How to Write a Better Question

A Guide to Construction of NBME-type Questions for the UASOM Pre-Clinical Curriculum

RIME Week
September 2012

Cathy Fuller Ph.D.
Dept. of Cell, Developmental and Integrative Biology
cfuller@uab.edu
934-6227
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INTRODUCTION

Writing questions for the basic science exams that are held in each module in the pre-clinical curriculum at UASOM is often seen as a daunting task by module directors and lecturers alike. Many times questions are recycled from one year to the next without too much consideration being given to the quality of the information being solicited. Most often, exam questions test memorization and isolated fact recall, rather than discerning whether or not students can apply the knowledge of the basic sciences that they should have obtained in class, to solve the puzzle posed by the question. One of the goals and challenges of the modular curriculum is to teach the students to integrate and use that information to problem solve, as this will be exactly what is required of them, not only to be successful in the Step 1 exam but also later in the clerkships and for the rest of their careers. As we all know, this skill which is second nature to us as clinicians, researchers and instructors, does not come easily to many of our students. However, the skill to write multiple choice questions that test this parameter, does not come easily to many of us!

The information in this guide is largely a distilled version of the item writing manual produced by the NBME entitled “Constructing Written Test Questions for the Basic and Clinical Sciences”. The book itself is available as a pdf download at:

http://www.nbme.org/publications/index.html#iwman

and is also available in Spanish and Russian, should that be of help to anyone. This version (only available in English!), is a brief introduction to item writing, listing the key points, and things to do and not to do (mostly not to do!) when constructing a question. In addition there are some examples of question lead-ins, potential topics that could form answer options, and some sample question templates. Obviously, the manual from the NBME has far more detail than will be included here. Writing good multiple choice questions takes time. However, we hope that this guide will help instructors to construct new questions or modify existing questions that will test a candidate’s ability to apply what they have learnt in class, while avoiding obvious question flaws and defeating “test-wiseness”. Fortunately, some of the most common flaws in question writing are among the easiest to fix.
BASIC RULES FOR WRITING NBME QUESTIONS

Each item should focus on an important concept, or a common or potentially catastrophic clinical problem.

Each item should assess application of knowledge, not recall of an isolated fact.

The stem of the item must pose a clear question and it should be possible to arrive at an answer with the options covered.

Each question should end in a question mark! No questions should end in a colon or semi-colon and no questions should consist of a single word, expecting the student to fill in the blanks.

Each question should have the correct grammar and spelling.

All options should be of roughly equal length and homogenous, i.e., all increase, all decrease or an equal mixture of the two; all drugs, all infections etc.

Do not use stems that ask any of the following:

Which of the following is TRUE/FALSE: All of the following are true/false EXCEPT:
Which of the following is NOT an example of: Which of the following is LEAST probable?

Do not use “All of the above” or “None of the above” as options.

Avoid stems that “teach”.

Avoid giving unintentional logical clues.

Avoid convergence, i.e., clueing the correct answer as the one that has the most in common with the other answers.

Avoid absolute terms such as “always” and “never” in stems and options.

Avoid repeating words and phrases in the stem and in the options.

Avoid using imprecise terms (usually, frequently) in stems and options.

Avoid irrelevant difficulty in options, and stems that are tricky or unnecessarily complicated.

Questions should have at least 4, usually 5 and can have as many as 11 options.

Extended match and case cluster questions are allowed.

Use of charts, graphs and images (i.e., data to be interpreted), is encouraged.
State numeric data consistently.

Use common presentations of common diseases, e.g. make your patient with liver spots eighty-five years old as opposed to twelve (unless liver spots at a young age is pertinent to the question being asked)!

Use normal words (no slang!) when speaking in the patient’s voice, e.g., a patient does not go to the physician with the chief complaint of scleral icterus – but they might say that the whites of their eyes have turned yellow!

Ideally, the student should be able to arrive at the answer just by reading the stem, i.e., the options are not necessary in order to successfully answer the question.
Flawed Questions:

Things not to do in stems, options and how to defeat “test-wiseness”.

A. Things NOT to do in Question Stems

1. Each question should end in a question mark! No questions should end in a colon or semi-colon and no questions should consist of a single word, expecting the student to fill in the blanks.

