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Topic Break Down

Topic	No. of Questions
Topic 1, Verbal Reasoning	194
Topic 2, Biological Sciences	249
Topic 3, Physical Sciences	340
Topic 4, Psychology and Sociology	28
Total	811

QUESTION NO: 1

Which type of DNA mutation involves the insertion of extra base pairs into the sequence?

A. inversion

B. substitution

C. addition

D. deletion

ANSWER: C

Explanation:

Addition involves the insertion of extra base pairs into the DNA sequence.

QUESTION NO: 2

Musical instruments generate vibrations in the air that are perceived as musical tones. In many kinds of drums, these vibrations are created by a standing waves in a vibrating membrane. In a timpani drum, membrane vibration is coupled to the vibration of an enclosed volume of air. There may also be a second membrane whose vibration is coupled to that of the first by the enclosed air space, as in a snare drum. An idealized circular membrane will vibrate at normal mode frequencies given by Equation 1 where T is the membrane tension, r is the membrane radius, σ is the mass per unit area of the membrane, and frel is the relative frequency shown under each mode in Figure 1. The pitch of drums can be tuned by adjusting the membrane tension.

$$f_{mn} = \frac{2.40 \times f_{rel}}{2\pi r}\sqrt{\frac{T}{\sigma}}$$

Equation 1

The modes are designated by two numbers, m and n. m indicates the number of diameter nodes, and n indicates the number of circular nodes. Several modes of vibration are shown in Figure 1.

