



American Board of Medical Microbiology (ABMM) Exam

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Eligibility Requirements

The ABMM Board uses the following criteria to evaluate your application to sit for the exam. If you fail to meet these criteria, your application will be denied and your application fee will not be refunded.

You must meet the criteria in one of the plans below to apply and sit in for the ABMM exam:

PLAN I: Applicants must possess a doctorate and complete a minimum of three years of experience, as defined below.

PLAN II: Applicants must possess a doctorate and complete two years of postgraduate training in a CPEP-approved program, as defined below.

PLAN III: Applicants must possess a doctorate and complete:

- i. an ACGME-accredited fellowship program in Medical Microbiology or
- ii. a Canadian College of Microbiologists' (CCM) Fellowship Training Program or
- iii. a Royal College of Physicians and Surgeons of Canada three-year medical microbiology/infectious disease or five-year medical microbiology residency.

All training and experience requirements must be met after the doctoral degree has been awarded.

EDUCATION

Applicants must possess a Doctorate of Philosophy or Doctorate of Science in microbiology or an equivalent degree in one of the related sciences acceptable to the ABMM Board. Other degrees (such as Doctor of Medicine, Doctor of Osteopathy, Doctor of Veterinary Medicine, Doctor of Public Health, Doctor of Dental Medicine, Doctor of Dental Surgery or Doctor of Philosophy in Health Sciences) may be accepted if your additional special training and experience is approved by the ABMM Board. Doctorate of Clinical Laboratory Sciences (DCLS) and Doctor of Pharmacy (PharmD) degrees are not an acceptable degree for ABMM eligibility.

- Applicants educated in the U.S.
 - All educational requirements must be earned from institutions accredited by a regulatory agency recognized by the U.S. Department of Education.
- Applicants educated in Canada
 - All educational requirements must be earned from institutions recognized by the Ministry of Education of the province in which each school is located.
- Applicants educated outside the U.S. or Canada
 - Degrees must be deemed equivalent to those earned at an accredited institution in the U.S. by World Education Services, Inc.

EXPERIENCE

Experience is defined as full-time postdoctoral training and/or full-time director-level laboratory experience which is directly relevant to the practice of clinical and public health microbiology and its subspecialties. Appropriate experience requires an ongoing relationship with a clinical and public health

microbiology, reference or other microbiology laboratory that includes a diagnostic service component such that the applicant has devoted at least 75% of his/her time to management, clinical and administrative activities during the three years of experience. Diverse professional experience means working at the director level or training in a CLIA-certified clinical/public health microbiology laboratory for at least three years, with recommended distribution of experience in the following manner:

- Responsibilities and skills in the clinical or public health microbiology laboratory (50-65%).
References should provide examples of:
 - Assisting clinical and public health microbiology technologists in interpreting the medical significance of laboratory findings.
 - Oversight of quality assurance/quality control.
 - Technical troubleshooting and problem solving.
 - Validation/verification of new tests
 - Regular review of laboratory procedures
- Interaction with healthcare providers (15-30%).
References should provide examples of:
 - Consultation with healthcare providers regarding the selection and interpretation of clinical and public health microbiology tests/results.
 - Consultation with local and state public health officials.
 - Reference lab consultation with clients.
 - Participation in hospital/institution committees (infection control, antibiotic subcommittee, etc.).
- Management and administrative skills (10-20%).
References should provide examples of:
 - Interacting with institutional and laboratory administration and personnel.
 - Performing financial analyses on new test methods or laboratory programs.
 - Assuring/overseeing accreditation, competency, proficiency testing, etc.
- Research (0-25%).
References should provide examples of:
 - Development/evaluation of new test methods/techniques/instrumentation.
 - Collaboration with clinical and public health microbiology/basic research colleagues.
- Teaching (0-25%).
References should provide examples of:
 - Didactic lectures and rounds.
 - Resident/fellow/student training.

A laboratory director who is qualified to serve as a director of a CLIA-certified laboratory, or the country's equivalent, must attest to the candidate's experience.

The minimum percentages in each area must be met. Research and teaching experience are not required, but applicants may have up to 25% of their time devoted to either, or a combination, of those areas provided the combination does not exceed 25%. Experience in which more than 25% of time is spent on research, teaching, grant writing or test development does not satisfy the experience requirement.

Applicants who will complete the requisite training and experience within 60 days following the exam date are eligible to apply.

NON-CPEP RESIDENCIES

- An infectious disease (ID) fellowship may count towards the requisite experience if it meets the eligibility outlined above. Despite the length of fellowship, no more than one year's experience will count towards meeting the three years of required experience. Experience must involve an active role in the laboratory (e.g., attended rounds and completed a microbiology rotation) and must be documented by a reference form submitted by the director of microbiology.
- A pathology residency, devoted to microbiology and molecular pathology, may count towards the requisite experience if it meets the eligibility outlined above. No more than six month's experience will count towards meeting the three years of required experience. The number of months devoted to microbiology and molecular pathology during the residency must be specifically documented on the reference form.

Exam Information

The ABMM exam is offered once a year in June, at [testing centers](#) located around the world.

OBJECTIVE

To measure the applicant's knowledge in the four subject areas considered necessary for the effective practice of clinical and public health microbiology:

1. Directing Laboratory Testing Functions
2. Directing Laboratory Administrative Functions
3. Ensuring Safety and Security in the Laboratory
4. Consulting with Other Clinical and Public Health Microbiology Professionals

[Responsibilities and roster](#) of the Exam Development Subcommittees.

EXAM FORMAT

The computer-based exam consists of 200 multiple-choice questions with only one correct answer. Candidates can move forward and back through the questions while examining and are allowed six hours to complete the exam.

ON EXAM DAY

Please plan to arrive at the testing center no more than 15 minutes prior to your scheduled exam time. The check-in process should only take five minutes.

