Examination Guide

American Board of Medical Laboratory Immunology

The American Board of Medical Laboratory Immunology
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GENERAL INFORMATION

WHAT IS THE ABMLI?
The American Board of Medical Laboratory Immunology (ABMLI) was established in 1975 to test the expertise of immunologists. Board-certified immunologists are adjudged capable to direct laboratories engaged in the practice of medical laboratory immunology. ABMLI certification is recognized by federal and state governmental agencies as a significant component toward meeting licensure requirements to direct laboratories engaged in the immunological diagnosis of human disease and is recognized under the Clinical Laboratory Improvement Amendments of 1988. Certification by the ABMLI is the highest credential available to practicing medical laboratory immunologists. ABMLI certification reflects the standards of professional expertise and knowledge of immunology as practiced in the United States. While available to candidates worldwide, the examination is not intended to be international in scope or utility.

WHAT IS CERTIFICATION?
Certification is the process by which a non-governmental agency or association grants recognition of competence to an individual who has met certain predetermined qualifications as specified by the agency or association.

WHAT IS MEDICAL LABORATORY IMMUNOLOGY?
Medical laboratory immunology is the science concerned with the study of all components of the immune system in healthy and diseased individuals. In particular, it is concerned with performance, development, and interpretation of immunologic tests. Medical laboratory immunology includes the following major areas:

- General principles of immunology
- Basic science relevant to medical laboratory immunology
- Cellular components of the immunologic response
- Humeral components of the immunologic response
- Complement
- Immunogenetics
- Inflammatory substances and mediators
- Granulocytes and monocytes-macrophages
- Autoantibodies
- Microbial immunity
- Immunoproliferative disorders and malignancies of the hematopic system
- Immediate hypersensitivity (e.g., allergy)
- Delayed hypersensitivity
- Major techniques, including cellular, serological, and molecular, in medical laboratory immunology
- Laboratory management and regulatory issues
- Instrumentation

WHEN AND WHERE ARE THE EXAMINATIONS GIVEN?
The examination is administered each spring on-site at the ASM General Meeting.
ABOUT THE EXAMINATION

OBJECTIVE

The objective is to measure the candidate’s knowledge, problem-solving abilities, and clinical judgment in subject areas considered necessary for the effective directorship of a laboratory engaged in the practice of medical laboratory immunology.

EXAMINATION FORMAT

It is a written examination composed of 200 multiple-choice questions and is divided into two sections.

EXAMINATION CONTENT

The first section, comprised of 20 questions, contains five case studies, each of which is followed by a series of associated questions based on major topics involved in medical laboratory immunology. Each case study is presented in the form of a case history, clinical situation, or other problem similar to one that may be faced by a medical immunology laboratory director. The questions address the following three areas:

- **Clinical implications.** Indications, interpretations, correlations.
- **Technical aspects.** Principles, limitations, rationale, comparison of methods.
- **Laboratory practice.** Specimen handling and distribution, quality control, standards and reference centers, data handling and reporting, personnel and training.

The second section of the exam is comprised of 180 questions. These questions are distributed among three broad areas and 28 specific categories that are described below:

**Domain I: Basic Immunologic Mechanisms.**
This domain comprises approximately 25% of the examination. Eight categories are included under this domain. Suggested topics to study include, but are not limited to, the following:

- Antigens and antibodies. The classes of antibodies, structure and function of antibodies, chemistry of antigen-antibody interactions, determination of affinity and avidity.

- Cells and tissues involved in the immune system. Lymphocytes, monocytes, macrophages, neutrophils, eosinophils, basophils; cell subpopulations; cell markers; functional differentiation and maturation; role in the immune response; lymph node, spleen, thymus, mucosal-associated lymphoid tissue, and bone marrow structure and function.
• Cell cooperation and immune regulation. Cellular interactions among the various cells involved in immune responsiveness; cellular activation, signal transduction, and apoptosis; immunization and adjuvants; adhesion molecules; major histocompatibility complex (MHC) restriction; mechanisms of action of immunosuppressive and immunomodulatory drugs.

• Effector mechanisms. Protective and destructive effects of immunologic reactions on the host, microbial and tumor immunity, autoimmunity, transplantation immunity, and immunotherapy.

