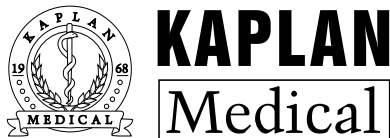


# Explanations to Kaplan MCAT Full-Length 3



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**VERBAL REASONING  
ANSWER KEY**

1.	B	11.	A	21.	A	31.	D	41.	C	51.	C	61.	D
2.	C	12.	D	22.	C	32.	B	42.	B	52.	B	62.	A
3.	C	13.	A	23.	C	33.	D	43.	B	53.	B	63.	B
4.	D	14.	A	24.	D	34.	B	44.	D	54.	C	64.	B
5.	B	15.	B	25.	C	35.	C	45.	D	55.	C	65.	D
6.	A	16.	B	26.	C	36.	D	46.	B	56.	B		
7.	B	17.	B	27.	D	37.	C	47.	D	57.	A		
8.	D	18.	A	28.	B	38.	B	48.	A	58.	C		
9.	B	19.	C	29.	A	39.	B	49.	B	59.	B		
10.	D	20.	B	30.	B	40.	A	50.	C	60.	A		

## VERBAL REASONING EXPLANATIONS

## Passage I (Questions 1—6)

**Topic and Scope:** A scientific debate on the evolutionary status of marsupials.

**Paragraph Structure:** In paragraph one, the author disputes the idea that the difference in brain structure between marsupials and placentals is indicative of a less advanced evolutionary state. The phrase “Yet it cannot be inferred” (line 7), for example, points out a flaw in the previously-held conclusion and arguments. The second paragraph argues that although marsupials are less intelligent, this is not a disadvantage to them. The theme is continued into paragraph three in relation to the matter of maternal protective behavior. And the last sentence revisits the idea of “anthropomorphic bias” that was mentioned in the first sentence and labels it a mistake.

**Questions:****1. B**

This is a main idea question. The first and last sentences of the passage are perfect book-ends summarizing the author’s argument through the passage as a whole. The author is in disagreement with those who brand marsupials as inferior. Note that the word “argue” in this answer choice reflects the tone of the passage.

Choice A is wrong because the passage doesn’t describe common misconceptions; it’s about very specific disagreements on points concerning the evolutionary status of marsupials versus placentals.

Choice C is wrong because the passage doesn’t deal directly with the question of environmental adaptation.

The word “determine” is the problem with incorrect answer choice D. This point is left open; by the end of the passage we’re still not sure where marsupials fit into the evolutionary tree.

**2. C**

This is a Roman numeral question, and the information we need to answer it is contained in the second paragraph. The last three sentences of that paragraph contain the most important information for our purposes. There we are told that the placentals need to leave their young to go foraging; that immediately justifies statement I. We’re told directly thereafter that this absence increases the risk of accidental death to the young. Hence, we can justify statement II as well. Note: At this point, only choice C meets our needs, but don’t ignore statement III! Statement III, on the other hand, applies only to marsupials. We are told that the absence of the mother while she forages decreases the opportunity for placentals to learn by observing the mother. Therefore, statement III is not true.

**Kaplan Strategy:** Use “+” and “-” symbols to annotate true statements and false statements, respectively, on roman numeral questions. This will guide you to the correct answer choice more quickly and will also prevent you from having to read the question over and over again.

**3. C**

The answers break down into two parts—first, there is the author’s attitude; second, there are the reasons for that attitude, which are going to test our ability to follow the logical progression of the passage. Choice D can be eliminated immediately because we know that the author does not support this view.

The point made in choice C echoes throughout the passage from the anthropomorphic bias of the first sentence to the point made in the last sentence in the passage. The context is inappropriate because the author seems to feel that what serves placentals, including humans, in the evolutionary sense, does not necessary serve marsupials.

Choice A misses the point of the passage. No such evidence is cited.

Choice B is wrong because it suggests that marsupials occupy a superior evolutionary position based on current studies. This is not correct.

#### 4. D

Often the use of quotation marks when they're not setting off a specialized term has an ironic intent. The context should tell us here that choice D is what we're after. Notice that the author says in this sentence that pointing out the absence of this virtue is an instance of how mistaken some people can be.

Choice A is incorrect as the author sees no specific or special connotation of the word in this application.

Choice B vastly overstates its case: "ridicule" implies too strong and negative a tone to attribute to the author.

Choice C characterizes the thoughts of the author too generally and does not address the question posed in the stem.

#### 5. B

Choice A is incorrect because throughout the passage the author questions the concept of which mammals are higher and which are lower.

Choice C is much too broad: just what the current concepts of evolution might be is very unclear from the passage. Also, the use of the phrase "new data" is off key here; there is no indication that any of the work the author cites is new.

Choice D is a little easier to eliminate, as this is the very attitude that the author is against. This idea would lead, naturally, to the conclusion that placentals are more advanced than marsupials.

Choice B is supported by the author's discussion of the marsupial's lack of maternal instinct. Thus, by process of elimination alone, choice B is our correct answer choice.

**Kaplan Strategy:** When you are in doubt, use the process of elimination to keep your thinking patterns clear.

#### 6. A

The information that enables us to answer this question correctly is found in the introductory paragraph. Choice A is justified by the discussion in the second to last sentence of that paragraph, in which the author tells us that, functionally speaking, there are parallel connections in the brains of both groups of mammals. Choice B should be easy to eliminate, as the precise *opposite* point is made in paragraph one. As for choice C, there are differences in maternal behavior that are discussed in the final paragraph. Placentals are protective of their young, while marsupials are not. Choice D is incorrect since it applies only to placental animals. The author implies in the passage that marsupials don't need to get smart.

### Passage II (Questions 7-14)

**Topic and Scope:** This passage contrasts California's image in the past with its present crises, which include education, state budget, and other public services. The author begins to examine the causes of these problems

(especially what Governor Wilson believes), hinting that they should not be ascribed to defense cuts and illegal immigration.

**Paragraph Structure:** Paragraph one recounts the glowing image of California in the past, labeling it an “El Dorado.” The second paragraph lists some modern problems in California such as education, public services, and public parks. Paragraph three focuses on education—the rising cost in conjunction with the decreased quality and accessibility. The fourth paragraph describes California’s budget problems.

In the fifth paragraph, the author illustrates why this new image of California should be familiar. Paragraph six looks at apocalypse imagery of the past, showing that this demise should come as no surprise. The next paragraph presents Governor Wilson’s analysis of the causes of California’s problems, not necessarily opinions with which the author agrees. The final paragraph confirms that the author does not agree with Governor Wilson and that the problems faced by California may very well have been created by California itself.

### Questions:

#### 7. B

The passage provides a general overview of some of the problems that have developed in California.

Choice A is incorrect because the passage doesn’t enter a deep analysis of the cause of these problems and never mentions any measurable factors leading to the problems.

Choice C is incorrect because although the passage mentions that other states have comparable university tuitions (line 35) and that California has the lowest bond rating (line 51), the primary concern of the passage is not to contrast California’s problems with those of other states. Rather, the passage highlights the state of decline in which California now exists as compared to its sunny past.

The final paragraph indicates that the author may examine causes other than the Federal Government or illegal immigrants; however, the passage as a whole is a general overview of existing problems in the state. Thus, choice D is incorrect.

#### 8. D

The passage never states that California’s bond ratings have improved in recent years. It does say that California has one of the lowest bond ratings in the country (lines 51-52). All the other choices are supported by the passage.

Choice A is supported by paragraph seven. Even though the author disagrees with Wilson’s quick-to-blame others approach, he does not deny that “the Clinton Administration has, on the one hand, cost California hundreds of thousands of jobs.”

Choice B requires that you use some logic skills. Paragraph two contains the information to eliminate this true statement. Lines 17-19 point out that weak constituencies such as “children’s protective services” (our answer choice) have suffered similar losses to those of California school systems. You can thus infer that constituencies such as the recipients of children’s protective services yield little political power or else they would improve their deteriorated circumstances.

Choice C is supported in paragraph three.

#### 9. B

An astute reader should immediately pick up on the tone of paragraph seven by its opening sentence. “If you believe people like Governor Wilson” The author mentions Governor Wilson in a sarcastic and disparaging tone in paragraph 7 and immediately disagrees with him in paragraph 8, writing, “...California’s trouble is...more complex than the political rhetoric claims.” Even in paragraph

7, the use of words like "denial" and "self-deception" indicate that the author does not agree with Governor Wilson.

A is incorrect because the author immediately disagrees with these opinions in paragraph 8.

C In the final sentence of the passage, the author claims that "a lot of the damage didn't just happen to us..." The author does not portray the problems as a natural result of unfortunate circumstances.

D Although the author does not agree with Governor Wilson's opinion, he does not lay the blame for California's problems on the Governor.

**10. D**

Only choice D contains two factors that were discussed in the passage to illustrate the new state of California's education system. The decrease in student enrollment is discussed in lines 38-40. The other choices may contain one factor that was mentioned in the passage but not the other.

Choice A is flawed by "the quality of staff and equipment." The passage does note that there has been a decrease in the staff (leading to long lines), but the passage does not discuss the quality of either the staff or the equipment.

Choice B is incorrect due to the statement, "atypically high tuition compared to the rest of the nation." Lines 34-35 point out that California's tuition today is "not out of line with tuitions...in other states." Choice C is flawed by the supposed "lack of distinguished professors." Evidence is not offered in the passage that there is a lack of distinguished professors. If anything, the author indicates the contrary—that the University of California is "wall-to-wall with Nobel laureates." is stated in line 33.

**11. A**

In line 18, the author states that services with no powerful constituencies have the same problems as the educational system, which appear to be many.

Choice B is a distracter choice that has little to do with information presented in the passage. The universality of this opinion is never discussed. Choice C is incorrect because it fails to take the past into account. In line 60, the author writes that the California legislature was "once said to be the nation's most professional and progressive..."

Choice D is part of Governor Wilson's opinion, cited in paragraph 7, not necessarily the author's. The author immediately disagrees with the Governor's opinions and states that the causes of the problems are "more complex."

**12. D**

Line 47 supports Roman Numeral I, showing that California has repeatedly borrowed funds from banks. The fact that California's demands (in education, children's services, parks) outstrip the state's ability to provide is explained in the beginning of paragraph four. This supports Roman Numeral III. Roman Numeral II is mentioned in paragraph 7, but the author immediately disagrees with this overly simplistic explanation in the following paragraph.

**13. A**

The first paragraph of the passage describes California's 1960s image as an "El Dorado." Even if you do not know the image associated with an "El Dorado"—a place associated with wealth and prosperity. Nonetheless, using the context of the passage, you should be able to decipher that an accompany "El Dorado" such as California is called that because of its sunshine, perfect lifestyles and opportunities—best education system in the country. This image is weakened by descriptions from around the same time, of "the dark side of the dream."

Choice B supports the image of California as an ideal state for opportunity. Choice D also supports the image of California as a "golden" state.

Choice C does not weaken the image of California as an "El Dorado" as much as does Choice A because the tuition is still comparable to other states. The MCAT will require that you make distinctions in degree as in this question. While the increase in the cost of education is not a positive portrayal of California, it does not weaken the "El Dorado" image as much as choice A. Choice A leads us to believe that the whole pretense of the "El Dorado" was rather weak and that inevitably California would see failure (an apocalypse).

**14. A**

Choice A is supported by line 51, which states that California had one of the highest bond ratings in the country.

Choice B can be deduced from information presented in paragraph three. The passage describes increases in tuition and then details the decreases in the numbers of enrolled students.

Although California did have a professional legislature at one point, the present California legislature is "oozing with corruption" (line 60).

Choice D is clearly wrong as indicated in paragraph four.

**PASSAGE III (Questions 15—22)**

**Topics and Scope:** How civilization has imposed constraints on human behavior that have led to a compromise of genuine, honest exchange.

**Paragraph Structure:** Paragraph 1 states that the sciences and the arts serve to reinforce the enslavement of people in modern society. Paragraph 2 points out the distinction between outward appearance and true internal character. Paragraphs 3 and 4 lament how manners and etiquette and other codes of conduct have masked people's intentions and fostered hypocrisy. Paragraph 5 lists the vices that the author sees as consequences of this discrepancy between actions and feelings.

**Questions:****15. B**

The primary argument is that man has become burdened by politeness, which springs from devotion to the graces. He implies that a "natural" man, who responded simply and plainly and with honesty, is preferable because his character is known from the outset.

A is not true—government and laws are necessary for the safety and well-being of mankind; C is incorrect because the arts cloud over the "original liberty" that each man is provided with; D is incorrect because the author believes the molding is absolutely not essential.

**16. B**

The author's primary analogy is that the needs of the body leads to government and laws, and in the same way the arts lead to the semblance of all virtues. A is incorrect because the author makes no direct cause-and-effect connection between the arts and earthly powers, whom he admonishes to cherish talents as that will serve to reinforce their control over men. C is incorrect because the arts make the chains that bind men more appealing. D is incorrect because the arts stifle man's sense of original liberty.



**17. B**

At the beginning of the second paragraph (and elsewhere) the author describes his ideal way of living: to always act out what we feel in our hearts, with no hypocrisy, no concealment, no artifice. Choices A and C are what he is opposed to. As for choice D, while it is clear in lines 67-68 that he would rather see a person boast of his own merits rather than belittle those of others, he does not imply that this is conduct most worthy of respect.

**18. A**

The author speaks very disparagingly of urbanity, and sees the arts and sciences as contributing to this sheen of respectability that he finds so distasteful. Choices B, C and D are what he considers noble and worthy.

**19. C**

In lines 16-17 the author indicates that urbanity of manner makes relations amiable and easy, and later on in the fourth paragraph he claims that the demands of politeness and propriety have stifled honesty in our public behavior. From this, then, one can infer that choice C contains the characteristics prized by an urbane person.

**20. B**

“Well-based confidence” is listed in paragraph 5 together with qualities like sincere friendships as something that is lost from the uncertainty mentioned on line 58. This uncertainty is the uncertainty of the exact nature of the people with whom one deals, as described in the previous paragraph. In other words, then, a knowledge about the true character of others is what makes “well-based confidences” possible. Choice A is the exact opposite: the uncertainty would lead to the demise of such confidences. Choice C is associated with other positive values, but there is no direct cause-and-effect relation between the two. Choice D is essentially an awareness of the detrimental effects of politeness, but this by itself cannot guarantee “well-based confidences.”

**21. A**

Choice A is not implied in the passage as the author does not make projections about the future of society. Furthermore, the “goals of society” is not a well-defined concept. According to the author, the purpose of society is to provide for the safety and well-being of the people, whose freedom is further compromised by the demands of politeness and propriety. Politeness, then, is a manifestation of a stranglehold in addition to, rather than in opposition to, society. Choices B through D are all points that the author makes in the passage.

**22. C**

The ideal man would compete in the nude, as it is argued in paragraph two, because the vile ornament of clothing would hamper the use of his strength. Choices A, B and D are characteristics the author despises.

**PASSAGE IV (Questions 23—30)**

**Topic and Scope:** The increased economic, cultural, and social sophistication of urban Asia.

**Paragraph Structure:** Paragraph one draws a parallel between Western and Asian cultures in terms of urbanity. Paragraph two presents a quote describing and characterizing the growing Asian middle class. Paragraph three argues that the Asian urbanity melds traditional and new economic patterns. Paragraph four

maintains that education is the strongest social belief of Asians. Paragraphs five, six, and seven delineate new areas of growth that may be open to Western investment. Paragraph eight concludes that Asian investment is wise, based on increasingly Western consumption patterns in Asia.

**Questions:****23. C**

Substantiation for this can be found in the fourth paragraph. Education, it is said, is considered as the most important factor in success.

Choice A is incorrect, since education is viewed as a means to financial security and success, rather than as something that is intrinsically valuable for its edifying capacity.

The author seems to believe that choice B to be correct, as indicated in the last sentence of the fourth paragraph, but he does not represent that as a view held by Asians themselves.

Choice D is incorrect since there is no mention of breeding in the passage and even though Asians tend to believe that education is important to success, there is no evidence that they see such a strong correlation between the two that it can serve as an indicator for wealth.

**24. D**

It is stated in paragraph four that there is a rush to enhance personal competitiveness through further education and training.

Choice A is negated in the fifth paragraph, which states that great opportunities exist in developing an indigenous fashion industry.

Choice B is incorrect. Nothing in the passage hints at an increased acceptance of the credit card as a method of payment. In fact, in paragraph three, the author gives an example in which the notion of paying by credit card is still meeting resistance.

Choice C is incorrect. Paragraph six discusses the increased congestion but does not judge its impact on public health. The author even implies that opportunities for outdoor activities are not as important in Asia as they are in America because of the healthfulness of the Asian diet.

**25. C**

If nature trails are being constructed and if they are heavily in use, then outdoor activity is by definition becoming more popular. The author claims on line 59 that the observation that “few indulge in outdoor activities” is “changing.” This claim is supported if the above two conditions were met.

Choice A is incorrect: unless we know that the trails are actually being utilized, and that those using the trails are not those that at one point exercised at health clubs, the level of exercise may not necessarily be increasing.

Choice B is incorrect because health clubs may be becoming more popular in conjunction with the construction of nature trails.

Choice D is incorrect: even if the people are to utilize these trails heavily, this is not necessarily correlated with any change in perception of their own health status. They may, for example, be using the trails because of their picturesque environment.

**26. C**

Choice C is the correct response by arguments found in paragraph seven.

Choice A is an oversimplification of the information given in the passage, which discusses the prosperity of certain regions in Asia, but which by no means imply that every nation in the continent can be regarded as wealthy.

Choice B is incorrect because the author attributes the health of Asians to their diet.

Choice D is incorrect: even though the author contends that trends and ideas are fostered by American goods, there is no discussion about their volume or market share.

27. **D**

Vitachi describes how executives in Asia have been able to attain financial prosperity.

The statements in all the other choices may or may not be correct, but this is not the reason why the quote is cited.

28. **B**

The author certainly believes that the Asian markets hold tremendous potential for investment. However, nowhere is it stated that such a course of action is necessarily the most lucrative among all possible courses.

The statement in choice A is supported by information contained in the first paragraph.

Choice C is directly stated in the fourth paragraph.

Choice D is also supported by the passage which states in paragraph three that despite their newfound wealth, Asians still tend to be frugal and cost-conscious.

29. **A**

The author does not resolve, or attempt to resolve, any economic paradox: for example, he does not try to present Asia's prosperity as an anomaly and explain this "Asia phenomenon." He does, however, interpret observed trends based on characteristics he attributes to Asians: cost-consciousness, low level of preoccupation with health, etc. Choice B is therefore incorrect. He describes business opportunities based on projection on current observations: popularity of further education, fashion trends, etc. In the last paragraph, he offers quite specific advice to his readers about investing in companies that are making a push in Asia. Choices C and D are hence also incorrect.

30. **B**

The passage is full of information on aspects of the Asian economy and markets, and contains some insights on the economic behavioral patterns of Asians. Business people considering opportunities in Asia would benefit from the information given in the passage. Choice A is incorrect since tourists would more likely be interested in the culture, accommodations, and sights of the various countries—something not addressed in the passage. Choice C is incorrect because public health is not a major concern of the author and not much concrete information is presented that would be useful from a health care perspective. Choice D is incorrect because the target reader is Westerners who may have previously been ignorant of the latest trends in Asia.

### PASSAGE V (Questions 31—37)

**Topic and Scope:** The collusion between television networks and two talent and production agencies in the mid-1950s.

**Paragraph Structure:** Paragraph one gives the scope of the discussion, how Van Doren's disclosure led to an investigation of the relationships between the agencies and the networks. Paragraph two retells the success of the first quiz show. Paragraph three relates how MCA leveraged that program's success with a quiz show of their own, and how they made it a success. Paragraph four discusses the rigging of the MCA show. Paragraph five explains how such a show might have become a part of the NBC network's schedule.

**Questions:****31. D**

It was stated in the passage that the reason why Stempel went to the press was because he did not like being the “predetermined loser.” If the contestants had been competing fairly, therefore, he would not have gone to the press.

Choice A is incorrect because even though the rigging of game shows was what precipitated intense investigation, it is stated in paragraph 1 that a secret investigation had been launched more than two years before because of suspected monopolizing activity within the industry.

Choice B is not the correct choice because Stempel may have lost fairly as well. Nothing in the passage indicates that his continued winning is necessarily a likely outcome.

Choice C is incorrect because there is no indication at all that the firing of Kintner is related to the quiz show scandal.

**32. B**

Werblin is described as the man behind “The Ed Sullivan Show,” but there is no evidence either for or against the claim that he is the ONLY creator.

Choice A is contradicted by the passage which makes it obvious that there was an arrangement made to make sure that Van Doren would win.

Choice C is clearly supported by information given in the second paragraph.

Choice D is also supported by the passage which states that Kintner had been the president of ABC.

**33. D**

As discussed in the explanation to #31 above, investigation of the agencies and the television industry had been initiated prior to the scandal of rigged quiz shows broke out. This is stated towards the end of paragraph one.