You must bring the following with you to the testing center:

- *Your Test Taker Authorization Code.* The proctor cannot launch the test without this code. This code will be included in the confirmation email you are sent when you register for the exam.
- *Two forms of identification, one must be a current, government-issued, photo ID such as:*
 - State-issued driver's license or identification card
 - Passport
 - Military identification
 - National identification card
- The other can be a non-photo identification such as:
 - Credit card
 - Check cashing card
 - Bank debit card
 - Student ID from an accredited school
 - Both forms of identification can be a government-issued photo ID.

NOTE: Both forms of ID must show your name exactly as it appears in your Webassessor profile.

RESPONSIBILITIES AND ROSTER OF SUBCOMMITTEES

ABMM Exam Development Subcommittee (EDS)

The primary responsibility of the EDS is overseeing the development of all examination questions. The subcommittee--

- ensures accuracy of questions in the exam question pool

- ensures there are a sufficient number of questions for each task
- ensures accuracy of documents available to examinees on <http://www.asm.org/abmm>
- reviews written examination questions
- reviews exam statistics and questions whose performance warrants review
- locates images as needed
- assigns writing tasks to Item Development Subcommittee members

In addition,

- EDS Chair coordinates review of exam questions
- EDS Chair, with the ABMM Board Chair and Vice Chair, reviews examination drafts and finalizes the exam. They also review written examination statistics and, when necessary, identify questions that should be removed from scoring.

Previous experience on the Item Development or Validation Subcommittees is preferred for new EDS members. A balance of gender, geographic location, and institution type (e.g., hospital, public health, reference, etc.) is sought when selecting members to add to the Subcommittee.

ABMM Diplomates who serve on EDS are Karissa D. Culbreath (Chair), Wade Aldous, J. Kristie Johnson, Sue C. Kehl, Margie A. Morgan, Melinda B. Nye, and Robert Tibbetts.

ABMM Item Development Subcommittee (IDS)

The ABMM IDS's primary responsibility is writing new exam questions. IDS members are typically recently certified Diplomates (within the past five years). Previous experience on the Validation Subcommittee is preferred. A balance of gender, geographic location, and institution type (e.g., hospital, public health, reference, etc.) is sought when selecting members to add to the Subcommittee.

ABMM Diplomates who serve on the IDS are Kendall A. Bryant, Blake Buchan, Sanchita Das, Mark Gonzalez, Brian Mochon, and Lars F. Westblade.

ABMM Validation Subcommittee (VS)

The ABMM VS is responsible for answering and commenting on examination questions.

New Validation Subcommittee members are recently certified Diplomates (within the past three years). A balance of gender, geographic location, and institution type (e.g., hospital, public health, reference, etc.) is sought when selecting members to add to the Subcommittee.

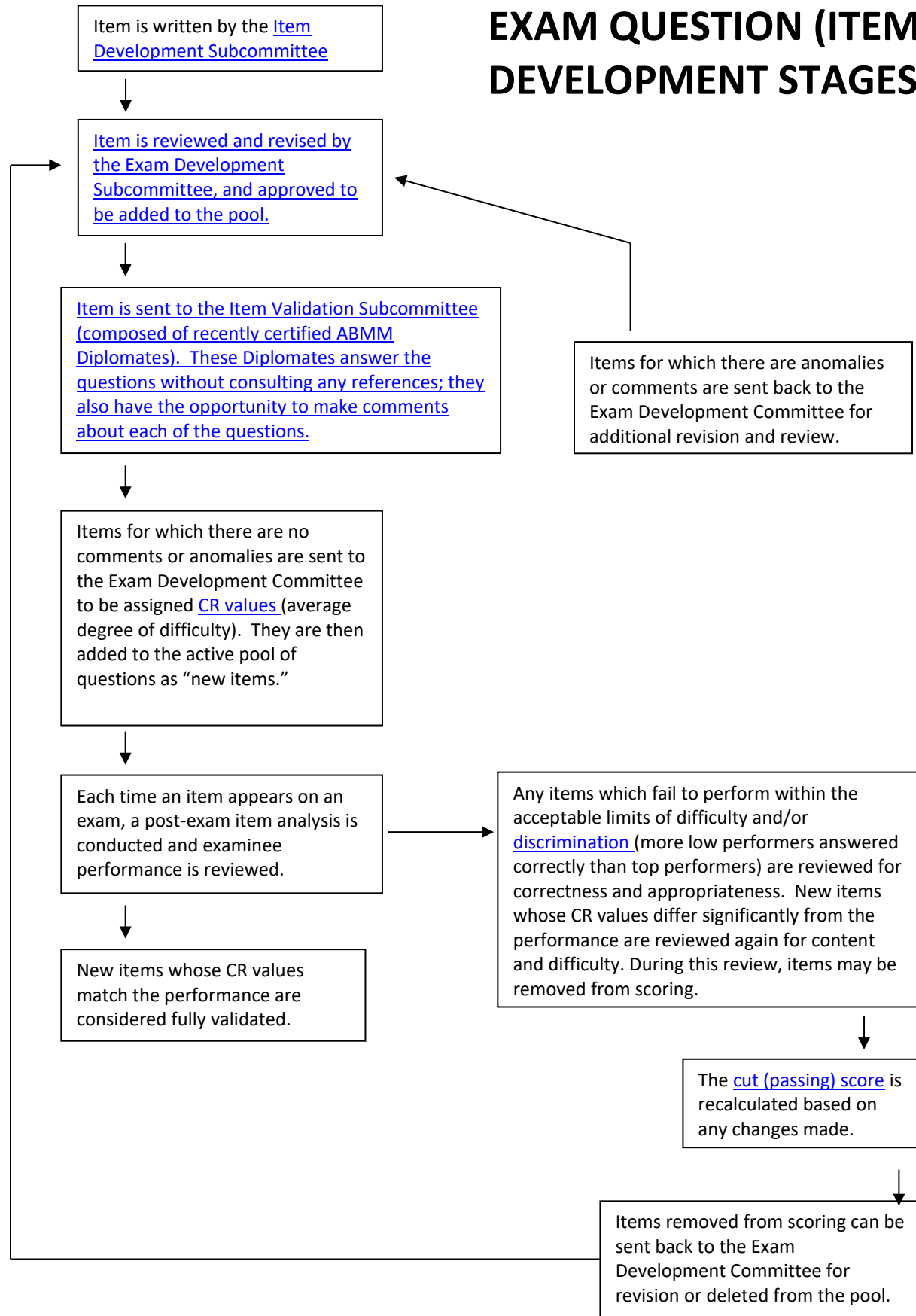
ABMM Diplomates who serve on the VS are Miguel Arroy-Cazurro, Allen Bateman, Rohit Chawla, Randal Fowler, Kurt Jerke, Brian Koeneman, Mark J. Lee, Rachel Liesman, Paul Luethy, Stephanie L. Mitchell, Chitra Pai, Mehul Panchal, Matthew Pettengill, Muhammad Rehan, Alessandro Rossi, Felix Roth, Salika Shakir, Kristen Smith, Christine Turenne, Tam Van, and Yun Ying.