• Inflammation. The process of inflammation and the cells involved; phagocytosis; the factors involved (excluding complement).

• Mediators. Cytokines, lymphokines, chemokines, and soluble molecules involved in the immune response and in innate immunity.

• Molecular immunology. Structure of immunoglobulin (Ig) and T-cell receptor genes, other receptor genes, and mediator genes; generation of diversity.

• Complement. Structure and function of complement proteins.

**Domain II: Methodology.**
This domain comprises approximately 35% of the examination. Eleven categories are included under this domain. Suggested topics to study include, but are not limited to:

• Assays of soluble and particulate antigen/antibody reactions. Precipitation, agglutination, flocculation, hemolysis, etc.; which methods to use in given circumstances.

• Complement assays. Various procedures to measure concentration and activity of complement components, calculations, specimen collection.

• Immunoassays for soluble antigens or antibodies. Radioimmunoassay (RIA), enzyme immunoassay (EIA), and the various configurations of such assays; appropriate use of these assays; advantages and disadvantages of the assays; calculations and interpretation of results.

• Immunohistology. Configuration, specificity controls, and appropriate use; specimen collection and processing; interpretation of results.

• Phagocyte assays. Types of procedures, appropriate use, specimen collection, controls, calculations, and interpretation of results.

• Cell-mediated immunity assays. In vitro and in vivo assays, including skin tests, proliferation, cytotoxicity, and mediator release assays; advantages and disadvantages of procedures; controls, calculations, and interpretation of results.
• Protein analysis and preparation. Chemicals and techniques used, purification, electrophoretic techniques, measurement.

• Quality assurance and laboratory management. Regulatory and legal issues; proficiency testing; laboratory safety; personnel requirements and testing qualifications; Federal laws and agencies (e.g., Clinical Laboratories Improvement Amendments [CLIA], Occupational Safety and Health Administration [OSHA], Centers for Disease Control and Prevention [CDC], Food and Drug Administration [FDA]; other agencies (e.g., College of American Pathologists [CAP], Joint Commission on Accreditation of Healthcare Organizations [JCAHO], American Society for Histocompatibility and Immunogenetics [ASHI], Clinical and Laboratory Standards Institute [formerly NCCLS]); quality control measurement and statistical analysis; critical pathways; cost of testing.

• Molecular biology-based techniques. Principles and performance of Southern, Northern, and Western blots, PCR, restriction fragment length polymorphism; various DNA- and RNA-based analyses; fluorescent in situ hybridization (FISH); microarray technology; sequencing; advantages and disadvantages.

• Instrumentation. Microscopy, image analysis, automated immunoassay systems, and other instruments and equipment used in a clinical immunology laboratory; the use of these instruments, basic understanding of the principles of operation, controls, calibration, and quality assurance related to the procedures.

• Flow cytometry. Types of procedures, specimen collection, controls, interpretation of histograms, cluster of differentiation (CD) nomenclature, selection of reagents, gating.

**DOMAIN III: Immunodiagnosis and Clinical Laboratory Correlation.**

This domain comprises approximately 40% of the examination. Nine categories are included under this domain. Suggested topics to study include, but are not limited to:

• Critical evaluation of laboratory tests. Decision-making strategies for test selection and implementation; preanalytical variables, including proper and appropriate specimen collection and transport; pretest clinical consultation; critical interpretation of test results; test algorithms and result reporting; predictive value of results.

• Infectious diseases. Diagnostic strategies based on disease processes, appropriate selection of tests, timing and analysis of appropriate specimen for disease staging based on immunologic analysis.

• Autoimmune diseases. Various systemic autoimmune diseases, including hemolytic and collagen-vascular diseases; diagnostic tests available and advantages or disadvantages of each; interpretation of test results.

• Organ-specific autoimmune diseases. Diseases of various organs and associated immunologic causes or parameters; tests and interpretation of results.

• Immunodeficiency disorders. Tests for differential diagnosis of immunodeficiencies, acquired (including HIV infection) and congenital immunodeficiencies, monitoring and prognostic tests, interpretation of results.
• Leukemias, lymphomas, multiple myeloma, and other immunoproliferative disorders. Tests for differential diagnosis of immunoproliferative disorders, monitoring and prognostic tests, interpretation of results.

• Allergic diseases. Allergen identification, evaluation of therapy.