Example:

The best way to a man’s heart is through his:
A. aorta
B. pulmonary arteries
C. pulmonary veins
D. stomach

A better stem would be “Which of the following is the best way to a man’s heart?” N.B. Although this is a better stem, this question as a whole only tests memorization rather than knowledge application.

2. Each question should have the correct grammar (and of course spelling!).

Example:

A 60 year old man is brought to the emergency department by the police who found him lying unconscious on the sidewalk. After ascertaining that the airway is open, the first step in management should be intravenous administration of:

A. Examination of CSF
B. Glucose with vitamin B1 (thiamine)
C. CT scan of the head
D. Phenytoin
E. Diazepam

In this question, the only grammatically correct options are B, D and E – so now the candidate only has to select from 3 possibilities rather than from 5 and the probability of simply guessing the correct answer has increased from 20% to 33%. This is also a poor question because of the “question mark” rule above!
3. **Avoid stems that ask any of the following:**

Which of the following is TRUE/FALSE:

All of the following are true/false EXCEPT:

Which of the following is NOT an example of:

Which of the following is LEAST probable?

Example:

True statements about cystic fibrosis (CF) include:

A. The incidence of CF is 1:2000  
B. Children with CF usually die in their teens  
C. Individuals with CF are sterile  
D. CF is an autosomal recessive disease

This is a bad question on a number of levels, but mostly because it is a True/False question. The answer any candidate might give would depend on their perspective, e.g., the incidence of CF might be an average of 1:2000 in North America, but is about 1:30,000 in Asian-Americans, therefore these numbers vary depending on population, location, age group being studied, etc., i.e., the incidence is a number about which experts might reasonably disagree. Similarly, B and C could also be true based on what exactly is being considered. The only one that is completely true would be D.

Example:

In children, ventricular septal defects are associated with:

A. Systolic murmur  
B. Pulmonary hypertension  
C. Tetralogy of Fallot  
D. Cyanosis

Here, the student has to make an assumption about the severity of the disease, age of the patient, and whether or not the underlying condition has been treated.

Although it is possible to write good T/F items from a structural perspective, for the purpose of NBME format questions, these are best avoided.
4. Avoid stems that “teach”.

Example:

Gastrin is synthesized as a large pre-cursor polypeptide that is then cleaved within the secretory granule to yield the two main circulating forms, G17 and G34. Which of the following is ONE of the main functions of gastrin in the gut?

A. Stimulation of parietal cell acid secretion
B. Stimulation of somatostatin release from D cells
C. Stimulation of vagal firing
D. Inhibition of mucosal growth
E. Inhibition of intrinsic factor release

The first sentence of this stem is not necessary in order to answer the question which is self-contained in the second part of the stem. Incidentally the lead in is very vague and emphasizes the word ONE; no words are ever emphasized in NBME formatted questions!
B. Things NOT to do in question options:

1. All options should be of roughly equal length.

Example:

Secondary gain is:

A. Synonymous with malingering
B. A frequent problem in obsessive-compulsive disorder
C. A complication of a variety of illnesses and tends to prolong many of them
D. Never seen in organic brain damage

In this question, option C is clued as correct to the test-wise student, simply because it is the longest option. It is also a double option, which also makes it stand out from the rest of the choices. The stem for this one isn’t great either! Furthermore, this question is not asking the student to solve a problem, only to remember a definition.

2. Options should be homogenous

Example:

Which of the following would you expect to find in a patient with Zollinger-Ellison syndrome?

A. Decreased blood CCK  
B. Decreased blood GIP  
C. Decreased blood secretin  
D. Decreased blood gastrin  
E. Increased blood gastrin

Although in this question all the options are hormones (which makes them homogenous from that perspective), E is clued as the correct answer because it is the only option that is “increased”. Also, the presence of two gastrin options clues the student further that either D or E will be correct.

3. Avoid giving unintentional logical clues.

Example:

Crime is:

A. Equally distributed among the social classes  
B. Overrepresented among the poor  
C. Overrepresented among the middle class and rich  
D. Primarily an indication of psychosexual maladjustment  
E. Reaching a plateau of tolerability for the nation

In this question, options A, B and C cover all the possibilities. As D and E are unlike the first three, it suggests to the test-wise student that one of the first three options is likely correct – again, the chances of getting the correct answer by guess work is now 33% as opposed to 20%. 