Choice A is clearly supported by information presented in the last paragraph.

Choice B can be inferred from the statement at the beginning of the second paragraph that the quiz show vogue began in 1955.

Choice C is supported by Van Doren’s admission mentioned in paragraph one.

**34. B**

It is stated in line 44 that Stempel went to the press, presumably to reveal that he was being “told to lose” on the show. Choice B must therefore be false, and is thus the correct answer. There is no information presented in the passage that requires choice A to be false: indeed, if one recognizes the reference to Attila the Hun, one would know that the characterization is correct. There is no evidence that *The \$64,000 Question* was rigged, but again, nothing in the passage indicates that it must not be either. There is also no indication that choice D has to be false.

**35. C**

The description is used by the author to describe the level of control Werblin had over NBC, with Kintner as its representative.

Choice A is irrelevant to the question.

Choice B can perhaps be inferred from the relationship between MCA and NBC, but the weakness of NBC’s leadership is not a point that the author is making specifically.

Choice D is incorrect because it does not contradict the implication that Kintner was unduly influenced by Werblin.

36. D

The exchange between Werblin and the producer clearly indicates that the former knows that the show is being rigged, but would like to be able to claim to the public that he has no such knowledge if called upon to do so. He therefore forestalled the producer's attempt to inform him of this officially. This testifies to his shrewdness, and implies that he must have been aware of the consequences if it were known that he promoted a show that he knew to be rigged.

Choice A is incorrect because Werblin clearly was not interested in public interest.

Choices B and C are both incorrect because even though they may be true, that is not the point of citing the exchange.

37. C

Statements I and II are general claims that cannot be concluded based solely on the incidents cited in the passage. Statement III is supported by information found in the third paragraph.

### PASSAGE VI (Questions 38—43)

**Topic and Scope:** Acoustic-emissions produced by sand. Their characteristics and mechanisms of generation. Factors contributing to the emission of these sounds.

**Paragraph Structure:** Paragraph one distinguishes between two types of sounds that are produced by sand and their characteristics. Paragraph two ponders on the relationship between the two and what it means for the sands that produce them. Paragraph three gives a brief description of how the two different kinds of sounds are generated. Paragraph four describes in detail how one kind ("booming") is created. Paragraph five is an observation about the volume of booming. The final three concluding paragraphs explore the different factors that facilitate booming.

#### Questions:

38. B

The first paragraph of the passage states that squeaking sand produces sounds with frequencies between 500 and 2500 hertz, while booming sand makes noises with frequencies from 50 to 300 hertz. This is the most definitive characteristic in distinguishing the two. None of the other choices allows for unambiguous categorization. Choice A, duration of sound, is not necessarily helpful since both kinds of sand can produce sounds lasting less than a second. Choice C, size of the sand grains, is also not useful: we are told in the passage that grains of booming sand tend to be of uniform size, but that there are exceptions. Nothing is known about the actual (absolute) sizes of the grains, nor do we know anything about the size of grains of squeaking sand. Choice D, smoothness of grains, does not help in distinguishing the two since grains from both kinds of sand tend to be smooth.

39. B

We are given an observation and are asked to determine what could provide an explanation for it. Note that we are not asked to evaluate the truthfulness of the statements in the choices: we are told to assume that they are true. Nor are we asked to decide if each is indeed the correct explanation necessarily; we only need to decide if they could conceivably play a role. Choice B is the correct answer because whether the sounds created are dissipated or not cannot be a factor in where the dunes are located: dunes do not form in anticipation of what happens to the acoustic emissions they send out. All the other choices provide at least a partial rationalization of the location of booming sand dunes.

Choice A states that sand grains that have traveled large distances can be smoothed in the process. We know that smooth grains are generally a requisite for booming (as well as squeaking) sand. Grains that have traveled large distances therefore have a higher probability of forming booming (as opposed to silent) sand dunes. A large distance also suggests that the desert needs to be large enough to provide the distance that needs to be covered. One can therefore see how choice A could play a role in leading to the preferential formation of booming dunes deep in large deserts.

Choice C also accounts for at least part of the observation. Booming is produced by the avalanching of dunes, which need to build up before shearing can occur to generate acoustic emissions. If it is indeed the case that a large sand source is needed to achieve a requisite volume (and we have been told in the question stem to assume the statement to be true), this will definitely translate to a preference for booming dunes to form in large deserts, where the probability of having dunes meeting the conditions would be higher.

Choice D is also a perfectly reasonable explanation as to why booming dunes form where they do: the need for the absence of moisture (which can impede avalanching) would mean that booming dunes need to be in an environment where water is scarce and far removed. Deep in large deserts would be an appropriate location.

**40. A**

The fourth paragraph describes the processes that cause sand to “boom.” The acoustic vibrations are generated by avalanches of sand, and for that to occur, the sand must dune up to a certain angle: generally about 35°, although this is not necessarily the case. Choice B is incorrect since the third last paragraph explicitly gives examples of booming sands that contain particles that are of a broad range of sizes. Choice C is incorrect because grains of booming sand tend to be smooth, as is stated in the next-to-last paragraph. Choice D is incorrect because while moisture does need to be removed, the process described here is not necessarily the only way this can occur.

**41. C**

The process by which booming is generated by certain dunes is described in the fourth paragraph of the passage. The precise mechanical motions that cause the acoustic vibrations are the shearing motion of intact sand layers together with the bouncing of the grains. The statement in choice C is therefore accurate. The first part of the statement contained in choice A is correct; in fact it is almost word-for-word what appears in the last paragraph of the passage. The second part of the statement, seeking to explain how humidity comes into play, is however exactly opposite to the information given in the passage: moisture, which may cause the grains to clump together, will in fact prevent shearing from happening, and the sand will therefore not be able to “boom.” Choice B is incorrect because the booming sounds can last up to 15 minutes (not seconds!), as stated in the first paragraph. Choice D is likewise not correct because small grains, instead of accelerating the shearing, actually impedes shearing, according to the last sentence of paragraph 6.

**42. B**

The information given in the question stem is not sufficient to determine whether the sand is of the booming or squeaking variety: smooth grains are characteristic of both kinds of sand, and both booming and squeaking sounds last (or may last) for less than a second. Choices C and D can therefore be eliminated. The most helpful piece of information would be the frequency of the sound produced, but unfortunately that is not one of our answer choices. Choice A, non-uniformity in grain size, is not enough: we know that booming sand grains tend to be similar in size, but that is not always the case; in other words, grains that are not similar in size can be booming sand. Furthermore, nothing is said about the grain sizes of squeaking sand in the passage. Choice B, however, describes the process by which the sound is produced: paragraph 3 tells us that squeaking sounds are produced by walking upon certain

types of sand. If the sound in question is produced not by avalanches but by this mechanism, then it must be squeaking sand that we are dealing with.

**43. B**

Paragraph two of the passage contains a rather tantalizing piece of information about the two kinds of sand: squeaking sounds can be produced by sand that normally “booms.” This is however not developed in the rest of the passage. In this question we are asked to consider what may be a rather radical hypothesis: that there is nothing unique about either squeaking or booming sand in terms of intrinsic physical or chemical properties; the same sand can be either kind, depending simply upon how the sound is created. We already know that booming sand can generate squeaking sounds; if, conversely, sand that is traditionally characterized as squeaking can actually produce booming, then this would strongly suggest that the hypothesis may be correct.

All the other answer choices fail to address the hypothesis. Choice A is very close to the correct choice: we know that avalanches are what create booming in booming sand. If squeaking sand can be induced to undergo avalanches, this might lead us to think that squeaking sand is similar to booming sand. However, we are not told in choice A that these avalanches produce the booming sound that essentially defines booming sand: it may be that the avalanches in squeaking sand are silent, and thus there may be something about booming sand that produces noise when undergoing an avalanche.

Choice C is incorrect because even if we discover that there are alternate ways to generate “booming,” there is no reason to believe that squeaking sand will boom via these mechanisms. It is possible that only sand with certain characteristics will boom through these processes, but that squeaking sand just does not possess these characteristics.

Choice D is also incorrect since even if rough sand grains can boom, there may be other requirements for the sand that squeaking sand does not satisfy.

**PASSAGE VII (Questions 44—51)**

**Topic and Scope:** Gwendolyn Brooks’ poetry; specifically, her “relationship to the Harlem Renaissance” (lines 5-7, question re-framed lines 7-11).

**Paragraph Structure:** Paragraph one clearly frames the question. Paragraph two leaves Brooks behind to focus on the Harlem Renaissance, and the second sentence is key in this regard: Those poets were variously realistic and romantic.

Paragraph three: Brooks’ “unique contributions” (line 34) set her work apart. Note especially lines 37-40 (her 1945 collection uniquely demystified romance) and lines 50-53 (what for Brooks was a “predominant theme” was for others a “minor chord”). Paragraph 4 offers summary; Brooks described as carrying one Renaissance element (realism) forward and rejecting another (idealization). The last sentence briefly looks at Brooks relative to those who followed her.

**Questions:**

**44. D**

This correctly cites the author’s purpose, mentioning both the 1920’s movement and Brooks, though properly emphasizing the latter.

(A) and (B) fail to mention the Harlem Renaissance, which cannot be separated from the author’s discussion. Also, (A) goes in the wrong direction (forward in time rather than backward from Brooks), while (B) tends to deny Brooks’ profound connection to the Black poets who preceded her.

(C) Scope error: Passage is not about scholars (author uses “contemporaries” differently in line 5). Also, the passage is trying to make an interpretation, not correct one.

(E) is too strong a judgment for this passage, and cannot be correct because it leaves out the topic of Gwendolyn Brooks.

**Kaplan Strategy:** The answer to “global” questions has to cover the same topic and scope, and reflect the same tone, as the overall passage itself.

**45. D**

The answer here requires a link between the two paragraphs in which the two works are described. The “realistic impulse” in McKay’s work (lines 20-21) parallels the realism credited to Brooks at the end of paragraph three.

Choice A is explicitly untrue about *Harlem Shadows* (lines 24-26).

The author makes no link between *Harlem Shadows* and the Black Arts Movement of the ‘60’s; thus, choice B can be eliminated.

Choice C implies that Brooks was wholly in sync with Harlem Renaissance romanticism, which we know was not so.

**Kaplan strategy:** Don’t over-think. Proceed to the relevant portion(s) of the text and take the clues you’re given.

**46. B**

Choice B is essentially a paraphrase of lines 17-20.

Choice A is a plausible idea but outside the scope of the passage, which encompasses not how the Harlem Renaissance began but Brooks’ relationship to it, so we can’t be sure the author would agree.

Choice C falls outside the author’s scope in that no reference is ever made to any critical assessment of the Harlem Renaissance.

Choice D is incorrect because to recognize and laud Brooks’ “technical accomplishments” is not to raise her above other poets, and the author does not fault this dimension of the Harlem Renaissance.

**47. D**

The key is line 44’s “for example.” The Hughes poem is explicitly meant to illustrate how (as mentioned in lines 40-42) Renaissance poets idealized Black women. This sets up the later contrast to Brooks’ more “biting” approach.

Choice A has no connection to the structure mandated by “for example.” Moreover, no reference to a Hughes poem can in and of itself “prove” anything about Brooks, making this an example of the “true but non-responsive” wrong answer choice. Choice B is a big time scope error—a highfalutin sentiment on general aesthetics that has no place in this tightly-organized discussion of Brooks and the Harlem Renaissance.

Choice C wrongly characterizes Hughes’ romantic idealization of a streetwalker as “naive.” Also, Brooks’ work isn’t painted as “ironic” in paragraph 3, just bitingly realistic.

**48. A**

Choice A notes the contribution Brooks made to the realistic nature of Black poetry.

Choice B is right in attributing optimism to Brooks’ poetry (lines 60-61) but wrong in alleging that the author would call that a “marring” influence. Inferably, optimism is one of the offshoots of the ethnic pride that both the Renaissance and Brooks shared.

Choice C goes too far in the other direction. To “enlarge” (line 58) upon a tradition is far from “completely rejecting” it.



Choice D is a conclusion whose scope goes beyond the passage. Any number of Black feminist writers could have preceded Brooks' appearance in 1945.

**49. B**

This comes right out of the opening paragraph: Critics didn't examine how Brooks' poems linked up with the Harlem Renaissance that preceded her.

In choice A, no such reaction on the part of critics is mentioned. Anyhow, (A) would be the judgment of sociologists, not literary critics.

Choice C cites a comparison between Brown and Brooks that is nowhere made, let alone alluded to by Brooks' contemporary critics. Choice D is incorrect because even though Brooks did demystify romantic love (lines 38-40), there's no sense that critics failed to notice that.

**50. C**

This choice works best because the last sentence is a conclusion for which no evidence is provided, and choice C provides that evidence. The author alleges "a vital link" (line 64) between Brooks and the Black Arts Movement, and identifying the latter with Brooks' mix of the idealized and the realistic is just such a link.

Choice A implies that paragraph 4's topic is how Brooks is remembered by readers, when in fact the paragraph exists to summarize Brooks' art and influence. Moreover, choice A focuses on technique, something we haven't really heard about since lines 1-4.

Choice B makes the odd implication that Brooks (who first published in 1945) was influenced by a Movement that came 15 years later. Possible but unlikely; no evidence provided.

Choice D is wrong in saying that "Brooks' relationship to the Harlem Renaissance" is "open to question," since the passage just got through assessing the same.

**51. C**

One of the major points of this passage is that Gwendolyn Brooks was one of the first poets to take her readers away from the overidealized Black woman represented as an "Egyptian Queen."

Choices A and B are incorrect because the author never indicates women poets to be self-serving, or how men and women were presented differently in the context of poetry. Choice D is a distracter choice because it touches on the theme of Brooks having served as a link between the Renaissance and the Black Arts Movement. However, upon close examination, we see that this would contradict with the author's view that Brooks did indeed serve as a vital link between the two periods of poetry, seen in her visionary portrayal of women.

**PASSAGE VIII (Questions 52—59)**

**Topic and Scope:** The trends in economic patterns and their statistical relevance to what truly plagues the nation's economy.

**Paragraph Structure:** Paragraph one describes the increase in worker productivity that occurred between the late seventies and the early nineties. In paragraph two, the statistics show a grim figure—almost no rise in "real" wages. Paragraph three suddenly destroys what we've read thus far. The economist Boskin describes how the C.P.I. was off the mark with its calculations by "failing to take account of changes in the patterns of consumption and improvements in product quality."

Once the C.P.I. has been revised, according to paragraph four, we should see an increase in productivity and an increase in “real” wages (due to adjustments in the way we measure consumer prices). Once these have been reconciled, we should see a similar distribution of income between capital and labor that we had seen before. The passage just took us full circle!

In paragraph four, the author focuses the reader away from these revelations by telling us that we should not place too much value on these numbers. Instead we should look at the disparity in the distribution of income between the socio-economic classes. The second-to-last paragraph offers statistics to back up this point. The author concludes the passage that we can’t blame America’s economic problems on simplistic ideas such as “greedy capitalists” and “oppressed workers.”

### Questions:

#### 52. B

Paragraph three implies that the Boskin report must regard an adjustment of the C.P.I. to account for changing consumption patterns and rising product quality. Kaplan strategy: you should have been immediately drawn to choice B, as it is the only one that mentions C.P.I.

Choice A is incorrect. There is no indication that the Boskin report directly addressed income distribution. Rather, analysts have used the Boskin report to reconcile productivity rates, wage rates, and income distribution percentages.

Choice C is incorrect, as the Boskin report never directly addressed productivity. It can also be argued that the result of the Boskin report was to indicate that worker *wages* had been understated in relationship to productivity for the last twenty years. This can be inferred from paragraph two, in which the author states that although Boskin’s estimates for a revised C.P.I. may not be taken completely into account, a revised C.P.I. will still reflect the result of Boskin’s theory, that “the rate of growth of real wages will look much higher--and so it will now be roughly in line with productivity.”

Choice D is incorrect, as the Boskin report never directly addressed wages; it addressed C.P.I. In addition, as indicated in the explanation to choice C, it can be argued that the result of the Boskin report was to reveal that worker wages had been understated in relationship to productivity for the last twenty years.

#### 53. B

In the last half of paragraph two, the author notes that a revision of the C.P.I. will “reconcile numbers on productivity and wages with data that show a roughly unchanged distribution of income between capital and labor.” Thus, even after a revision of the C.P.I., labor’s percentage share of the national income will appear the same.

Choice A is incorrect. The passage discusses revision of the C.P.I. in terms of labor’s percentage as a whole, not in terms of the breakdown of income within labor itself (e.g., into highest and lowest income brackets).

Choice C is incorrect. There is no indication in the passage that the percentage share will appear smaller as a result of a revision of the C.P.I.

Choice D is incorrect, as paragraph two of the passage reveals that a revision of the C.P.I. will not affect the calculation of labor’s percentage share of the national income.

**Kaplan strategy:** When passages seem to go in circles, make annotations in the margins to keep track of the issues being discussed.

#### 54. C

Boskin points out that previously the C.P.I. had been overstating inflation by “failing to take account of changes in the patterns of consumption and improvements in product quality.” Choice C paraphrases

this. Further support for this can be found in paragraph five's description of old data that has been "Boskinized."

Choice A may have been appealing; however, Boskin did not reconcile the disparity by decreasing productivity (he showed increased values for productivity after an adjustment of the C.P.I.).

Choice B can be eliminated because this goes beyond the scope of the passage—technology's role is not discussed in regard to the level of efficiency. Choice D is wrong because this is what the author examines, while Boskin focuses on the C.P.I. and the rates of productivity and of wages.

**55. C**

Paragraph four of the passage indicates, "[t]he overwhelming evidence of a huge increase in income inequality in America has nothing to do with price indexes and is therefore unaffected by recent statistical revelations." As Boskin's report is concerned with price indexes and led to recent statistical revelations, it follows that his report has no connection to the increasing disparity between highest and lowest wage earners.

Choice A is incorrect as the primary revelation of the Boskin report was that the C.P.I. has been inaccurate. That Boskin's report addresses CPI inaccuracy can be inferred from paragraph two of the passage, in which it is noted that Boskin and his colleagues have proposed that the C.P.I. be revised.

Choice B is incorrect. One of the primary results of the Boskin report was that it reconciled the previously perceived disparity between productivity levels, wage levels, and labor's share in the national income. As the second paragraph of the passage notes, once the C.P.I. has been revised (as Boskin and his colleagues recommend), "...the rate of growth of real wages will look much higher--and so it will now be roughly in line with productivity, which will therefore reconcile numbers on productivity and wages with data that show a roughly unchanged distribution of income between capital and labor."

Choice D is incorrect. Paragraph three of the passage reveals the clarifying effect of Boskin's report on understanding 50s and 60s economic progress. The author notes that "...if we 'Boskinized' the old data--that is, if we tried to adjust the C.P.I. for the 50s and 60s to take account of changing consumption patterns and rising product quality--we would find that official numbers understated the rate of progress just as much if not more than they did in recent decades."

**56. B**

First, the passage implies that the 1950s and 1960s were decades of economic progress when the author states in paragraph three that "the rate of economic progress over the past 25 years has been much slower than it was in the previous 25." Paragraph five points out that percentage wise the median incomes of families increased by 35 percent in the last 25 years and 100 percent in the previous 25 years. This would indicate that the family workers in the 50s and 60s received more substantial yearly pay increases in the 50s and 60s than they did in the late 70s through the early 90s.

Choice A is incorrect, as there is no specific indication in the passage that workers in the 50s and 60s amassed the same percentage of national income that workers did in 1994. The only information that the passage gives is that workers' wages in 1978 accounted for about the same share of national income as wages in 1994.

Choice C is incorrect. There is no indication in the passage that the C.P.I. increased wages at a rate *higher* than economic progress in the 50s and 60s.

Choice D is incorrect. On the contrary, we can *not* be sure from the information in the passage that workers' incomes accurately reflected the significant economic progress of the period because the passage notes that over the years 1945 to 1970, the income of the median family rose 100 percent. The last line of paragraph five states that if we "Boskinized" data from the 50s and 60s we would see an undervalued rate of economic progress.

## 57. A

That the perception existed that there was a large gap between productivity and wages can be inferred in paragraph two of the passage. Therein, the author states that once C.P.I. revisions (which the Boskin report recommends) are accounted for, “productivity growth will probably look somewhat higher than it did before...but the rate of growth of real wages will look much higher--and so it will now be roughly in line with productivity.” Thus the implication is that prior to C.P.I. revisions (the recommendation of Boskin’s report), there was a perception that wages were lagging behind productivity.

Choice B is incorrect, as it was proved above that perceptions prior to the release of Boskin’s report held that productivity was far outpacing wage growth.

Choice C is incorrect. It can be inferred from the passage that the distribution of national income to labor has *not* changed significantly since 1978.

