Guidelines for Cardiology Credentials Package

(Credentials Committee, 2025)

Introduction

Cardiology credentials submission serves as an assessment of a candidate's readiness to sit for the Cardiology Specialty Examination and includes evaluation of a candidate's progress in fulfilling their RTP requirements as well as submission of a set of questions for potential use in future cardiology specialty examinations. The intent of these questions is to demonstrate the candidate's knowledge of cardiovascular medicine and to demonstrate that individual's clarity of scientific communication. In addition, it gives residents input for future examinations. See below for details on the formulation of these questions. Note that this document is a supplement to the guidelines written in the Cardiology Specialty Manual (SM). It does not replace those guidelines but is included to better explain the type and complexity of submission questions required. The candidate is urged to carefully review both this document and the guidelines written in the SM.

Credentials Submission

The Credentials submission fee must be **PAID ONLINE** via the link provided in your Datto Access email. **All Credentials paperwork/video and images must be uploaded to the candidates' individual Datto folder no later than 11:59 pm MST, December 1, 2025.** ACVIM is not responsible for late submissions, and we will not accept materials after the deadline for any reason whatsoever.

Candidates will each receive a personalized access link/password for their individual Datto folder (via email, from Adam@ACVIM.org), to which they will upload all Credentials Materials. Candidates should label each file with their ACVIM Candidate ID (e.g. "Candidate ID 123456_Questions," "Candidate ID 123456_ ECG #1"). **Datto Folder access links/passwords are set to expire after 11:59 pm MST, December 1, 2025.** Candidates will be able to view/add to documents/materials within their Datto folder as needed, up until this time. See the *Using Shared Folders with Datto* document for detailed instructions on Datto folders, including deleting files.

Cardiology Logs

Candidates must submit up-to-date logs to ensure adequate progress towards fulfilling their RTP requirements. The Cardiology Residency Training Program Log Summary Form should be placed directly in front of the Catheterization, Echocardiography, and Education logs. The candidate must meet or surpass the following RTP requirements toward receiving board certification in cardiology:

- Complete 500 echocardiograms.
- Complete 15 catheterization procedures.
- Complete 150 structured educational hours.

- Complete 80 journal club hours (not included in the 150 hours of structured educational experiences).
- Complete the research requirement.

All logs should be a complete compilation of the residency thus far, NOT just the most recent year. Please follow the requirements stipulated in the Certification Manual.

Credentials Questions

1. Grading: Please see the *2025-2026 Cardiology Credentials Questions Grading Rubric*.

2. Each question should be numbered within each section and presented on a separate page with 1" margins. Each section should be clearly identified with a separator. All questions should be double-spaced, using 12 pt. Arial, Times New Roman, or Helvetica fonts. Your ACVIM Candidate ID number should be included at the top of each submitted question.

3. Level of questioning: Candidates should aim for a level of question/answer that would be answerable by ~75% of Board-certified clinical cardiologists in the time provided, but the questions should be at a level above the cardiology knowledge of most internists. Some questions in some fields will cover the relative strengths of the candidate and may be at a higher level than others.

4. Referencing questions/answers: All questions in all sections should be fully referenced as footnotes at the bottom of the question, not at the end of the section. Numerical superscripts should denote the footnoted references. References should demonstrate that the candidate has performed independent reading and research at a level appropriate to a specialist. References should come from a variety of sources including veterinary and applicable human journals, textbooks, scientific abstracts, and proceedings. Please note: A single reference is rarely sufficient to demonstrate that the candidate has done appropriate research into the topic to enhance their understanding.

5. Multiple choice: The candidate should provide 5 multiple choice questions from 4 <u>different</u> subcategories listed on the study outline. The subcategories are designated by upper case letters and can be found listed under each category, designated by Roman numerals on the Subject Category Study Outline. No more than two questions can address a single subcategory. The subject category and subcategory must be clearly indicated for each question. All questions should be formatted with **5** answer choices, including 1 correct answer and 4 incorrect answers (distractors). Questions should be structured such that the 4 distractors are untrue. That is, candidates should avoid questions that require the "incorrect" answer to be identified amongst the 4 "correct" distractors (i.e. questions phrased as "which of the following is INCORRECT", or "all of the following are correct, EXCEPT"). The correct answer should be clearly identified as a separate statement. All questions should have a brief explanation justifying the correct answer and refuting the distractors (see example). Please read the attached question writing guidelines, provided by the American Board of Internal Medicine, before composing multiple choice questions.

6. Essays: Candidates should submit 3 essays which should be less than 500 words (excluding references). Questions may require prose answers or may require that the candidate provide diagrams or calculations based upon information provided. Essay questions should be answerable in 20-30 minutes by most adequately prepared candidates. Answers may be given in outline/point-form. Multiple short-answer (component) questions are also acceptable. Each of the three essay questions must be from <u>different</u> categories (designated by Roman numerals in the Subject Category Study Outline) listed on the study outline.