ABOUT THE EXAM QUESTIONS

- Two types of questions are incorporated in the exam:
 - Questions designed to test the recall of basic knowledge, direct interpretation of data or simple synthesis of information.

- Questions that require a higher level of thought process, reasoning skills or interpretation of data to arrive at the correct answer.
- Any calculations needed on the exam will not require a calculator.
- Questions are reevaluated and updated annually. You should expect to see questions on technical advances or issues that occurred during the past year.

EXAM QUESTION (ITEM) DEVELOPMENT STAGES



SCORING

The ABMM uses a criterion-referenced scoring system.

You are not graded on a curve and do not compete against each other.

CRITERION-REFERENCING

The ABMM uses a criterion-referencing system (the modified Nedelsky method) to assign each item (question) a difficulty value. This value is determined by how difficult the Exam Development Committee perceives an item to be, which corresponds directly to the number of sophisticated distractors within the item.

Here is a simple example: Which body of the United States government has the power to declare war on another country?

- A. The Executive Branch (-1)
- B. The Congress (1)
- C. The Supreme Court (-2)
- D. The Federation of States (-2)

CR Value = 0.60; there is one sophisticated distractor.

KEY: Sophisticated Distractors	
1	Correct answer This is the only correct answer.
-1	Sophisticated distractor Examinees with <i>some knowledge</i> of the subject <i>might</i> choose this response.
-2	Non-sophisticated distractor Examinees with <i>minimum knowledge</i> of the subject <i>would not</i> choose this response.

KEY: CR Values		
Difficulty Value	# of Sophisticated Distractors	Expected Candidate Correct Response Rate*
.90	0	approximately 90% (relatively easy question)
.60	1	approximately 60%
.45	2	approximately 45%
.36	3	approximately 36% (very difficult question)

* This is the expected candidate correct response rate for a group of minimally competent examinees (i.e., those with just enough knowledge to competently perform the job being assessed by the exam). Actual candidate response rates may differ, depending on the strength (or weakness) of the candidates in a given year.

DISCRIMINATION

Discrimination is a function of how the highest scoring examinees did in comparison to the lowest scoring examinees. This index can range from -1.00 (weak examinees significantly outperform strong examinees on the item) to +1.00 (strong examinees significantly outperform weak examinees on the item). In other words, a question's discrimination will be positive if the stronger examinees scored better on that item than the weaker examinees. The discrimination values are also applied to the distractors (i.e., incorrect answers).

Usually, positive discrimination above +0.20 for a correct answer, and low or negative discrimination (i.e., below +0.20) for the distractors, is a sign of a good item. An item showing a low or negative discrimination for the correct answer indicates that lower scorers on the exam scored almost as well or better on that item than the higher scorers did. Similarly, an item showing a positive discrimination for a distractor indicates that higher scorers on the exam were attracted to that distractor at a greater rate than the lower scorers. A discrimination value of zero (0.00) indicates that weak and strong examinees performed equally well.

CUT (PASSING) SCORE

The cut (pass/fail) score of an exam is directly related to the number of easy, medium, and hard questions appearing on that exam. For example, if all of the items on an exam have CR values of 0.90 (i.e., they are all easy questions), examinees will need to answer 90% of the items correctly to pass.

The ABMM uses an assessment software tool to generate exams each year. The software pulls questions from the pool that meet the exam's content requirements and the average degree of difficulty (which has been set at 0.70 since 1999). The average degree of difficulty ensures the rigor of the exam is consistent from year-to-year.

Following the administration of the exam, all items appearing on the exam are reviewed. Their performance is compared to their CR and discrimination values to assess which items have performed as expected and which items should be reviewed by the ABMM Chair, Vice-Chair, and Exam Development Chair.

In the case of items that do not perform as expected, the current year's performance statistics are compared to those of previous exams, if the data is available, to discern whether any discrepancies are due to an anomaly in examinee knowledge. If previous statistics are unavailable, the ABMM Chairs review items to ensure that they are not ambiguous or incorrect.

Items with content flaws are removed from scoring, and the cut score is calculated based on the average difficulty of the items remaining on the exam. The exam is not scored on a curve; each examinee's score is derived solely from the number of questions answered correctly.

RESULTS

Exam results are emailed by September 1 to the email address provided in your Webassessor profile. Please be sure to keep your contact information in your Webassessor profile updated to ensure you receive correspondence from the ABMM.