Choice D is incorrect, as the passage indicates in paragraph three that “it remains true that the rate of economic progress over the past 25 years has been much slower than it was in the previous 25.” Thus, progress has slowed down over the last 25 years, a trend that shows anything but a steady rate of progress. There is no indication in the passage that this perception was held before or after the release of Boskin’s report; it is probable, actually, that this perception was held before the release of the report and continues to be held, because the author states that “it *remains* true” that economic progress has slowed over the last 25 years.

## 58. C

Immediately before citing the numbers in lines 68–73, the author makes the point that the “evidence of a huge increase in income inequality in America has nothing to do with price indexes...” In other words, regardless of the merit or flaws of the Boskin study, income inequality is still a problem. The figures cited are used to illustrate this point.

All the other choices do not pertain to the statistics quoted.

## 59. B

As a glance at the last two sentences of the passage indicates, the author is strongly rebuking the popular misconception that workers are being oppressed. Further, he refers to those who buy into this “simplistic morality play about greedy capitalists and oppressed workers” as “would-be sophisticates.” Clearly, he is highly critical and rebuking of this belief and its advocates.

Choice A could be perceived as correct, especially considering the author’s tone in the last two sentences of the passage; however, this answer choice is a bit more extreme than choice B. Note: an important Kaplan strategy is never pick the extreme answer choice in tone questions. Further, the author’s approach is more logical in its delineation of the Boskin report than it is merely confrontational.

Choice C is incorrect. Pedantic, which means condescendingly instructive, would not thoroughly describe the author’s tone. Certainly, the author attempts to be somewhat instructive in the passage, but that is not his primary intent.

Finally, choice D is also incorrect, as the author gives a very detailed description of the Boskin report and its implications, as well as some tangential issues. In addition, the main point of the passage is to rebuke a misperception, not blindly accept it.

**PASSAGE IX (Questions 60—65)**

**Topic and Scope:** The passages introduces the theory that the Mediterranean existed as a dry valley that was flooded by Atlantic waters passing through what is now the Strait of Gibraltar.

**Paragraph Structure:** Paragraph one introduces the theory that the Mediterranean was once a dry desert. Paragraph two describes the Mediterranean's present geological characteristics. Paragraph three states that movement of water between the Atlantic and the Mediterranean ceased during the upper Miocene, prior to the Pliocene. Paragraph four describes the formation of the dry basin through evaporation. It also describes the subsequent flooding at Gibraltar and presents evidence for these geological changes. Paragraph five states that the evidence for the dry desert theory is not sufficient. The concluding paragraph indicates that the theory is not realistic and that more work must be done to fill in the gaps.

**Questions:****60. A**

Although the passage indicates that the end of the Miocene occurred "6 to 5.5 million years ago" and that a "hot, dry climate" existed during this time, it never compares this to the Earth's present climate. Choice A is outside the scope of the passage, and therefore incorrect. We can verify this choice by making sure that the other answer choices are features of the "desert theory".

Choice B is found in line 33 of the passage which states that the dry sea floor of the "Death Valley" existed "as far as 2,000 meters below sea level.

Choice C is part of the desert theory. The waterfall described at the end of paragraph four (lines 40-46) converted the desert into a sea. "This flooding event is recorded by the Miocene-Pliocene boundary". The passage indicates that the formation of the desert occurred at the end of the Miocene, so the waterfall must have occurred at the start of the Pliocene.

Choice D is given at the end of paragraph three which states that "water-mass exchange continued for a while in the Rif Strait..." during the upper Miocene.

**61. D**

The last two paragraphs of the passage indicate that geological theories, exemplified by the one described in the passage, evolve as more information is obtained through research. Paragraph five states that "to interpret [geologists] findings... more comprehensive concepts must be envisioned." Paragraph six compares the understanding of the Mediterranean to a puzzle into which new information is fitted like puzzle-pieces.

Choice A is incorrect. Line 47 states "Geological theories usually fall at a glacial pace into a sea of controversy..."

Choice B is not supported by the passage which indicates that lots of research, over a long period of time, is required to formulate geological theories.

Choice C is not supported either. Again, paragraph five and six imply that new trends in scientific thought are incorporated into the pool of knowledge and become part of comprehensive theories.

**62. A**

Lines 17-20 describe the connection between rocks dredged offshore (from the sea) and those found on land. This implies that the "adjacent emerged land masses" are those regions of dry land surrounding the sea.

Choice B is related to the region of high relief at Gibraltar, but not to the emerged land masses.

Choice C is incorrect. It is outside the scope of the passage.

Choice D is incorrect. The passage mentions the tectonic mobility of the Mediterranean in paragraph two, but never provides any further information regarding continent movement. This answer is also outside the scope of the passage but may have been tempting if you used outside knowledge regarding plate tectonics.

**63. B**

Paragraph 2 provides all of the information required to answer this question. It states that the seafloor and adjacent borderland have highly variable topography and relief. So choice B is not a characteristic of the modern Mediterranean. The other choices can all be found in the description of the modern Mediterranean in paragraph 2.

**64. B**

Although some controversy is presented in the passage, there is no doubt that the Mediterranean was very different in the late Miocene. It may have been a dry desert, or a region with different "depth of the seafloor and the water" as described in line 51. In either case, the composition of the Mediterranean was very different.

Choice A can be eliminated based on the idea of tectonics. Tectonics are mentioned in paragraph 2, but the details of tectonic events are never described. The passage never states that collision of tectonic plates created the waterfall at the Strait of Gibraltar.

Choice C is incorrect because it is outside the scope of the passage. Although it may be reasoned that rivers might dry up if the water flowed into the dry Mediterranean, this information is not provided by the passage and requires a leap of logic.

Choice D is wrong. The only mention of fauna occurs in line 45 which states that marine fauna were reintroduced to the Mediterranean at the Miocene-Pliocene boundary. Again, the passage does not provide any support for the extinction of flora and fauna from the Miocene. This answer is outside the scope of the passage.

**65. D**

The final paragraph of the passage indicates that the author believes theories concerning the formation of the Mediterranean are still developing and that much is not known.

Choice A is incorrect because the author states explicitly that "it is not realistic to envision the Mediterranean... as a desert at 3,000 meters below present ocean level."

Again, the author does not completely support the "Death Valley" theory. Flooding of the Mediterranean by a waterfall at Gibraltar is part of this theory. Thus, choice B is incorrect.

Choice C is never mentioned in the passage. There is no evidence that the author would support this theory.

**PHYSICAL SCIENCES ANSWER KEY**

66.	B	86.	B	106.	A	126.	B
67.	C	87.	B	107.	A	127.	A
68.	A	88.	D	108.	D	128.	B
69.	C	89.	D	109.	A	129.	A
70.	D	90.	D	110.	D	130.	B
71.	C	91.	A	111.	C	131.	A
72.	C	92.	A	112.	C	132.	B
73.	B	93.	A	113.	D	133.	C
74.	D	94.	C	114.	A	134.	D
75.	A	95.	B	115.	B	135.	C
76.	D	96.	D	116.	A	136.	C
77.	C	97.	B	117.	B	137.	B
78.	A	98.	D	118.	C	138.	C
79.	B	99.	C	119.	C	139.	A
80.	A	100.	A	120.	D	140.	B
81.	C	101.	C	121.	A	141.	C
82.	B	102.	B	122.	C	142.	A
83.	A	103.	A	123.	A		
84.	C	104.	B	124.	A		
85.	D	105.	B	125.	D		

**66. B**

The stem says to assume laminar flow, indicating that we should consider the blood as a simple homogeneous fluid. Using the continuity equation it is clear that the greatest velocity will occur in the region of smallest cross sectional area.

**continuity equation**

$$v_1 A_1 = v_2 A_2$$

where  $v$  is the velocity  
 $A$  is the cross sectional area

Note that following the divergence of the arteriole into two branches, the total cross sectional area has not changed greatly so the velocity in each branch will not be different from the velocity at C.

Choices A, C, and D are incorrect because the cross sectional area is greater for each than at B, so the velocity at these locations is lower.

**67. C**

According to the passage, when fluid flows out of the gut (because the hydrostatic pressure in the capillary bed is lower than the osmotic pressure), the gut will become lighter and will ascend. Thus, the mass  $m$  will descend. The question stem indicates that the section of gut has become lighter. Fluid must be returned to the gut section to make it heavier and maintain the balance level. Increasing the venous pressure will increase the hydrostatic pressure in the capillary bed, leading to flow of fluid from the capillary into the gut section. Note that no quantitative analysis (calculation) is necessary to answer this question.

Choice A is incorrect because moving the mass  $m$  away from the fulcrum will increase the distance between the force applied and the fulcrum, thus increasing the torque produced by the mass  $m$  causing it to descend more. The equation for torque is shown below:

$$\text{torque} = Fr \sin \theta$$

where  $F$  is the magnitude of the force applied  
 $r$  is the distance between the force and the fulcrum  
 $\theta$  is the angle between the force and the vector  $r$

Choice B is incorrect because decreasing the arterial pressure will decrease the hydrostatic pressure in the capillary bed causing more fluid to be lost from the gut. The gut will become lighter and will ascend, causing the mass  $m$  to descend more.

Choice D is a distractor choice: the pipette (from Method 1) does not come into play in this set-up, which deals with Method 2.

**68. A**

The passage states that using Method 1, the capillary pressure is given by  $P = \rho gh$ . We are measuring the same capillary, so the measured pressure is constant. If we use a less dense fluid, the column will rise higher for a given pressure.

Choice B is incorrect for the reasons described above. Using a fluid more dense than blood would give a column with a lower height.

Choice C is incorrect, although the pressure is the same, the height of the column changes with respect to the density of the fluid as described above.

Choice D is a distractor choice that may have been tempting if you remembered that Bernoulli's equation relates the velocity of fluid flow to the pressure. Again, if the velocity is the same, and the pressure is the same, then the height of the fluid will depend on its density.



69. C

The osmotic pressure of a solution is given in the passage by the following equation:

$$\Pi = MRT$$

where  $M$  is the molarity of particles in solution

$R$  is the universal gas constant

$T$  is the temperature

Knowing the number of particles and the volume of the solution, it is possible to calculate the molarity of particles in solution. (The number of moles of particles in solution is found by dividing the number of particles by Avogadro's number.) If the temperature and the gas constant are known, the osmotic pressure can be calculated.

Choice A is incorrect because knowing the mass of the solid is not enough information to determine the number of particles in solution. We must also know its molecular weight (to determine the number of moles of solid) and its molecular formula (to determine how many particles it forms when it dissolves).

Choice B is incorrect because knowing only the molecular formula of the solute is not enough information to determine the number of particles in solution. We must also know the mass of solid dissolved.

Choice D is incorrect because knowing the moles of solid dissolved is not enough information to determine the concentration of particles in solution. We must know the volume in order to calculate the concentration. We must also know the molecular formula of the dissolved solid. For example, 1 mole of NaCl will give 2 moles of particles in solution while 1 mole of  $MgCl_2$  will give 3 moles of particles in solution.

70. D

The net torque determines the angular acceleration of the beam. If the net torque is zero then the beam will remain level. Recall the following equation for calculating the torque.

$$\text{torque} = Fr\sin\theta$$

where  $F$  is the force applied

$r$  is the distance between the force and the fulcrum

$\theta$  is the angle between the force and the vector  $r$

Choice A is incorrect because the passage does not describe any specific relationship between the arterial pressure and the osmotic pressure. It does state that when the capillary pressure equals the osmotic pressure, there is no net fluid flow into or out of the capillary bed and the gut section will not change weight, keeping the balance level. Note that the capillary pressure is related to both the osmotic pressure and the hydrostatic pressure.

Choice B is incorrect because the net torque may not be zero even if the weight of the gut equals the weight of the mass ( $m$ ). If the distance from the fulcrum  $r$  is not equal, then the net torque will not be zero and the beam will not remain level.

Choice C is incorrect because the net torque may not be zero even if the net force on the beam is equal to zero. Note that when the beam is level, two forces are applied downwards (by the gut section and by the mass  $m$ ) and the beam does not rotate. It is true that when the beam balance is not translated (moved without rotation), the net force is zero. Under these conditions, the fulcrum will apply an upwards force to counteract the two downwards forces described above. However, the beam balance can

be translated, indicating a net force, and the beam will still remain level if the net torque is zero— consider pushing the beam balance around the room while the weights keep it level.

**71. C**

The passage states that if the arterial pressure is decreased fluid will leave the gut section and its mass will decrease. The mass will decrease until a certain amount of fluid is lost and a new equilibrium between hydrostatic pressure and osmotic pressure in the capillaries is reached. Choice C best shows the initially rapid decrease in mass and the gradual leveling out as a new equilibrium is reached.

Choice A is incorrect because the mass of the gut will not decrease to zero. Also, the rate of mass loss will not be linear. There will be rapid mass loss followed by a gradual leveling out.

Choice B is incorrect because the mass of the gut will decrease as fluid is lost from the gut section to the capillaries.

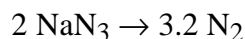
Choice D is incorrect because the mass loss will occur rapidly at first, followed by a gradual leveling out as a new equilibrium is reached. Choice D indicates a gradual increase in the rate of mass loss which is the opposite of what actually happens.

**72. C**

The decomposition reactions require an activation energy. Initially, this is supplied by the electrical impulse. In order for the reaction to continue following this ignition, however, the reaction must release sufficient energy to overcome the activation barrier of subsequent decompositions. In other words, in order for the reaction to spread throughout the sample, it must produce enough heat to provide the activation energy for adjacent reactions. The reaction must be exothermic and spontaneous.

**73. B**

According to the passage, each 2 moles of  $\text{NaN}_3$  ultimately lead to the production of 3.2 moles of  $\text{N}_2$ , 3 moles from Reaction 1 and 1/5 moles from Reaction 2.



A single mole of an ideal gas at STP occupies 22.4 L. Thus, we require 2 moles of gas to occupy about 45L. Calculating for x, the number of moles of  $\text{NaN}_3$  required to produce 2 moles of  $\text{N}_2$ :

$$\frac{2}{3.2} = \frac{x}{2}$$

$$x = \frac{4}{3.2} = 1.25 \text{ moles}$$

Now we determine the mass of 1.25 moles by multiplying by the mass of  $\text{NaN}_3$  (from the periodic table):

$$1.25 \text{ moles} \times (23 + 3(14)) \text{ grams/mole} = 81.25 \text{ grams}$$

**74. D**

D is correct because rapid expansion is a key requirement of any airbag inflatant. The airbag must inflate before the driver and passenger hit the windshield. All the other statements are true and are reasons why potassium chlorate is not suitable as an airbag inflatant.

75. A

This pure stoichiometry problem requires you to figure out, either quantitatively or qualitatively, that the more CO a formula contains and the less a mole of the compound weighs, the more CO per gram of the compound will be produced. Since chromium has the smallest atomic mass of any of the metals offered, and since  $\text{Cr}(\text{CO})_6$  has six moles of CO per formula mole, choice A is the best choice.

Quantitatively, choice A produces 6 mol CO for every 220 g of  $\text{Cr}(\text{CO})_6$ , choice B produces 5 mol CO per 195 g  $\text{Mn}(\text{CO})_5$ , choice C produces 4 mol CO per 208 g  $\text{Mo}(\text{CO})_4$ , and choice D produces 6 mol CO per 274 g  $\text{Pd}(\text{CO})_6$ . Since  $6/220$  is greater than any of the other ratios, choice A is quantitatively proven correct.

76. D

The formal charges are assigned incorrectly: their values should be as indicated in choice B. Resonance structures vary only in their arrangement of electrons. The connectivity of nuclei is preserved. The other resonance structures for  $\text{N}_3^-$  are valid and contribute to the resonance hybrid structure that is more stable than any of the individual resonance structures alone.

77. C

Only choice C would drive the reaction towards the right, according to Le Châtelier's principle. The products include 3 moles of gas ( $\text{N}_2$ ). The reaction is exothermic (although not excessively so according to the passage); increasing the temperature, therefore, would make the reactants more favorable thermodynamically.

78. A

The passage gives the composition by weight of black powder as 75:15:10, potassium nitrate:charcoal: $\text{S}_8$ . Let's assume we have 100 grams of black powder, composed of 75 grams of potassium nitrate, 15 grams of charcoal, and 10 grams of  $\text{S}_8$ . First, we must determine the mass of one mole of each of the materials from the periodic table:

$$\text{KNO}_3: 39.1 + 14 + 3(16) = 101.1 \frac{\text{grams}}{\text{mol}}$$

$$\text{C}: 12 \frac{\text{grams}}{\text{mol}}$$

$$\text{S}_8: 8(32) = 256 \frac{\text{grams}}{\text{mol}}$$

Now we can determine how many moles of each material is present by dividing the mass by the mass per mole:

$$\text{moles of KNO}_3 = \frac{75}{101} \approx 0.75 \text{ mol N}$$

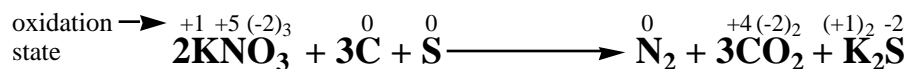
$$\text{moles of C} = \frac{15}{12} \approx 1.25 \text{ mol C}$$

$$\text{moles of S}_8 = \frac{10}{256} \approx 0.04 \text{ mol} = 8(.04) = 0.32 \text{ mol S}$$

Therefore, our mole ratio is 0.75:1.25:0.32, or 75:125:32.

79. B

Carbon is oxidized from 0 to the +4 state in carbon dioxide. Both N and S are reduced in the reaction, as shown below:

**80. A**

Covalent bonds are formed by the sharing of electrons between atoms. In bonds between the same elements, these electrons are shared evenly. In most bonds, the electrons are not shared evenly and one element draws electrons towards itself, imparting a partial negative charge on that element and a partial positive charge on the other element in the bond. This uneven sharing is defined as ionic character of the bond and depends on the relative electronegativities of the two elements involved in the bond. The greater the difference in electronegativities, the greater the ionic character. At the extreme end of the spectrum, when the electronegativities are vastly different, electron transfer is complete and the bond is considered ionic.

According to periodic trends, electronegativity increases to the right and up in the periodic table. Chlorine has a very high electronegativity while Sr and Ba have very low electronegativities. Because Ba is lower on the periodic table, it has a lower electronegativity than Sr and thus,  $\text{BaCl}_2$  has more ionic character than  $\text{SrCl}_2$  because the difference in electronegativities is greater. It may help to remember that F is the most electronegative element while Cs is the least electronegative.

Choice C is incorrect because the bond between two atoms of the same species is completely covalent.

Choice D is incorrect because carbon and oxygen are closer together on the periodic table than are Ba and Cl.

**81. C**

In most combustion reactions, oxygen is provided by the air. Flares can burn underwater because the pyrotechnic combustion mixture includes an oxidizing agent. In black powder,  $\text{KNO}_3$  is the oxidizing agent.

Choice A is incorrect because  $\Delta H$  is a measure of the enthalpy change of a reaction which indicates if heat is released or absorbed by the reaction. Both burning wood and burning flares are exothermic. The degree of exothermicity is not relevant to burning without an outside oxygen source.

Choice B is incorrect because wood can be ignited by a spark. Again, the activation energy of the reaction is not relevant to burning underwater.

Choice D is incorrect: water is a powerful flame retardant because it suffocates a flame by decreasing oxygen supply. Water does not increase the activation energy of combustion.

**82. B**

In order to determine the energy of a photon, we plug the value of the frequency emitted into the equation:

$$E = hf$$

Note that if you did not remember this equation, you could use the constants provided at the bottom of the passage to determine the equation through dimensional analysis. Energy has units of J, so multiplying a  $\text{s}^{-1}$  value by h would provide a calculation of energy.

The passage provides the wavelength of light produced by barium chloride as 510—530 nm. We can perform the calculation with the approximate value of 500 nm.

$$E = \frac{hc}{\lambda} = \frac{(6.63)(3)}{500} \times 10^{-34+8+9} = \frac{20}{500} \times 10^{-17} = \frac{20}{5} \times 10^{-19} \text{ J}$$

**83. A**

Looking at Equation 1, we see that the frequency is inversely proportional to the membrane radius and directly proportional to the square root of the tension.

$$\frac{2.40 \times f_{\text{rel}}}{2\pi a} \sqrt{T/\sigma}$$

$\swarrow$  *inversely proportional to membrane radius*       $\swarrow$  *directly proportional to square root of membrane tension*

**84. C**

The nodes of a standing wave are the points where the amplitude is zero, the static points. In a drum membrane, these are regions where there is no motion of the membrane. As the adjacent membrane regions vibrate, sand will accumulate at the points where no vibration occurs (nodes: either circular or diameter), forming the Chladni patterns.

Choice A is incorrect because sand would accumulate at both the circular and diameter nodes.

Choice B is incorrect because the antinodes are the points of maximum amplitude where sand would be least likely to stay.

Choice D is incorrect because the point between the nodes and antinodes would vibrate.

**85. D**

The frequency of vibration of the membrane determines the frequency of pressure waves in the air, and thus, the pitch of the sound detected. Changing the density of the air will not change the frequency of vibration of an ideal membrane. Note that air density does not appear in Equation 1.