7. ECGs: Candidates should submit 3 electrocardiograms for interpretation. ECGs should be of publishable quality

and should be submitted as high-quality digital images (300 DPI or higher). ECGs should be optimized for amplitude where possible. Paper speed should be 50mm/sec (if other paper speeds are used, the candidate must ensure that diagnosis is possible based on the sample provided). ECGs should be reproduced as actual size or larger (i.e. 1mm on an ECG should be at least 1mm on the reproduced image). Each ECG must be labeled appropriately with calibrations and gridlines clearly visible. Submitted ECG images do not need to be embedded in the word document of the question, they can be submitted as a separate file that is clearly labeled (i.e. ECG #1).

Each ECG interpretation and any associated question(s) need to be able to be interpreted and answered within 4-6 minutes under examination conditions. Therefore, any adjunct questions should be direct and succinct. However, candidates should justify their answers completely in a separate subsection together with footnoted references. Differential interpretations for the ECG should be listed and prioritized where appropriate (see example).

8. Graphics: Candidates should submit 3 still image graphics for interpretation. Images should be 300 DPI or higher to ensure publishable quality. Images where color is important should be provided as color images. Submitted graphics do not need to be embedded in the word document of the question, they can be submitted as a separate file that is clearly labeled (i.e. Graphic #2). It is preferred that a single graphic image is sufficient to make a diagnosis. If a single graphic image is insufficient to allow a diagnosis, then it is strongly recommended that each graphic contain no more than 2 parts (i.e. graphic #1A and graphic #1B).

   The graphic and any associated question(s) need to be interpreted and answerable within 2-3 minutes under examination conditions. Therefore, questions should be direct and succinct. However, candidates should justify their answers completely in a separate subsection together with footnoted references. The three submitted graphics should be from three <u>different</u> subcategories (designated with capital letters in the Subject Category Study Outline). This includes gross or microscopic anatomy or pathology, radiographs, phonocardiograms, echocardiography (2-D, M-mode, Doppler, Color-flow), cardiac catheterization data, angiograms, nuclear cardiology, and other special imaging studies. In other words, the submitted graphics should be from 3 different modalities. A candidate cannot submit multiple still echocardiographic images. For example, an appropriate submission could include the following subcategories: I-A (gross anatomy), III-C (radiograph), III-J (pressure tracing).

9. Video Recording: Candidates should submit one digital video recording with accompanying typed question and detailed, referenced answer. This may include echocardiograms, angiograms or other fluoroscopic procedures, or other video examinations.

   The digital video should consist of a single, high quality, digital video loop. The video loop should be recorded with a frame rate that allows the recording to be viewed in real time. Multiple video loops are NOT acceptable for submission in this section. The candidates should ensure that a diagnosis can be made from a single video loop.

10. Case Study: Candidates should submit one case study with multiple images or videos and 3 questions including diagnosis and answer. The ideal submitted case should have some complexity and should not be a “simple” case (e.g., a congenital case with more than 1 defect might be a possibility for submission). A submitted case study would need to have a minimum of 3 diagnostic studies, but more than 3 is acceptable and strongly encouraged. The 3 diagnostic studies should come from different subcategories (designated with capital letters in the Subject Category Study Outline). Broadly, they can be comprised of a heart sound recording or phonocardiogram, ECG, thoracic radiographs, diagnostic echocardiogram (multiple loops and stills), angiogram, pressure tracings, or other forms of imaging or diagnostics (computed tomography, magnetic resonance imaging, oximetry, EP study). The candidate should submit a minimum of 3 questions that can be

answered from these case materials, including the diagnosis; and the answer to the questions should be referenced as described above.

SAMPLE QUESTIONS: **Candidate ID: 123456**

Multiple Choice Question 1

Section _____ (Electrophysiology)

The inward rectifying current (I_{K1})

(a) moves K^+ ions out of the cell during phase 2 depolarization (b) moves K^+ ions into the cell during phase 3 depolarization (c) moves K^+ ions out of the cell during phase 3 depolarization (d) exchanges Mg^{2+} for K^+ during phase 3 depolarization

(e) exchanges Ca^{2+} for K^+ during phase 2 depolarization

Correct answer: C

Explanation

All K^+ channels (other than the Na/K pump) move K^+ out of cells at membrane potentials > E_K. The inward rectifier (I_{K1}) has a seemingly paradoxical current – as the cell depolarizes from the resting membrane potential (-90mV), the inward rectifier initially moves K^+ out of the cell according to predicted Nernstian responses. However, at potentials more positive than –50mV less and less K^+ moves out of the cell, until, at membrane potentials >-20mV, the current stops completely. This occurs extremely rapidly during phase 0 depolarization, so little K^+ moves out of the cell during this phase. The loss of conductance of I_{K1} permits the plateau of the action potential to persist, rather than resulting in an immediate repolarization of the cell (as would happen if conductance continued to increase and more K^+ continued to leave the cell). Finally, as repolarization occurs (phase 3 depolarization), I_K (the delayed rectifier) initially decreases the membrane potential to more negative values, which allows I_{K1} to resume moving potassium out of the cell, further hyperpolarizing the cell. This in turn has a positive feedback on it's own conductance, causing more and more K^+ to leave the cell until the resting membrane potential is
reached (E_K). The decrease in conductance of I_{K1} during depolarization is thought to be mediate by a blocking Mg^{2+} ion.