• Transplantation. HLA system and MHC antigens, HLA matching and detection of humoral sensitization, ABO-Rh compatibility, analysis of rejection or tolerance, stem cell collection and enumeration, posttransplant complications and monitoring.

• Tumor markers. Prognosis, staging, monitoring effects of therapy.

QUESTION FORMAT

• Each question is multiple-choice with one correct answer.

• Questions have a stem and four or five possible responses.

• In some cases, questions may require calculations. Examples of such questions include assessment of sensitivity, specificity, dilution factors, and cost-accounting results.

• Two types of questions are incorporated in the examination:
  - Questions designed to test basic recall knowledge, direct interpretation of data, or simple synthesis of information.
  - Questions that require a higher level of thought process, reasoning skills, or interpretation to arrive at the correct answer.

• Questions are updated and reevaluated every year by the examination committee, which consists of five or six ABMLI Diplomates. Candidates should expect to see questions on technical advances or immunologic issues that occurred during the past year.

• There is no penalty for guessing.
EXAMINATION PREPARATION SUGGESTIONS

Laboratory experience is the single most important way to prepare for the examination. It is important to become familiar with all areas of the laboratory, including administrative functions, serology, flow cytometry, molecular diagnostics, and laboratory instrumentation. In addition, examinees have identified the following activities as beneficial for examination preparation:

- Studying clinical and basic immunology textbooks and reference manuals such as *Manual of Clinical Immunology* and *Manual of Clinical Microbiology* (both published by ASM Press).
- Reviewing recent articles in clinical immunology- and laboratory-oriented journals, CAP inspection checklists, manufacturer’s technical manuals and procedures, and laboratory procedural manuals.
- Working in or visiting those areas of the laboratory (e.g., flow cytometry, autoimmunity, infectious disease serology, electrophoresis, administration) with which the candidate is less familiar.
- Attending rounds in immunology, tumor, transplantation, transfusion, infectious disease, etc.

EXAMINATION ADMINISTRATION

- The examination is administered on-site at the ASM General Meeting.
- Proctors will supervise the examination. Candidates are allowed four hours to complete the examination. The time allotted is considered to be much greater than required for answering the questions, but the committee does not wish time constraints to be a factor in performance.
- Bring several #2 lead pencils and a legal document with your photograph and signature to the examination. Acceptable legal documents are a driver’s license, government identification card, passport, or notarized photograph bearing your signature.
- Reference materials and calculators are not permitted.
- Results will not be released by telephone.

SCORING

- The examination answer sheets are scored electronically. Scores falling within two points of the passing score are verified by hand.
- The ABMLI uses a criterion-referenced scoring system. This method sets a standard of performance in absolute, not relative, terms. As a result, candidates are not graded on a curve and do not compete against each other. Each question is rated
individually by its relative difficulty and scored according to a predetermined standard of performance determined by a consensus of at least five examination committee members. Thus, if more difficult questions are chosen for a particular examination, the passing score will be lower than that of another examination of equal length but consisting of easier questions, as determined by the examination committee. Each candidate’s score is based only on the number of correct answers; there is no comparison among candidates.

- After the examination has been scored, the examination committee evaluates the responses. Occasionally, questions fail to perform as expected and are dropped from the scoring; the examinations are then rescored.

- Examination results are mailed to candidates within 10 to 12 weeks. Results are not released over the telephone.

- The ABMLI does not encourage examinees with scores close to passing to request hand-scoring. Examinations that are close to the passing score are automatically hand-scored. Any hand-scoring requests must be submitted, in writing, within 30 days of notification and be accompanied by a $25.00 fee.

**SAMPLE QUESTIONS**

The sample questions included in this examination guide are actual questions from previous examinations. They have been removed from the question pool. Do not judge the content as indicative of content in current questions, but use these sample questions as templates for the format.

*Section 1: Sample Case Study and Related Questions*

The following case study is related to the next four questions in bold:

An obstetrician evaluated a 32-year-old female for problems with repeated miscarriages. All miscarriages have occurred in the second or third trimester. In each miscarriage there was no evidence of anatomic, genetic, or hormonal causes. A notable pathological finding in the last miscarriage was placental thrombosis. Of interest was the report that the patient had a false-positive serological test for syphilis. The physician considered an autoimmune disorder in the patient’s differential diagnosis. The physician ordered tests and the laboratory results are shown in Table 1.