The wavelength will change as shown by the following equation:

$$\text{Speed of Sound} = \text{wavelength} \times \text{frequency}$$

If the speed of sound increases, the wavelength will increase as well, while the frequency remains constant.

Choice A is incorrect because the sound intensity at a particular point will not be changed. Sound intensity depends on the distance from the source and the amplitude of the wave, not on the speed of sound in a particular medium.

Choice B is incorrect because the amplitude of vibration is not directly related to the medium in which the vibration occurs.

Choice C is incorrect because the pitch will not change.

**86. B**

Sound waves are longitudinal waves in which pressure displacement occurs parallel to the propagation of the wave. This is in contrast to transverse waves, like those in the ocean, in which the displacement (up and down motion of the water) is perpendicular to the direction of propagation of the wave.

**87. B**

Sounds that differ in their frequency produce "beats" of high amplitude by interference at a frequency equal to the difference between their frequencies. The greater the difference in frequencies between the two sounds, the greater will be the frequency of the beats produced. Musicians may use beats to help tune instruments. When an instrument is tuned to a known frequency, the beats will slow down, then disappear when the frequencies are equal.

$$\text{Freq}_{\text{beats}} = \text{Freq}_1 - \text{Freq}_2$$

The relative frequencies given in Figure 1 are directly proportional to the actual frequency of vibration, so we can compare them directly. Among the choices, the greatest difference is between the (0,1) and (0,2) modes.

**88. D.**

The momentum of the rocket prior to discarding its first stage will equal the momentum of the rocket (and its parts) following loss of the first stage. Its initial momentum is purely vertical (in the Z-direction), and so, the X and Y components of the momentum following loss of the first stage must sum to zero. The only choice that allows the vector sum of these horizontal momentums to cancel out is choice D. Note that the discarded masses do not need to be equal, given the answer choices.

**89. D.**

Note that we can determine either the convex or concave mirror distortion to answer the question. We do not need to determine both. Solving for the convex bottom, we first note that the focal length of a convex mirror must be some negative value (while for the concave mirror it will be positive). We will solve this problem by drawing a diagram.

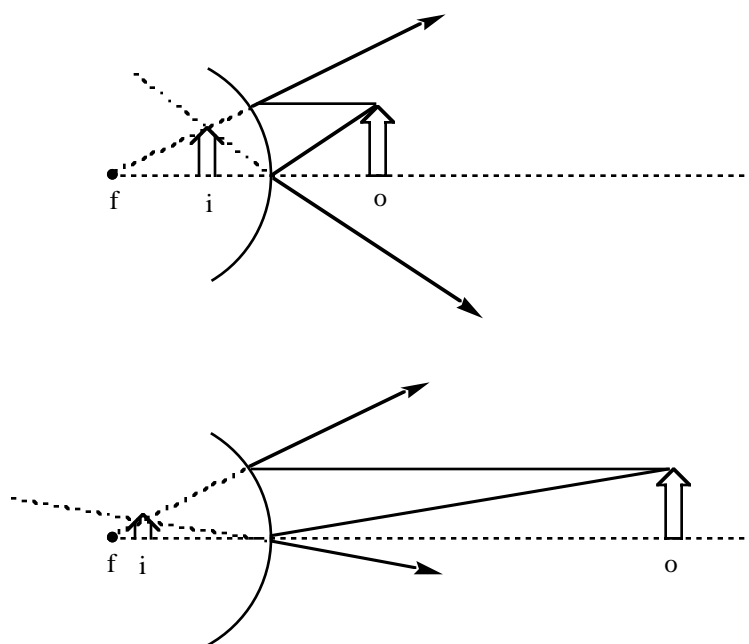
Let's draw a diagram and examine the distortion of the clown's feet in the convex bottom of the mirror as she walks away from it. Recall that we can draw three kinds of rays in a ray tracing diagram:

1. Rays that pass through the focal point will be reflected parallel. For a convex mirror, rays directed towards the focal point will be reflected parallel (because the focal point is in the virtual space behind the mirror).

2. Rays that hit the axis of the mirror will be reflected with the same angle on the other side of the axis (like a plane mirror).

3. Parallel rays will be reflected through the focal point. For a convex mirror, parallel rays will appear to pass through the focal point (because the focal point is in the virtual space behind the mirror).

The image shrinks as the object moves farther from a convex mirror.



From the diagram above, it is clear that the image in a convex mirror shrinks as the object moves away. Thus, the image of the clown's feet will shrink in the convex bottom of the mirror as she walks away.

90. D

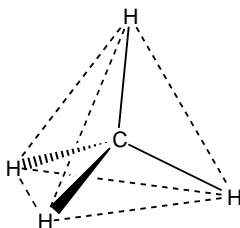
As the volume of the gas decreases, the space between molecules decreases and the frequency of collisions with the cylinder will increase.

Choices A and B are incorrect because the kinetic energy is directly related to the temperature of a gas. If the temperature does not change, the kinetic energy will not increase.

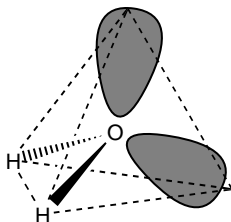
Choice C is incorrect because the mass of gas particles will not change.

91. A

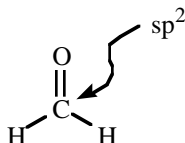
The electron pairs in  $\text{CH}_4$  are arranged in the tetrahedral form typical of  $\text{sp}^3$  hybridization.



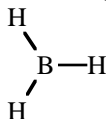
In water, the *electron pairs* are also arranged tetrahedrally. This allows maximum separation between electron pairs and gives water its characteristic bent geometry.



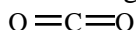
Choice B is incorrect. Methanal (formaldehyde) has an  $sp^2$  hybridized carbon leading to a planar configuration of constituents.



Choice C is incorrect.  $BH_3$  has a trigonal planar configuration of electron pairs (and bonds).



Choice D is incorrect because  $CO_2$  has a linear configuration. The C is  $sp$  hybridized.



**92. A**

The normality of an acid solution is a measure of its proton donating ability. A polyprotic acid, like  $H_3PO_4$  can contribute 3 moles of  $H^+$  for each mole of acid. Therefore, a 1M solution of  $H_3PO_4$  is 3N. Looking at the choices, a 2N solution of  $H_3PO_4$  is  $2/3M$ . This is the lowest molarity among the choices.

Choice B is a 2M solution.

Choice C is a 1M solution.

Choice D is a 1M solution.

**93. A**

An electric field indicates the direction in which a positive charge would be accelerated. The ink droplet is negatively charged and will thus be accelerated in the opposite direction to that of the electric field. Since the electric field in Figure 1 points down, the charged ink droplet will be deflected upwards in the plane of the page.

Choice B is incorrect because a positive charge would be deflected downwards in the plane of the page.

Choices C and D are incorrect applications of the right hand rule. The right hand rule is used to determine the force on a charge moving through a magnetic field. This problem concerns movement of a charge through an electric field.

**94. C**

To deflect an ink droplet, the deflector must do work on the drop. The formula for calculating work is ( $W=Fdcos\theta$ ). To answer the question we must calculate the force generated by the electric field of the deflector. Because the electric field is uniform, the electric force will also be uniform. The electric force is related to electric field by the formula  $F = Eq$ . So, to calculate the work done by the drop, we can use the formula  $W = E \times q \times d$ . (The field and the displacement are parallel, so  $\theta = 90^\circ$  and  $cos \theta = 1$ .) The



question gives the distance as 1.5 mm and the passage gives a range of values for the field generated by the deflector and for the charge on the oil droplet. Because the answer choices are fairly spread out, we can calculate using average values for the drop charge and field strength.

$$W_{\text{avg}} = -E_{\text{avg}}q_{\text{avg}}d$$

$$W_{\text{avg}} = -(3.2 \times 10^6 \text{N/C})(-6.5 \times 10^{-14} \text{C})(1.5 \times 10^{-3} \text{m})$$

$$W_{\text{avg}} = -(3.2 \times -6.5 \times 1.5)(10^{-11})$$

$$W_{\text{avg}} \approx 30 \times 10^{-11} = 3 \times 10^{-10} \text{ J}$$

Choice A is incorrect because work is done by the electric field. If a magnetic field were involved, no work would be done because the force is always perpendicular to the direction of movement.

**95. B**

Superimposing a uniform electric field pointing upwards would lead to a uniform decrease in the electric field each ink droplet experiences. A uniform decrease in the electric field will decrease the acceleration of each of the droplets used to produce the letter. Thus, the letter will be shifted uniformly. Only choice B shows a uniform shift of the letters. Recall that the force on a particle in an electric field is given by  $\mathbf{F}=\mathbf{E}q$ . If the field (E) is increased and the charge does not change, then the force will increase.

Choice A is incorrect because it is identical to the original letter. Since the droplets are deflected by an electric field, the entire pattern would be shifted by a uniform decrease in the electric field.

Choice C is incorrect because it shows a pattern in which the letter is reduced in size. This pattern might arise if the field decrease were not uniform. For example, if the field were decreased proportionally (decreased by a certain percentage), we would expect a scaling of the letter to occur.

Choice D is incorrect because it shows rotation of the letter. This would not occur in a uniform electric field.

**96. D**

The negatively charged particle is accelerated upwards by the downwards directed electric field. Therefore, the magnetic field must apply a downwards force to counter the upwards electric force. According to the right hand rule, a positive particle travelling towards the left must move through a magnetic field directed into the page to experience a downwards force. This is equivalent to a negative charge moving towards the right through a magnetic field directed into the page.

Choices A and B are incorrect because a magnetic field directed towards the right would apply no force to a charged particle moving to the right (because the two vectors are parallel).

Choice C is incorrect because a magnetic field directed out of the page would apply an upwards force on a negative particle travelling towards the right. This is the same direction as the force applied by the electric field.

**97. B**

All of the group 1 elements are stronger reducing agents as indicated by Table 2. Their reduction potential is more negative, indicating that their oxidation is highly favored. Materials that are oxidized act as reducing agents.

Choices A and D are incorrect because acidity and basicity refer to electron pair donation and acceptance, while redox reactions may involve single electron transfer.

Choice C is incorrect because the elements are weak oxidizing agents. They themselves are easily oxidized.

**98. D**

To qualify as single displacement, a reaction must have the general form:  $AB + C \rightarrow A + CB$ ; the reaction shown in choice D does follow this general format, with  $A = \text{Cu}$ ,  $B = (\text{OH})_2$ , and  $C = \text{Fe}$ , while those shown in the other choices do not. (Single displacement reactions are invariably also redox reactions, although the converse is not necessarily true.)

Choice A shows a combination reaction, of the general form  $A + B \rightarrow C$ . This reaction also qualifies as a formation reaction, and involves redox, but it is not a single displacement.

Choice B shows a double displacement reaction, that is, one following the general format:  $AB + CD \rightarrow AD + CB$ . This reaction can alternatively be classified as a metathesis or neutralization reaction, but not as a single displacement, nor can this reaction be classified as redox, since no change in oxidation numbers takes place.

Choice C represents a decomposition reaction, one with the general format:  $A \rightarrow B + C$ . With only one reactant, displacement of either kind is impossible.

**99. C**

This two part question can be answered without performing any quantitative work. Since zinc is less active than aluminum according to Table 2, this reaction is not spontaneous as written. An electrochemical cell based on this reaction would need to be driven by an outside source of electrical energy and is therefore an electrolytic cell, not a galvanic cell. Choices A and B can thus be eliminated. To distinguish between the remaining choices, we need only recognize that an electrolytic cell will have a negative cell potential; choice D can now be eliminated, leaving C as the credited choice. (Recall that the equation relating free energy change and cell potential is  $\Delta G = -nFE_{\text{cell}}$ , where  $n$  and  $F$  are positive constants, implying that free energy change and the cell potential will have opposite signs. Nonspontaneous reactions have positive free energy changes. The cell potential is therefore always negative for an electrolytic cell.)

**100. A**

The product containing the metal,  $M(\text{OH})_n$ , is a neutral species and hence has an overall charge of zero. The sum of the oxidation numbers of its constituent groups too then must also add up to zero. The hydroxide ions each have a charge of  $-1$ , giving a total of  $-n$  since  $n$  such groups are found in the molecule. In order to balance this out, the metal in the product must therefore have an oxidation number of  $+n$ , making  $n$  its oxidation state.

Choice B is incorrect, as well as ambiguous, since there is more than one nonmetal on the product side. The oxygen on both sides of the equation has an oxidation state of  $-2$ , the hydrogen in both water and hydroxide ion has an oxidation state of  $+1$ , while the oxidation state of the hydrogen in the  $\text{H}_2$  product, as a standard state element, is zero. None of these oxidation numbers is variable.

Choice C is wrong since the oxidation state of the (nonoxidized) metal on the reactant side is zero, regardless of the identity of the metal.

Choice D is incorrect, as was choice B, since there is more than one nonmetal element on the reactant side. The oxygen on both sides of the equation has an oxidation state of  $-2$ , while the hydrogen in water has an oxidation state of  $+1$ . Neither of these oxidation numbers is dependent on  $n$ , which is merely a stoichiometric coefficient on the reactant side.

**101. C**

The basic gist of the activity series is that the more active element will displace the less active element from its salts; while the passage limited its discussion to the relative activity of metals, it can be inferred that nonmetals could be similarly compared. If chlorine is indeed more active than bromine, then chlorine should displace Br from bromide compounds, such as the hydrobromic acid depicted in choice C.

Choice A is incorrect since no actual displacement is taking place; when solid KCl is added to aqueous HBr, it dissolves. (Dissolution is a physical process rather than a chemical one; no reaction takes place at all in choice A.) Choice A could most rapidly be dismissed based upon the observation that neither reactant is in its elemental form.

Choice B is incorrect because it is not a single displacement reaction, but rather a double displacement, in this case precipitation. No redox takes place; the reaction proceeds as written because AgBr is less soluble than AgCl, and the formation of solid AgBr is the driving force for this metathesis. Choice B, like choice A, can be quickly eliminated since neither reactant is in its elemental form.

Choice D is wrong because, as written, it depicts the reaction of molecular bromine with molecular chlorine; the success of this combination reaction will not allow one to infer which one is more reactive.

**102. B**

This question asks you to apply a group trend from the periodic table to the situation described in the passage. As one descends a group in the periodic table, atomic radius increases while effective nuclear charge,  $Z_{\text{eff}}$ , does not. It follows that if the electron on an atom is further from the same  $Z_{\text{eff}}$ , it will be less strongly held and thus more easily removed; this ease of removal, or ionization potential, is therefore the best explanation for the observed group trend in activity. While ionization potential is not offered as a choice, it is the direct result of the distance from the nucleus to the valence electron, allowing us to select choice B as the best answer to this question.

Choice A is incorrect since, when descending a column of the periodic table,  $Z_{\text{eff}}$  remains constant.

Choice C is not relevant since atomic mass has nothing to do with the number of valence electrons or their attraction for the nucleus; recall that it is the valence electrons which are responsible for chemical behavior.

Choice D is wrong since the ratio of particles in the nucleus will only affect the isotopic mass and nuclear stability of the atom; it will have no effect on chemical behavior, which is a direct result only of valence electron configurations.

**103. A**

The formal charge on an atom is given by the following equation:

Formal charge = valence electrons in neutral atom – non-bonding electrons – 1/2 bonding electrons

Formal charge H = 1 - 0 - 2 = -1

**104. B**

The passage describes a very intricate mechanism for producing polywater and does not support the fact that polywater can be produced in a variety of conditions.

Choice A is incorrect because polywater has a higher index of refraction than normal water and so would bend light more towards the normal (smaller angle).

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

so, if  $n_{\text{poly}} > n_{\text{water}}$  then  $\theta_{\text{poly}} < \theta_{\text{water}}$

Choice C is incorrect because polywater is 40% more dense than water. So, an equal mass of polywater will have a smaller volume.

Choice D is incorrect because the passage states that polywater has a freezing-point of  $-40^\circ\text{C}$ .

### 105. B

Decreasing the pressure would increase the water vapor production. Looking at the equilibrium below, it is clear that reduction of pressure would favor the formation of gas by Le Chatelier's principle.



Choice A is incorrect. Decreasing the temperature would decrease water vapor production. Note that adding heat to the equilibrium shown above would drive the reaction to the right. Conversely, removing heat would drive the reaction to the left.

Choice C is incorrect because decreasing the cross-sectional area of the tube, if anything, would slow down the rate of vapor production because the vapor would not escape the first chamber as rapidly.

Choice D is incorrect because increasing the solute concentration of the water would tend to decrease the vapor pressure.

### 106. A

Vapor pressure and boiling point are colligative properties that depend on the number of particles in a solution. Assuming that hypothesis 2 is correct and that polywater is merely an aqueous solution with dissolved materials, vapor pressure depression and boiling point elevation would occur.

### 107. A

Using Boyle's Law,  $P_i V_i = P_f V_f$ . Solving for  $P_f = \frac{P_i V_i}{V_f}$ .

### 108. D

The water would condense less rapidly because the rate of heat transfer from the water vapor to the atmosphere would be decreased. Heat is transferred from a body of high temperature to one of lower temperature. This is a consequence of the second law of thermodynamics. The rate of heat transfer depends on the temperature gradient.

Choice A is incorrect because the water would condense. The boiling point of water is  $100^\circ\text{C}$ , so elevating the temperature to  $50^\circ\text{C}$  would not stop water condensation.

Choice B is incorrect because the temperature of the tube ( $500^\circ\text{C}$ ) has not been changed and only water vapor will pass through. Liquid water will be vaporized.

Choice C is incorrect because the passage indicates that polywater never formed (Hypothesis 2). Furthermore, there is no evidence that altering the temperature would change the structure of polywater.

**109. A**

If the mass of the capillary was unchanged, this would weaken Hypothesis 2 which states that the contaminants in polywater dissolved from the quartz capillary. Weakening Hypothesis 2 would support Hypothesis 1.

Choice B is incorrect. If de-ionization of polywater increased its freezing temperature, this would indicate that polywater contained dissolved solids and provide support for hypothesis 2.

Choice C is incorrect. If hypothesis 2 is correct, we expect polywater to differ from normal water in its boiling point. Polywater would then have a higher boiling point.

Choice D is incorrect because, as described in the explanation to question 108, this would neither support nor weaken hypothesis 1.

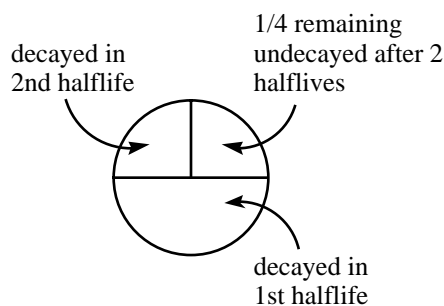
**110. D**

Beta particles have a negative charge. They are electrons, as shown in Figure 1 of the passage. Beta particles travelling up in the plane of the page will be deflected to the left by a magnetic field directed out of the plane of the page. Gamma rays are high energy photons lacking any charge. They will not be deflected in a magnetic field or an electric field precisely because they are uncharged.

**111. C**

After two half-lives (28.56 days),  $\frac{3}{4}$  of the sample will have decayed.  $\frac{1}{2}$  in the first half life, and  $\frac{1}{4}$  in the second. Only  $\frac{1}{4}$  of the sample will remain undecayed. In other words,  $\left(\frac{1}{2}\right)^2 = \frac{1}{4}$  remains.

Therefore  $\frac{3}{4}$  is gone.

**112. C**

The circuit diagram indicates that the resistor and speaker are wired in parallel. Therefore, the voltage across the resistor is the same as the voltage across the speaker. We can calculate the voltage across the resistor using  $V = IR$ . The only additional information we need is the value of  $I$ , the current flowing through the resistor.

Choice A is incorrect. We need to know the current through the speaker, as well as its internal resistance, to determine the voltage across the speaker. The resistance alone is insufficient.

Choice B is incorrect because the duration of the discharge would not provide us with any useful information. If we knew the charge transmitted and the duration, we could calculate the current. The duration alone is insufficient.

Choice D is incorrect because other information is required as described above

**113. D**

The half-life indicates the time required for half of a sample to decay and is thus a relative measure of the frequency of decay between two samples of equal mass. However, without knowing the mass, we cannot determine the absolute frequency of decays. A huge sample with a long half-life may produce more decays than a small sample with an extremely short half-life.

**114. A**

A Geiger counter provides a largely qualitative measure of radioactivity in an area.

Choice B is incorrect because a Geiger counter cannot locate radioactivity with the precision required for a radioimmuno assay.

Choice C is incorrect because a Geiger counter does not provide a quantitative measure of the energy of a particle. If the particle has enough energy to produce an ionization, it will produce a click. Any energy beyond this is not detected.

Choice D is incorrect because a Geiger counter cannot differentiate between different types of ionizing radiation.