Probably the item writer did not pay much attention to D and E, as he/she knew they were incorrect options. This can also be a problem in “decreases” and “increases” type items.

4. Avoid convergence, i.e., clueing the correct answer as the one that has the most in common with the other answers:

Example:

Local anesthetics are most effective in the:

A. Anionic form, acting from inside the nerve membrane
B. Cationic form, acting from inside the nerve membrane
C. Cationic form, acting from outside the nerve membrane
D. Uncharged form, acting from inside the nerve membrane
E. Uncharged form, acting from outside the nerve membrane

In this question the stem is obviously a problem. At first glance however, the options look pretty good; however this question is clued for the test-wise student. This student will automatically discount answer A, as it is the only option that is an anion; There are three options for the anesthetic working from the inside of the nerve, and only two for it working from the outside of the nerve, therefore an answer including “inside” is more likely to be correct, i.e., either A, B, or D; A has already been discarded as a possibility however. Similarly, three of the original five options are “charged” forms, therefore the correct answer is most likely to be one of those, i.e., A, B, or C. A and C have been discarded, leaving us with B as the most likely answer – which is, of course, correct!

5. Avoid using “All of the above” or “None of the above” as options.

Example:

Xerostomia may be seen in which of the following conditions?

A. Diabetes
B. Sarcoidosis
C. Bulimia
D. HIV infection
E. All of the above

Again, depending on your perspective or experience, option E which is keyed as the correct answer, could be true or false. Because of these ambiguities, which are really the same as those posed by True/False question stems, all of the above and none of the above options are best avoided.
Things NOT to do in Stems OR Options

1. Avoid absolute terms such as “always” and “never” in stems and options.

Example:

In patients with advanced dementia, Alzheimer’s type, the memory defect:

A. Can be treated adequately with phosphatidylcholine
B. Could be a sequela of early Parkinsonism
C. Is never seen in patients with neurofibrillary tangles at autopsy
D. Is never severe
E. Possibly involves the cholinergic system

Here again the test-wise student will eliminate options C and D, knowing that absolutes are less likely to be correct; the chance of guessing the correct answer is now 33% as opposed to 20%.

2. Avoid repeating words and phrases in the stem and in the options.

Example:

A 58 year old man with a history of heavy alcohol use and previous psychiatric hospitalization is confused and agitated. He speaks of experiencing the world as unreal. Which of the following conditions best fits these symptoms?

A. Depersonalization
B. Derailment
C. Derealization
D. Focal memory deficit
E. Signal anxiety

Because of the repetition in stem and option, the test-wise student will select option C as correct.

3. Avoid using imprecise terms in stems and options.

Example:

True statements about pseudogout include:

A. It occurs commonly in women
B. It is often associated with acute pain
C. It is usually hereditary
D. Serum calcium levels are frequently increased

Apart from the horrible stem, in this question the options are not absolutely true or absolutely false; the student has to rely on his/her own judgment for the meaning of terms such as frequently and usually, and hope that their definition coincides with that of the examiner.
4. Avoid irrelevant difficulty in options.

Example:

Peer review committees in HMOs may move to take action against a physician’s credentials to care for participants of the HMO. There is an associated requirement to assure that the physician receives due process in the course of these activities. Due process must include which of the following?

A. Notice, an impartial forum, council, a chance to hear and confront evidence against him/her.

B. Proper notice, a tribunal empowered to make the decision, a chance to confront witnesses against him/her, and a chance to present evidence in defense.

C. Reasonable and timely notice, impartial panel empowered to make a decision, a chance to hear evidence against himself/herself and to confront witnesses, and the ability to present evidence in defense.

In this question, as well as having option C, which covers all possibilities, and asking the student to decide the difference between proper and reasonable and timely notice, the options are very long and complex. The stem in this case however is fine – many Step 1 questions have lengthy stems, which is why the number of questions asked per hour has decreased from 50 to 46 in recent years.