PASS RATE (2016-2021)

		2021	2020	2019	2018	2017	2016
	Number of Examinees	47	39	54	59	70	74
	Number Passing	24	24	35	31	33	38
	Pass Rate	51%	62%	65%	53%	47%	51%
1st Time or Repeat Examinee	1st Time	34	30	40	32	40	47
	Number Passing	24	23	31	24	29	32
	Pass rate	71%	77%	78%	75%	73%	68%
	Repeat	13	9	14	27	30	27
	Number Passing	0	1	4	7	4	6
	Pass rate	0%	11%	29%	26%	13%	22%
Completed CPEP Program (At Any Point in Career)	CPEP	20	16	19	15	19	22
	Number Passing	18	15	18	14	16	21
	Pass rate	90%	94%	95%	93%	84%	95%
	Non-CPEP	27	23	35	44	51	52
	Number Passing	6	9	17	17	17	17
	Pass rate	22%	39%	49%	39%	33%	33%
Years Experience	Straight Out of CPEP	18	16	17	14	16	14
	Number Passing	18	15	17	14	16	14
	Pass rate	100%	94%	100%	100%	100%	100%
	ACGME/RCPSC Fellowship	3	1				
	Number Passing	2	1				
	Pass rate	67%	100%				
	3-9	15	17	26	25	31	35
	Number Passing	4	7	15	16	18	19
	Pass rate	27%	41%	58%	64%	58%	54%
	10+	11	5	11	24	29	25
Number Passing	0	1	3	6	5	5	
Pass rate	0%	20%	27%	25%	17%	20%	
Degree(s) Held	M.D.	13	12	20	22	27	25
	Number Passing	3	5	11	12	11	11
	Pass rate	23%	42%	55%	55%	42%	44%
	Ph.D.	31	24	33	33	35	43
	Number Passing	20	18	23	17	18	24
	Pass rate	65%	75%	70%	52%	51%	56%
M.D. & Ph.D.	3	3	1	4	8	6	
Number Passing	1	1	1	2	4	3	
Pass rate	33%	33%	100%	50%	50%	50%	
Where Most Recent Degree Was Obtained	US/Canada	39	31	36	30	36	43
	Number Passing	24	24	28	21	24	29
	Pass rate	62%	77%	78%	70%	67%	67%
	Other	8	8	18	29	34	31
	Number Passing	0	0	7	10	9	9
	Pass rate	0%	0%	39%	34%	26%	29%

FAQs

I used my email address as my login and now my email address has changed. How can I change my login to my new email address?

You need to log in to your account and update the email address field with your current email address. Once you have done this, you will need to submit a request to certification@asmusa.org to change your login to match your new email address.

What if my application is not approved?

If your application is not approved, you will be informed of the reason and you will have 30 days to appeal the decision by having additional supporting materials (in the form of a transcript, educational evaluation, and/or an online reference form) submitted on your behalf. If your application is not approved on appeal, it will be withdrawn and you will need to submit a new application for your eligibility to be reevaluated.

I applied previously, but my application was withdrawn. Do I have to resubmit all of my application materials to reapply?

Transcripts are kept on file for seven years, however you must wait at least two years after your application was withdrawn in order to reapply. If you reapply within seven years of your application's withdrawal, you will not need to resubmit your transcripts and/or educational evaluation. A new application fee must be submitted; all other application materials do not need to be resubmitted.

I created a Webassessor profile and paid the application fee through the ASMscience. Is there an actual application that I need to fill out to document my education and work experience?

No. Your educational background will be evaluated based on the transcripts/educational evaluation you submit and your work experience will be evaluated based on the online reference forms submitted on your behalf by your current or former immediate supervisor(s).

Do I need to have my undergraduate or master's degree transcripts sent to the ABMM or evaluated?

No. You only need to have your doctoral degree transcript submitted to the ABMM if educated in the U.S. or Canada or obtain a U.S. degree equivalency statement for your doctoral degree if educated outside the U.S. or Canada.

Does experience need to be gained within the United States in order to be considered for eligibility?

No, it does not matter where the experience is gained, as long as it meets the Board's requirements delineated on the Eligibility page.

I am trying to register to take the exam, but the dates on the calendar are grayed out and I do not have the option to select an exam time.

If all of the dates in a given month are grayed out, it means that testing center is not available. Check the availability of other testing centers in the area and, if none of them are available in the exam administration window, try expanding your testing center search to include testing centers that are further away. Additionally, you can submit a request to open the testing center in the exam administration window by sending an email to certification@asmusa.org (please include your desired testing center's name and location and your first, second, and third choices for an exam date in your request). While a request to open a testing center is being processed, examinees are encouraged to

schedule their exams at one of the other testing centers to ensure they are able to sit for the exam in the current year.

What if my first choice of a testing center is not available?

You can submit a request to take the exam at your first choice of a testing center and we will do our best to accommodate your request. In case your request cannot be accommodated, however, you are advised to schedule your exam at an alternate testing center to ensure you are able to sit for the exam in the current year.

What if there aren't any testing centers in my area?

If there is not a testing center close to you when it is time to register to take the exam, you will need to travel to the nearest testing center to take the exam.

Can I reschedule my exam?

Yes. As long as it is 72 hours before your scheduled exam time, you can reschedule your exam by logging into your Webassessor account, clicking on the Details link next to your scheduled exam and clicking on the "Reschedule" button. To reschedule an exam within 72 hours prior to your scheduled exam time, you must contact the ABMM office (at certification@asmusa.org or 202-942-9257). No refunds will be issued for exams rescheduled within 72 hours of the scheduled exam sitting, and rescheduling an exam within this time frame will result in your having to pay another exam registration fee.

What if I need to cancel my exam registration once it has been scheduled?

To cancel your exam, you must send an email notification of your intent to cancel to certification@asmusa.org. In order to be issued a \$350 refund for a cancellation, your request must be received by the ABMM at least five business days prior to your scheduled exam. No refunds will be issued for cancellations within this time frame.

Besides my authorization code and two forms of identification, what else can I bring to the testing center?

You will not be allowed to bring anything into the exam room with you except for your identification and authorization code. Any other personal items including, but not limited to, bags, purses, wallets, coats, jackets, hats, briefcases, books, mobile devices such as beepers, cellphones and smartphones, calculators, personal digital assistants (PDAs) and watches must be stored outside of the exam room. The testing centers have locked cabinets available to store personal items, should you decide to bring any of these items with you. Please be advised that the ABMM, Kryterion, Inc., and the testing center are not responsible for lost or stolen personal items that you bring with you to the testing center. Additionally, tobacco products, food, drinks and chewing gum are not allowed in the exam room.