**115. B**

The rate of a reaction is dependent on the activation energy. The lower the activation energy, the more rapid the reaction. Choice B has the lowest activation energy of all of the choices. Note that Reaction B indicates an increase in the total energy of the compounds in the reaction. Although the reaction is not energetically favorable, it is still the most rapid. Do not confuse thermodynamics with kinetics.

**116. A**

The question asks which will precipitate first. Each metal hydroxide,  $M(OH)_n$ , has an equilibrium equation of the following form:



$$K_{sp} = [M^{n+}][OH^-]^n$$

Since the concentration of each metal  $[M] = 1$  molar, the equilibrium equation reduces to:

$$K_{sp} = [OH^-]^n$$

Thus, the saturation concentration of hydroxide ion, in each case, is:

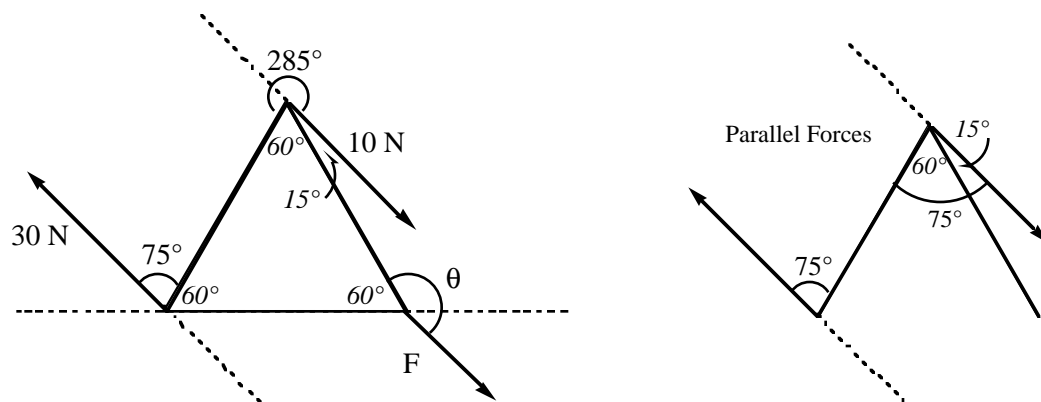
$$[OH^-] = \sqrt[n]{K_{sp}}$$

	$K_{sp}$	saturation $[OH^-]$
AgOH	$1.5 \times 10^{-8}$	$1.5 \times 10^{-8}$
Al(OH) <sub>3</sub>	$3.7 \times 10^{-15}$	$1.5 \times 10^{-5}$
Mg(OH) <sub>2</sub>	$1.2 \times 10^{-11}$	$3.4 \times 10^{-6}$
Mn(OH) <sub>2</sub>	$2.0 \times 10^{-13}$	$4.5 \times 10^{-7}$

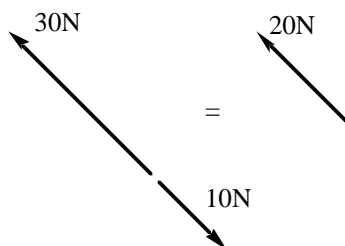
AgOH is saturated at the lowest  $[OH^-]$  and will therefore precipitate first.

## 117. B

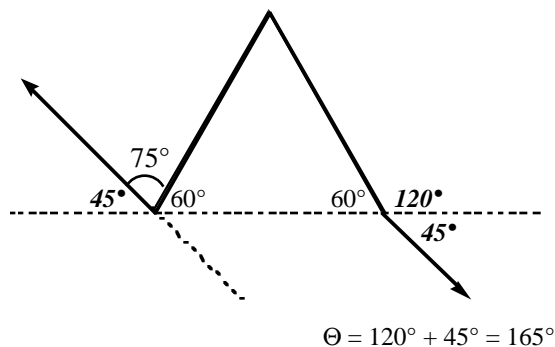
This problem can be solved by examining the angles and noting that the two given forces are antiparallel. First, each of the angles in an equilateral triangle is  $60^\circ$ , adding up to the  $180^\circ$  characteristic of all triangles. We know that the forces are antiparallel because they make the same angle,  $75^\circ$ , with a line that intersects both of them. That line is the left edge of the equilateral triangle.



Once we determine that the two given forces are antiparallel, we know that the third force must be applied along the same angle (in order to cancel out with the other two.) Summing the two given forces, we get a net force of 20N to the upper left.



So we know that the answer must be 20N towards the bottom right. This narrows the choices to A and B. Now we must determine the angle. The supplementary angle is  $120^\circ$ , as shown below. Knowing that the two forces are parallel, we can calculate the  $45^\circ$ , as shown below. This allows us to calculate  $\theta$ .



**118. C**

We will calculate to determine the energy supplied by the sun to a  $10 \text{ cm}^2$  region during 1 hour, assuming that the device is 100% efficient.

$$10 \text{ cm}^2 \times 1.5 \frac{\text{kJ}}{\text{m}^2 \cdot \text{s}} \times \frac{1 \text{ m}^2}{10000 \text{ cm}^2} \times 3600 \text{ s} = 5.4 \text{ kJ} = 5400 \text{ J}$$

**119. C**

We can determine the rate law of the general form

$$\text{rate} = k[\text{A}]^x[\text{B}]^y$$

using the experimental data in the chart. Recall that rate laws can only be determined experimentally. They cannot be determined from the balanced reaction equation alone.

initial [A] (mol/L)	initial [B] (mol/L)	initial rate of reaction (mol/L·min)
0.50	0.10	0.01
1.00	0.40	0.16
1.00	1.60	0.64

Looking at trials 2 and 3, we see that only [B] was changed. Increasing the [B] by a factor of 4 increased the rate by a factor of 4. This shows that the reaction is 1st order with respect to [B].

$$\text{rate} = k[\text{A}]^x[\text{B}]^1$$

To determine the order with respect to [A], we look at trials 1 and 2.

initial [A] (mol/L)	initial [B] (mol/L)	initial rate of reaction (mol/L·min)
0.50	0.10	0.01
1.00	0.40	0.16
1.00	1.60	0.64

[A] is doubled. Note that [B] was increased by a factor of 4. So, we expect the rate to increase by a factor of  $4 \times$  the effect of doubling [A]. The rate increases by a factor of 16. Therefore, the effect of doubling [A] is to quadruple the rate (because  $4 \times 4 = 16$ ). Therefore, the reaction must be 2nd order with respect to [A] because  $\text{double}^2 = \text{quadruple}$ . We can simplify the table by removing the effect of [B] as shown in the table below:

initial [A] (mol/L)	initial [B] (mol/L)	initial rate of reaction (mol/L·min)
1	1	1
2	1	4
1.00	1.60	0.64



$$\text{rate} = k[A]^2[B]^1$$

And the overall order is 3.

**120. D**

In order for the hovercraft to hover above the ground, the pressure in the skirt must apply an upward force equal (and opposite) to the gravitational force on the hovercraft. The weight of the hovercraft is given by:

$$F = mg = 9.8 \frac{\text{m}}{\text{s}^2} \times 600 \text{ kg} = 5880 \text{ N}$$

The pressure, which is force per unit area, is therefore:

$$P = \frac{\text{Force}}{\text{Area}} = \frac{5880\text{N}}{4\text{m} \times 2\text{m}} = 735 \frac{\text{N}}{\text{m}^2} = 735 \text{ Pa}$$

This pressure, however, is only the gauge pressure: the pressure in excess of atmospheric pressure. The absolute or total pressure under the skirt is:

$$\text{pressure} = \text{gauge } P + \text{atm } P = 101,735 \text{ Pa} = 101.74 \text{ KPa}$$

Note that this choice is the only choice greater than atmospheric pressure. The pressure must be greater in order to lift the hovercraft.

**121. A**

When the thrust fan is shut off, there will no longer be a centripetal force to sustain the hovercraft in its circular motion. Thus, it will proceed in a straight line tangent to its path at the moment the fan is turned off.

Choice B is incorrect because a force (centripetal force) is required to cause an object to move in a circle. No such force is being applied to the hovercraft after the thrust fan is shut off.

Choice C is incorrect. This arrow indicates the direction of a centripetal force required to keep an object moving in a circle. This would be the force generated by the thrust fan before it is shut off.

Choice D is incorrect because a force directed out of the circle would be required to cause the hovercraft to follow this path. No such force exists in this scenario.

**122. C**

This problem can be solved very quickly using dimensional analysis.

$$N = \text{kg} \times \frac{\text{m}}{\text{s}} \times \frac{1}{\text{s}} \Rightarrow \text{force} = (600) \left( \frac{60000}{3600} \right) \left( \frac{1}{4} \right) = \frac{10000}{4}$$

We can also solve it the longer way. The final velocity of the hovercraft in units of m/s is:

$$V_{\text{final}} = 60 \frac{\text{km}}{\text{hour}} \times 1000 \frac{\text{meters}}{\text{km}} \times \frac{1 \text{ hour}}{60 \text{ minute}} \times \frac{1 \text{ minute}}{60 \text{ second}}$$

$$V_{\text{final}} = 16.67 \frac{\text{m}}{\text{s}}$$

The average acceleration is:

$$a_{\text{average}} = \frac{16.67}{4 \text{ sec}} = 4.17 \frac{\text{m}}{\text{s}^2}$$

The force can be determined using Newton's Second Law:

$$F = ma = 600 \text{ kg} \times 4.17 \frac{\text{m}}{\text{s}^2} = 2500 \text{ N}$$

**123. A**

The thrust fan provides the force which propels the hovercraft forward. In the absence of wind resistance, it is the only (and hence net) force acting upon the hovercraft. From the time  $t_1$  that the fan is turned on until time  $t_2$ , the hovercraft will experience an acceleration supplied by the thrust in accordance with Newton's second law. At the moment  $t_2$  that the fan is turned off, the hovercraft experiences no net force and therefore no acceleration. According to Newton's first law, in the absence of a net force the hovercraft will continue in motion with constant velocity. The increasing velocity due to a constant acceleration between  $t_1$  and  $t_2$  is represented by the positively sloped line in graph A. The constant velocity after the fan is turned off is represented by the horizontal line of graph A.

Choice B is incorrect because in the absence of air resistance, the velocity of the hovercraft would not decrease after the thrust has been turned off at time  $t_2$ .

Choice C is incorrect because according to the graph, the hovercraft undergoes constant acceleration even after  $t_2$ . This cannot be true, as after  $t_2$  the hovercraft experiences no net force and thus no acceleration.

Choice D is incorrect as the graph shows an instantaneous change in velocity which would require an infinite acceleration.

**124. A**

Using the continuity equation it is clear that the volume of air entering the fan must equal the volume of air leaving the fan. The air is accelerated and so its velocity is increased. Conservation of momentum shows why propelling air backwards at a high velocity will move the hovercraft forward.

Choice B is incorrect because the air intake velocity must be lower than the output velocity. The velocity is increased by the fan.

Choice C is incorrect because the intake volume is equal to the output volume since no compression of the air takes place.

Choice D is incorrect because the intake pressure is equal to the output pressure by the continuity equation.

**125. D**

The passage states that "As a parcel of hot air rises, it expands approximately adiabatically doing work on the surrounding air". Adiabatic processes have no transfer of heat. This eliminates Choices A and B. Choice C is incorrect because the kinetic energy decreases as temperature decreases.

**126. B**

This question requires an understanding of the energy of photons. The energy is related to the frequency by the following equation, where  $h$  is Planck's constant:

$$E = hf$$

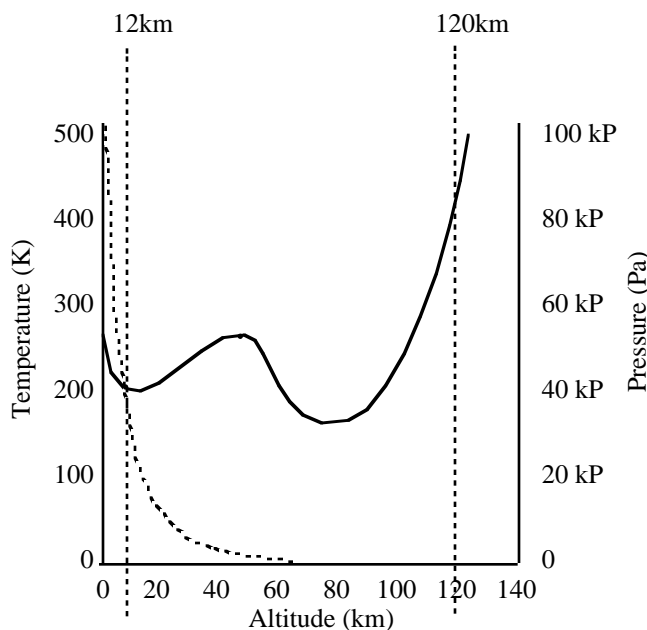
Higher energy photons have a higher frequency, and shorter wavelength. The frequency is inversely related to the wavelength according to the following equation:

$$c = f\lambda$$

Thus, the cutoff energy for photodissociation would be related to a minimum frequency (or a maximum wavelength) of light.

### 127. A

Looking at Figure 1, we see that the temperature at 120 km is significantly higher than at 12 km.



However, the graph also indicates that the pressure at 120 km is essentially zero. The passage indicates that as the pressure decreases, so does the density. Thus, the mass of a liter of air at this altitude is near zero and the energy content of the air is minimal, regardless of the higher temperature. You may also rearrange the ideal gas law to obtain:

$$\frac{n}{V} = \frac{P}{RT}$$

which tells you that as  $P$  approaches zero, so does  $n/V$ , which is an indication of density.

### 128. B

The buoyant force acting on an object is equal in magnitude to the weight of the fluid it displaces. Because the balloons are of equal volume, they displace an equal volume of fluid. Lower altitude air is more dense, and thus, a given volume will weigh more. The balloon at the lower altitude (2000m) will have a greater buoyant force applied to it because the air is more dense at the lower altitude.

This is similar to submerging an object in water, or in mercury which is much more dense. The buoyant force acting on the object when it is submerged in mercury will be much greater. Also, note that the question does not ask about the net force acting on the object, a calculation which would require us to determine the gravitational force.

**129. A**

Conduction is the transfer of heat between two objects in physical contact. Heat is conducted from the engine to the pipes by direct contact. Convection is the transfer of heat by movement of fluid. In this case, the flow of water and steam carries the heat away from the engine and into the atmosphere. Radiation is the transfer of heat without contact, through thermal radiation. The sun transfers heat to the earth by radiation.

Choice B is incorrect because the heat is first transferred by conduction.

Choice C is incorrect. The question does not specifically state that the water pipes are in direct contact with the engine. It could be supposed that the engine radiates heat to the pipes, which then carry the heat away by convection. However, there is no conduction following the transfer of heat to the atmosphere by convection, and so this answer is incorrect.

Choice D is incorrect because there is no conduction following the transfer of heat by convection.

**130. B**

The passage provides the equation  $Q = nC_p\Delta T$ . A gas with a high  $C_p$  will have a smaller change in temperature for a given  $Q$  than a gas with a low  $C_p$ . Change in temperature is directly proportional to change in volume (at constant pressure). Charles' Law describes this relationship:

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Thus, the gas with the high  $C_p$  will expand less than a gas with a low  $C_p$  and the ratio of this expansion will be less than 1.

$$\frac{\text{expansion of high } C_p}{\text{expansion of low } C_p} < 1$$

**131. A**

Looking at the titration curve (Figure 1), it is clear that 500mL is added before the first endpoint of the titration (point B). The amount of base added is thus  $500\text{mL} \times 0.01\text{mol/L} = 0.005\text{ mol}$ . This quantity is the same as the amount of acid present initially. In other words, there is 0.005 mol of phosphoric acid initially present in the sample. In the second paragraph of the passage we are told that the sample has a volume of 1 L, and so the concentration of phosphoric acid in the sample is  $0.005\text{ mol}/1\text{ L} = 0.005\text{ M}$ .

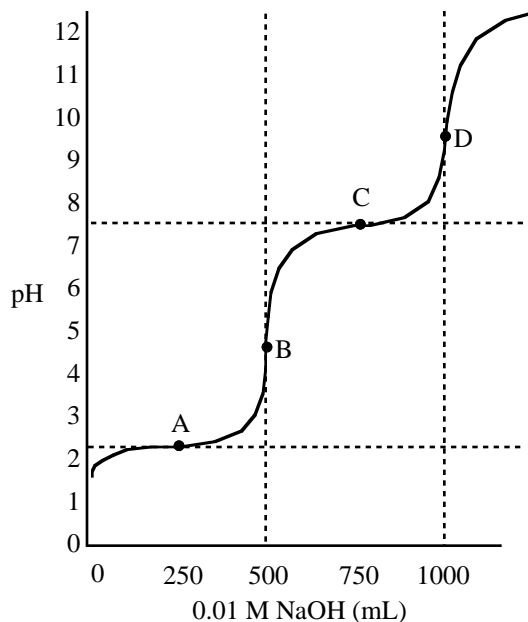
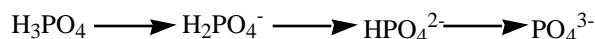
The question asks for the concentration of a 0.5 L sample, but it does not make a difference: If we take 0.5 L from the 1-L sample, it will contain less phosphoric acid, but the concentration is the same.

**132. B**

If a significant quantity of precipitate were lost, the student would conclude that there was less carbonic acid than was actually present. This would lead to the calculation of a less acidic, higher pH, than the actual pH.

## 133. C

During the titration, the phosphoric acid is undergoing the following transitions:

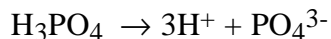


Points A and C are the best buffering regions, as indicated in the titration curve by the lack of change in pH with the addition of NaOH. They are the best buffering regions because they contain equal concentrations of the acid and its conjugate base. So point A has equal concentrations of  $\text{H}_3\text{PO}_4$  and  $\text{H}_2\text{PO}_4^-$ , and point C has equal concentrations of  $\text{H}_2\text{PO}_4^-$  and  $\text{HPO}_4^{2-}$ . We can see from the titration curve that point A has a pH of around 2.3 and point C has a pH around 7.5.

Looking at the answer choices, only choice C shows an equal concentration of these species at the given pH values.

## 134. D

The passage states that barium phosphate is insoluble and will precipitate. This will drive the reaction shown below to completion:



The  $[\text{H}^+]$  will increase and the pH will drop.

Choice A is incorrect because a Lewis base is an electron pair donor.  $\text{Ba}^{2+}$  is not an electron pair donor.

Choice B is incorrect because a reduction in the hydrogen ion concentration would lead to an increase in pH.

Choice C is incorrect because the chloride ion is a spectator in this reaction and does not participate in the formation of barium phosphate precipitate.

## 135. C

The best buffering occurs in the flat regions of the titration curve where the concentrations of acid and conjugate base are equal. Points A and C are good buffering regions, but point C is the best buffering region around neutral (7) pH.

**136. C**

The beverage is kept at a low temperature to reduce its kinetic energy and minimize the loss of water by evaporation. If too much water were lost, the concentration of the remaining fluid would increase and inaccurate measurements of the phosphoric acid concentration would result.

Choice A is incorrect because  $\text{CO}_2$  is a non-polar molecule and would not be involved in dipole-dipole interactions with water.

Choice B is incorrect because extracting the gas from the beverage would not result in a violent expansion of the gas.

Choice D is incorrect because reducing the temperature would decrease the kinetic energy.

**137. B**

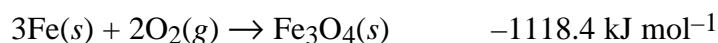
Removing  $\text{CO}_2$  would shift the equilibrium shown below towards the left, decreasing the  $\text{H}^+$  concentration in the blood and thus, increasing the pH. The body uses this technique (hyperventilation) as a means of regulating plasma pH.

**138. C**

The  $\Delta\text{H}^\circ$  for a reaction can be calculated as the difference between the heat of formation of the products and that of the reactants.

$$\Delta\text{H}^\circ_{\text{reaction}} = \Delta\text{H}^\circ_{\text{f products}} - \Delta\text{H}^\circ_{\text{f reactants}}$$

Recall that heat of formation is the heat of the reaction that produces 1 mol of the material in question from pure elements in their standard states. The heat of formation of elements in their standard states is zero. The passage provides the reaction for formation of  $\text{Fe}_3\text{O}_4$ :



So we can determine the heat of formation of  $\text{Fe}_2\text{O}_3$  from the first equation and the  $\Delta\text{H}^\circ_{\text{f}}$  of  $\text{Fe}_3\text{O}_4$  given by the equation above.