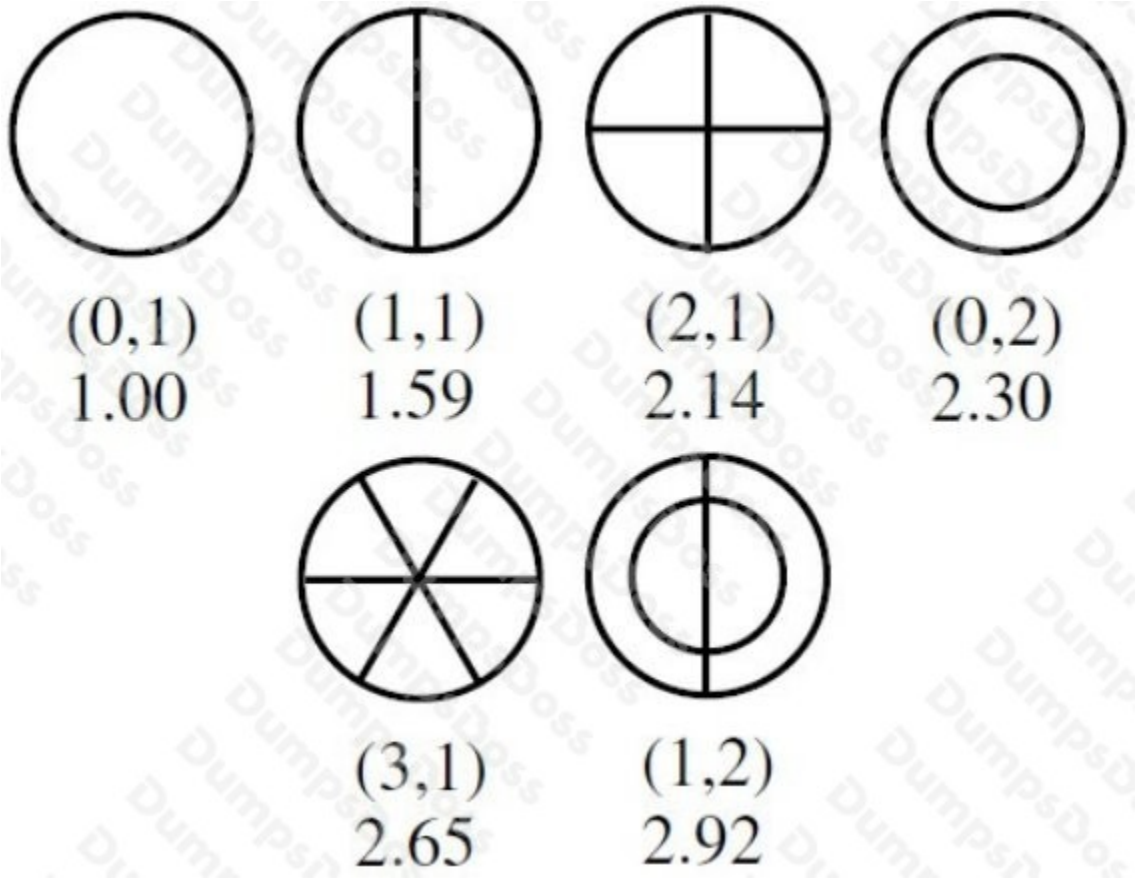

Figure 1

Chladni patterns are formed when fine sand is placed on a vibrating membrane. The regions of localized sand indicate the:

A. circular nodes only.

B. antinodes.

C. circular nodes and diameter nodes.

D. region equidistant between nodes and antinodes.

ANSWER: C

Explanation:

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.

QUESTION NO: 3

The anthropomorphic bias of those who would relegate marsupials to an inferior evolutionary status is most apparent in their recourse to data on brain structure and behavior. Unlike humans and other placentals, marsupials lack the corpus callosum, which facilitates inter-hemisphere transfer of data acquired through the senses. Yet it cannot be inferred that marsupials are thus deprived of such function. Didelphis Virginiana, one of the opossums, makes use of the anterior commissure, an adaptation that is also found in reptiles and monotremes. Diprodontons, including kangaroos and koalas, supplement the anterior commissure with the fasciculus aberrans. While the modes of neocortical interconnection may be diverse, the work of Johnson, Heath and Jones points to the conclusion that, functionally speaking the cortices and neocortices of both groups of mammals exhibit parallel connections. Parker also notes “a similar range of brain size to body weight ratios and of neocortical expansion”.

Another stigma borne by marsupials is the consensus that they are less intelligent than placentals. Yet Williams argues that, all else being equal, natural selection will favor instinctive over learned behavior as being more biologically efficient and that it is the accidental death of the young that is the prime selective pressure for the evolution of intelligence. Seen in this light, marsupials have a competitive edge; their gestation period is brief and the young remain in the pouch for an extended period exposed only to those dangers which also affect the mother. There they are directly exposed to the mother’s food supply and can observe her behavior at leisure. Placentals, on the other hand, not only have a longer gestation period but, once their young are born, must often leave while foraging. Such absences increase the risk of mortality and decrease the opportunity to learn. Thus, among placentals, selection would favor the apparent intelligence in the young and protective behavior in the mother.

Marsupials are not known to exhibit maternal protective behavior. In fact, Serventy has reported that frightened female kangaroos will drop their pouch-young as they flee, drawing a predator’s attention to the less able offspring while the adult escapes. This behavior, whether purposeful or accidental, instantaneously relieves the female marsupial of the mechanical difficulties of pregnancy with which her placental counterpart would be burdened, while marsupials can replace any lost young quickly. Thus, in the absence of any need for close maternal supervision, sacrificing their offspring in this manner may well have been favored in selection. Pointing to the absence of the “virtue” of maternal protectiveness in marsupials is an instance of how mistaken are those theorists who see similarities with humans as marks of evolutionary sophistication.

The author’s primary purpose in this passage is to:

A. correct some common misconceptions about marsupials.

B. argue against the view that marsupials represent a less developed evolutionary stage than placentals.

C. provide support for the proposition that marsupials have adapted more successfully to the environment.

D. determine the place of marsupials in the evolutionary hierarchy.

This point is left open; by the end of the passage we’re still not sure where marsupials fit into the evolutionary tree.

ANSWER: B

Explanation:

This is a main idea question. In this case, 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.

QUESTION NO: 4

An automobile reaches a velocity of 30 m/s after accelerating at 4 ms−2 for 5 seconds. What was its initial velocity?

