomegalovirus, retrovirus, Epstein-Barr, and rubella tests

- Demonstrate knowledge of anti-human immunodeficiency virus (HIV) tests
- Demonstrate knowledge of analyses related to cytomegalovirus, retrovirus, Epstein-Barr virus, HIV, rubella, hepatitis markers, ANA, alpha-fetoprotein (AFP), tumor markers, and other viral markers

## **[22] VI. Immunohematology (10.5% of exam)**

### **General knowledge**

- Define terminology related to immunohematology:
 

|                |                                           |
|----------------|-------------------------------------------|
| antigen        | anti-human globulin (direct and indirect) |
| antibody       | compatibility testing (methods)           |
| immunoglobulin | autoimmunity                              |
| genotype       | Rh immune globulin                        |
| phenotype      | agglutination                             |
| hemolysis      | elution                                   |
| sensitization  | hemolytic disease of the newborn (HDN)    |

### **Blood typing**

- Demonstrate knowledge of the principles of antigen-antibody reactions, histories of the ABO and Rh systems, chemical structures of the H, A, and B antigens, antigens and antibodies of the ABO system, and frequencies of antigen phenotypes (screening for antigens)
- Demonstrate knowledge of ABO forward typing and reverse typing
- Demonstrate knowledge of subgroup typing for A
- Demonstrate knowledge of Rh<sub>o</sub>(D) typing and Du (weak D) testing
- Demonstrate knowledge of genotyping (ABO and Rh systems, genetics of blood group antigen)

### **Immune response**

- Demonstrate knowledge of antibody identification tests; know soluble components of immune response (immunoglobulins, complement, and cytokines)
- Demonstrate knowledge of the following related to antibodies: five major classes of immunoglobulins, ABO antibodies, Rh antibodies, antibodies to other common blood group systems (MNS, Duffy, Kidd, Lewis, HTLA), cold-reacting antibodies, warm-reacting antibodies, naturally-occurring antibodies
- Demonstrate knowledge of direct antiglobulin tests
- Demonstrate knowledge of indirect antiglobulin tests
- Demonstrate knowledge of principles of the anti-human globulin (AHG) test (indirect): polyspecific AHG, monospecific AHG, grading of results, mixed-field, negative results, false results, interferences (drugs and improper technique), recognition of error
- Demonstrate knowledge of tests for IgG and IgM immunoglobulins

### **Compatibility testing principles and procedures**

- Demonstrate knowledge of compatibility tests (crossmatch); know crossmatch principles and procedures (saline tube, Gel, enzyme, pre-warmed)

- Interpret compatibility testing (crossmatch) results: use of auto control, grading of reactions, interferences (cold agglutinins, Rouleaux)

#### **Rh immune globulin**

- Demonstrate knowledge of Rh immune globulin evaluation; know principles of Rh immune globulin (indications, patient criteria, dosage)
- Demonstrate knowledge of qualitative fetal screen and fetal stain (Kleihauer-Betke)

#### **Special tests**

- Demonstrate knowledge of tests to detect cold agglutinins
- Address cold agglutinins and ABO discrepancies
- Demonstrate knowledge of tests to elute antibodies from red blood cells
- Demonstrate knowledge of tests to detect secretors

### **[17] VII. Blood Banking and Transfusion Services (8.1%)**

#### **General knowledge**

- Define terminology associated with blood banking:
 

|                     |                          |
|---------------------|--------------------------|
| directed donations  | autologous transfusions  |
| anticoagulants      | deglycerized units       |
| cryoprecipitate     | whole blood units        |
| frozen blood cells  | packed red cell units    |
| fresh frozen plasma | platelet transfusion     |
| platelet pheresis   | leukocyte-reduced units  |
| leukopheresis       | radiated units           |
| plasma pheresis     | HLA antigen              |
| washed red cells    | therapeutic phlebotomies |
| product pooling     |                          |
- Know blood donor requirements
- Know blood storage requirements
- Know all requirements for blood bank operation
- Know how to visibly inspect units of blood daily
- Know regulations for the disposition of blood bags and patient samples
- Know policies for proper storage of blood and blood products for transfusion
- Know procedures for transfusion reaction investigation
- Know the blood components, their uses, storage requirements, and preparation
- Know regulations for checking blood bank and freezer temperatures and alarms, and checking incubator temperatures
- Know labeling requirements, and codebar and ISBT numbering systems
- Know issuance of blood products, 30-minute rule, return, and quarantine procedures
- Know transfusion-transmitted infections and look-back/recall procedures
- Know procedures for transfusion reaction investigations