Thus I_{K1} primarily allows K^+ to leave the cell during phase 3 depolarization (repolarization), as membrane potentials become more negative.

All other answers are incorrect – I_{K1} has no effect during phase 2 depolarization (it is blocked and not conducting at this time); K^+ ions always leave the cell, especially during phase 3 depolarization; there is no exchange of ions via these channels (they are not ionic pumps or ion exchangers).

References:

1. Lynch III C. Cellular Electrophysiology of the heart. In Lynch C (ed.) Clinical Cardiac Electrophysiology: Perioperative Considerations. J.B Lippincott Co, Philadelphia PA, 1994, 1-52.

Multiple Choice Question 2 **Candidate ID: 123456**
Section _____ (hemodynamics)

Right-to-left shunting patent ductus arteriosus (PDA) does not normally have a murmur associated with it because:

(a) Pulmonary vascular resistance is equal to systemic vascular resistance

(b) Pulmonary artery pressure is equal to aortic pressure

(c) The ductus has a narrow opening at the pulmonary end, so the murmur dissipates in the ampulla of the ductus and can only be detected with intravascular microphones

(d) The turbulent flow is in the opposite direction to a normal left-to-right shunting PDA, and therefore cannot be ausculted in the normal location

(e) Pulmonary vascular resistance is slightly lower than systemic vascular resistance, resulting in a small pressure gradient and laminar flow

Correct answer: B

Explanation

All fluid moves along the path of least resistance. Pressure is merely the product of resistance and flow; therefore it is a dependent variable. If the resistance in a circuit increases, pressure increase, or flow decreases. With a right-to-left shunting PDA, the pulmonary circulation and the systemic circulation can be considered continuous. The right ventricle ejects blood into the pulmonary artery, which is connected by a large conduit to the aorta – the two arteries can be considered as one, so pressures in both are identical. What is different between the two circulations is the resistances of the vascular beds. The pulmonary vascular resistance is greater than the systemic vascular resistance – that is why flow proceeds right-to-left.[1] In fact, complete ligation of the pulmonary artery distal to the PDA (infinite vascular resistance) would produce the same effect (except that no blood would be oxygenated and the patient would soon die), i.e., the pressure in the main pulmonary artery would still be equal to that in the aorta.

The other answers are incorrect because (a) if resistances were equal there would be no shunting at all (or it would be equally bi-directional)[2]; (b) right-to-left PDAs have wide openings (they are non-resistive) [1]; (d) there is no turbulent flow across the right-to-left PDA – if pulmonary vascular resistance was slightly lower than systemic, even if flow was laminar, it would still shunt left-to-right.[1]

References:

1. Kittleson MD. Patent ductus arteriosus. In Kittleson MD and Kienle RD (ed.): Small animal cardiovascular medicine. Mosby Inc, St Louis, MO, 1998; 218-230

2. Oswald GP, Orton EC. Patent ductus arteriosus and pulmonary hypertension in related Pembroke Welsh Corgis. J Amer Vet Med Assoc, 1993;202:761-764.

ECG 1.

ECG obtained from a 6 year-old Labrador Retriever. Lead II @ 50mm/sec, 10mm=1mV. Note: there is no ECG provided with this question – for the purposes of the example, a typically formatted answer to a hypothetical ECG is provided.

Question: Interpret the ECG
Answer:

a. Underlying rhythm is a sinus arrhythmia, presumed respiratory, with a wandering pacemaker and a rate of 70-80 bpm. The QRS complexes are small and display some electrical alternans, which is probably related to respiration and slight shifts in lead position (the complexes appear to increase in size throughout inspiration and are smallest at the start of inspiration). Pericardial effusion should be considered, however, most cases of pericardial effusion are not characterized by respiratory sinus arrhythmia, unless it is small, in which case electrical alternans is unlikely to occur.

b. There are single monomorphic interpolated VPCs with a relatively fixed coupling interval. The second VPC in the lower strip is preceded by a non-conducted p-wave.

c. There is altered AV nodal conduction on the post-extrasystolic complexes, expressed as delayed or blocked conduction (1^{st} or 2^{nd} degree AV block). The closer the p-wave of the complex is to the VPC the more delayed or blocked the conduction. This likely reflects a retrograde depolarization of the AV node by the ventricular ectopy (concealed VA conduction), resulting in a partially refractory AV node at the onset of the post-extrasystolic sinus complex and abnormal antegrade conduction.