Once you have entered the testing center, you will need to participate in their pre-exam inspection, including:

- **Pocket Turn-Outs:** You will be asked to turn-out your pockets (on jackets, jeans, slacks, etc.) to verify that your pockets are empty or do not contain any prohibited items.

Please note: Proctors have been given strict instructions not to make physical contact with you. Ideally, you should empty your pockets prior to entering the Testing Center.

- **Eyewear Inspections:** Due to technological advances, such as "Google Glass", external eyewear will be inspected by the proctor to ensure it is not technology-enabled.

You are not allowed to leave the testing facility during breaks.

What if there is a power outage or other technical difficulties at my testing center?

In the event of an unforeseen circumstance preventing the exam or interrupting the exam (for example, a power outage or loss of internet connectivity), the testing center and Kryterion will work diligently to resolve the problem as quickly as possible. If necessary, your exam can be rescheduled for another date in the exam administration window, or at another testing center: you will have the time remaining (out of a total of six and a half hours) to complete the exam. Please note, however, that if this happens toward the end of an exam administration window, it may not be possible to reschedule your exam in the current exam window. If this happens, your exam will need to be rescheduled for the next year's exam window and a new exam will be administered to you at that time. As such, you are advised to schedule your exam as early as possible in the exam administration window.

Kryterion, Inc. (the company that runs Webassessor) has security and back-up measures in place to ensure that examinees' answers are recorded accurately and that examinees are given the full time allowed to complete the exam. Answers are transmitted and recorded individually by Kryterion each time you hit the Next button on your exam. As such, if something happens in the middle of the exam to prevent your completion of the exam on that day, your answers will not be lost. Additionally, Kryterion will keep track of how much time is remaining in your exam session. When your exam is re-launched, the last question you were answering when your exam was interrupted will appear, as will the exam timer showing the time remaining in your session.

What if I do not pass the exam?

Applicants have three exam attempts from their approval date to pass the exam. This means that if you do not pass the exam the first time you take it, you can take the exam up to two more times within the next two years. You must pay the exam registration fee of \$400 each time you register to take the exam. If you fail three times, you will need to wait two years before reapplying. After the two year break, you must reapply by submitting a new application. You must pay the application fee for approval. Once approved, you may examine one last time. If you do not pass, you are no longer eligible to apply to the ABMM.

Preparing for the Exam

STUDY SUGGESTIONS

Past examinees have identified the following activities as beneficial for examination preparation. These activities are NOT meant to be comprehensive guides to the examination and are not endorsed by the ABMM.

- Studying medical microbiology textbooks and reference manuals such as those listed in the “Suggested References” list below.
- Reviewing medical microbiology case studies and reports from various sources (journals, textbooks, and Web sites).
- Reviewing the Morbidity and Mortality Weekly Report (MMWR).
- Reviewing websites such as <http://www.cdc.gov> (for information about infectious diseases, immunizations, and susceptibility testing), <http://www.clsi.org/>, and https://emedicine.medscape.com/infectious_diseases.

SUGGESTED RESOURCES

The following references are NOT meant to be comprehensive guides to the examination but have been suggested by the ABMM.

Centers for Medicare and Medicaid Services. Clinical Laboratory Improvement Amendments (CLIA). (available at: <https://www.cms.gov/Regulations-and-Guidance/Legislation/CLIA/index.html>)

Centers for Disease Control and Prevention. DPDx Laboratory Identification of Parasites of Public Health Concern. (available at: <https://www.cdc.gov/dpdx/index.html>)

Chosewood, L.C., and D. E. Wilson (ed.). 2008. Biosafety in Microbiological and Biomedical Laboratories, 5th ed. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, and National Institutes of Health. U.S. Government Printing Office, Washington, D.C. (available at: <http://www.cdc.gov/biosafety/publications/bmbl5/index.htm>)

Clinical and Laboratory Standards Institute. QMS04 (Laboratory Design), M100 (Performance Standards for Antimicrobial Susceptibility Testing) and M60 (Performance Standards for Antifungal Susceptibility Testing of Yeasts). CLSI, Wayne, PA. (available at: <http://www.clsi.org>)

Garcia, L.S. (ed.). 2014. Clinical Laboratory Management, 2nd ed. ASM Press, Washington, D.C.

Heymann, D.L. (ed.). 2014. Control of Communicable Diseases Manual, 20th ed. American Public Health Association, Washington, D.C.

Procop, G.W. et al. 2017. Koneman’s Color Atlas and Textbook of Diagnostic Microbiology, 7th ed. Lippincott Williams & Wilkins, Philadelphia, PA.

Walsh, T.J., R.T. Hayden and D.H. Larone. 2018. Larone's Medically Important Fungi: A Guide to Identification, 6th ed. ASM Press, Washington, D.C.

Miller, J. M. et al (ed.). 2012. Guidelines for Safe Work Practices in Human and Animal Medical Diagnostic Laboratories: Recommendations of a CDC-convened, Biosafety Blue Ribbon Panel. MMWR Suppl. 61(01):1-101. CDC, Atlanta, GA. (available at: <http://www.cdc.gov/mmwr/preview/mmwrhtml/su6101a1.htm>)

Kimberlin, D.W. et al (ed.). 2018. Red Book: Report of the Committee on Infectious Diseases, 31st ed. American Academy of Pediatrics, Elk Grove Village, Ill. (available at: <http://aapredbook.aappublications.org>)

Carroll K.C., M.A. Pfaller, M. L. Landry, A.J. McAdam, R. Patel, S.S. Richter and D. W. Warnock (ed.). 2019. Manual of Clinical Microbiology, 12th ed. ASM Press, Washington, D.C.

Detrick, B., J.L. Schmitz and R.G. Hamilton (ed.). 2016. Manual of Molecular and Clinical Laboratory Immunology 8th ed. ASM Press, Washington, D.C.

Ash, L.R. and T.C. Orihel (ed.). 2007. Ash and Orihel's Atlas of Human Parasitology, 5th ed. ASCP Press, Chicago, IL.