**Table 1.**

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
<th>Reference range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antinuclear antibodies</td>
<td>Negative</td>
<td>Negative</td>
</tr>
<tr>
<td>Anti-ds-DNA antibodies</td>
<td>Negative</td>
<td>Negative</td>
</tr>
<tr>
<td>Platelet counts</td>
<td>60 K/µl</td>
<td>150 – 400 K/µl</td>
</tr>
<tr>
<td>Urine protein</td>
<td>3+</td>
<td>Negative</td>
</tr>
<tr>
<td>Activated partial thromboplastin time</td>
<td>&gt;40 seconds</td>
<td>24-35 seconds</td>
</tr>
</tbody>
</table>
1. What is the most probable clinical diagnosis?
   a. Idiopathic thrombocytopenic purpura
   b. Systemic lupus erythematosus (SLE)
   c. Thromboangiitis obliterans
   d. Antiphospholipid antibody syndrome

2. Cross-reactivity with which antigen would cause a false-positive syphilis test result for this patient?
   a. Cardiolipin
   b. Protein C and S
   c. Annexins
   d. Myeloperoxidase

3. What subsequent test(s) would you suggest that the physician order?
   a. Anti-SSA antibody
   b. Anti-phospholipid antibodies and anti-β2-glycoprotein
   c. Anti-platelet antibody
   d. C-ANCA

4. You are considering bringing an assay for anti-phospholipid measurement into your laboratory. This test is currently sent to another laboratory. As part of the validation study, you have found a considerable degree of interlaboratory variation. What technical area(s) should be evaluated for these variations?
   a. Sample volume
   b. Sample storage
   c. Calibration curve used and units of measurement
   d. Operator pipetting technique

Section 2: Sample Questions for Remainder of Exam

5. Which of the following cell surface markers are normally associated with both T and B cells?
   a. CD19 antigens
   b. Receptors for tumor necrosis factor (TNF)
   c. CD3 antigens
   d. MHC class I (MHC-I) gene products
   e. CD2 antigens

6. The skin biopsy of a patient having a delayed hypersensitivity reaction is characterized by:
   a. the deposition of Ig and complement in the arterial wall.
   b. neutrophil infiltrates around arteries.
   c. necrosis of the epidermis.
   d. mononuclear cell infiltrates surrounding small vessels.
   e. edema.

7. Serum samples from patients on heparin therapy, particularly those receiving renal dialysis, may contain fragments of fibrin. In solid-phase RIA for HBsAg with polystyrene beads, these fragments:
   a. produce false-negative results by trapping radiolabeled antibody.
   b. trap radiolabeled antibody on the bead with resulting false positives.
   c. interfere with binding of the radiolabeled antibody on the bead.
   d. do not affect the specificity of the test result.

8. In a patient with a positive antinuclear antibody (ANA) and a history compatible with systemic lupus erythematosus (SLE), the MOST specific test is:
   a. anti-single-stranded DNA (anti-ssDNA).
   b. anti-double-stranded DNA (anti-dsDNA).
c. anti-Ro.
d. positive immunofluorescence of uninvolved skin with an intracellular pattern.
e. anti-RNP.

9. Interleukin-3 (IL-3) stimulates:
   a. hematopoiesis of lymphoid and myeloid stems.
   b. development of lymphokine-activated killer (LAK) cells.
   c. generation of NK cells.
   d. proliferation of helper T cells.
   e. differentiation of NK cells.

10. A cell with phenotype CD2\(^-\), terminal deoxynucleotidyltransferase negative (TdT\(^-\)), HLA-DR\(^+\), slg\(^-\), clg\(^+\) is MOST likely to be a:
   a. monoblast.
   b. pre-B cell.
   c. mature B cell.
   d. plasma cell.
   e. myeloblast.

11. Optimal efficiency of PCR is obtained when primers:
   a. are random hexamers.
   b. are complementary to sequences which are over 5,000 bp apart.
   c. are complementary to positive DNA strands.
   d. are complementary to negative DNA strands.
   e. complement both positive and negative DNA strands.