A. −10 m/s

B. 0 m/s

C. 10 m/s

D. 20 m/s

ANSWER: C

Explanation:

vf = vi + at

30 = vi + (4 × 5) 30 = vi + 20 vi = 10 m/s

QUESTION NO: 5

Early experimentation on the single-celled organism Acetabularia led to important discoveries about the role of the nucleus in regulating cell function. Acetabularia is an enormous single cell with three distinct regions: a cap, a root-like rhizoid, and a stalk which connects the two. The following experiments were conducted to study the development of the cell:

Experiment 1

The stalk of an Acetabularia was cut, fragmenting the cell. The fragment which included the cap died shortly afterwards while the fragment containing the rhizoid regenerated to form a complete Acetabularia.

Experiment 2

The nucleus from Acetabularia mediterranea, which has a flat cap, was transplanted into Acetabularia crenulata, which has a tufted cap, following removal of the Acetabularia crenulata nucleus. The Acetabularia crenulata cap eventually assumed the flat shape.

Experiment 3

The nucleus of Acetabularia mediterranea was removed from the young cell before it first formed a cap. A normal cap formed several weeks later. The cell proved to be inviable and died shortly thereafter.

Experiment 4

A young Acetabularia was fractioned into a number of portions before it first formed a cap. Several weeks later, both the portion containing the nucleus and the portion containing the apical tip of the stalk formed caps. The other portions did not form caps.

Which of the following conclusions can be logically drawn from the fact that the Acetabularia segment containing the rhizoid regenerated a complete and viable Acetabularia in Experiment 1?

A. The cell nucleus is located in the rhizoid.

B. Acetabularia reproduces by budding.

C. The Acetabularia cap is a vestigial structure.

D. Cap-coding mRNA is stored in the rhizoid.

ANSWER: A

Explanation:

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.

QUESTION NO: 6

The value of the water dissociation constant Kw varies with temperature. Its value is normally given as 1.00 × 10−14 mol2 dm−6 at room temperature but 1.00 × 10−13 mol2 dm-6 at 60°

C. What is the pH of pure water at 60 ° C?

A. Equal to 7.0 thus the water is neutral.

B. Less than 7.0 thus the water is acidic.

C. What is the pH of pure water at 60 ° C?
Less than 7.0 but the water is basic.

D. Less than 7.0 but the water is neutral.

ANSWER: D

Explanation:

It is not necessary to calculate anything to solve this problem but we will go through the steps.

The dissociation of water (note carefully that the ratio of the products is 1:1; also keep in mind that this is the basis of the neutrality of pure water: acid units = base units): H2O + H2O ↔ H3O+ + OH-

The expression for the self-ionization of water or the water dissociation constant:

Kw = [H3O+][OH−] = [H+][OH−]

At room temperature, keeping in mind that the dissociation of the ions is 1:1, we get: 10−14 = [H+][OH−] = [H+]2. And so [H+] = 10−7 and then −log[H+] = 7 = pH.

Doing the identical math but using Kw = 10−13 yields a pH of 6.5. BUT because the ratio of the ions is still 1:1 (if not, you would not have done the calculation) thus it must be neutral.

QUESTION NO: 7

A researcher in a molecular biology lab planned to carry out an extraction procedure known as an alkaline plasmid prep, which is designed to purify plasmids, small pieces of the hereditary material DNA, from bacterial cells. The bacteria are first placed into a test tube containing liquid nutrient medium and allowed to grow until they reach a high population density. The culture, which consists of solid cells suspended in the medium, is then centrifuged; a solid pellet is formed. The supernatant is poured out, leaving the pellet behind, and the cells are resuspended in a mL of lysis buffer solution (50 mM glucose, 25 mM Tris buffer and 10 mM ethylenediaminetetraacetic acid (EDTA), with 5 mg of the enzyme lysozyme added). They are then incubated for 30 minutes at 0° C, during which time the bacterial cell walls break down and the cell contents are released into the solution. After incubation, 1 mL of 0.4 N sodium hydroxide and 1 mL of 2% sodium dodecyl sulfate (SDS) are added, and the solution is again incubated on ice for 10 minutes. 2 mL of 3 M sodium acetate are added and the mixture is incubated for 30 minutes at 0°

C. The test tube is centrifuged once more and the supernatant is decanted into a clean tube, leaving behind the protein and most other cell components in the pellet.