5. Avoid stems that are tricky or unnecessarily complicated.

Example:

Arrange the parents of the following children with Down’s syndrome in order of highest to lowest risk of recurrence. Assume that the maternal age in all cases is 22 years and that a subsequent pregnancy occurs within 5 years. The karyotypes of the daughters are:

I: 46, XX, -14, +T(14q21q) pat
II: 46, XX, -14, +T(14q21q) de novo
III: 46, XX, -14, +T(14q21q) mut
IV: 46, XX, -21, +T(14q21q) pat
V: 47, XX, -21, +T (21q21q) (parents not karyotyped)

A: III, IV, I, V, II
B: IV, III, V, I, II
C: III, I, IV, V, II
D: IV, III, I, V, II
E: III, IV, I, II, V

This question requires the student to rank the options and then to select an answer that matches that rank. The notation being in Roman numerals is complex and unnecessary. A better question might be to simply ask the student to select the option with highest risk of recurrence.

Example:

Following a second episode of infection, what is the likelihood that a woman is infertile?

A. Less than 20%
B. 20 to 30%
C. Greater than 50%
D. 90%
E. 75%

Here some options are expressed as ranges, some as specific percentages; all options should be of one type. In addition, option C covers options D and E, thereby ruling out D and E as being the correct answer.
Anatomy of A Question

An NBME multiple choice question consists of three parts – a stem, which is frequently a clinical vignette, a lead in and an option list.

Vignette

If using a true clinical vignette, it should contain the following information in the order given below:

- Age, gender (A 45 year old man…)
- Site of care (comes to the emergency room)
- Presenting complaint (because of a headache)
- Duration (that has continued for 2 days)
- Patient/Family History (if there is no pertinent history, you can say that the patient history is non-contributory; if the physical exam is normal, you can say that the PE is normal or is unremarkable; NBME likes to include HR, pulse, BP, respiration rate and BMI, even if they are normal)
- Results of Diagnostic Studies (Lab values or biopsy images are good to include here; students are provided with a list of normal lab values, e.g. blood counts, serum proteins etc. for the Step 1 exam.)
- Initial Treatments, Subsequent Findings (drugs administered, results of tests post-treatment, etc.).

However, especially for basic science questions, it is not necessary to use a complete clinical vignette as outlined above, although some type of vignette is required. For example:

A 62 year old man develops left sided ataxia, Horner’s syndrome, nystagmus and loss of appreciation of facial pain and temperature sensations. What artery is most likely to be occluded?

And some “vignettes” can be even more basic:

Genes on the bacterial chromosome have the following linkages in conjugal transfer: x and y, 25% of the time; y and z, 50% of the time. If the gene order is x-y-z, approximately what percentage of the time will x and z be transferred together?

The key point is to ask questions that require problem solving rather than fact recall.
Examples of Lead-ins and Option Lists

Which of the following is (abnormal)?

Sample options:

Sites of lesions, list of nerves, muscles, enzymes, hormones, cells, neurotransmitters, toxins, molecules, vessels, spinal segments

Which of the following findings is most likely?

Sample options:

Lab results, additional physical signs, autopsy results, results of microscopic examination of fluids, tissue, DNA analysis, serum levels.

Which of the following is the most likely cause?

Sample options:

Underlying mechanisms of the disease, side effects of medications, drugs or drug classes, toxic agents, hemodynamic mechanisms, viruses, pathogens, metabolic defects.

Which of the following should be administered?

Sample options:

Drugs, vitamins, amino acids, enzymes, hormones

Which of the following is defective/deficient/non-functioning?

Sample options:

Enzymes, feedback mechanisms, endocrine structures, dietary elements, vitamins
The Concept of the Best Answer

For each question, the candidate needs to select the “best” answer. Most students translate this to mean that there is only a single correct answer and all of the other options will be wrong. In NBME questions, this is generally not the case; in NBME questions, if the best answer was not there, the next best option, though maybe not completely fitting all of the conditions laid out in the stem, would be the “best answer”. This is a concept most students have problems coming to terms with, but is essential for writing questions that really test whether or not a student knows his/her stuff.

Example:

A 32 year old man has a 4-day history of progressive weakness in his extremities. He has been healthy except for an upper respiratory tract infection 10 days ago. His temperature is 38.7°C (100°F), blood pressure is 130/80 mm Hg, pulse is 94/min and respirations are 42/min and shallow. He has symmetric weakness of both sides of the face and the proximal and distal muscles of the extremities. Sensation is intact. No deep tendon reflexes can be elicited; the plantar responses are flexor. Which of the following is the most likely diagnosis?