Microbiology Board Review Course. A one-day workshop held at the ASM Microbe meeting. <https://asm.org/Events/ASM-Microbe/Home>

College of American Pathologists (CAP) Accreditation Checklist (Microbiology sections). <https://www.cap.org/laboratory-improvement/accreditation/accreditation-checklists>

EXAM CONTENT: UPDATED JANUARY 2019

A list of the topics tested on the exam is provided below. Questions are classified first by domain, then category, and then task. The tasks should be used as a guideline for questions that may appear on the exam.

		% of questions on exam	% of questions in each category						
Domain			1	2	3	4	5	6	7
I.	Directing Laboratory Testing Functions	44.5%	12%	10%	9%	9.5%	4%		
II.	Directing Laboratory Administrative Functions	19%	5%	1%	2%	4.5%	1.5%	2.5%	2.5%
III.	Ensuring Safety and Security in the Laboratory	11.5%	9%	2.5%					
IV.	Consulting with Other Medical Professionals	25%	14.5%	4%	3%	3.5%			
Total		100%							

Domain I. Directing Laboratory Testing Functions (44.5% of exam)

Category 1. Up-to-date practices (standards, evolving technologies, and emerging infectious diseases) (12%)
Troubleshoot laboratory processes
Consult sources of relevant literature/review and critically analyze published studies/data, and consult sources of current professional practices and procedures (e.g., MCM, CLSI, CAP Checklist, ClinMicroNet, IDSA, JCM, etc.)
Determine appropriate methods for microorganism detection, identification, and AST
Revise SOP (standard operating procedure) and assess current operations
Monitor regulatory aspects of receiving/shipping samples
Identify issues surrounding the management of high-density information
Match organisms associated with emerging infectious diseases
Category 2. Test protocols (development, assessment and implementation - including evidence based testing methods) (10%)
Interpret patient test and control data used in test development
Assess evidence basis for test validity
Review and critically compare published studies/data regarding test methods
Describe accepted microbiology testing practices
Implement good manufacturing practices (GMP) in the context of LDTs
Calculate sensitivity, specificity, positive and negative predictive values, agreement, accuracy
Identify CLIA/CAP requirements for FDA approved and non-approved tests including POCT tests
Develop and perform verification studies
Category 3. Test menu (population, costs, logistics) (9%)
Determine infectious disease prevalence and risk factors in a population
Determine positive and negative predictive values based on a given population prevalence
Determine the demographics of population served
Assess test cost-effectiveness per actionable outcome
Determine appropriate test procedure, test complexity, and time required to perform the test
Assess critical nature of the test
Assess specimen processing and test performance logistics
Recognize situational logistics that affect point of care testing
Category 4. Test Quality Control (9.5%)
Recognize events that trigger corrective action, determine a corrective action, and monitor the effectiveness of the action
Recognize acceptable values and appropriate controls for a test
Perform root cause analysis for the cause of quality control failure
Recognize types of errors that may occur
Perform analysis and determine action thresholds for unusual results patterns or trends
Category 5. Critical results (identification and communication) (4%)
Recognize normal and abnormal values for test results
Identify regulations regarding critical value notification
Establish and monitor protocols for caregiver notification of critical results
Assure compliance with regulations regarding notifiable diseases and other public health agency communication

Domain II. Directing Laboratory Administrative Functions (19% of exam)

Category 1. Personnel (assessment, development, and management) (5%)
Correlate workload and staffing levels
Identify basic human resources management principles and regulations
Implement and assess effectiveness of continuing education program; assure compliance with regulatory requirements
Develop goals and expectations for personnel reviews
Outline and assess the skill level and productivity of staff
Implement and assess staff training and competency program plan
Category 2. Facility needs (assessment and design) (1%)
Design efficient work flow
Determine facilities requirements
Category 3. Equipment and supplies (2%)
Evaluate performance of equipment
Arrange equipment requirements to match test menu
Evaluate support requirements for equipment
Assess legal, regulatory, and business considerations for equipment purchase/leasing/maintenance, etc.
Category 4. Finances (budgets, forecasts, revenues, and expenses) (9%)
Assess emerging technologies/trends and potential impact on future costs
Calculate return on investment for a test
Perform test cost analysis using basic accounting principles
Interpret and assess financial reports
Assess laboratory capacity to absorb new work, including equipment/supplies options
Category 5. Market opportunities (1.0%)
Identify potential market opportunities given the patient population and physician demand, including interaction with customer groups to establish needs
Assess the stakeholder needs
Category 6. Quality Management Systems (2.5%)
Develop and ensure compliance with document control procedures
Perform Root Cause Analysis
Recognize types of errors that may occur, acceptable error rate and analysis of trends
Consult data sources, analyze data and generate reports
Category 7. Proficiency testing program (2.5%)
Institute and assure appropriate proficiency testing program
Investigate failures and determine corrective actions
Set up internal (alternative) proficiency testing program

Domain III. Ensuring Safety and Security in the Laboratory (11.5% of exam)

Category 1. Laboratory safety (general, biosafety, biosecurity) (9%)
Comply with accrediting and regulatory agencies regarding safety procedures
Develop and implement chemical hygiene plan and spill control plan
Recognize potential laboratory biosafety hazards
Identify biocontainment practices
Recognize safety considerations in laboratory design and operations
Implement expert and regulatory guidelines for agents of bioterrorism, select agents, and pandemic threats
Develop and implement biosecurity SOPs (standard operating procedures)
Comply with accrediting and regulatory agencies regarding safety procedures
Category 2. Emergency response plans (2.5%)
Assess laboratory readiness to respond to emergency situations
Prioritize testing and manage resources
Perform site-specific risk assessment
Develop emergency testing plans

Domain IV. Consulting with Other Medical Professionals (25% of exam)