Finally, 10 mL of pure ethanol are added to the supernatant from the previous step to precipitate out the DNA, and the test tube is incubated at −20° C for 60 minutes, during which the mixture remains liquid. The mixture is centrifuged a final time and the supernatant removed. The translucent precipitate that results is washed with 70% ethanol (70% ethanol and 30% water by volume), allowed to dry, and resuspended in 1 mL of TE buffer (10 mM Tris, 1 mM EDTA).

In preparation for this experiment, the researcher prepared stock solutions of the various chemicals that she will need in the experiment. Stock solutions are highly concentrated solutions of commonly used chemicals in water from which dilute solutions are prepared for daily use. Table 1 shows the chemicals, their molecular formulas and weights, and the composition of commonly used stock solutions.

EDTA is available commercially in the form of a hydrated sodium salt, Na2 EDTA × 2H2O. How much of this salt must be used to produce 1 L of a 0.5 M stock solution?

A. 145 g

B. 146 g

C. The test tube is centrifuged once more and the supernatant is decanted into a clean tube, leaving behind the protein and most other cell components in the pellet.
Finally, 10 mL of pure ethanol are added to the supernatant from the previous step to precipitate out the DNA, and the test tube is incubated at −20° C for 60 minutes, during which the mixture remains liquid. The mixture is centrifuged a final time and the supernatant removed. The translucent precipitate that results is washed with 70% ethanol (70% ethanol and 30% water by volume), allowed to dry, and resuspended in 1 mL of TE buffer (10 mM Tris, 1 mM EDTA).
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EDTA is available commercially in the form of a hydrated sodium salt, Na2 EDTA × 2H2O. How much of this salt must be used to produce 1 L of a 0.5 M stock solution?

186 g

D. 187 g

ANSWER: C

Explanation:

The first thing we have to do here is figure out the molecular weight of the compound being dissolved, which is Na2 EDTA × 2H2O, or the dihydrate of the disodium salt of ethylene diamine tetraacetic acid. Right there is the trick in this question – you have to realize that we're not talking about exactly the same compound as the one in the table, but another closely related species. This species is a salt consisting of one molecule of EDTA, plus two molecules of water, plus two atoms of sodium. The two sodium atoms will replace hydrogen atoms in two of the carboxyl groups of EDTA, so you have to subtract the weight of two hydrogen atoms from the weight of the EDTA molecule. You also have to add the weight of two sodiums and of two molecules of water. If we add these all up, we get a total of 372 as the molecular weight of the EDTA salt. To make one liter of a point five molal solution of EDTA, we need half a mole of this salt, which is 186 grams, choice C.

QUESTION NO: 8

Hemoglobin (Hb) and myoglobin (Mb) are the O2-carrying proteins in vertebrates. Hb, which is contained within red blood cells, serves as the O2 carrier in blood and also plays a vital role in the transport of CO2 and H+. Vertebrate Hb consists of four polypeptides (subunits) each with a heme group. The four chains are held together by noncovalent attractions. The affinity of Hb for O2 varies between species and within species depending on such factors as blood pH, stage of development, and body size. For example, small mammals give up O2 more readily than large mammals because small mammals have a higher metabolic rate and require more O2 per gram of tissue.

The binding of O2 to Hb is also dependent on the cooperativity of the Hb subunits. That is, binding at one heme facilitates the binding of O2 at the other hemes within the Hb molecule by altering the conformation of the entire molecule. This conformational change makes subsequent binding of O2 more energetically favorable. Conversely, the unloading of O2 at one heme facilitates the unloading of O2 at the others by a similar mechanism.