Reference:

1. Rinkenberger RL, Polumbo RA, Bolton MR, Dunn M. Mechanism of electrical alternans in patients with pericardial effusion. *Cathet Cardiovasc Diagn*, 1978;4(1):63-70

2. Zipes DP. Specific arrhythmias: diagnosis and treatment. *In* Braunwald E (ed.) *Heart Disease*. 4^{th} Edition, WB Saunders, PA, 1992; 667-725.

ESSAY QUESTION:

Essay Question 1_____ Candidate ID: 123456

Dynamic subaortic stenosis has been recognized as a complication of hypertrophic cardiomyopathy (HCM) since the 1960s. It has also been described as a finding in small animals, both as a complication of HCM and with other congenital heart disease. Various hypotheses have been proposed to explain this phenomenon. Briefly discuss these hypotheses, presenting arguments for and against each one.

Dynamic subaortic stenosis (DSAS) has several proposed contributory mechanisms. These include systolic anterior motion of the mitral valve (SAM), excessive basilar septal hypertrophy, and ventricular isometric contraction.[1]

1. *Systolic anterior motion of the mitral valve*. Most current theories involve the observation that in DSAS the anterior mitral valve cusp is displaced or moves into the left ventricular outflow tract (LVOT) during systole, and appears to come into apposition with the septum, producing simultaneous outflow turbulence and mitral insufficiency.[1] The cause of the mitral valve cusp displacement is not clear, but postulated mechanisms include:

(a) Venturi effect within the LVOT. As blood accelerates through the LVOT, Venturi forces "suck" the mitral valve into the LVOT.[1,2] This theory has several flaws. First, in order to establish Venturi forces, fluid needs to be flowing at a high velocity, creating a decrease in pressure, and pulling the mobile mitral valve into the path of flow. This implies that a pressure gradient is established prior to valvular displacement. Some experimental evidence suggests that SAM is not induced by Venturi forces,[3] and this belief is supported by the observation that SAM may occur during isovolumic contraction (prior to any flow across the LVOT), or at low velocity flows.[4]

(b) Elongated mitral valve cusps. Echocardiographic and post-mortem measurements of the mitral apparatus in humans have demonstrated that patients with HCM and DSAS have longer mitral valve cusps than normal humans, or humans with non-obstructive HCM, possibly due to mitral valve stretching secondary to ventricular hypertrophy and distortion.[5]
Alternatively, the valvular abnormality might be independent of ventricular geometry.[6]
Some authors believe that elongation of the mitral valve cusps is a prerequisite of SAM.[7]

(c) Papillary muscle displacement. Some investigators have suggested that SAM occurs with HCM because of a change in ventricular geometry with a resultant anterior displacement of the papillary muscles, placing the coaptation point of the mitral valve closer to the LVOT, and allowing the anterior cusp to have a slightly redundant cusp edge.[8,9] Additionally, the displaced papillary muscles might pull the mitral valve into the LVOT during systole. Abnormal papillary muscle morphometry, position and hypertrophy are common features of HCM. Investigators have demonstrated that even in normal experimental animals, physical displacement of the posterior papillary muscle towards the interventricular septum can produce SAM.[10]

2. Septal Hypertrophy. Septal hypertrophy of the basilar portion of the septum is noted in most cases of hypertrophic obstructive cardiomyopathy. Abnormal systolic thickening can cause obstruction of the LVOT in the absence of SAM. Additionally, this narrowing can produce high- velocity flows in the LVOT, promoting Venturi forces to act on the mitral cusps.[11]

Strong evidence for at least partial involvement of the basilar septum in DSAS is the ability to alleviate or markedly attenuate the obstruction in patients with hypertrophic obstructive cardiomyopathy by either surgical resection,[12] or more recently, alcohol ablation of the septal region.[13]

3. Ventricular isometric contraction. An unpopular theory holds that the pressure gradient observed with DSAS is due to excessive emptying of the left ventricle (cavitary obliteration), with subsequent mid/end systolic isometric (isovolumic) contraction.[14] This in turn produces very high intraventricular pressures within the body of the LV and a pressure gradient across the LVOT which is unable to obliterate its cavity because of different geometry and forces. This is relatively implausible with Doppler studies showing continued rapid blood flow in the region of the stenosis (this would not be possible if the LV chamber contained no blood), and evidence of DSAS in early systole in many cases, where the ventricular chamber still contains blood.