A. Acute disseminated encephalomyelitis
B. Guillain-Barre syndrome
C. Myasthenia gravis
D. Poliomyelitis
E. Polymyositis

This question really forces the candidate to think about what they know about each condition and how the hallmark symptoms of these conditions fit with the clinical vignette. If we were to write down the common characteristics of each illness it might look like this:

A. Acute disseminated encephalomyelitis: abrupt onset, lethargy, irritability; muscle weakness; children <12 yrs)
B. Guillain-Barre syndrome: symmetric muscle weakness; loss of deep tendon reflexes
C. Myasthenia gravis: weakness that improves with rest; involvement of eyelids, facial muscles
D. Poliomyelitis: asymmetric loss of muscle function; pain
E. Polymyositis: symmetric proximal muscle weakness; normal reflexes;

Clearly option B best fits the clinical picture provided by the vignette; however, if option B was not present, the next best answer would be E. These options can be diagrammed from least to most correct as follows:

```
D  C  A  E  B

Least Correct               Most Correct
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Does Writing a Better Question make a Difference?

The short answer is YES!! Take the two questions below:

The most likely renal abnormality in children with nephrotic syndrome and normal renal function is:

A. Acute post-streptococcal glomerulonephritis  
B. Hemolytic-uremic syndrome  
C. Minimal change nephrotic syndrome  
D. Nephrotic syndrome due to focal and segmental glomerulosclerosis  
E. Schonlein-Henoch purpura with nephritis

This question is flawed because a) it requires recall of an isolated fact, b), it doesn’t follow the question mark rule, and c), the word nephrotic appears in both the stem and the options. This question would focus a candidate on options C and D, and given that the stem mentions normal renal function, might clue the candidate further to selecting C, which is the right answer, or D because it is the longest option. When this question was administered to a group of students, 82% of the class answered this question correctly.

The following is essentially the same question, but now re-written as a clinical vignette in NBME format:

A 2 year-old boy is taken by his mother to see his pediatrician because of a 1 week history of edema. His blood pressure is 100/60 mm Hg, and there is a generalized edema and ascites. Laboratory tests showed the following serum concentrations: creatinine 0.4 mg/dL, albumin 1.4 g/dL, and cholesterol 569 mg/dL. Urinalysis shows 4+ protein and no blood. Which of the following is the most likely diagnosis?

A. Acute post-streptococcal glomerulonephritis  
B. Hemolytic-uremic syndrome  
C. Minimal change nephrotic syndrome  
D. Nephrotic syndrome due to focal and segmental glomerulosclerosis  
E. Schonlein-Henoch purpura with nephritis

This question is now asking the student to apply what they know about renal diseases to solve this particular problem. The question also ends with a question mark, and there is no repetition of key words between the stem and options. When this question was administered, only 66% of the class answered correctly.
Here is another example for a more basic science type question.

Isolated fact recall:

Acute intermittent porphyria is the result of a defect in the biosynthetic pathway for:

A. Collagen
B. Corticosteroid
C. Fatty acid
D. Glucose
E. Heme
F. Thyroxine

NBME format:

An otherwise healthy 33 year old man has mild weakness and occasional episodes of steady, severe abdominal pain with some cramping but no diarrhea. One aunt and a cousin have had similar episodes. During an episode his abdomen is distended, and bowel sounds are decreased. Neurologic examination shows mild weakness in the upper arms. These findings suggest a defect in the biosynthetic pathway for which of the following substances?

A. Collagen
B. Corticosteroid
C. Fatty acid
D. Glucose
E. Heme
F. Thyroxine
Sample Templates for Writing Basic Science Questions

A (patient description) has a (type of injury and location). Which of the following structures is most likely to be affected?

A (patient description) has (history, findings) and is taking (medications). Which of the following medications is the most likely cause of his (one history, physical or lab findings)?

A (patient description) has (abnormal findings) Which (additional finding) would suggest/suggests a diagnosis of (disease 1) rather than (disease 2)?

A (patient description) has (symptoms and signs). These observations suggest that the disease is a result of the (absence or presence) of which of the following (enzymes, mechanisms)?

A (patient description) follows a (specific dietary regimen). Which of the following conditions is most likely to occur?