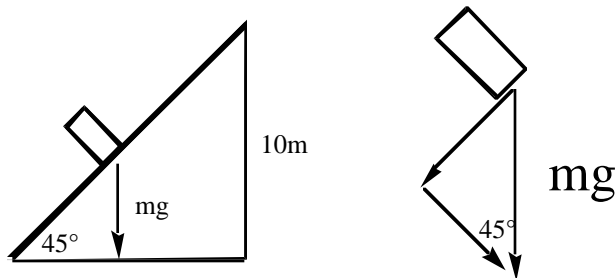
$$\begin{aligned} \Delta\text{H}^\circ_{\text{reaction}} &= 4(\Delta\text{H}^\circ_{\text{f Fe}_3\text{O}_4}) + \Delta\text{H}^\circ_{\text{f O}_2} - 6(\Delta\text{H}^\circ_{\text{f Fe}_2\text{O}_3}) \\ +472 &= 4(-1118.4) + 0 - 6(\Delta\text{H}^\circ_{\text{f Fe}_2\text{O}_3}) \\ 4944 &= -6(\Delta\text{H}^\circ_{\text{f Fe}_2\text{O}_3}) \\ \Delta\text{H}^\circ_{\text{f Fe}_2\text{O}_3} &= -824 \text{ kJ mol}^{-1} \end{aligned}$$

You should, of course, use approximations judiciously to save time.

**139. A**

There are two ways to solve this problem. The fast, easy way is to conduct a work-energy analysis. The initial energy of the mass is taken as 0. The final energy (at the top of the incline) is  $mgh = 5(10)(10) = 500\text{J}$ . This change in energy is equal to the work done on the mass.

We could also calculate the  $F$  required to lift the box and the distance over which that force is applied.



The force required to move the box is equal to  $\frac{\sqrt{2}}{2} mg = \frac{\sqrt{2}}{2}(5)(10) = 25\sqrt{2}\text{N}$ . The distance travelled by the box up the incline is given by the pythagorean equation. Distance =  $\sqrt{10^2 + 10^2} = \sqrt{200} = 10\sqrt{2}$ .  
Work = Distance  $\times$  force =  $10\sqrt{2} \times 25\sqrt{2} = 500\text{J}$ . Ta da!

**140. B**

The two resistors are wired in parallel, and so the voltage across each is the same. In this particular case, since there are no other resistive elements in the circuit, the voltage across each is the same as the emf of the battery,  $V$ . The current through  $R_1$  and  $R_2$  is therefore  $V/R_1$  and  $V/R_2$  respectively. Removing  $R_1$  will not change the voltage across the parallel resistor  $R_2$ : From Kirchhoff's law, the voltage across  $R_2$  is still  $V$ , and so there will be no change in the current through  $R_2$ .

(Note, however, the current through the battery will decrease (to 1/2 its original value).)

**141. C**

$$\begin{aligned} v_f &= v_i + at \\ 30 &= v_i + 4(5) \\ 30 &= v_i + 20 \\ v_i &= 10\text{m/s} \end{aligned}$$

**142. A**

This question is a simple energy analysis. The height of the gibbon will decrease by the length of its arm as it reaches the bottom of the swing. Its potential energy of  $mgl$  will be converted to kinetic energy.

$$\begin{aligned} mgl &= \frac{1}{2}mv^2 \\ \sqrt{2gl} &= v \end{aligned}$$

Choice B is the kinetic energy at the bottom of the swing.

Choice C is just wrong.

Choice D calculates for the period of an ideal pendulum.





ANSWER KEY

143.	D	163.	D	183.	B	203.	A
144.	C	164.	C	184.	D	204.	C
145.	A	165.	B	185.	A	205.	D
146.	C	166.	D	186.	B	206.	B
147.	A	167.	A	187.	A	207.	B
148.	D	168.	D	188.	C	208.	B
149.	B	169.	C	189.	C	209.	A
150.	C	170.	C	190.	C	210.	C
151.	D	171.	D	191.	B	211.	C
152.	B	172.	B	192.	A	212.	A
153.	C	173.	D	193.	A	213.	B
154.	A	174.	C	194.	A	214.	C
155.	A	175.	C	195.	D	215.	C
156.	B	176.	D	196.	B	216.	C
157.	C	177.	A	197.	D	217.	D
158.	D	178.	B	198.	B	218.	A
159.	D	179.	B	199.	A	219.	B
160.	C	180.	D	200.	A		
161.	A	181.	A	201.	C		
162.	D	182.	B	202.	B		

**143. D**

The question stem asks for support of the fact that the information for forming the cap is stored in the apical tip of the stalk. This information is in the form of mRNA which is used as the template for translation of the proteins which coordinate cap formation. The other choices may be true but they do not provide evidence for the storage of information in the apical tip.

Choice A is incorrect because the DNA coding for cap inducing proteins would be present at all times in the *Acetabularia* genome. This does not provide evidence for the storage of information in the stalk tip.

Choice B is incorrect because, although exposure of the *Acetabularia* to ribonuclease and the consequent cleavage of RNA would temporarily block formation of the cap (until more RNA is transcribed), this does not provide evidence for the storage of information in the apical stalk segment. Rather, it provides evidence that RNA is the conveyor of information.

Choice C is incorrect because although the passage describes this exchange of nuclei in Experiment 2, this does not provide evidence for the storage of information in the apical stalk.

**144. C**

The passage describes *Acetabularia* as a single cell with a nucleus. Only eukaryotes have nuclei, and other membrane bound organelles.

Choice A is incorrect because a virus does not have a cell membrane, nucleus, or many of the other components of a cell. A virus is essentially composed of DNA or RNA and a protein coat.

Choice B is incorrect because prokaryotes lack a nucleus.

Choice D is incorrect because the term *bacteria* refers to prokaryotes which, by definition, lack nuclei.

**145. A**

In order for a cell fragment to survive, it must contain all of the necessary machinery for maintaining life. This requires the production of proteins which are coded for by DNA. In *Acetabularia*, the region with the rhizoid survives, indicating that the nucleus must be located there.

Choice B is incorrect because, while some prokaryotes multiply by budding, eukaryotic cells multiply by mitosis. Also, this information cannot be concluded from the fact that the rhizoid bearing fragment survives.

Choice C is incorrect because while there is indication in Experiment 1 that the cap alone is not sufficient for the *Acetabularia* to survive, there is no indication that the cap is a vestigial (unnecessary) structure.

Choice D is incorrect because although the statement may be true, it is not unambiguously proven by the experiment. The experiment demonstrates that cap-coding mRNA is *present* in the rhizoid region of the fragmented *Acetabularia* at some point during regeneration. The cap-coding mRNA may have been stored in the rhizoid region when the *Acetabularia* was cut or it could have been transcribed only after the cell was fragmented.

**146. C**

Translational regulation occurs when the translation of RNA to protein is a regulated step. In *Acetabularia*, the mRNA is transcribed and stored in the cap for a number of weeks before being translated. This can be concluded from Experiment 3 (in which the cap is produced a number of weeks

after the nucleus is removed) and from Experiment 4 (in which the apical stalk region produces a cap a number of weeks following fragmentation of the cell).

Choice A is incorrect because transcriptional regulation occurs when transcription of RNA from DNA is regulated. Choice A indicates incorrectly that transcriptional regulation occurs when mRNA lies dormant. This is translational regulation.

Choice B is incorrect because translational regulation occurs when RNA translation to protein is regulated. Choice B indicates incorrectly that translational regulation occurs when mRNA transcription from DNA is regulated.

Choice D is incorrect because translational regulation is occurring in *Acetabularia*.

**147. A**

The genotype consists of the genes (DNA) which code for specific proteins. Differences in these proteins lead to a difference in the appearance of an organism. Observable differences in the structure of the organism constitute differences in the phenotype. In this case, the genes coding for different cap structures are part of the cell's genotype. The manifestation of these genes, a flat or a tufted cap, is part of the cell's phenotype.

Choice B is incorrect because the difference in phenotype does not cause the difference in cap structure, it *is* the difference in cap structure.

Choice C is incorrect because *Acetabularia mediterranea* and *Acetabularia crenulata* do not differ in genus. Their genus is *Acetabularia*. Their species are *mediterranea* and *crenulata*.

Choice D is incorrect because *Acetabularia mediterranea* and *Acetabularia crenulata* do not differ in their phylum, only in their species. Organisms in the same genus must be in the same phylum (and kingdom, class, etc...).

**148. D**

mRNA is transcribed through complimentary base pairing from the template strand of DNA. The sequence of mRNA runs antiparallel to the strand of DNA from which it was synthesized. The base pairs in DNA bind to base pairs in RNA in the following way - G-C, C-G, A-U, T-A. Note that RNA contains uracil in place of thymine. The complimentary strand of DNA to the given mRNA is:

5'-UGUAAUC-3' mRNA

3'-ACATTAG-5' DNA

The DNA strand above must be rewritten in the 5' → 3' direction to fit the answer choices.

3'- ACATTAG- 5' DNA = 5'-GATTACA-3'

Choice A is incorrect because there is no uracil in DNA.

Choice B is incorrect because the sequence is backwards. Note that the strands must be antiparallel.

Choice C is incorrect because the base pairs are not complimentary.

**149. B**

The passage states that bNOS inhibitors have been found to block the release of neurotransmitter. Since bNOS inhibitors would decrease the production of NO, this implies that NO functions to promote the release of neurotransmitter. The passage does not describe the mechanism by which NO promotes neurotransmitter release, so any mechanism that would increase such release is a possibility.

Choice A is incorrect because NO promotes the release of neurotransmitter. Inhibiting the fusing of vesicles at the presynaptic membrane would inhibit the release of neurotransmitter.

Choice C is incorrect because the passage states that NO acts as a vasodilator, not as a vasoconstrictor. Besides, vasoconstriction to maintain blood pressure is not necessarily related to brain function.

Choice D is incorrect because NO promotes the release of neurotransmitter. While the passage does not imply a role for NO in neurotransmitter synthesis, decreasing neurotransmitter synthesis would most likely tend to decrease the amount of neurotransmitter released.

**150. C**

A point mutation is the substitution of a single nucleotide. Point mutations can result in missense mutations in which a single amino acid is substituted for another in the translated protein, or in nonsense mutations. The mutation described in the question is a missense mutation.

Choice A is incorrect because a frame shift mutation changes the reading frame of the mRNA and would change the amino acid sequence of the entire protein from that point on.

Choice B is incorrect because deletion of a single base pair would be a frame shift mutation leading to changes in the amino acid sequence from that point on.

Choice D is incorrect because a nonsense mutation is a point mutation that introduces a stop codon into the mRNA. This leads to translation of a shorter protein.

**151. D**

eNOS produces NO in endothelial tissue, leading to vasodilation. This would tend to decrease blood pressure. An eNOS inhibitor would thus block production of NO, decreasing vasodilation and thereby increasing blood pressure.

Choice A is incorrect because an eNOS inhibitor would produce an increase in blood pressure.

Choice B is incorrect because a macNOS regulates the production of NO in the immune system. Also, inhibiting NO production would not increase immune response which is positively linked to NO concentration.

Choice C is incorrect because increased blood pressure would tend to increase urine production.

**152. B**

The passage states that in blood vessels, NO acts as a major vasodilator. Thus, NO could be used to alleviate high blood pressure. Nitroglycerin, as stated in the question stem, breaks down spontaneously (i.e., without requiring catalyzation by an NOS enzyme). Thus, by administering nitroglycerin, NO will be generated (without eNOS) in the patient's body and its presence will lead to vasodilation, causing a drop in blood pressure and relieving the hypertension.

Choice A is incorrect because NO will not activate eNOS. eNOS is activated by  $\text{Ca}^{2+}$  and functions normally to produce NO.

Choice C is incorrect because NO will be spontaneously generated from the nitroglycerin without requiring catalyzation by eNOS. Thus, although eNOS will not be activated, the NO generated from the administered nitroglycerin will dilate the blood vessels and relieve hypertension.

Choice D is incorrect because NO is very unstable and will not tend to build up. It is also not likely that NO would be capable of crossing the blood/brain barrier and affecting the nervous system.

**153. C**

The passage indicates that NO inhibits viral replication and mediates the activities of macrophages. It does not mention the denaturing of viral protein coats as an activity of NO.

Choice A is incorrect because macrophages are white blood cells which engulf and destroy foreign agents and their activity is mediated by NO.

Choice B is incorrect because NO inhibits viral replication and may do so by inhibiting the synthesis of viral RNA.

Choice D is incorrect because NO may inhibit viral replication by inhibiting viral release from infected cells.

**154. A**

The passage states that bNOS is activated by a  $[Ca^{2+}]$  between 200 and 400 nM. This question requires you to understand the prefix "nano" or nM. Nano indicates  $10^{-9}$ . So,  $3.2 \times 10^{-7}$  equals  $320 \times 10^{-9}$  which equals 320 nM, a concentration within the range given as capable of activating bNOS. The other concentrations are too low to activate bNOS.

**155. A**

Since malachite green, as depicted in figure 1, is cationic, it follows that it will have an affinity for anionic binding sites. Such anionic binding sites, alluded to in the passage, would be produced from acidic side chains upon treatment with aqueous base, and acidic side chains in natural proteins would most likely contain the COOH functionality.

Choice B is incorrect since acidic side chains on natural amino acids often contain OH groups.

Choice C is wrong since treatment with base is part of the process of producing color-fast yarns; this treatment makes the color stick, it does not break down the yarn into smaller polypeptide chains as choice C suggests.

Choice D is incorrect because the base reacts with the fiber before the dye is added, and not with the dye.

**156. B**

Dacron, as shown in figure 2, is a *polyester* since it contains the COOR functionality in its monomer (subunit).

Choice A is incorrect since polyamides would need to contain nitrogen in their monomers in order to contain an amide functional group, CONR<sub>2</sub>. Dacron does not. (However, nylon, also shown in figure 2, is a polyamide.)

Choice C is wrong, like A, for lack of nitrogen, a necessary element to classify the monomeric compound as a urethane, ArNHCOOR.

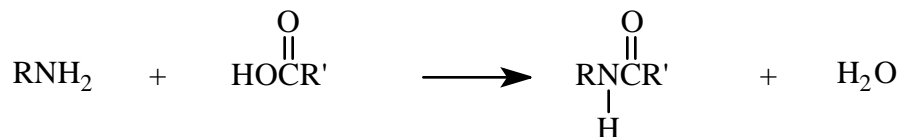
Choice D is wrong since the monomer structure is not a peptide.

**157. C**

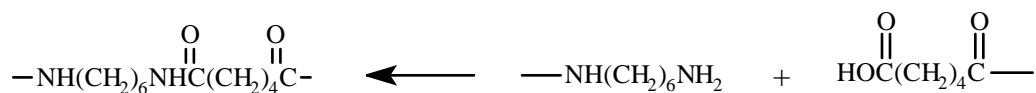
Hydrogen bonding occurs between OH groups and NH groups in any combination. Since the glucose monomer in cellulose has OH groups, cellulose should be capable of hydrogen bonding to either alizarin, with its two OH groups, or to aniline yellow, with its aromatic amine functionality. Malachite green, on the other hand, has no acidic protons available for hydrogen bonding due to the methylation of the nitrogen atoms.

**158. D**

Amides are produced by the condensation of amines with carboxylic acids:



To produce a repeating chain, or polyamide, one would need to condense a diamine with a dicarboxylic acid. As indicated in figure 2, nylon 66 has a straight chain of six carbons between the two nitrogen atoms and six more carbon atoms, also unbranched, in the dicarbonyl portion of the monomer. As such, the amine starting material must therefore be 1,6-hexanediamine, while the carboxylate reactant is hexanedioic acid:



Choice A is incorrect because *cis*-2-butenoic acid has only one carboxylate functionality and therefore would not condense on both ends, and it would produce a condensation product in which the butene double bond is still present. It also contains only four carbon atoms, rather than the required six.

Choice B is incorrect since, while butanedioic acid can polymerize with the diamine, it would produce a polymer with only two methylene groups between the carbonyl carbons in each monomer. (This product would be called nylon 64.)

Choice C is wrong on two counts: first, the hexanoic acid is a monocarboxylic acid, and thus will not combine with two amine molecules; second, any polyamide formed via condensation of an appropriate diacid and the suggested amine, 2,5-hexanediamine, would have two methyl group side chains.

### 159. D

Aromatic diazonium salts have the general formula  $\text{ArN}_2^+\text{X}^-$ . The second step of the diazotization reaction described is electrophilic aromatic substitution, with  $\text{ArN}_2^+$  acting as the electrophile, thus one should predict that the nitrogen of the salt should attach to the second ring in the position dictated by the second ring's substituents. Since the second aromatic compound, *p*-nitroanisole, has two substituents, we need to examine the directing effect of each: the nitro group is a meta director, while the ether is an ortho/para director. The effects of these two groups should thus be additive, placing the new substituent ortho to the  $-\text{OCH}_3$ , as shown in choice D.

Choices A and B are incorrect since the substitution reaction will take place at one of the ring protons rather than one of the substituent groups.

Choice C is wrong because  $-\text{NO}_2$  is meta directing but is forced here to be ortho directing.

### 160. C

As stated in the passage, color is the result of electronic transitions due to the delocalized  $\pi$  system in the dye. If the two aromatic rings of alizarin are completely hydrogenated, the resulting compound will contain only the two isolated ketone double bonds; the system will thus no longer be delocalized, and color production will cease.

Choice A is incorrect since the two  $-\text{OH}$  groups would still be present in the hydrogenated product; it is this feature of the molecule which accounts for the affinity for Dacron, via hydrogen bonding.

Choice B is wrong since solubility in aqueous base is mainly due to the presence of the two  $-\text{OH}$  groups, and to a lesser extent to the polar carbonyl bonds, which will still be present in the hydrogenated product.

Choice D is incorrect because it is not the aromatic nature of alizarin which accounts for its affinity, or lack thereof, for nylon 66. As the passage states, side chains are often necessary to provide a binding site; this is very likely to be the case between nylon and alizarin.

**161. A**

The passage states that hypoxic hypoxia is caused by any factor that leads to a decreased plasma  $pO_2$ . Since emphysema decreases the diffusing capacity of the lungs, less oxygen will diffuse into the blood, leading to a lower  $pO_2$ .

Choice B is incorrect because anemic hypoxia is caused by a decreased oxygen carrying capacity of the blood. Emphysema affects the amount of oxygen in the blood, not the ability of the blood to carry oxygen.

Choice C is incorrect because ischemic hypoxia is caused by a decreased delivery of blood to the tissues. Emphysema has no effect on blood circulation.

Choice D is incorrect because histotoxic hypoxia is caused by the inability of the tissues to utilize oxygen. Emphysema does not affect the ability of the tissues to use oxygen.

**162. D**

All blood cells (RBCs and WBCs) are produced by division of stem cells in the bone marrow. Damage to the bone marrow would therefore affect the formation of blood cells which would be likely to result in decreased production of erythrocytes (RBCs). Since the passage states that anemia is defined as a decrease in the number of functional erythrocytes, damage to the bone marrow by exposure to radiation could be a cause of anemia.

Choice A is incorrect because damage to the blood vessels could affect blood circulation but would not affect the number of erythrocytes in the blood.

Choices B and C are incorrect because the spleen and thymus are involved in the development and maturation of lymphocytes, a type of white blood cells, and not of red blood cells. Damage to the spleen or thymus, which would affect the number of lymphocytes, would not necessarily affect the number of red blood cells.

**163. D**

The passage states that cyanide blocks the action of cytochrome oxidase in the electron transport chain. The enzymes of the electron transport chain, including cytochrome oxidase, are located on the inner membrane of the mitochondria. If cyanide blocks the action of cytochrome oxidase, it is most likely located in the same place.

Choices A, B, and C are incorrect because these cellular locations are not involved in the electron transport chain which is blocked by cyanide action.

**164. C**

The question stem states that the physiological dead space is not involved in gas exchange. This means that the composition of air in the dead space is virtually identical to that of atmospheric air. In the alveoli, where gas exchange occurs, oxygen is taken up by the blood and carbon dioxide is released. Thus, the air in the alveoli will have a lower  $pO_2$  and a higher  $pCO_2$  than dead space air. Conversely, dead space air will have a higher  $pO_2$  and a lower  $pCO_2$  than alveolar air.

Choices A, B, and D are incorrect because they do not indicate that the alveolar air will have a higher concentration of carbon dioxide and a lower concentration of oxygen.

**165. B**

Although the shape of the curves is similar, the X-axis indicates that hemoglobin becomes saturated with CO at a much lower partial pressure (0.4 mmHg) than with oxygen (140 mmHg).

Choice A is incorrect because the graphs indicate that carbon monoxide binds with a higher affinity.

Choice C is incorrect because oxygen will not saturate hemoglobin as much (or as rapidly) as an equal partial pressure of carbon monoxide.

Choice D is incorrect because the structure of the binding of oxygen and carbon monoxide to hemoglobin cannot be determined from the graphs.

**166. D**

Oxygen therapy will help any condition which would be alleviated by an increase in the  $pO_2$  of oxygen in the blood. The question stem states that beri beri leads to histotoxic hypoxia. The passage tells us that histoxic hypoxia occurs when the tissues cannot utilize oxygen. So, increasing the amount of oxygen transported in the blood through ventilation with pure oxygen will not serve any purpose.

Choice A is incorrect because breathing pure oxygen will greatly help an individual suffering from hypoventilation. If pure oxygen is inhaled, much more oxygen will diffuse into the blood and be carried to the tissues.