REFERENCES:

1. Wynne J, Braunwald E. The cardiomyopathies and myocarditidies: toxic, chemical and physical damage to the heart. In Braunwald E (ed): Heart disease. 4th edition, WB Saunders PA, 1992, p 1394-1450

2. Sherrid MV. Dynamic Left Ventricular Outflow Obstruction in Hypertrophic Cardiomyopathy Revisited: Significance, Pathogenesis, and Treatment. Cardiol Rev, 1998;6:135-145.

3. Schwammenthal E, Vuille C, Weyman AE et al. Venturi forces fail to produce systolic anterior motion of the mitral valve in upper septal hypertrophy. J Amer Coll Cardiol, 1993;21:353A

4. Jiang L, Levine RA, King ME, Weyman AE. An integrated mechanism for systolic anterior motion of the mitral valve in hypertrophic cardiomyopathy based on echocardiographic observations. Am Heart J, 1987;113:633-44.

5. Klues HG, Maron BJ, Dollar AL, Roberts WC. Diversity of structural mitral valve alterations in hypertrophic cardiomyopathy. Circulation. 1992;85:1651-60.

6. Mautner SL, Klues HG, Mautner GC, Proschan MA, Roberts WC, Maron BJ. Comparison of mitral valve dimensions in adults with valvular aortic stenosis, pure aorticregurgitation and hypertrophic cardiomyopathy. Am J Cardiol, 1993;71:949-53.

7. He S, Hopmeyer J, Lefebvre XP, Schwammenthal E, Yoganathan AP, Levine RA. Importance of leaflet elongation in causing systolic anterior motion of the mitral valve. J Heart Valve Dis, 1997;6:149-59.

8. Levine RA, Vlahakes GJ, Lefebvre X et al. Papillary muscle displacement causes systolic anterior motion of the mitral valve. Experimental validation and insights into the mechanism of subaortic obstruction. Circulation, 1995;91:1189-1195

9. Lefebvre XP, Yoganathan AP, Levine RA. Insights from in-vitro flow visualization into the mechanism of systolic anterior motion of the mitral valve in hypertrophic cardiomyopathy under steady flow conditions. J Biomech Eng, 1992;114:406-13.

10. Levine RA, Vlahakes GJ, Lefebvre X, Guerrero JL, Cape EG, Yoganathan AP, Weyman AE. Papillary muscle displacement causes systolic anterior motion of the mitral valve. Experimentalvalidation and insights into the mechanism of subaortic obstruction. Circulation, 1995;91:1189-95.

11. Panza JA, Maris TJ, Maron BJ. Development and determinants of dynamic obstruction to left ventricular outflow in young patients with hypertrophic cardiomyopathy. Circulation, 1992;85:1398-405.

12. Nakatani S, Schwammenthal E, Lever HM, Levine RA, Lytle BW, Thomas JD. New insights into the reduction of mitral valve systolic anterior motion after ventricular septal myectomy in hypertrophic obstructive cardiomyopathy. Am Heart J,
1996;131:294-300.

13. Maron BJ. Role of alcohol septal ablation in treatment of obstructive hypertrophic cardiomyopathy. Lancet, 2000;355:425-6.

14. Criley JM, Siegel RJ. Subaortic stenosis revisited: the importance of the dynamic pressure gradient. Classics in Medicine, 1993:412-436

ABIM Question-Writing Guidelines

The multiple-choice question (MCQ) typically consists of text that provides the information required to present a problem (the "stem"), the question itself ("lead line"), and, finally, by a list of options (one correct answer and "distractors") from which the examinee chooses a response. The Board strongly encourages development of patient-based questions; in other words, questions relating to clinical scenarios. A good MCQ contains medical content presented in such a way that the candidate who possesses the required knowledge will be able to answer the question correctly; the candidate who does not possess this knowledge will be unable to do so. Correct answers must be absolutely correct. Incorrect answers should look correct to the less knowledgeable candidate. Questions should not be tricky or overly difficult; rather, they should focus on assessing the examinee's ability to provide excellent care to patients. Consider asking yourself about each question, "Is this material that a general internist or subspecialist in practice must recall daily, weekly, monthly once a year, or perhaps once in a lifetime?" Less frequently used information still is important if it deals with potentially life- or function-threatening conditions or important management decisions.

All ABIM examinations contain only A-type (single-best-answer) questions. The use of only A-types (1) simplifies and increases the efficiency of examination development, (2) simplifies examination administration and scoring. (3) makes candidate scores and feedback more meaningful and understandable, and (4) increases the proportion of questions assessing synthesis and clinical judgment, which enhances examination relevance and validity.

A. Before Writing:

1. Be sure to allow sufficient time for question writing. Many authors estimate that each question requires at least one hour of work.

2. Select and write down the **general content area** (such as recognition of congestive heart failure or evaluation of upper GI bleeding). Then write down the **testing point** (such as recognition of diastolic left ventricular failure or indications for upper GI endoscopy in the setting of upper GI hemorrhage).