12. Antibodies to polysaccharides in humans are MOST likely to be of which one of the following isotypes?
   a. IgG1
   b. IgG2
   c. IgG3
   d. IgG4
   e. IgA2

13. Which of the following best correlates with active SLE?
   a. Deposition of Ig and complement along the glomerular basement membrane
   b. High-titer ANAs and anti-centromere antibodies
   c. Circulating cryoglobulin complexes formed by IgM-IgG aggregates
   d. Antibodies to dsDNA and depressed levels of serum complement

14. The marginal zone of a secondary follicle contains high numbers of:
   a. activated T cells.
   b. nonactivated B cells.
   c. dendritic macrophages.
   d. large cleaved lymphocytes.
   e. equal mixtures of T and B cells.

15. Laboratory diagnosis of Goodpasture’s syndrome is largely dependent on the demonstration of:
   a. anti-glomerular basement membrane antibodies in serum by complement fixation.
   b. lumpy staining of glomerular basement membrane by electron microscopy.
   c. linear staining of tubular basement membrane by indirect immunofluorescence.
   d. linear staining of glomerular basement membrane by indirect immunofluorescence.
   e. antibody in kidneys cross-reactive with cardiac sarcolemma.
16. A 62-year-old female with progressive rheumatoid arthritis and a tubular-type proteinuria by urine electrophoresis has a positive heat test for Bence Jones proteins in concentrated urine. The MOST probable cause is:

   a. marked increase of polyclonal light chains.
   b. gamma heavy-chain disease.
   c. light-chain disease.
   d. plasma cell myeloma.
   e. non-Hodgkin’s lymphoma.

17. The following results are obtained by nephelometry from a patient suspected of having hereditary angioedema.

<table>
<thead>
<tr>
<th>Test</th>
<th>Result (mg/dl)</th>
<th>Reference range (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IgG</td>
<td>1,158</td>
<td>723–1,685</td>
</tr>
<tr>
<td>IgA</td>
<td>221</td>
<td>69–312</td>
</tr>
<tr>
<td>IgM</td>
<td>144</td>
<td>56–353</td>
</tr>
<tr>
<td>C3</td>
<td>127</td>
<td>83–177</td>
</tr>
<tr>
<td>C4</td>
<td>29</td>
<td>12–43</td>
</tr>
<tr>
<td>C1 esterase inhibitor</td>
<td>17.3</td>
<td>11.5–19.5</td>
</tr>
</tbody>
</table>

The physician calls and explains that the patient appears to have a classic case of hereditary angioedema, but the laboratory results do not confirm this. What additional tests would you recommend?

   a. C3b inactivator, functional
   b. C3 activator
   c. CH50
   d. C1 esterase inhibitor, functional
   e. Total C1

18. A 35-year-old man presents with a history of episodic subcutaneous swelling and incapacitating, colicky, abdominal pain lasting 1 to 3 days that is sometimes associated with nausea and vomiting. The abdominal pain occurs independently of the swelling. He has also had episodes of swelling in the throat. He has a positive family history: his mother had similar episodes when she was younger; one son has similar attacks; another son is completely normal. Several distant cousins have the same symptoms.

Physical examination shows a male in no acute distress. Height, 5’ 11”; weight, 177 lb; blood pressure, 125/80 mm/Hg, pulse, 82 beats/min. The rest of the examination is unremarkable.

The laboratory data include the following results:

<table>
<thead>
<tr>
<th>Test</th>
<th>Result (mg/dl)</th>
<th>Reference range (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemoglobin</td>
<td>14 g/dl</td>
<td></td>
</tr>
<tr>
<td>Hematocrit</td>
<td>48%</td>
<td></td>
</tr>
<tr>
<td>White blood cells (WBC)</td>
<td>8,000/mm³</td>
<td></td>
</tr>
<tr>
<td>Differential</td>
<td>26% lymphocytes</td>
<td>68% segmented neutrophils</td>
</tr>
<tr>
<td></td>
<td>3% monocytes</td>
<td>2% eosinophils</td>
</tr>
<tr>
<td></td>
<td>1% basophils</td>
<td></td>
</tr>
</tbody>
</table>

Electrocardiogram, SMA-12, chest X-ray, and urinalysis results were within normal limits. Which of the following tests is more likely to be abnormal in this patient?

   a. CH50
   b. C3
   c. C4
   d. C5
   e. IgE
19. Which of the following characteristics is shared by radioimmunoprecipitation (RIPA) and Western blot assays for specific antibodies recognizing viral antigens?
   a. An electrophoretic step is required to separate the viral antigens on the basis of molecular weight.
   b. The antigen-antibody reaction takes place before the electrophoretic step.
   c. The viral antigens are radiolabeled.
   d. An enzyme-conjugated goat anti-mouse Ig reagent is used.