Category 1. Medical personnel (14.5%)
Perform analytical interpretation
Recommend alternate or confirmatory tests
Determine the extent of testing
Communicate test performance and limitations
Recognize the interrelatedness of laboratory tests, interact with other laboratory disciplines to develop collaborative networks of expertise and interpretive algorithms
Recognize organisms associated with specific infectious diseases
Recognize degree of clinical importance of an abnormal value
Recognize modes of organism transmission and epidemiology of disease
Develop protocols and train the end user on proper specimen collection and transport techniques.
Communicate at the appropriate level of the end user
Recognize disease state and Perform clinical interpretation and provide interpretation of tests in context with other external tests and identify legal implications and liability associated with ancillary laboratory functions
Communicate results
With physician input, assess the degree of harm to the patient when a testing or interpretation error occurs
Category 2. Technologists (4%)
Interpret test results
Recognize unusual results, patterns, or trends
Describe microbiology test principles
Demonstrate a working knowledge of laboratory bench procedures

Category 3. Pharmacists (formulary, susceptibility testing, antibiogram, sterility testing) (3%)
Discuss CLSI guidelines and updates
Compile, analyze, and maintain antibiograms
Classify antimicrobial agents, routes of administration, and resistance mechanisms
Recognize trends in resistance
Advise on proper sample collection for and discuss regulations (<i>e.g.</i> , FDA) on sterility testing
Category 4. Infection preventionists (3.5%)
Establish and monitor resistant organism surveillance
Advise on specimen collection and transport of surveillance specimens
Associate transmission based precautions with specific organisms/diseases
Develop SOPs for surveillance specimen work up



SAMPLE QUESTIONS

1. A patient with a history of travel to Somalia presents with an ulcerative lesion on his forearm. Biopsy revealed small, intracellular organisms. Which of the following is an appropriate medium for recovery of the organisms?
 - a. Diamond's medium
 - b. Fletcher's medium
 - c. Novy-MacNeal-Nicolle (NNN) medium
 - d. Eagle's minimal essential medium

Question tests Category 1.1 (Up-to-date practices)

2. A research study was conducted to determine the performance of a new rapid HIV-1 antibody test. The results were compared with a gold standard methodology. Based on the results below, what is the sensitivity of the rapid antibody test?

		Number of specimens tested by gold standard methodology	
		Positive	Negative
Number of specimens tested by rapid test	Positive	85	10
	Negative	15	390

- a. 89.5%
- b. 97.5%
- c. 96.3%
- d. 85.0%

Question tests Category 1.2 (Test Protocols)

3. Which parasitologic procedures should be available on a 24-hour basis?
 - a. Blood films for *Plasmodium* species
 - b. Ova and parasite examination for *Giardia lamblia*
 - c. Baermann concentration for *Strongyloides stercoralis*
 - d. Scotch tape preparations for *Enterobius vermicularis*

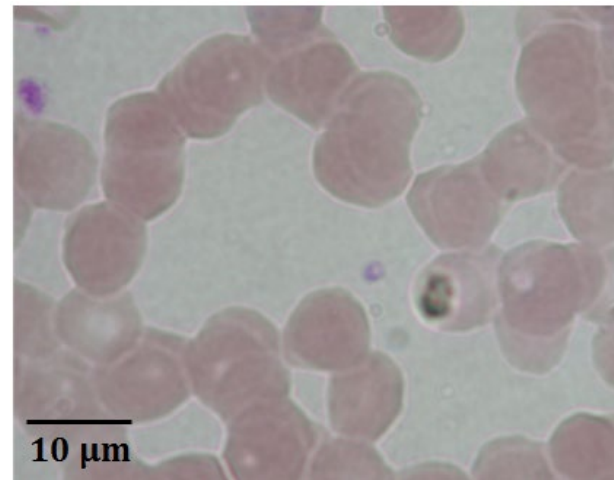
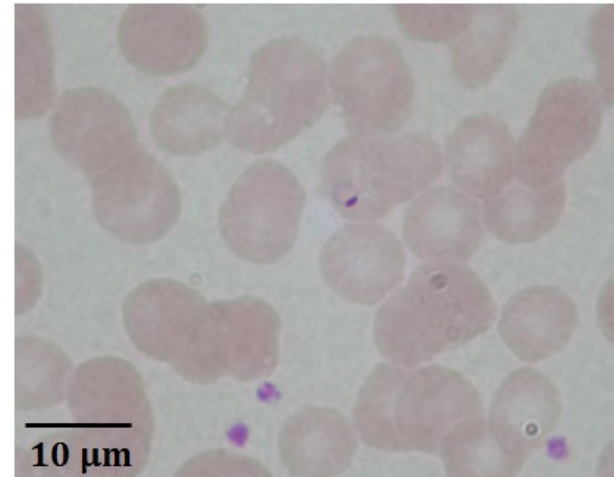
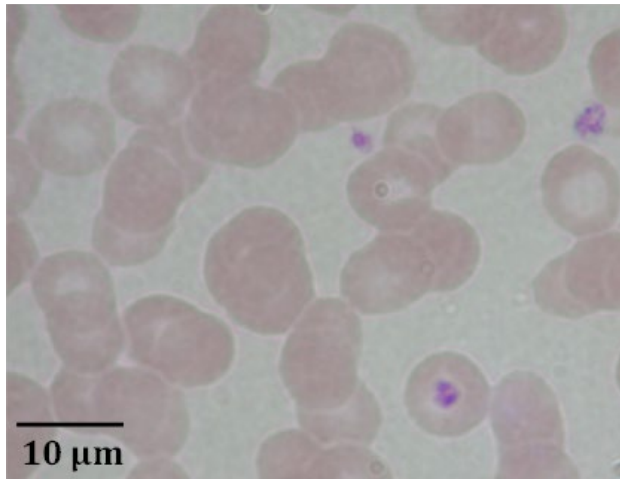
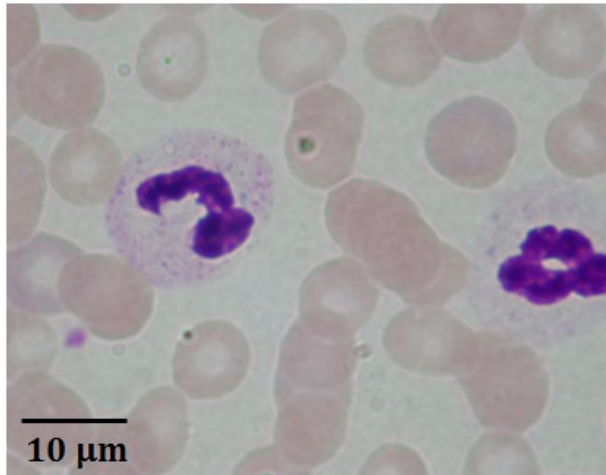
Question tests Category 1.3 (Test menu)