Choice B is incorrect because, although sickle cell anemia reduces the oxygen carrying capacity of the blood (anemic hypoxia), inhaling pure oxygen will allow more oxygen to dissolve in the plasma, somewhat increasing delivery of oxygen to the tissues.

Choice C is incorrect because increasing the concentration of oxygen in the blood will increase delivery of oxygen to the tissues and take full advantage of the carrying capacity of the poor circulation.

**167. A**

The foramen ovale is a shunt that diverts blood away from the lungs in the fetal circulatory route. The foramen ovale allows blood to enter the left atrium directly from the right atrium. If an infant's foramen ovale does not close completely at birth, deoxygenated blood will continue to flow from the right atrium directly to the left atrium without ever being oxygenated in the lungs. In the left atrium, the deoxygenated blood will mix with the oxygenated blood returning from the lungs. The overall effect will be hypoxic hypoxia as the  $pO_2$  of the blood flowing to the body is decreased.

Choice B is incorrect because the defining characteristic of anemic hypoxia is the reduction of the oxygen-carrying capacity of the blood. In this case, the carrying capacity of the blood has not changed (there is no anemia or damage to hemoglobin). The problem is that much of the infant's blood never reaches the lungs to be oxygenated. The infant's blood is capable of carrying oxygen, it just does not receive enough oxygen to carry.

Choice C is incorrect because the blood flow is not shunted away from the tissues which need oxygen. In ischemic hypoxia, the movement of blood is reduced, thus reducing delivery of oxygen to the tissues. In this case, the flow of blood throughout the body is not affected. It is true that the flow of blood through the heart and lungs is not normal, but the flow of blood to the tissues is normal.

Choice D is incorrect because Choice A is correct.

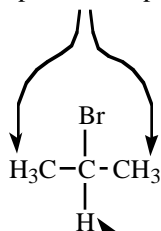
**168. D**

The NMR spectra shows a distinct absorption split into 7 peaks, the classic absorption of an isopropyl group. This absorption is downfield, indicating that it is deshielded. From this information alone, we can determine that there is at least one proton with 6 equivalent neighboring protons, that is



near some electronegative species. Only choice A has 6 neighboring protons that can lead to splitting into  $(N+1)$  seven peaks. The downfield shift is caused by the bromine bonded to the same carbon as the single hydrogen.

these 6 equivalent neighboring protons split the single protons peak into 7 peaklets



this proton's absorption is shifted downfield (to higher PPM)

Choice A is incorrect because there are no neighboring protons, and so there will be no splitting.

Choice B is incorrect because there are no neighboring protons and so, splitting into seven peaklets will not occur.

Choice C is incorrect because the single proton has only 3 neighboring protons and will only be split into 4 peaklets (a quadruplet). Note that the absorption for the single proton in this molecule will be shifted more downfield because there are many electronegative species around it.

### 169. C

The sarcomere illustrated in the question stem consists of thin and thick filaments. Contraction occurs through the sliding of the thin filaments along the thick filaments, towards the center of the sarcomere. During this contraction, the length of both the thick and thin filaments remains unchanged. This sliding can be seen in the increased overlap between thick and thin filaments.

Choice A is incorrect because it indicates that the thick filaments have shortened.

Choice B is incorrect because it indicates that the thin filaments have shortened.

Choice D is incorrect because it indicates that both the thick and thin filaments have shortened.

### 170. C

Secondary active transport is defined as the transport of a material across the cell membrane against its concentration gradient without direct hydrolysis of ATP. The energy required to drive this active transport is acquired by harnessing favorable concentrations gradients, like the flow of sodium ion into a cell. Note that the sodium gradient is created by the primary active transport of sodium out of the cell by the sodium/potassium pump.

Choice A is incorrect because simple diffusion is the movement of materials down a concentration gradient through the membrane without the assistance of pumps or protein channels. Small molecules ( $O_2$ ) and non-polar molecules (steroids) can move into a cell by simple diffusion.

Choice B is incorrect because facilitated diffusion is movement of a material along its concentration gradient through protein channels. Ions can move in and out of the cell through specific ion channels.

Choice D is incorrect because primary active transport involves transport against a concentration gradient driven directly by ATP hydrolysis. The sodium/potassium pump is an ATPase (hydrolyzes ATP).

**171. D**

Aldehydes do not occur in the 20 amino acids found in naturally occurring proteins.

Choice A is incorrect because the hydroxyl group is found on serine and threonine.

Choice B is incorrect because the methyl group is found on alanine and a number of other nonpolar amino acids.

Choice C is incorrect because the carboxylic acid functionality is found on the side chain of aspartic acid and glutamic acid.

**172. B**

The question stem describes the effects of the mammalian dive reflex, indicating that blood flow to the extremities is reduced. This would increase heat retention of the body.

Choice A is incorrect because oxygen demand by the tissues depends on the metabolic rate of the tissues, which is not affected by changes in blood pressure, heart rate, or blood flow to the extremities.

Choice C is incorrect because the dive reflex will not lead to a decrease in oxygen partial pressure. The partial pressure of oxygen will decrease during a dive because the individual is holding their breath, not because of the accommodations of the dive reflex.

Choice D is incorrect because venous return, the amount of blood returned to the heart by the venous circulation, will not be increased. If stroke volume (the volume of blood pumped with each beat) remains constant, the decrease in heart rate caused by the dive reflex would lead to a decrease in venous return.

**173. D**

In order to cleave *scotophobin* into three fragments, the protein must be cleaved at two sites. Clostripain will cleave *scotophobin* at both Arg residues, while pepsin will cleave *scotophobin* at the Asp residue and at the Tyr residue. Note that the enzymes cleave at the carboxy end of the residue. Thus, according to the direction in which the sequence of the protein is written in the text (carboxy to amino end), the enzymes will cleave before, i.e., to the left of, the specified amino acid residue.

Choice A and B are incorrect because trypsin will cleave the peptide at two Arg location and one Lys location, creating 4 fragments.

Choice C is incorrect because chymotrypsin will cleave the peptide at a single point (Tyr), creating 2 fragments.

**174. C**

Hypothesis 2 states that *scotophobin*, which is similar to ACTH and ADH, increases sympathetic activity. Thus, any observation of ACTH or ADH-like effects, or of increased sympathetic activity (fight-or-flight) would support Hypothesis 2. Only Choice C, increased heart rate, is a result of increased sympathetic activity.

Choice A is incorrect because ADH-like activity would tend to decrease urine volume by increasing water reabsorption in the collecting duct of the nephron.

Choice B is incorrect because, although sympathetic activity will lead to pupil dilation, if this causes the rats to *prefer* darkness then it does not support Hypothesis 2 which tries to explain why an increase in sympathetic activity would cause the rats to avoid darkness.

Choice D is incorrect because sympathetic activity will tend to decrease blood flow to the digestive tract. Dilating arterioles would increase blood flow. Also, vasopressin acts to constrict blood vessels and increase blood pressure.

**175. C**

A codon, which codes for a single amino acid in the final protein, consists of three nucleotides. At least one nucleotide must be changed to code for a different amino acid. Note that changing three nucleotides can also lead to a change in a single amino acid, but only if these nucleotides are in the same codon.

Choice A is incorrect because the gene consists of DNA, not amino acids.

Choice B is incorrect because a change in three codons will lead to a change in three amino acids, not one.

Choice D is incorrect because a change in a single nucleotide can cause a codon to code for a different amino acid.

**176. D**

If the amino acid sequence encoding for Protein X is thirty nucleotides long, then Protein X consists of 10 amino acids. Protein X is thus smaller than *scotophobin*. The technique of electrophoresis uses an electrical field to separate proteins based on size. Larger proteins subjected to the same electric field will move more slowly than smaller proteins. Band C on Figure 1 which is common to the extract and to the purified protein represents *scotophobin*. Bands A and B which are closer to the top of the gel would represent proteins larger than *scotophobin*. Band D, which is below band C, represents a protein that has migrated further and is thus smaller than *scotophobin*. Of the choices, only band D could potentially represent Protein X.

Choices A and B are incorrect because bands A and B, which have migrated less than band C, represent proteins that are larger than *scotophobin*.

Choice C is incorrect because band C is common to both the extract and the purified protein, and must therefore represent *scotophobin* itself.

**177. A**

The electrophoresis of Ungar's extract shows that multiple compounds were present. This weakens the argument that *scotophobin* alone is responsible for the apparent transfer of learning.

Choice B is incorrect because the extract does have a band at a similar displacement as that of the synthetic *scotophobin* indicating that *scotophobin* is present.

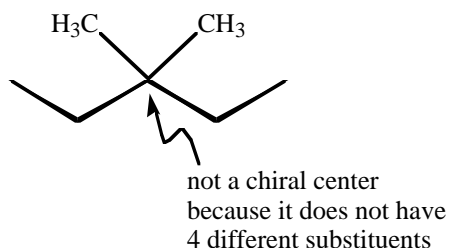
Choice C is incorrect because the passage never discusses the concentration requirements for *scotophobin* to elicit a response. Electrophoresis is useful for identifying the proteins in a mixture, but it is not as useful for calculating concentrations. This information cannot be concluded from the data.

Choice D is incorrect because the electrophoretic data does not provide information about the structure of the other proteins in the extract.

**178. B**

A quaternary carbon is bonded to four alkyl groups. Any carbon that forms four bonds adopts the tetrahedral configuration and must be  $sp^3$  hybridized.  $sp^3$  hybridization occurs when one  $s$  orbital and three  $p$  orbitals mix to form four equivalent hybrid orbitals capable of forming four bonds.

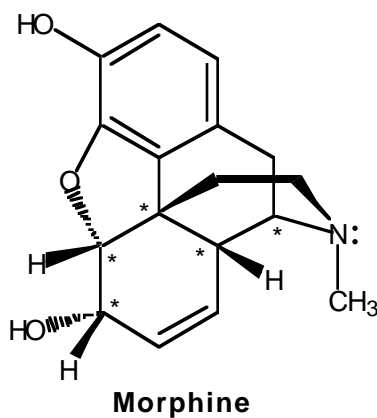
Choices A and C are incorrect because a quaternary carbon (bonded to 4 alkyl groups) need not be a chiral center if two of these alkyl groups are identical. This is shown below:



Choice D is incorrect because an  $sp^2$  hybridized carbon adopts a planar configuration and can only bind to three substituents (not the four required of a quaternary carbon).

**179. B**

Any carbon bonded to four different substituents will be chiral. Morphine has five such carbons as shown below:



Note that the nitrogen atom is also a chiral center. If nitrogen's lone pair of electrons is considered a fourth substituent bonded to nitrogen, it can be seen that nitrogen can also act as a chiral center. Some amines can invert configuration (and thus are not chiral). The tertiary amine of morphine cannot invert – it is locked into its configuration by the ring structure. However, the question asks for the number of chiral carbons, not the number of chiral centers.

**180. D**

The passage states that there are certain requirements, the “morphine rules,” that give a compound morphine-like biological activity. These requirements are an aromatic ring attached to a quaternary carbon and a tertiary amine situated two carbons away from that quaternary carbon. A quaternary carbon is a carbon bonded to four alkyl groups. A tertiary amine is bonded to three alkyl groups. The only structure that meets these requirements is structure D. The other answer choices look like the structures

in the passage but do not meet all of the "morphine rules". Note that if the written description of the "morphine rules" is not clear enough, you can look at the figures in the passage as well.

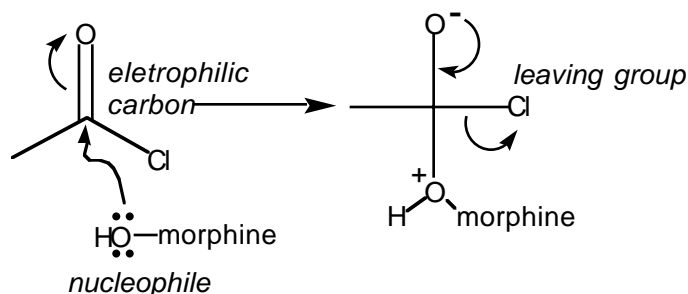
Choice A is incorrect because the aromatic ring is not attached to a quaternary carbon. It is attached to two secondary carbons.

Choice B is incorrect because it lacks a tertiary amine. It has a secondary amine bonded to only 2 alkyl groups.

Choice C is incorrect because the tertiary amine is not located two carbons away from the quaternary carbon. It is only one carbon away from the quaternary carbon.

### 181. A

This reaction proceeds through nucleophilic attack by the hydroxy oxygen (of morphine) on the electrophilic carbonyl carbon of ethanoyl chloride. A nucleophile is an electron rich (Lewis Base) species that can attack an electrophile (electron poor species).



Thus, the hydroxy groups on morphine act as nucleophiles.

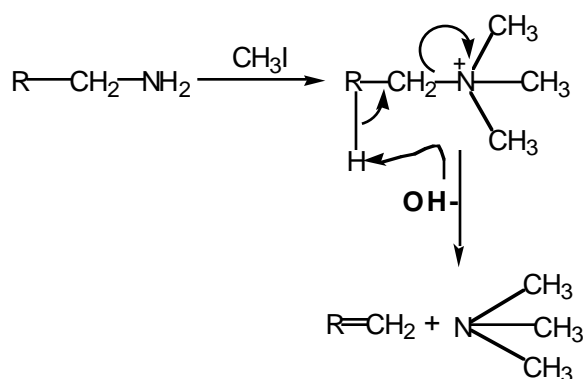
Choice B is incorrect because the carbonyl carbon is the electrophile in this reaction. The carbonyl group is polarized. Electrons are drawn towards the electronegative oxygen leaving the carbon with a slightly positive charge. Thus, the carbon is electron deficient and "wants" electrons. It is an electrophile.

Choice C is incorrect because chloride acts as the leaving group in this reaction.

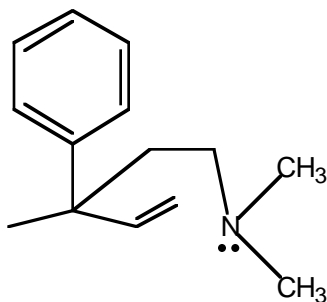
Choice D is incorrect because Lewis acids are electron pair acceptors. The hydroxy group acts as an electron pair donor, a Lewis base.

### 182. B

Hofmann elimination proceeds through exhaustive methylation of the amine to the quaternary ammonium compound followed by elimination.



Choice B shows a structure that has the double bond and the tertiary amine produced by Hofmann elimination. Note that the alkene bond could have formed on the other side of the nitrogen by an equally likely elimination giving the product shown below:



Choice A is incorrect because the structure indicated is the intermediate of the Hofmann elimination. Choice A shows the structure following methylation but prior to elimination.

Choice C is incorrect because the amine is not fully methylated (to the tertiary amine). Note the similarity between choice C and the valid elimination product shown above.

Choice D is incorrect because it does not show the cleavage of the N-C bond that occurs in a Hofmann elimination (as described in the question stem).

### 183. B

Enantiomers like (-)-Methadone and (+)-Methadone do not differ in their physical or chemical properties. They can only have different physiological effects by interacting with a stereospecific receptor – a receptor that is itself chiral.

Choice A is incorrect because (+)-Methadone would follow all of the morphine rules because it has the same connectivity of atoms as (-)-Methadone.

Choice C is incorrect because analgesic effects are physiological and would not depend on the rotation of light. The rotation of plane polarized light is used as a test for chirality. The light would rotate an equal degree measure, but in the opposite direction.

Choice D is incorrect because the passage states that methadone is a synthetic alkaloid. Even if it was naturally occurring, Choice D might be true but would still not explain the difference in physiological activity.

### 184. D

Proton NMR is used to identify the number and environments of  $^1\text{H}$  nuclei. Only nuclei with an odd number of protons+neutrons can be used for NMR. Deuterium,  $^2\text{H}$ , does not appear on the NMR and as the alpha hydrogens are replaced with deuterium, the signals will disappear.

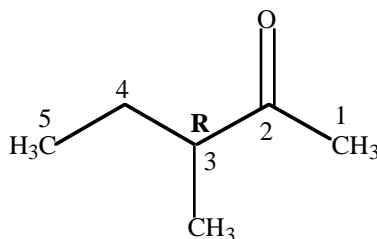
Choice A is incorrect because a peak at 9.8 ppm, which, by the way, is rarely a singlet, indicates an aldehyde proton. No aldehydes are present here.

Choice B is incorrect because a quadruplet in the alkane range (1.0-2.0) indicates hydrogens with 3 neighboring hydrogens, leading to splitting.

Choice C is incorrect because a peak between 3.0-4.0 may indicate an alcohol. A doublet indicates splitting by a single neighboring hydrogen.

185. A

The structure can be drawn as shown below:



(R)-3-methyl-2-pentanone

The longest chain has 5 carbons and this compound will be named with the **pent-** prefix. This is enough to select **Choice A**. Numbering proceeds to give the lowest numbered ketone (the highest priority group in this compound).

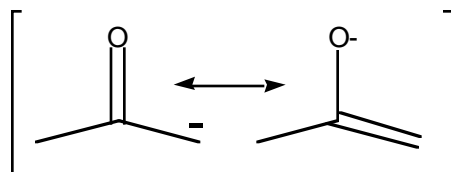
Choice B is incorrect because it does not number the longest chain correctly, naming the molecule as an ethyl substituted butanone.

Choice C is incorrect because it too does not number the longest chain correctly.

Choice D describes an impossible molecule.

186. B

Alpha hydrogens are relatively acidic because of resonance stabilization as shown below. The acidity of the alpha hydrogens will be increased by proximity to electron withdrawing groups.



The chloride groups in choice B are electron withdrawing and will help stabilize the negative charge.

Choice A is incorrect because dimethylketone has no additional electron withdrawing groups.

Choice C is incorrect because an amine is an electron donating group and would tend to decrease the acidity of the alpha hydrogen.

Choice D is incorrect because there is no alpha hydrogen to be removed.

187. A

The passage states that a racemic mixture is produced, indicating the presence of enantiomers in equal concentrations. Figure 3 shows the structure of the two compounds. The compounds differ in configuration at their only chiral center, indicating that they are enantiomers.

Choice B is incorrect because diastereomers are not mirror images. Diastereomers may have optical rotations of different magnitudes. Thus, a solution with equal concentrations of two diastereomers may still rotate plane polarized light. In contrast, a racemic mixture does not rotate plane polarized light.

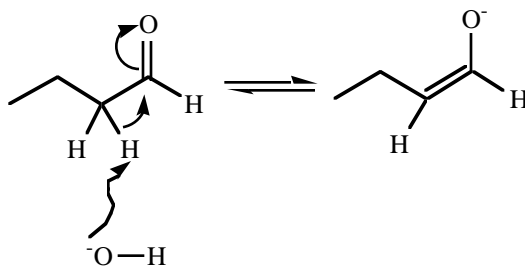
Choice C is incorrect because the compounds are not conjugate acids and bases.

Choice D is incorrect because meso compounds are compounds that have chiral centers but lack optical activity due to an internal plane of symmetry.

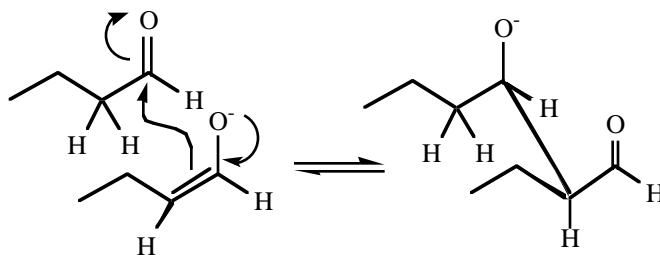
188. C

The reaction proceeds through the following steps:

Enolate formation



Nucleophilic attack



Choices A, B, and D are incorrect because they would not lead to the indicated aldol condensation product.

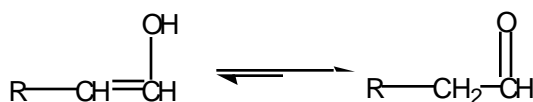
189. C

All of the reactions will lead to formation of an aldehyde except oxidation of a secondary alcohol which will lead to formation of a ketone.

Choice A is incorrect because reduction of an acyl halide (alkanoyl halide) with the poisoned, Lindlar reagent-like, catalyst will lead to formation of an aldehyde.

Choice B is incorrect because PCC (Pyridinium chlorochromate), will convert a primary alcohol into an aldehyde (without further oxidation to the carboxylic acid).

Choice D is incorrect because reaction of an alkyne with dicyclohexylborane and hydrogen peroxide give anti-Markovnikov addition of water to the terminal carbon. This will tautomerize to the aldehyde as shown below.



190. C

The enolate anion is stabilized by resonance which delocalizes the negative charge to the electronegative oxygen.

Choice A is incorrect because it shows delocalization of a positive charge. The enolate ion is a negative ion (anion) created by loss of an alpha proton as described in the passage.