Figure 1 depicts the O2-dissociation curves of Hb (Curves A, B, and C) and myoglobin (Curve D), where saturation, Y, is the fractional occupancy of the O2-binding sites. The fraction of O2 that is transferred from Hb as the blood passes through the tissue capillaries is called the utilization coefficient. A normal value is approximately 0.25.

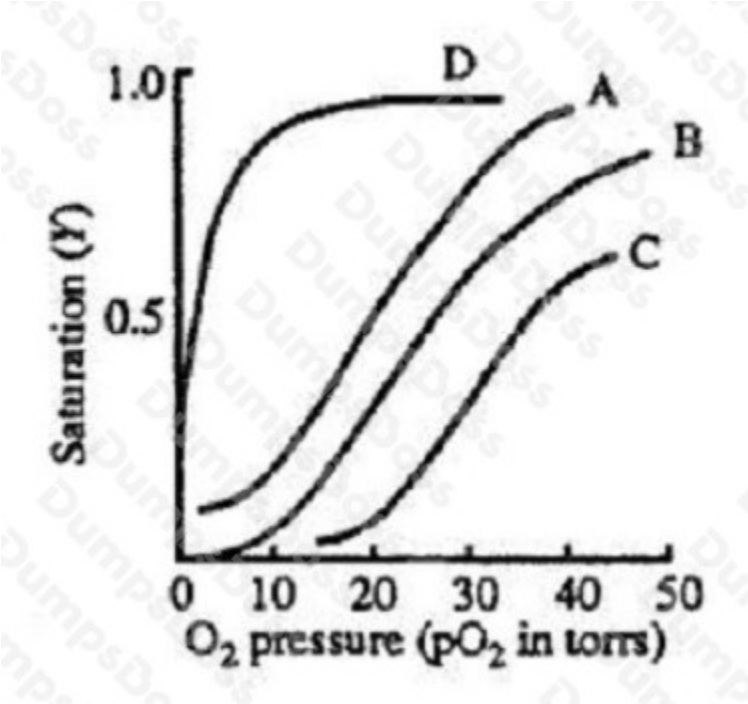


Figure 1

Myoglobin facilitates transport in muscle and serves as a reserve store of O2. Mb is a single polypeptide chain containing a heme group, with a molecular weight of 18 kd. As can be seen in Figure 1, Mb (Curve D) has a greater affinity for than Hb.

The sigmoidal shape of the O2-dissociation curve of Hb is due to:

A. the effects of oxidation and reduction on the heme groups within the Hb molecule.

B. the concentration of carbon dioxide in the blood.

C. the fact that Hb has a lower affinity for than Mb.

D. the cooperativity in binding among the subunits of the Hb molecule.

ANSWER: D

Explanation:

The sigmoidal shape of the oxygen-dissociation curve for hemoglobin can be explained by the cooperativity among the subunits of the hemoglobin molecule. According to the passage, hemoglobin is composed of four subunits, each with its own heme group. Each heme unit is capable of binding to one molecule of oxygen, and so the entire molecule is capable of binding four molecules of oxygen. The binding of oxygen at the first heme group induces a conformational change in the hemoglobin molecule such that the second heme group's affinity for oxygen increases. Likewise, the binding of oxygen at the second heme group increases the third heme's affinity for oxygen; and the binding of oxygen at the third heme groups increases the fourth's affinity for oxygen. Therefore, the partial pressure of oxygen and the % oxygen-saturation of hemoglobin are NOT linearly proportional. As a consequence of these shifts in oxygen affinity with each binding, the line representing the oxygen-dissociation curve for hemoglobin is not straight, but rather a sigmoidal, or S-shaped, curve. Thus, choice D is the right answer. Let's take a look at the wrong answers for a minute. When the iron molecule of the heme group binds to oxygen, it is reduced; when the iron releases the oxygen, it is oxidized. However, this neither results in the sigmoidal shape of the curve, nor does it affect it. So, choice A is wrong. The concentration of carbon dioxide in the blood, choice B, is

a factor that does affect hemoglobin's affinity for oxygen, and therefore affects the positioning of the curve, but it is NOT RESPONSIBLE for the sigmoidal shape. A high concentration of carbon dioxide in the blood will decrease hemoglobin's affinity for oxygen, and will therefore shift the curve to the right. So, choice B is also wrong. Choice C is also a true statement – myoglobin does have a higher affinity for oxygen than does hemoglobin, as shown in Figure 1. However, this does not affect the shape of the sigmoidal curve. Therefore, choice C is also wrong.