   The MCQ should have one and only one testing point; testing multiple points confounds the measurement information obtained about the examinee. For example, are you assessing the examinee's ability to make diagnostic inferences from the data given or the examinee's knowledge of appropriate diagnostic or therapeutic approaches to a particular problem?

   A clear testing point will help you write the question. Although it is not part of the question as presented to the examinee, a sentence or two about the question's testing point or its rationale should be determined by the question writer before the question is written.

3. Keep in mind the level of knowledge required to answer the question. Is it appropriate for the candidate? A good question is relevant and neither too hard nor too easy.

4. Think about the **cognitive ability** you wish to test that fits the testing objective. MCQs can assess the cognitive abilities of recall knowledge, synthesis, and judgment.

Recall knowledge questions require only the recall of facts; for example:

> *Which of the following **malignant conditions is most likely to be cured if the patient remains** disease free for 30 months?*

(A) *Acute myelogenous leukemia*
(B) *Carcinoma of the breast*
(C) *Ovarian carcinoma*
* (D) *Embryonal cell carcinoma of the testis*
(E) *Small cell carcinoma of the lung*

RATIONALE: In this example, the candidate's knowledge of the prognosis of several treatable cancers is being tested. The candidate must select the malignancy that has the highest probability of cure from among the options, each of which has a reasonable response rate to treatment. Thus, the ability being tested is recall knowledge.

Synthesis questions require the integration and interpretation of facts to reach a conclusion; for example:

A 72-year-old woman has had increasing fatigue and limb weakness for one year. One month ago she was treated for pneumonia, and since that time the weakness has become much worse. She cannot rise from a chair or lift her arms to comb her hair.

Physical examination reveals weakness and hypotonia of all four limbs, with more weakness proximally than distally. There is weakness of neck flexors and extensors. No fasciculations or atrophy is noted. The muscles are not tender, and reflexes are preserved. Babinski's sign is absent. Sensory examination is normal.

Laboratory studies:

Leukocyte count	*4500/1; normal differential*
Erythrocyte sedimentation rate	*77 mm/hr*
Serum creatine kinase:	
Total	*3200 U/L*
MB isoenzymes	*21*

Which of the following is the most likely diagnosis?

(A) *Amyotrophic lateral sclerosis*
(B) *Polyneuropathy*
(C) *Limb-girdle syndrome*
* (D) *Polymyositis*
(E) *Polymyalgia rheumatica*

RATIONALE: In this example, the candidate must consider a constellation of symptoms and laboratory findings and then formulate a differential diagnosis. A list of diseases with similar presentations is given; the candidate must select the most likely diagnosis based on his or her knowledge of these entities (prevalence, clinical features). Thus, the ability being tested is synthesis.

Judgment questions require knowledge, interpretation, synthesis, and then the application of judgment to take the appropriate action, for example:

You are asked to see a 73-year-old woman who has had epigastric pain for several months. The pain is relieved by sucralfate. Her illness has not interfered with her activities.

Findings of *physical examination are normal. Upper gastrointestinal series with small bowel follow-through, obtained by the referring physician, was normal. Serum gastrin was 789 pg/mL four weeks ago and 830 pg/mL two weeks ago.*

Which of the following tests should you order next?

(A) Serum calcium level
* *(B) Measurement of gastric pH*
(C) Secretin stimulation test
(D) Upper gastrointestinal endoscopy
(E) Computed tomography of the abdomen

RATIONALE: In this example, the candidate first must recognize that the most likely condition causing this patient's symptoms is atrophic gastritis. Then the decision must be made about which test to order. Each test listed might be considered as part of the evaluation of a patient with abdominal pain and elevated gastrin; however, measurement of gastric pH would provide the necessary confirmatory information at the lowest cost and morbidity. To arrive at a correct decision, the candidate must consider issues of test sensitivity, specificity, and cost. Thus, the ability being tested is clinical judgment.

Patient-based questions that test the ability to synthesize information or demonstrate clinical judgment generally are considered more relevant than questions testing only recall knowledge. However, recall knowledge questions assess ability more directly than synthesis or judgment questions. With a recall knowledge question, the examinee either knows the requisite information or does not; with synthesis and judgment questions, the test developer does not know how the examinee arrives at a particular answer. The recall knowledge format is recommended for initially testing the knowledge base in a new or emerging discipline, because it allows test developers to accurately gauge the extent to which the discipline has been learned by the test population; in other words, it provides a baseline measure.

B. Building the Stem:

1. The "stem" is the set-up, or scenario, that leads to the question being asked. **The information in the stem should be complete, concise, clear, and unambiguous.** It should contain only the information needed to answer the question, and extraneous details should be avoided. In an exam, a patient scenario is not a "real case"; rather, it is **a convenient fiction** that sets up the testing point.