A (patient description) has (symptoms, signs or a specific disease), and is being treated with (drug or drug class). The drug acts by inhibiting which of the following (functions, processes)?

A (patient description) has (abnormal findings). Which of the following (positive laboratory results) would be expected?

(Time period) after a (event such as a trip or meal with certain foods) a (patient or group description) became ill with (symptoms and signs). Which of the following (organisms, agents) is most likely to be found on analysis of (food, stool, etc)?

Following (procedure), a (patient description) develops (symptoms and signs). Laboratory findings show (findings). Which of the following is the most likely cause?

A (patient description) dies of (disease). Which of the following is the most likely finding at autopsy?

A (patient description) has (symptoms and signs). Which of the following is the most likely explanation for the (findings)?

A (patient description) has (symptoms and signs). Exposure to which of the following (toxic agents) is the most likely cause?

Which of the following is the most likely mechanism of the therapeutic effect of this (drug, drug class) in patients with (disease)?

A patient has (abnormal findings) but (normal findings). Which of the following is the most likely diagnosis?
Some Examples of Basic Science Items:

Several contiguous cells are labeled with a fluorescent dye that cannot cross cell membranes. One cell is experimentally bleached with light that destroys the dye, but soon recovers fluorescence. This recovery is best explained by the presence of which of the following structures between the bleached cell and its fluorescent neighbors?

A. A basal lamina
B. Desmosomes (maculae adherens)
C. **Gap junctions**
D. Glycosaminoglycans
E. Tight junctions (zonulae adherens)

A 30 year old man has loss of pain and temperature sensation from the neck down the right side of the body and on the left side of the face; partial paralysis of the soft palate, larynx, and pharynx on the left; and ataxia on the left. This syndrome is most likely to result from thrombosis of which of the following arteries?

A. Basilar
B. Right posterior inferior cerebellar
C. **Left posterior inferior cerebellar**
D. Right superior cerebellar
E. Left superior cerebellar

During an operation, the arterial PCO₂ and pH of an anesthetized patient are monitored. The patient is being ventilated by a mechanical respirator, and the initial values are normal (PCO₂ = 40 mm Hg; pH = 7.42). If the ventilation is decreased, which of the following is most likely to occur?

<table>
<thead>
<tr>
<th>Arterial PCO₂</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Decrease</td>
<td><strong>Decrease</strong></td>
</tr>
<tr>
<td>B. Decrease</td>
<td>Increase</td>
</tr>
<tr>
<td>C. Decrease</td>
<td>No change</td>
</tr>
<tr>
<td><strong>D. Increase</strong></td>
<td><strong>Decrease</strong></td>
</tr>
<tr>
<td>E. Increase</td>
<td>Increase</td>
</tr>
<tr>
<td>F. Increase</td>
<td>No change</td>
</tr>
</tbody>
</table>

A patient with post-hepatic cirrhosis develops rapid enlargement of the liver associated with deterioration of hepatic function. Serum concentration of which of the following is most likely to be abnormal?

A. Alpha-1 antitrypsin
B. Carcinoembryonic antigen
C. Chronic gonadotropin
D. **Alpha-fetoprotein**
E. Gastrin
Laboratory tests on an edematous 35 year-old man show a normal serum concentration of complement and an increased serum concentration of cholesterol. Urinalysis shows 4+ protein, 0-5 erythrocytes /hpf, and several hyaline casts. Examination of tissue obtained on renal biopsy is most likely to show which of the following?

A. Acute post-streptococcal (proliferative) glomerular nephritis  
B. Membranoproliferative glomerulonephritis  
C. Membranous glomerulonephritis  
D. Minimal change disease (lipoid nephrosis)  
E. Rapidly progressive glomerulonephritis

The first-born infant of an Rh-negative 26 year old woman who had two previous second trimester abortions has severe hemolysis and circulatory failure. This condition could have been prevented by treating the mother with which of the following?

A. Anti-RhD IgG during the most recent pregnancy  
B. Anti-RhD IgG on termination of each prior pregnancy  
C. Anti-RhD IgM during the most recent pregnancy  
D. Anti-RhD IgM on termination of the first pregnancy

Genes on the bacterial chromosome have the following linkages in conjugal transfer: x and y, 25% of the time; y and z, 50% of the time. If the gene order is x-y-z, approximately what percentage of the time will x and z be transferred together?

A. 1% of the time  
B. 5% of the time  
C. 13% of the time  
D. 20% of the time  
E. 40% of the time