QUESTION NO: 9

The Russian wheat aphid, Diuraphis noxia, is a small green insect discovered in southern Russia around the turn of the century. Agricultural researchers are not quite sure, but they believe the Russian aphid adapted itself to wheat about ten thousand years ago, when the crop was first domesticated by man. What is not in doubt is the insect's destructiveness. Spread by both wind and human transport, the Russian aphid has destroyed wheat fields throughout Asia, Africa, and Latin America. Until a few years ago, the United States had been free of this pest. But in the spring of 1986, a swarm of Russian aphids crossed the Mexican border and settled a few hundred miles north, in central Texas. From there, it quickly spread to other Western states, destroying wheat fields all along its path. In fact, the level of destruction has been so great over the past five years that entomologists are calling the Russian aphid the greatest threat to American agriculture since the Hessian fly, Phytophaga destructor, was inadvertently brought to the colonies on ships by German mercenary troops during the Revolutionary War. A combination of several factors has made it particularly difficult to deal with the threat posed by this aphid. First, Russian aphids reproduce asexually at a phenomenal rate. This process, known as parthenogenesis, often results in as many as twenty generations of insects in a single year. Although most generations remain in a limited geographic area because they have no wings, a few generations are born with wings, allowing the insect to spread to new areas. Second, because wheat is a crop with a very low profit margin, most American farmers do not spray it with pesticides; it simply is not economical to do so. And since the Russian aphid has only recently entered the United States, it has no natural enemies among North American insects or animals. As a result, there have been no man-made or natural obstacles to the spread of the Russian aphid in the United States.

Agricultural researchers seeking to control the Russian aphid have looked to its place of origin for answers. In the Soviet Union, the Russian aphid has been kept in check by predators which have evolved alongside it over many thousands of years. One species of wasp seems to be particularly efficient at destroying the aphid. The pregnant females of the species search the Russian aphid's home, the interior of a wheat stalk, sting the aphid into paralysis, and then inject an egg into its body. When the egg hatches the wasp larva feeds off of the aphid, killing it in the process.

The introduction of predators like the wasp, coupled with the breeding of new strains of insect-resistant wheat, may substantially curb the destructiveness of the Russian aphid in the future. For the time being, however, American farmers are left to their own devices when it comes to protecting their wheat crops.

The author suggests the best way to control the Russian aphid population in the United States is to:

A. devote less acreage to the production of wheat.

B. spray wheat fields with large quantities of pesticides.

C. transplant its natural enemies from the Soviet Union.

D. disrupt its reproductive process by sterilizing females.

ANSWER: C

Explanation:

This is an inference question about the author's perspective on how to control the Russian aphid population in the United States. The last 2 paragraphs of the passage concern control of the aphid population. In the first sentence of the fifth paragraph, the author suggests that the introduction of the aphid's natural predators into the United States holds the

possibility of controlling the aphid population in the future. In other words, the author thinks that transplanting the Russian aphid's natural enemies from the Soviet Union, choice (C), is a logical way of controlling the aphid population in the United States, so (C) is the correct answer to this question. Nowhere in the passage does the author state or suggest that reducing the acreage devoted to the production of wheat, choice (A), would control the aphid population in the United States, so (A) is wrong. Although some people might logically conclude that growing less wheat would lessen the aphid population in the long-run, but the author doesn't suggest this as a logical method of aphid control. The question stem asks for a suggestion of the author. As for spraying large quantities of pesticides on wheat fields, choice (B), the author indicates in the fifth sentence of the third paragraph that, for economic reasons, this is not a reasonable method of aphid control, so choice (B) is wrong. Finally, the author doesn't suggest that sterilizing female aphids is a logical way of controlling the aphid population in the United States, making choice (D) incorrect. In fact, in the first half of the third paragraph, the author makes a point of noting that aphids reproduce asexually at a phenomenal rate, so "sterilizing females" is not logical at all and certainly is not suggested by the author.