## **Blood banking practices**

- Perform therapeutic phlebotomy
- Understand purpose for therapeutic phlebotomy
- Know and understand regulation parameters for computer crossmatch
- Know and understand special requirements of blood products (e.g., cmv-negative, baby units)
- Know and evaluate blood donor collection requirements and deferrals

## **[31] VIII. Microbiology (14.8%)**

### **Bacteriology**

#### **General knowledge**

- Define terminology associated with bacteriology:

|               |                       |           |
|---------------|-----------------------|-----------|
| bacteria      | osmosis               | capsule   |
| autotrophic   | semipermeable         | ambient   |
| heterotopic   | cytoplasm             | nucleus   |
| pathogenic    | cell wall/membrane    | spore     |
| flagella      | microaerophilic       | aerobic   |
| phagocytosis  | facultative aerobic   | anaerobic |
| bacteriophage | facultative anaerobic | Pili      |
| mesophilic    | thermophilic          |           |
- Describe and identify shapes and arrangements of bacteria
- Demonstrate knowledge of staining procedures (acid-fast stains, fluorescent stains, Gram's stain, Giemsa and Wright's stains, India ink stain)
- Interpret/identify structures through microbiological slide preparations
- Demonstrate knowledge of quality control procedures

#### **Media quality control, techniques, and cultures**

- Demonstrate knowledge of additives used in media preparation (inhibitors, salts and buffers, indicators, pH, enrichments)
- Prepare bacterial smears and stains (including Gram's, acid-fast stains, and other stains)
- Justify uses of bacterial culture methods: selective and differential media, enrichment procedures, anaerobic media and techniques, living host cells, candle jars
- Prepare specimens and know rejection criteria
- Culture clinical specimens: blood, urine, stool (feces), sputum, throat, spinal fluid, upper respiratory, wound, abscess, other body fluids/tissue specimens, urethral/cervical/gynecological, catheter tip (intravenous), intrauterine devices (IUD)
- Interpret morphological characteristics
- Isolate, identify, and differentiate microorganisms
- Demonstrate knowledge of proper processing and planting of specimens
- Prepare and interpret gram stain
- Recognize normal flora from cultures
- Recognize pathogens from cultures

- Identify criteria for proper collection and rejection of specimens for the clinical microbiological laboratory
- Concentrate and culture sputum for acid-fast bacilli
- Test for multi-drug resistant tuberculosis (MDR-TB)
- Perform quality control on media based on standards of the Clinical and Laboratory Standards Institute (CLSI)

### Bacterial identification

- Demonstrate knowledge of various methods of bacterial identification
- Examine stained smears
- Examine smears for acid-fast bacilli
- Demonstrate knowledge of various systems of bacterial identification (API, automated systems, biochemical and carbohydrate systems)
- Perform bacterial identification using biochemical and carbohydrate systems
- Perform differentiating tests
 

|                 |                                   |               |
|-----------------|-----------------------------------|---------------|
| oxidase         | beta lactam disk (cefinaise disk) | indole        |
| catalase        | optochin disk (P disk)            | Camp test     |
| coagulase       | bile esculin (enterococcal slant) | TSB with NACL |
| bile solubility | bacitracin disk (A disk)          |               |

 Mannitol salt test for differentiating *Staphylococcus* species
- Isolate, identify, and differentiate gram-positive cocci
- Isolate, identify, and differentiate gram-positive bacilli
- Isolate, identify, and differentiate gram-negative cocci and coccobacilli
- Isolate and identify gram-negative Enterobacteriaceae and differentiate genera and species
- Isolate, identify, and differentiate gram-negative bacilli: *Brucella*; *Bordetella*; HACEK family (upper respiratory): *Haemophilus*, *Actinomyces*, *comitans*, *Cardiobacterium hominis*, *Eikenella corrodans*, *Kingella kingae*; *Pseudomonas*; *Campylobacter*; Anaerobic bacteria (*Fusobacterium*, *Bacteroides* group, *actinomyces*, *Clostridium difficile*)
- Demonstrate understanding of MRSA and its importance in nosocomial infections; differentiate nosocomial from community-acquired MRSA
- Understand the emergence, significance, and impact of multi-drug resistant organisms (MDRO)
- Understand the significance of vancomycin-resistant *Enterococcus*
- Know and perform quality control and maintenance of instrumentation for microbiologic diagnostic procedures