   Be sure to include the following in all patient-based questions:

   (a) Gender
   (b) Age
   (c) Site of care

   Information about race/ethnic origin and occupation should be included only if it is relevant to the testing point and cannot be answered correctly without it.

2. **Avoid tricks** to mislead examinees away from the correct answer. Often unintentional ambiguities can distract an examinee, but sometimes test developers deliberately place obstacles in the examinee's way that are not part of the testing point but can reasonably be interpreted as significant when in fact they are not (so-called red herrings). This practice is unfair to examinees and interferes with interpretation of

examination results.

3. **Avoid ambiguous or indefinite terms of degree or amount,** such as *rarely, commonly, frequently, generally, sometimes,* and *usually.* These are not interpreted in the same way by all readers. Adjectives such as *young, middle-aged, older,* and *obese* are also subject to interpretation, so quantitative terms should be used (50 years old, and BMI of 31). Finally, avoid constructions that may appear pejorative, such as the use of *complains* and *denies* in the patient history.

4. **Avoid jargon** or other language that may not be known by all examinees.

5. **Avoid unnecessary ancillary material,** such as an illustration, that will consume testing time if it is not part of the testing objective. Pictures should be used only when they must be interpreted by the examinee to reach the correct answer. Illustrations or other non-textual stimuli should always demonstrate clear-cut, non-subtle findings because readers in test-taking situations tend to over interpret what they see in an illustration.

C. Posing the Question and Identifying the Task:

l. **Focus on the cognitive task** as you begin to write a question line (or "lead line"). A question should pose one clear task, such as diagnosis, or treatment, or a definition. If the stem describes a patient with many problems, the question should be focused on the problem related to the testing objective.

The question task is posed clearly if the examinee can cover up the response options and correctly deduce what some of them are. For example, in the question *Which* of *the following is the most likely diagnosis?,* the examinee could deduce that the responses will be the diagnoses that would be considered in the case presented. But in the question *Which* of *the following statements is correct about depression?,* the examinee has no clear idea what the response options will address because no specific task is posed in the question.

When more than one point is addressed, such as in a statement-based question, the assessment information is confounded because precision is lost. In addition, the examinee can easily be confused by "irrelevant difficulty"; in this case, difficulty related to question format rather than question content. (See further discussion at D.3., later.)

Here is a list of appropriate question tasks for ABIM questions:

(a) Diagnostic inference/Differential diagnosis:
Which of the following is the most likely diagnosis?
Which of the following best explains this patient's current symptoms?

(b) Clinical features:
The clinical manifestations of [disease named] *include which of the following?*
Which of the following is characteristic of this patient's illness?

(c) Diagnostic testing:
Which of the following will document the source of this patient's symptoms?
Which of the following laboratory studies should you order next?

(d) Natural history/Epidemiology:

This patient is at increased risk for the development of which of the following?
Which of the following best predicts the development of [disease named] *in a patient who has* [condition named]?
A statistically significant correlation between a history of [feature named] *and the population prevalence of* [disease named] *exists for which of the following?*

(e) Treatment:
Which of the following is most likely to correct this patient's problem?
Which of the following drugs [or therapeutic interventions] *should you order?*

(f) Management decision:
Which of the following should you do next [or now]? *Which of the following is the best management plan?*

(g) Pathophysiology/Basic science:
Gram stain of the causative organism is most likely to reveal which of the following?
Which of the following is the best explanation for this patient's poor response to therapy?
The biopsy specimen shown is consistent with which of the following conditions?

(h) Interpretation of literature/Statistical methods:
Which of the following statements best describes the findings of these researchers?
Which of the following is the best interpretation of these data?

2. **Focus the lead-in question** on your testing point:

a. Avoid using the phrase *associated with.* More specific language should be used to describe a relationship.

b. Avoid "negative" questions. The use of *Which of the following is NOT true* or *Which of the following is LEAST likely* is unacceptable, because this format requires the examinee to switch from positive to negative thinking. An example follows:

A 72 year-old black man who has insulin-dependent diabetes mellitus has had a chronic, draining ulcer of the left foot for six weeks. The wound is purulent and foul-smelling. The patient is afebrile; leukocyte count is 11,600/.L. Radiographs of the foot show osteomyelitis.

Which of the following would be LEAST appropriate as initial therapy?

* *(A) Nafcillin, intravenously*
(B) Cefoxitin, intravenously
(C) Cefotaxime, intravenously
(D) Cefazolin and metronidazole, intravenously
(E) Clindamycin and tobramycin, intravenously

CRITIQUE: In this example, the candidate is asked to use "negative" reasoning to identify the LEAST appropriate option. He or she first must recognize that a patient with diabetes and osteomyelitis requires anaerobic, broad-spectrum antibiotic coverage, and then must identify nafcillin as the least appropriate choice among the options given. This backward logic forces the candidate to switch tracks in thinking, and it fails to duplicate clinical reasoning that would focus on which drug to prescribe.