At a banquet, the menu included fried chicken, home-fried potatoes, peas, chocolate éclairs and coffee. Within 2 hours, most of the diners became violently ill with nausea, vomiting and abdominal pain. Analysis of the contaminated foods is most likely to yield large numbers of which of the following organisms?

A. Escherichia coli  
B. Proteus mirabilis  
C. Salmonella typhimurium  
D. Staphylococcus aureus  
E. Streptococcus faecalis
A patient seen in the emergency department does not know which “heart drug” he is taking. His heart rate is greater than 80/min, and the PR and QRS intervals on an ECG are prolonged. The patient reports ringing in his ears. Which of the following drugs has the patient most likely been taking?

A. Digoxin
B. Lidocaine
C. Phenytoin
D. Propranolol
E. Quinidine

Drug Y has a volume of distribution (Vd) of 75 L in both younger and older adult men. In younger adults it has a clearance rate of 15L/h, 50% of which is via the liver and 50% via the kidneys. For younger men, the maintenance regimen is 100 mg every 6 hours. Which of the following regimens will produce essentially the same steady-state concentration in an older man, whose creatinine clearance is reduced to half that of younger men, but whose hepatic function is unimpaired?

A. 75 mg every 3 hours
B. **75 mg every 6 hours**
C. 75 mg every 9 hours
D. 100 mg every 3 hours
E. 100 mg every 6 hours
F. 100 mg every 12 hours

An 8-year old boy needs to be coaxed to go to school, and often, while there, he complains of severe headaches or stomach pain. Sometimes his mother has to take him home because of his symptoms. At night he tries to sleep with his parents. When they insist he sleep in his own room, he says there are monsters in the closet. These findings are most consistent with which of the following diagnoses?

A. Childhood schizophrenia
B. Normal concerns of latency-age children
C. **Separation anxiety disorder**
D. Socialized conduct disorder
E. Symbiotic psychosis
Case Clusters

Case cluster questions refer to a situation where two to three questions refer to a single vignette. These questions can involve aspects of both basic and clinical science and are appropriate to be written by a team of the relevant lecturers. These questions might be ideal comprehensive questions, drawing on information provided in earlier modules.

Examples:

A 34 year old woman has had severe watery diarrhea for the past three days. She abuses drugs intravenously and has antibodies to HIV in her blood. Physical examination shows dehydration and marked muscle weakness.

1. Laboratory studies are most likely to show which of the following?
   A  Decreased serum K^+
   B  Decreased serum Ca^{2+}
   C  Increased serum HCO_3^-
   D  Increased serum Na^+
   E  Increased serum pH

2. In evaluating the cause of her diarrhea, which of the following is most appropriate?
   A  Colonic biopsy to identify Giardia lamblia
   B  Culture of the oral cavity for Candida albicans
   C  Duodenal biopsy to identify Entamoeba histolytica
   D  Gastric aspiration to identify Mycobacterium avium-intracellulare
   E  Stool specimens to identify Cryptosporidium

3. Further studies to evaluate her HIV infection show the ratio of helper T lymphocytes to suppressor T lymphocytes to be 0.3. This occurs because HIV does which of the following?
   A  Induces proliferation of helper T lymphocytes
   B  Induces proliferation of suppressor T lymphocytes
   C  Infects cells bearing CD4 receptors
   D  Infects macrophages
   E  Stimulates the synthesis of leukotriene

However with case cluster you must be careful to avoid cueing and hinging. Cueing means to inadvertently provide or indicate the correct answer to a question in the stem or options of another question. Hinging means that in order to answer one question, the student must already have answered a previous question correctly, such that the answer to question B hinges on the answer given in question A.
Extended Match Questions

These are a series of questions when all the answers come from a single set of options. The maximum number of extended match options in a single set is 26.

For each extended match group you need a theme, a list of options (i.e. potential answers), a lead-in statement and at least two question stems.

Example:

Theme: Fatigue

Options: 
A Acute leukemia
B Anemia of chronic disease
C Congestive heart failure
D Depression
E Epstein-Barr virus infection
F Folate deficiency
G Glucose-6-phosphate dehydrogenase deficiency
H Hereditary spherocytosis

Lead in: For each patient with fatigue, select the most likely diagnosis.