Choice B is incorrect because, although this enolate anion may form through abstraction of an alpha proton from the methyl group, it will not lead to racemization of the chiral center. Note that the structure



in Choice B maintains a chiral center which has not been turned into an achiral, planar configuration which would lead to racemization.

Choice D is incorrect because this resonance structure would not occur.

**191. B**

If the dialyzing fluid is isoosmotic, it has the same concentration of particles and thus, the same osmotic pressure exists on either side of the membrane. There will be no net flow of water by osmosis between the blood and the dialyzing fluid.

Choice A is incorrect because a hypoosmotic dialyzing fluid would lead to flow of water into the circulation from the dialyzing fluid.

Choice C is incorrect because a solution with a higher concentration of solutes is hyperosmotic. A hyperosmotic dialyzing fluid would lead to flow of water out of the circulation from the dialyzing fluid.

Choice D is incorrect because hydrophilicity has nothing to do with the net flow of water. A hydrophilic protein is "water-loving" because it contains polar amino acids.

**192. A**

Reading from Table 1, it is clear that the urea concentration in a patient with renal failure is much higher than that in a normal individual. Filtration of urea decreases, leading to decreased excretion and a higher urea concentration in the plasma.

Choice B is incorrect because a decrease of absorption from the nephron tubule would tend to increase excretion and decrease the plasma urea concentration.

Choice C is incorrect because increased urea filtration would lead to increased excretion.

Choice D is incorrect because increased secretion of urea into the nephron tubule would increase excretion.

**193. A**

The glomerulus functions like a sieve, allowing the filtration (movement from the circulation into the nephron tubule) of small molecules while blocking the filtration of the plasma proteins. The semi-permeable membrane serves an analogous function in the dialysis machine.

Choice B is incorrect because the ureter is merely a tube connecting the kidney to the bladder.

Choice C is incorrect because the descending loop of Henle endothelium does not serve a filtration function. The primary action of the descending loop is reabsorption of water.

Choice D is incorrect because the vasa recta are the capillaries that supply nutrients to the nephron.

**194. A**

Salt is removed from the blood by filtration at the glomerulus. Recall that the fluid in Bowman's capsule is isotonic to plasma. Without reabsorption or secretion, isotonic urine can still be produced.

Choice B is incorrect because production of hypertonic urine requires the concentration gradient between the medulla and cortex of the kidney. This gradient is generated by active secretion and reabsorption.

Choice C is incorrect because production of hypotonic urine requires active reabsorption and secretion.

Choice D is incorrect because amino acids are filtered and then actively reabsorbed in the proximal convoluted tubule.

**195. D**

By comparing the concentration of a material in the dialyzing fluid with the concentration in plasma, we can determine the net flow by passive diffusion through the semi-permeable membrane. Of all of the choices, only glucose has a higher concentration in the dialyzing fluid than in the plasma (with or without renal failure). Thus, glucose will not be removed from the plasma by dialysis.

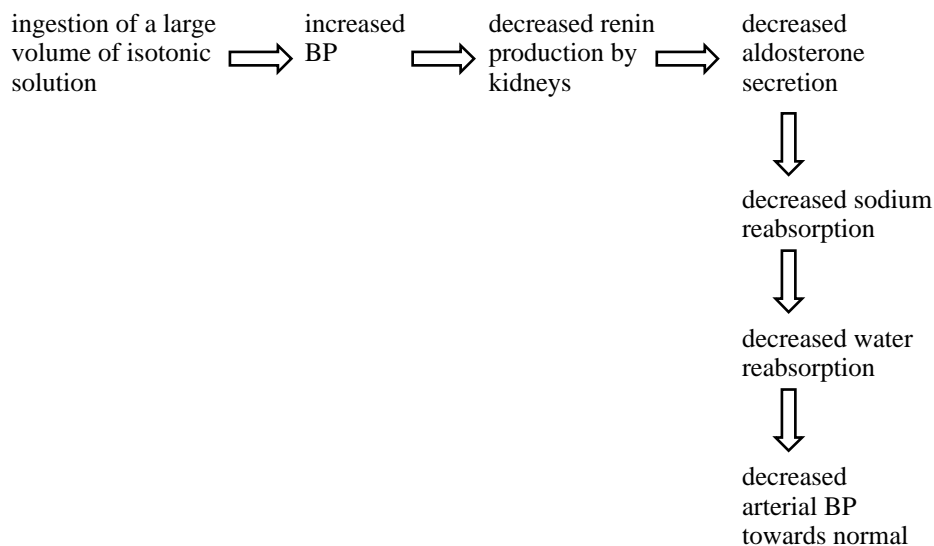
Choice A is incorrect because the concentration of  $\text{Na}^+$  in the dialyzing fluid is 133 mEq/L which is less than the concentration in plasma (142 mEq/L). Sodium will be removed.

Choice B is incorrect because the concentration of  $\text{K}^+$  (1.0 mEq/L) is much lower than the concentration in the plasma.

Choice C is incorrect because there is no urea in the dialyzing fluid. One of the primary functions of dialysis is the removal of urea from the circulation.

**196. B**

The question stem states that kidneys secrete renin in response to decreased arterial pressure. Ingesting a large quantity of isotonic solution would tend to increase the arterial pressure. This would lead to a decrease in renin production and a consequent decrease in aldosterone secretion. Decreased aldosterone secretion would decrease sodium reabsorption which is accompanied by reabsorption of water. Decreasing reabsorption of water tends to increase water excretion and reduce blood pressure. This is shown in the flow chart below:



Choice A is incorrect because sodium reabsorption would decrease.

Choice C is incorrect because renin production would decrease.

Choice D is incorrect because renin production would decrease.

**197. D**

This question is really only asking "Which of the following is most activated?" The compound in choice D has two activating groups,  $\text{OCH}_3$ , and is thus the most reactive towards electrophilic aromatic substitution.

Choice A is incorrect because both F and CN are electron withdrawing, deactivating substituents.

Choice B is wrong since each of the aromatic rings has two deactivating groups, Cl and CO, and only one activating group, the ether linkage.

Choice C is incorrect since Cl is deactivating.

**198. B**

This question is primarily testing your knowledge of nomenclature. Reacting an alkanoyl halide with an alcohol will lead to formation of an ester, as shown. Note that we have added 3 carbons to our molecule, and so the unknown reactant must have three carbons. Propanol is the only three carbon choice, and the only alcohol.

**199. A**

The parasympathetic nervous system is involved in "rest-and-digest" functions which include lowering the heart rate and promoting digestion. The question stem states that a vagotomy will reduce parasympathetic stimulation. This would tend to increase heart rate and reduce gastrointestinal activity. The question asks for the LEAST likely effect of a vagotomy. A vagotomy would not decrease heart rate.

Choices B and C are incorrect because decreased parasympathetic activity would decrease gastric motility and HCl production.

Choice D is incorrect because decreased parasympathetic activity would increase heart rate, and thus increase blood pressure.

**200. A**

An action potential begins with the opening of voltage gated sodium channels that allow sodium to flow into the axon, depolarizing the cell. This is followed by opening of potassium channels that allow potassium to flow out of the cell, repolarizing it. Blocking the sodium channels would block depolarization.

Choice B is incorrect because repolarization is achieved primarily by opening potassium channels.

Choice C is incorrect because hyperpolarization is also due primarily to the flux of potassium ions out of the axon.

Choice D is incorrect because saltatory conduction refers to conduction between nodes of Ranvier in myelinated fibers.

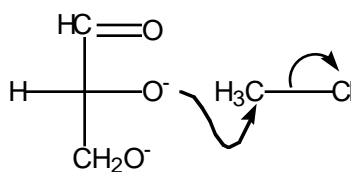
**201. C**

The question stem states that female athletes may not menstruate and discusses a decrease in LH and FSH secretion. It can be inferred that ovulation does not occur. The corpus luteum is formed, following ovulation, by the cells of the follicle. Without ovulation, there will be no formation of the corpus luteum.

Choices A, B, and C are incorrect because lack of any of these structures could not be caused by exercise. The anterior pituitary and hypothalamus are structures in the brain which serve endocrine roles. The ovary is the female gonad, located in the abdomen, which is responsible for egg production and release.

**202. B**

The passage states that an  $S_N2$  reaction occurs. This requires a good nucleophile. Alkoxides ( $RO^-$ ) are strong bases and thus good nucleophiles. Sodium hydroxide (NaOH) is used in this reaction to remove the hydrogen from the hydroxyl group to form the alkoxide. The  $S_N2$  reaction is shown below.



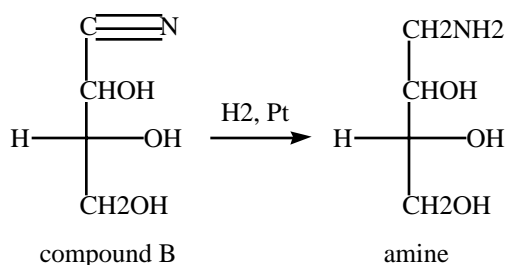
Choice A is incorrect because a hydroxyl group would be converted to water, a good leaving group, under acidic conditions. The reaction in Figure 2 occurs under basic conditions.

Choice C is incorrect because carbocation intermediates occur in  $S_N1$  and  $E1$  reactions, but not in  $S_N2$ .

Choice D is incorrect because tetrahedral intermediates are formed during addition reactions to a carbon/oxygen double bond. The reaction in Figure 2 does not involve attack on the carbonyl group.

### 203. A

The cyanohydrin (compound B) is reduced to an **imine** (compound C). If platinum were used, reduction would proceed all the way to the amine as shown below. This must be avoided in order to produce the carbonyl group on the extended sugar.



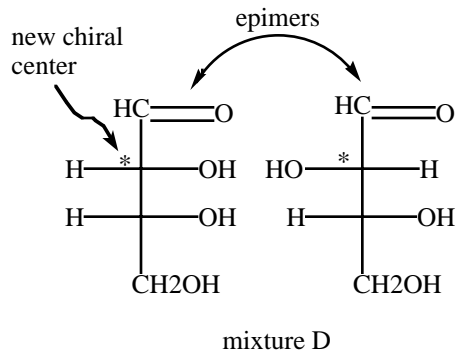
Choice B is incorrect because a catalyst will not alter the thermodynamic favorability of a reaction. A catalyst will only increase the rate of reaction by lowering the activation energy.

Choice C is incorrect because a Lewis acid is an electron pair acceptor. The palladium catalyst acts as an activator of hydrogen. Platinum would function in the same way.

Choice D is incorrect because compound B does not even have a carbonyl group (carbon double bonded to oxygen).

### 204. C

Epimers are sugars that differ in the configuration about a single stereocenter. A new chiral center is formed in the first step of the sugar extension (cyanohydrin formation). This will lead to the formation of two different sugars in Mixture D.



Choice A because enantiomers are mirror images that differ in configuration at every stereocenter. As shown above, these epimers differ at a single stereocenter.

Choice B is incorrect because anomers are sugars that differ in their configuration about the new stereocenter formed when they adopt a ring configuration. The sugars shown above would generally not form rings because of the ring strain of 4-membered rings.

Choice D is incorrect because disaccharides are formed from the condensation of two monosaccharides (like the ones in mixture D).

**205. D**

This reaction is called the **Wolff-Kishner Reduction** and reduces a carbonyl group to the corresponding alkane. The first step, reaction with hydrazine, leads to the formation of a hydrazone. The second step occurs in basic solution and leads to the evolution of nitrogen gas and the formation of the corresponding hydrocarbon.

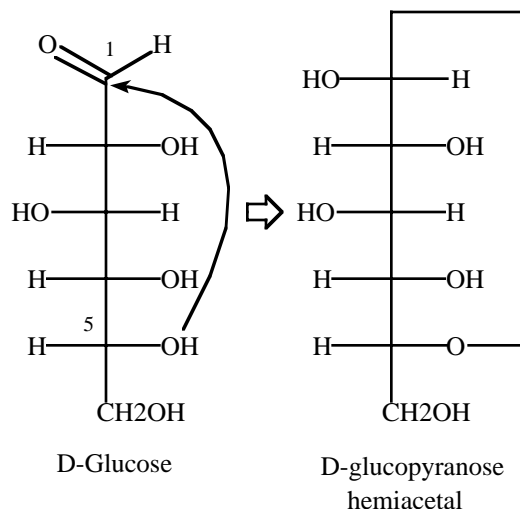
Choice A is incorrect because the indicated structures do not form.

Choice B is incorrect because ethers do not form alkoxides under basic conditions. Ethers are relatively unreactive.

Choice C is incorrect because hydrazine reacts with a carbonyl to form hydrazone. This is a condensation reaction, not an addition reaction, and the addition product shown would not form.

**206. B**

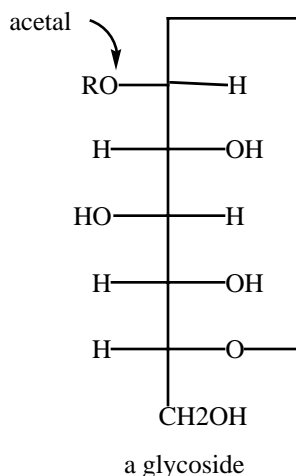
A hemiacetal is formed through reaction of a carbonyl group and a hydroxyl group. In this question, these two groups occur on the same molecule of glucose.



Choice A is incorrect because glucofuranose is the five-membered ring that is formed through attack by the hydroxyl oxygen of carbon-4, not carbon-5 as the question stem states. Furanose refers to a five-membered ring while pyranose refers to the more energetically favorable six-membered ring.

Choice C is incorrect because a lactone is a cyclic ester. No ester linkage is formed in this case.

Choice D is incorrect because a glycoside is a sugar acetal. These acetals are formed during polysaccharide formation. They can also be formed by exposing a sugar like D-glucose to another alcohol in an acidic environment.



**207. B**

The passage states that aromatase converts testosterone to estradiol. Estradiol that has been derived from testosterone leads to defeminization (loss of cyclicity and female sex behavior) and masculinization (induction of male sex behavior) of the rodent brain. If aromatase is defective, no estradiol will be produced even when large doses of testosterone are present. Thus, the brain will develop along female lines. Results of this situation are similar to those of experiment 1 in which the rodent is castrated and therefore has no source of testosterone.

Choices A, C, and D are all incorrect because these effects are caused by estradiol in the brain. Without aromatase, there will be no estradiol in the male rodent brain.

**208. B**

The passage states that the conversion of testosterone to estradiol is catalyzed by aromatase. In this reaction, an aromatic ring is formed. Thus, it is an aromatization reaction.

Choice A is incorrect because a reduction involves addition of hydrogens to a molecule. In this case, hydrogens are removed. A pair of hydrogens is removed from the ring and the resulting cyclic dienone tautomerizes to its enol form.

Choice C is incorrect because electrophilic aromatic substitution is substitution on an aromatic ring. This reaction did not begin with an aromatic ring.

Choice D is incorrect because (Friedel-Crafts) alkylation requires an aromatic ring (it is an electrophilic substitution reaction).

**209. A**

The passage indicates that estradiol is an estrogen. Choice A states that tamoxifen is an anti-estrogen. Therefore, injecting tamoxifen blocks all estradiol activity. So, as predicted by the given experiments, masculinization would not occur in female neonates injected with tamoxifen and male sex behavior would not be induced. The lack of female sex behavior and cyclicity, and lack of male sex behaviour, indicates that induction of female sex behavior and cyclicity also requires estradiol.

Choice B is incorrect because aromatase is only responsible for converting testosterone to estradiol. So, lacking aromatase would have no effect on estradiol present in females that is not testosterone-derived. And, most of the estradiol in females is not derived from testosterone. This experiment, then, provides no information about the role of estradiol in inducing female sex behaviour.

Choice C is incorrect because large doses of estradiol lead to defeminization and masculinization as expected. This does not support the hypothesis.

Choice D is incorrect because males convert testosterone to estradiol in the brain, leading to normal male development. This does not support the hypothesis. Note that while the incorrect choices did not oppose the hypothesis, they did not support the hypothesis either.

**210. C**

The experiments were designed to demonstrate the effects of testosterone on sexual differentiation. The ovaries were transplanted to allow the rodent to demonstrate whether or not it had the ability to cycle normally. Thus, it is important that transplantation of the ovaries did not influence the development of the rodent. To make sure that the transplantation of ovaries had no effect on the sexual differentiation of the rodent brains, the ovaries had to have been transplanted once the sexual differentiation of the rat brain had already occurred. According to the passage, this differentiation occurs during the critical period which begins a few days after birth. The researchers castrated the neonate and waited for the rodent to mature past the critical period before implanting the ovaries.

Choice A is incorrect because it would not take 3 months for the rat to recover from surgery. Also, the rat is castrated at birth indicating that surgery is not an obstacle. Implanting the ovaries would require another surgery.

Choice B is incorrect because testosterone levels would not rise in the castrated rat (no testes).

Choice D is incorrect because defeminization would be promoted by estradiol (or testosterone converted by aromatase).

**211. C**

The rat has been masculinized and so exhibits male sex behavior. However, the rat has not been fully defeminized in that it exhibits some female sex behavior.

Choice A is incorrect because the passage does not discuss hermaphrodites. It focuses on the sexual differentiation of the brain, not the sex organs.

Choice B is incorrect because the passage does not discuss demasculinization.

Choice D is incorrect. The passage defines masculinization as the development of male sex behavior, which the rat exhibits by mounting females. Thus, the rat has been masculinized. The passage's definition of defeminization includes the loss of female sex behavior. Since the rat still demonstrates some aspects of female sex behavior, (i.e., allowing itself to be mounted by males), it has not been fully defeminized.

**212. A**

Steroid hormones diffuse into the nucleus and bind to receptors. The steroid/receptor complex binds to DNA and regulates mRNA transcription. In contrast, peptide hormones bind to receptors on the surface of the cell and exert their effects through secondary messenger systems.

Choice B is incorrect because protein translation by ribosomes is not regulated by steroid hormones.

Choice C is incorrect because cAMP production is generally associated with protein hormones binding to cell membrane receptors. It is part of a single transduction mechanism, acting as a second messenger.

Choice D is incorrect because DNA replication is not regulated by steroid hormones.

**213. B**

Estradiol has a positive feedback effect on the pituitary, causing it to secrete LH and FSH. Estradiol also has a positive feedback effect on the hypothalamus, causing it to secrete GnRH. Estradiol injection will lead to an LH surge in rodents capable of cycling.

Choice A is incorrect because LH secretion increases.

Choice C is incorrect because GnRH secretion increases.

Choice D is incorrect because progesterone is not secreted by the follicle. It is secreted by the corpus luteum or placenta.

**214. C**

Upon penetration of the egg, the sperm mitochondria fall apart and are not replicated when divisions begin. This question can best be answered by eliminating the wrong answer choices.

Choice A is incorrect because sperm have large numbers of mitochondria used to drive locomotion.

Choice B is incorrect because mitochondria are replicated prior to cell division. Also, this choice would not explain the presence of the maternal genome which should also be diffused by division.

Choice D is incorrect because many of the genes coding for mitochondrial proteins are located in the mitochondrial DNA.

**215. C**

As the host cell engulfs a prokaryotic aerobic cell, the host cell membrane forms a vesicle about the aerobic cell, giving a double membrane structure. The inner membrane is formed by the plasma membrane of the aerobic cell.

Choice A is incorrect because enzymes in the cytoplasm of the anaerobic host cell would remain in the cytoplasm.



Choice B is incorrect because enzymes on the plasma membrane of the anaerobic host cell would be found on the outer membrane of the mitochondria formed by endosymbiosis.

Choice D is incorrect because enzymes in the cytoplasm of the aerobic cell would be within the matrix of the mitochondria formed by endosymbiosis.

**216. C**

The affinity of hemoglobin for oxygen will not decrease. The adaptation of hemoglobin's affinity for oxygen would take longer than one day. Besides, even if given time to adjust, in order to maintain delivery of oxygen to tissues at high altitudes (low  $pO_2$ ), the affinity of hemoglobin for oxygen would increase so as to maximize the amount of oxygen transported by the hemoglobin in the blood.

Choices A, B, and D are incorrect because these are all acclimatizations that occur immediately. The body will make rapid adjustments to the low  $pO_2$  of high altitude in order to maintain delivery of oxygen to the tissues. Tidal volume and respiration rate will increase, in order to increase the minute volume (amount of air inhaled and exhaled in a minute). Inhaling more air than normal will compensate for the fact that the inhaled air has less oxygen than normal. In addition, the body will secrete erythropoietin to increase the number of erythrocytes in the blood and thus increase the oxygen carrying capacity of the blood.

**217. D**

At its isoelectric point, an amino acid exists as a zwitterion with positive and negative charges that cancel each other out. Because it has no net charge, it will not migrate in an electric field.

**218. A**

The stability of free radicals decreases from tertiary>secondary>primary>methyl. Choice A is the only choice that can form a tertiary radical.

Choices B, C, and D will form secondary radicals.

**219. B**

The hydropathy plot indicates two regions of hydrophobicity. Because the cell membrane has a hydrophobic internal structure, hydrophobic regions of proteins can reside within the membrane.