D. Developing a List of Options:

1. Make sure there is one clearly best answer. There must be one response option that the content experts agree is clearly the best answer for the situation presented. Questions in which the best answer is a matter of disagreement or controversy among experts should not be used because they cannot be scored fairly; these questions do not make it onto Board exams. Questions for which there may be multiple answers that are equally correct cannot stand as a traditional MCQ unless only one of the equally correct options is included and is keyed as the correct answer; otherwise, it is difficult for test developers to devise a scoring scheme that weights acceptable answers defensibly; and the examinee is put in a bind by having to contradict the exam instructions to pick the single best option as the answer.

2. **Add realistic, plausible distractors.** Distractors may be partially correct, but not the best answer among those listed. The distractors should reflect the realistic choices that could be considered for the situation posed; they may reflect common misconceptions, outdated beliefs, or commonly confused ideas. If you are unable to come up with adequate distractors, then the question will not work, regardless of how realistic the scenario or how important the content.

   Guessing is not a significant contributor to test scores at this level of examination, so including implausible, trivial, or nonsense distractors will only weaken the question. Three or four good options are better than five options that include one or more nonsense distractors.

3. **Avoid combining right and wrong in the same distractor.** This puts examinees in a bind. For example, in a treatment question in which there are two equally good drugs for a given condition, making one of the options wrong by specifying the wrong dosage.

4. **Avoid irrelevant clues to the correct answer.** Here are some ways to avoid giving the candidate a clue to the answer of your question:

   Do not create implausible, obvious, or nonsense distractors. For example, in a test of ethics, do not include an obviously unethical choice as a response option.

   Do not make the correct answer too attractive to resist. By including obviously appropriate management recommendations (such as to stop smoking and start exercising) only in the correct answer and not in the distractors, the answer is given away.

   Do not make the correct answer substantially longer or more detailed than the distractors. All the response options should be homogeneous and similar in grammatical construction, length, and complexity. It is a common belief among test-savvy candidates that the longest option is the correct answer.

   Do not create two distractors that illustrate the same wrong way of thinking. When two distractors are very similar in meaning or intent, this is a clue that neither of them can be the correct answer.

5. **Do not use non-homogeneous options.** These questions ask the candidate to choose between apples and oranges; that is, to select the best option from a list of options addressing different points. For example:

   An 87 year-old white man who has severe longstanding Alzheimer's disease now resides in a nursing home because of his dementia and total dependence in all activities of *daily living. He has a long history of recurring constipation and laxative use. Several episodes of fecal impaction have*

been relieved manually. During the past year, despite a treatment program that included dietary fiber, increased f *fluid intake, toileting schedules, and enemas, he has required three urgent hospital visits for abdominal problems that included constipation, fecal impaction, and abdominal distention. On each of these occasions, radiographs have shown massive colonic dilation.*

Which of *the following statements regarding this patient's gastrointestinal syndrome is true?*

(A) The first symptom is usually abdominal pain
(B) The use of *fiber supplements is essential in treatment*
(C) Effective treatment requires cleansing tap water enemas every three to four days
(D) It may be exacerbated by nonsteroidal anti-inflammatory drugs (NSAIDs)

Every question should address a single content point. When more than one point is addressed, the assessment information is confounded because precision is lost. More importantly, the examinee can easily be confused by such a question because it introduces "irrelevant difficulty" (in this case, difficulty related to question format rather than question content). In your question, the essence of the problem should be in the stem, which means that the question should pose a specific, single task such as diagnosis, treatment, and so forth. One way to identify any well-constructed question is first to cover the options and then to guess what they might be from the question asked. If some of the options can be deduced, it is clear that a specific, meaningful task is being posed. In the question above, no specific task is posed; therefore it would be almost impossible to deduce any of the options.

6. **Do not use *"All of the above."*** This is an unacceptable option because it increases the chance that a less knowledgeable examinee will guess the correct answer.

7. **Do not use *"None of the above."*** This is an unacceptable option because it is an imprecise measure of the candidate's knowledge. When *None* of *the above is* the correct answer, it may be chosen by a candidate who thinks it refers to another "answer" that is not be correct. When *None of the above is* a distractor, it may mislead a candidate who is thinking of an unlisted but possible correct alternative to the correct answer.

E. **After Completing Questions**:

1. Experienced authors suggest setting questions aside for a week or more, then returning to them for a fresh review.

2. Consider adding a brief rationale that describes (1) the testing point, (2) why you picked the different options, and (3) why the indicated answer is best. Time spent writing a rationale may prove useful when the time comes to discuss your question with the committee. If the question tests a new or controversial area, a reference also may be appreciated by other committee members.