20. Which of the following approaches would be best to deal with the problem of an increasing number of celebrations (birthdays, etc.) by laboratory personnel during normal working hours?
   a. Prohibit all celebrations except on break time and lunch periods.
   b. Predesignate a reasonable time for all celebrations each month, chosen to least interfere with laboratory performance.
   c. Allow each section supervisor to deal with the problem.
   d. Act only if you have gathered data showing that celebrations are interfering with laboratory performance and productivity.

21. Isoelectric focusing is a technique that can be used to analyze proteins. Which of the following is true of isoelectric focusing?
   a. It is commonly used to quantitate IgA.
   b. It separates proteins in an aqueous environment where one is able to maintain a net charge of +1 on the proteins.
   c. It is restricted to the analysis only in an acidic environment (pH < 6).
   d. It is restricted to the analysis only in an alkaline environment (pH > 6).
   e. It separates proteins based on the pH at which the net charge on a protein is zero.

22. The skin biopsy of a patient having a Jones-Mote reaction is characterized by:
   a. a deposit of Igs and complement in the arterial wall.
   b. neutrophils around the arteries.
   c. basophil-rich infiltrates in the dermis.
   d. mononuclear cell infiltrates surrounding small vessels.
   e. subcutaneous edema.

23. The finding by nephelometry of low IgG, IgA, and IgM levels in a patient with a monoclonal protein of gamma mobility (8 g/dl) and no Bence Jones protein should first be followed by:
   a. repeating the assay of IgG, IgA, and IgM with higher dilutions of serum.
   b. immunofixation using anti-IgD and anti-IgE.
   c. repeating the assay with different antisera.
   d. reevaluating the quality control in your laboratory.
   e. reassignment of the technician in charge of the nephelometer.

24. In the direct antiglobulin test (DAT), it is essential that the antiglobulin reagent contain anti-IgG antibodies and:
   a. anti-IgM antibodies.
   b. anti-C1r antibodies.
   c. anti-C3d antibodies.
   d. anti-P antibodies.
   e. anti-MN antibodies.

25. Prekallikrein can be activated by:
   a. components of the extrinsic pathway of coagulation.
   b. tissue thromboplastin and coagulation factor IX.
   c. plasmin and coagulation factor Xa.
   d. thrombin and kininogen.
   e. activated factor XII.
26. Chronic inflammation in response to foreign bodies is characterized by the accumulation of:
   a. polymorphonuclear leukocytes.
   b. sensitized T lymphocytes.
   c. platelets.
   d. macrophages.
   e. basophils.

27. Which of the following factors attracts neutrophils?
   a. C-reactive protein
   b. Soluble antibody-antigen complexes
   c. C5a
   d. IL-2
   e. Amyloid A protein

28. Which of the following cell types are positive for TdT analysis by immunofluorescence?
   a. Germinal center cells
   b. Resting cells in diffuse cortex
   c. Plasma cells
   d. Peripheral T cells
   e. Mantle cells

29. The finding of a positive result with the serum control in a complement fixation test is MOST likely explained by the presence of:
   a. anti-Forssman antibodies.
   b. anti-human red blood cell antibodies.
   c. free antigen in circulation.
   d. high levels of heat-labile IgE.
   e. soluble immune complexes.

30. An activated CD4-positive lymphocyte will:
   a. recognize antigens associated with MHC-I.
   b. release large amounts of IL-2.
   c. interact with CD2+ lymphocytes.
   d. interact with antigen-presenting cells through the MHC-I molecule.
   e. express MHC-I molecules but NOT MHC-II molecules on its membrane.

31. The radioallergosorbent test (RAST) is used instead of a skin test under which of the following circumstances?
   a. The suspected allergen is not present.
   b. The patient is very young.
   c. C1q binds to an IgE-allergen complex in patient serum.
   d. IgG antibody to suspected allergen interferes with the skin test.
   e. The patient has hypogammaglobulinemia.