### Special tests

- Demonstrate knowledge of streptococcal testing: rapid enzyme immunoassay test (or other antigen detection kits) from throat swabs; cultures for beta hemolysis screening, bacterial identification
- Demonstrate knowledge of *Clostridium difficile* toxin test
- Demonstrate knowledge of *Campylobacter* urease test and antigen/antibody test
- Demonstrate knowledge of *Helicobacter pylori* screening; shiga toxin test
- Demonstrate knowledge of antimicrobial susceptibility testing (Kirby-Bauer, MIC, and

automated systems)

- Demonstrate knowledge of DNA probe testing
- Demonstrate knowledge of fecal occult blood and immunochemical test
- Demonstrate knowledge of molecular assays in bacteriology

### **Virology**

- Demonstrate knowledge of laboratory procedures for specimens submitted for diagnostic evaluation of viruses

### **Parasitology**

- Demonstrate understanding of terminology related to parasitology
- Demonstrate understanding of types, descriptions, and classifications of parasites
- Prepare clinical specimens for parasitology studies
- Perform examination for parasites in clinical specimens (feces, blood, urine, other body fluids, tissue)
- Demonstrate knowledge of examination of specimens, direct and concentrated methods for intestinal parasites (Cestodes, Protozoa, Nematodes, Trematodes)
- Prepare and stain permanent smears for ova and parasites using iron hematoxylin and trichrome methods
- Know, identify, and stain cryptosporidium species
- Perform trichrome stain
- Perform stool concentration technique
- Perform stool flotations technique
- Prepare and read thick and thin smears of blood for blood parasites
- Calibrate ocular micrometer; measure standard objects using ocular micrometer
- Demonstrate knowledge of and perform quality control and maintenance for microbiology diagnostic procedures and instrumentation
- Perform special tests and examinations for parasites in clinical specimens (tests for blood parasites; staining for fats in stool; concentration methods for identifying intestinal parasites; antigen tests for parasites such as Giardia)

### **Mycology**

- Define terminology associated with mycology
- Demonstrate understanding of types, descriptions, and classifications of mycological organisms
- Prepare clinical specimens for mycological studies (KOH and fungal cultures)
- Demonstrate knowledge of mycological procedures for both standard and advanced methods
- Know and perform quality control for mycological procedures
- Identify mycological organisms in clinical specimens
- Demonstrate knowledge of mycological procedures for both standard and advanced methods (exoantigen and DNA probe testing)

## **[10] IX. Urinalysis and Body Fluids (4.8% of exam)**

### **General knowledge**

- Define terminology associated with urinalysis:

|                 |            |                            |
|-----------------|------------|----------------------------|
| prerenal        | Clinitest® | sulfosalicylic acid (SSA)  |
| renal threshold | Ictotest®  | amniocentesis              |
| myoglobin       | Acetest®   | Tamm-Horsfall protein      |
| osmolality      | glycoseria | xanthochromic              |
| suprapubic      | acites     | pass-through refractometer |
- Demonstrate knowledge of specimen collection, handling, preservation, and processing for random, midstream, catheterized, and timed (2, 12, 24-hour) specimens

### **Renal function**

- Understand renal function; formation of urine, renal anatomy and physiology
- Describe physical and chemical properties of urine
- Identify microscopic structures formed in urine

### **Urinalysis procedures**

- Perform physical examination of urine (color, clarity, specific gravity)
- Perform chemical examination of urine:
  - Chemical tests (pH, glucose, nitrate, urobilinogen, specific gravity, protein, ketones, bilirubin, blood, leukocyte esterase)
  - Confirmatory tests (Ictotest®, sulfosalicylic acid (SSA) test, Acetest®, Clinitest®)
- Perform microscopic examination of urine (cells, casts, crystals, artifacts/contaminants, microorganisms)
- Correlate complete urinalysis results to normal and disease states

### **Special tests**

- Demonstrate knowledge of special urinalysis testing on urine, feces, and gastric contents (Bence Jones protein, Watson-Schwartz differentiation test, Hoesch screening test, osmolality, myoglobin, urine pregnancy test (HCT), stool and gastric occult blood tests)
- Demonstrate knowledge of body fluid counts
- Demonstrate knowledge of fluid cytospin preparation and morphology

**Task inventory note:** The entries constituting this inventory are considered to be representative of the laboratory practitioner's role. This document should be considered dynamic, to reflect the practitioner's current role with respect to contemporary health care. Therefore, entries may be added, removed, or modified on an ongoing basis, without notice.