1. A 19 year old woman has had fatigue, fever, and sore throat for the past week. She has a temperature of 38.3°C, cervical lymphadenopathy and splenomegaly. Initial laboratory studies show a leucocyte count of 5000/mm³ (80% lymphocytes, with many lymphocytes exhibiting atypical features). Serum AST activity is 200 U/L. Serum bilirubin concentration and serum alkaline phosphatase activity are within normal limits.

2. A 15 year old girl has a two week history of fatigue and back pain. She has widespread bruising, pallor, and tenderness over the vertebrae and both femurs. A complete blood count shows hemoglobin concentration of 7 g/dL, leucocyte count of 2000/mm³ and a platelet count of 15,000/mm³.

(Normal values should be included)
To write an extended match set:

- Select your theme.
- Write the lead-in.
- Prepare the list of options.
- Write the stems; patient vignettes are probably best.
- Review the items; single best answer; at least four good distractors for each question; check for hinging and cueing.

A Flawed Extended Match Set:

Match each item with the best option:

A is motion sickness
B have no effects on people
C indirectly increase CO2
D cause death
E increased odor sensitivity
F is a reduction in visibility
G esthetics, economics, health
H products of fossil fuel combustion
I are completely controlled
J cause plant and eye damage
K increase risk of skin cancer
M cannot be controlled
N excess acute respiratory illness among children
O contrary to public opinion

1. Factors that people consider when evaluating air quality
2. A principal effect of particulate matter in air
3. The products of photochemical smog

Problems:

The non-specific lead-in poses inconsistent and ambiguous tasks;

Options are heterogeneous; require examinee to rank them as “more or less true” for a given stem; there should be NO verbs in options

Stems are vague; cannot answer without reading options; stems do not have unambiguous answers
Good and Bad Stems for Extended Match Sets:

For this series of questions, the options were a list of bacteria and viruses:

For each patient with fever, select the pathogen most likely to have caused his/her illness.

A 7 year old girl has a high fever and a sore throat. There is pharyngeal redness, a swollen right tonsil with creamy exudate and painful right submandibular lymphadenopathy. Throat culture on blood agar yields numerous small β-hemolytic colonies that are inhibited by bacitracin.

An encapsulated gram-positive organism that usually grows in pairs or short chains. (This stem just tests memorization);

For this series of questions, the options were a list of vitamins and minerals:

For each patient with clinical features caused by metabolic abnormalities, select the vitamin or mineral that is most likely to be involved.

A 70 year old widower has ecchymoses, perifollicular petechiae, and swelling of the gingiva. His diet consists mostly of cola and hot dogs.

Involved in clotting factor synthesis (Again just memorization of an isolated fact).

Options for Extended Match questions should be:

- Single words or short phrases
- Must be homogeneous
- Can be labeled areas in a graph or image
- Can be expressed in tables, e.g. lab values
- Subtle distinctions and uncommon diagnoses are probably inappropriate
Examples of Potential Extended Match Questions and Options:

For each of the following patients select the (e.g. nerve) that is most likely to be (abnormal, defective, deficient, non-functioning).

List of nerves; muscles; neurotransmitters; enzymes; hormones; proteins; types of cells; pathologic processes;

For each of the following patients select the (finding) that would be expected.

List of laboratory results; additional physical signs; autopsy results; results of the microscopic examination of fluids, muscle or joint tissue; DNA analysis results; hormone levels.

For each of the following patients, select the most likely (cause).

List of underlying mechanisms of disease; medications that might cause side effects; drugs or drug classes; toxic agents; hemodynamic mechanisms.

For each of the following patients, select the (e.g. drug) that should be administered.

List of drugs; vitamins; amino acids; enzymes; hormones.

For each of the following patients with (chief complaint), select the most likely diagnosis.

List of diagnoses, most often organized around a chief complaint such as diseases that cause chest pain or diseases that cause fever or jaundice.

Other Ideas for Option Lists:

Arteries Connective Tissue Types
Nerves Anatomic Structures
Muscles Endocrine Structures
Amino acids Neurotransmitters
Peptides Metabolic defects
Hormones Immune disorders
Enzymes Motor system components
Cell Components Cardiac structures
Cell Types Organelles
Blood Components Congenital anomalies
Molecules Segments of the spinal cord
Karyotypes CNS components
Proteins Secretory products
Lipids ECM components
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