32. The lectin pathway leads to activation of the classical complement pathway through:
   a. antibody binding.
   b. production of C1 complex.
   c. mannose-binding lectin (MBL) and activation of MBL-associated serum proteases (MASP).
   d. C5 convertase.
   e. decay-accelerating factor (DAF).
33. Which one of the following statements demonstrates the linkage disequilibrium of HLA-A1 and HLA-B8 alleles in the Caucasian population?

a. The observed A1-B8 haplotype frequency is usually higher than the expected frequency.
b. The observed A1-B8 haplotype frequency is usually lower than the expected frequency.
c. The observed A1-B8 haplotype frequency is the same as the expected frequency.
d. The observed A1-B8 haplotype frequency is the sum of the A1 and B8 gene frequencies.
e. The observed A1-B8 haplotype frequency is the product of the A1 and B8 gene frequencies.

34. The function of MHC-I molecules is to present:

a. endogenous antigen peptides to T helper cells.
b. exogenous antigen peptides to T cells.
c. processed antigen peptides to CD4+ T cells.
d. processed antigen peptides to CD8+ T cells.
e. processed antigen peptides to B cells.

35. The function of MHC-II molecules is to present:

a. exogenous antigen peptides to T killer cells.
b. endogenous antigen peptides to T cells.
c. processed antigen peptides to CD4+ T cells.
d. processed antigen peptides to CD8+ T cells.
e. intact antigen molecules to B cells.

**Answers**

1. d  11. e  21. e  31. b
2. a  12. b  22. c  32. c
3. b  13. d  23. a  33. a
4. c  14. b  24. c  34. d
5. d  15. d  25. e  35. c
7. b  17. d  27. c
8. b  18. c  28. a
9. a  19. b  29. e
10. b  20. b  30. b
ELIGIBILITY

ABMLI candidates must demonstrate appropriate education, postdoctoral training, and/or work experience. Each candidate must apply under one of four plans.

<table>
<thead>
<tr>
<th>Plan</th>
<th>Education</th>
<th>Acceptable Postdoctoral training (years)</th>
<th>Acceptable Postdoctoral experience (years)</th>
<th>Total years of training and experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan A</td>
<td>Earned doctorate as defined below.</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Plan B</td>
<td></td>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Plan C</td>
<td></td>
<td>0</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>ABMM Diplomates</td>
<td></td>
<td>0</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

**Education:** Applicants must possess an earned Doctor of Philosophy (Ph.D.), Doctor of Science (D.Sc.) or Doctor of Medicine (M.D.) degree with special training and experience in immunology or clinical laboratory immunology. The degrees of Doctor of Osteopathy (D.O.), Doctor of Veterinary Medicine (D.V.M.), Doctor of Public Health (D.P.H.), or Doctor of Dental Surgery (D.D.S.) may be accepted if the candidate's postdoctoral training and experience is deemed appropriate by the Credentials Committee. Degrees must have been granted by member institutions of the American Medical Association, veterinary schools accredited by the American Veterinary Medical Association, or by other institutions having satisfactory standards in the opinion of the Board. Applicants educated outside of the United States must have their education evaluated by an approved foreign credential evaluation agency (see list under "How to Apply").

**Postdoctoral Training:** Postdoctoral training must be gained in a setting where a broad range of immunologic procedures are performed under the direction of a qualified immunologist. This setting should be in conjunction with either a clinically oriented immunology service or a basic research laboratory utilizing multiple procedures applicable to medical laboratory immunology.
**Postdoctoral Experience:** Postdoctoral experience is time spent in a laboratory actively involved in medical laboratory immunology as defined by this Board and should involve familiarity and direct experience with a broad range of diagnostic procedures, including interpretation and laboratory management, as well as supervisory duties.

All training and experience requirements must be gained after receipt of the doctoral degree.

Candidates may apply up to one year prior to completion of all experience requirements although all eligibility requirements must be met before the examination process can begin. Eligibility is determined on a case-by-case basis by the Credentials Committee. Once notified, eligible candidates have two examination periods in which to begin the examination process. The exam will next be administered in the spring of 2007 on site at the ASM General Meeting. Beginning in 2008, the exam will be administered every other year (i.e., 2008, 2010, 2012, etc.) on site at the ASM General Meeting.