4. The laboratory asks for your interpretation of a real-time PCR run. The positive control was negative and the negative control was positive. The tech wants to know how to proceed. What should you tell her?
 - a. The controls for the run did not display expected results; therefore, the entire run failed and must be repeated.
 - b. Report out the negatives: since at least one tube was positive, it demonstrates that amplification took place. Repeat any positives on the next run to ensure there was no contamination.
 - c. Report out the positive specimens, since at least one tube was negative and one was positive, demonstrating that amplification took place. Repeat negatives on the next run to make sure they all had mastermix added to them.
 - d. Report out all the specimens, since the reagents are expensive, and the negative and positive controls were clearly reversed.

Question tests Category 1.4 (Quality control)



5. Which of the following blood smears is the best example of a critical value?



Images courtesy of Michael Loeffelholz, Univ. Texas Medical Branch

Question tests Category 1.5 (Critical results)



6. In a situation where a clinical laboratory scientist and a laboratory technician are performing the same work at different pay scales, review and revision of which of the following are recommended?
- Detailed job descriptions and performance standards
 - Employee self-evaluation and past performance reviews
 - Employee technical skills and salary scales
 - Educational requirements and available funding

Question tests Category 2.1 (Personnel)

7. Which laboratory design or process would allow the safe disposal of infectious material?
- Red plastic bags for disposal of needles
 - An exterior door that restricts access to non-employees
 - A Class II Biosafety Cabinet for preparing specimens
 - An autoclave readily available in the laboratory

Question tests Category 2.2 (Facility needs)

8. Based on your laboratory's current financial report below, what is your laboratory's contribution margin for this fiscal year?

	Current Fiscal Year ACTUAL
VOLUME	
Inpatient Volume	160,000
Outpatient Volume	130,000
Total Volume	290,000
REVENUE	
Inpatient Revenue	3,000,000
Outpatient Revenue	2,500,000
Gross Patient Revenue	5,500,000
Estimated Deductions from Revenue	(1,500,000)
Net Patient Revenue	4,000,000
EXPENSE	
Total Expense	1,400,000

- \$4,100,000
- \$4,000,000
- \$2,600,000
- \$1,500,000

Question tests Category 2.4 (Finances)

9. According to the College of American Pathologists, which of the following is appropriate for laboratory procedure manuals?
- A package insert is an acceptable substitute for a written procedure.
 - A manufacturer-generated CLIA procedure is not acceptable for use.
 - Procedure summaries are not acceptable to use at the bench.
 - Electronic copies of manuals are acceptable as long as backup is available.

Question tests Category 2.6 (Data analyses)



10. What action should be taken after failing a proficiency survey?
- Repeat testing three times on three different days with new material.
 - Perform testing on quality control material and continue reporting if results are correct.
 - Send the remaining proficiency material to a reference laboratory.
 - Determine the cause of the error, correct it, and document actions.

Question tests Category 2.7 (Proficiency testing program)

11. According to the *Biosafety in Microbiological and Biomedical Laboratories* (BMBL), culture isolate manipulation may be performed outside a biological safety cabinet for which infectious agent?
- Mycobacterium fortuitum*
 - Neisseria meningitidis*
 - Salmonella Typhi*
 - Yersinia pestis*

Question tests Category 3.1 (Laboratory safety)

12. What is responsible for the endemic spread of cytomegalovirus?
- Contact with infected nonhuman primates
 - Inhalation of airborne virus
 - Persistent and recurrent excretion of virus from infected patients
 - Contact with virus-contaminated fomites

Question tests Category 4.1 (Consulting with medical personnel)

13. The *Staphylococcus aureus* strain indicated by the arrow below was tested against erythromycin (E) and clindamycin (CC). How should the results be reported?

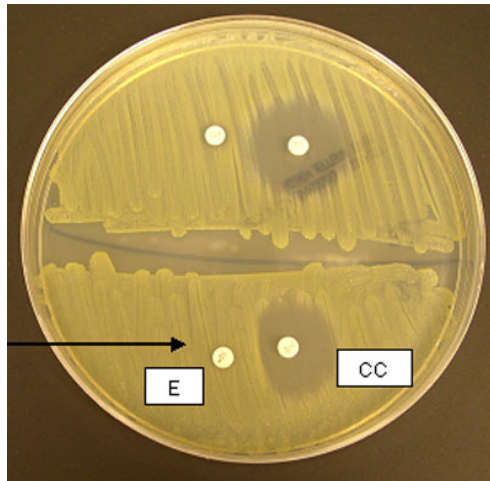


Image courtesy of Dr. Andrea Linscott, LSU Health Sciences Center

- Erythromycin – resistant, Clindamycin – susceptible
- Erythromycin – resistant, Clindamycin – resistant
- Erythromycin – susceptible, Clindamycin – susceptible
- Erythromycin – susceptible, Clindamycin – susceptible

Question tests Category 4.2 (Consulting with technologists)

14. The activity of which of the following antimicrobics is destroyed by an acetylating enzyme?
- Tetracycline
 - Gentamicin
 - Erythromycin
 - Oxacillin

Question tests Category 4.3 (Consulting with pharmacy)

15. Patients exhibiting signs and symptoms of botulinum intoxication require which of the following isolation precautions?
- Standard
 - Airborne
 - Contact
 - Droplet

Question tests Category 4.4 (Consulting with infection control preventionists)

ANSWERS

- C
- D
- A
- A
- C
- A
- D
- C
- D
- D
- A
- C
- B
- B
- A

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