**How Do I Apply?**

Applications and supporting documents must be received no later than February 1, 2007 for the examination that will be administered in the spring of that year. **Submit the following to be evaluated for examination eligibility:**

1. ABMLI Application Form: Application form must be completed and notarized. It is available online at [www.asm.org/college](http://www.asm.org/college).

2. Official Graduate Transcripts: Transcripts must be mailed directly to the ABMLI from issuing institutions within the United States. Photocopies will not be accepted. All educational requirements must be met through institutions accredited by a regulatory agency recognized by the U.S. Department of Education. **Note:** If the name on your transcript(s) does not match the name on your application form and reference letters, you must submit a notarized copy of your marriage license or name change certificate with your application.

If you were educated outside the United States, your graduate transcripts must be evaluated by a foreign educational evaluation agency, a process which may take several months. Transcripts received directly from a foreign institution or translation of transcripts from such institutions will not be accepted by the ABMLI. For applicants to be considered eligible to sit for the ABMLI examination, their degrees earned outside the United States must be deemed equivalent to those earned at an accredited institution in the United States.
International Transcripts. Evaluations of transcripts from institutions outside the United States will be accepted from the following agencies:

Center for Applied Research, Evaluation and Education, Inc.
P.O. Box 20348
Long Beach, CA 90801
Telephone: 562-430-1105
Fax: 562-430-8215
E-mail: evalcaree@earthlink.net

International Educational Research Foundation, Inc.
P.O. Box 3665
Culver City, California 90231-3665
Telephone: 310-258-9451
Fax: 310-342-7086
E-mail: info@ierf.org

Josef Slimy & Associates, Inc.
7101 SW 102 Avenue
Miami, FL 33173
Telephone: 305-273-1616
Fax: 305-273-1338
E-mail: info@jsilny.com

World Education Services, Inc.
P.O. Box 745
Old Chelsea Station
New York, New York 10113-0745
Telephone: 212-966-6311
Fax: 212-966-6395
E-mail: info@wes.org

3. Letters of Reference: Three letters of reference must be submitted; one letter must be from an immediate supervisor, and two must be from persons (not related to you) having definite knowledge of your training and experience qualifications.

4. Examination Fee: ASM members are eligible for discounts on all examination and reexamination fees. The fee for ASM members is $600, and the fee for non-members is $657. This fee must be submitted with the application. Cash will not be accepted.

Remember that a complete application consists of the following:

- Completed, notarized application form
- Official graduate transcripts or transcript evaluation, if educated outside the United States
- Notarized copy of your marriage license or name change certificate, if applicable
- Letters of reference
- Application fee

Supporting documents will not be returned to applicants.

Incomplete or ineligible applications will be withdrawn after the deadline and returned with a partial refund (application fee minus a 25% processing fee).
WHEN WILL I BE NOTIFIED OF THE RESULTS?
Examination results are mailed within 10 to 12 weeks. Results are not released by telephone.

WHAT IF I FAIL THE EXAMINATION?
The reexamination fee is $400 for ASM members and $457 for non-members. Candidates have up to three opportunities within four examination cycles to pass the examination. Additionally, applications not active (no examinations taken) for two consecutive examination periods will be withdrawn. Subsequent reexamination requires a new application with full fee.

APPEALS
If you wish to appeal any part of the application or examination process, you must submit your concerns, in writing, to the ABMLI. Your concerns will be addressed; you will not be permitted to review any portion of your examination.

The ABMLI does not release or disclose the content or answers for specific test items. Incorrect responses will not be reported when requesting a review.

A NOTE TO CANDIDATES:
It is ABMLI policy not to discriminate on the basis of race, religion, national origin, sex, mental or physical disability, or age. The ABMLI complies with the policies set forth by the Americans with Disabilities Act.

The ABMLI is prepared to assist you in applying for Board certification. Questions or comments about the ABMLI and its certification programs are welcome and may be directed to the ABMLI at the following address:

American College of Microbiology
American Society for Microbiology
1752 N Street, NW
Washington, DC 20036-2904
tel: (202) 942-9281
fax: (202) 942-9353
E-mail: certification@asmusa.org