QUESTION NO: 10

Four major blood types exist in the human ABO blood system: types A, B, AB, and O; and there are three alleles that code for them. The A and B alleles are codominant, and the O allele is recessive. Blood types are derived from the presence of specific polysaccharide antigens that lie on the outer surface of the red blood cell membrane. The A allele codes for the production of the A antigen; the B allele codes for the production of the B antigen; the O allele does not code for any antigen.

While there are many other antigens found on red blood cell membranes, the second most important antigen is the Rh antigen. Rh is an autosomally dominant trait coded for by 2 alleles. If this antigen is present, an individual is Rh+; if it is absent, an individual is Rh−. For example, a person with type AB blood with the Rh antigen is said to be AB+.

These antigens become most important when an individual comes into contact with foreign blood. Because of the presence of naturally occurring substances that closely mimic the A and B antigens, individuals who do not have these antigens on their red blood cells will form antibodies against them. This is inconsequential until situations such as blood transfusion, organ transplant, or pregnancy occur.

Erythroblastosis fetalis is a condition in which the red blood cells of an Rh+ fetus are attached by antibodies produced by its Rh− mother. Unlike ABO incompatibility, in which there are naturally occurring antibodies to foreign antigens, the Rh system requires prior sensitization to the Rh antigen before antibodies are produced. This sensitization usually occurs during the delivery of an Rh + baby. So while the first baby will not be harmed, any further Rh+ fetuses are at risk.

The Coombs tests provide a method for determining whether a mother has mounted an immune response again her baby's blood. The tests are based on whether or not agglutination occurs when Coombs reagent is added to a sample. Coombs reagent contains antibodies against the anti-Rh antibodies produced by the mother. The indirect Coombs test takes the mother's serum, which contains her antibodies but no red blood cells, and mixes it with Rh+ red blood cells. Coombs reagent is then added. If agglutination occurs, the test is positive, and the mother must be producing anti-Rh antibodies. The direct Coombs test mixes the baby's red blood cells with Coombs reagent. If agglutination occurs, the test is positive, and the baby's red blood cells must have been attacked by its mother's anti-Rh antibodies.

A new virus has been discovered that evades detection by the immune system of only those individuals with type A or type AB blood. Which of the following best accounts for this observation?

A. The viral antigens resemble the A antigen.

B. The viral antigens resemble the B antigen.
How do type A and type AB blood differ from type B and type O blood. Well, individuals with type A and AB blood express the A antigen on the surface of their red blood cells. These individuals will therefore NOT produce antibodies to the A antigen. On the other hand, individuals with type B and O blood do NOT express the A antigen, thus they will produce antibodies to the A antigen. Well if the virus' antigen mimicked the A antigen, then people who normally express the A antigen – that is, people with type A or type AB blood – would not recognize the virus as foreign. Thus, no immune response would be elicited, and the virus would be able to persist in these people. Thus, choice A is the correct answer. If the viral antigens mimicked the B antigen, as in choice B, then the virus would evade detection by the immune system in those

individuals who normally expressed the B antigen – type B and type AB people, but would be detected by the immune system of those individuals who do not normally express the B antigen, namely, type A and type O people.

C. The viral antigens are

D. The viral antigens are too small to elicit an immune response.

If the viral antigens are too small to elicit an immune response, the virus would evade all immune systems, not just those of individuals with A or AB blood types. Choice C can also be eliminated since the presence of the Rh factor is independent of ABO blood type. So now we need to decide between choices A and

ANSWER: A

Explanation:

From this question stem you know that this virus avoids detection by the immune system of only those individuals who have type A or AB blood. From this fact you can conclude that the virus must NOT evade the immune system of people with B or O blood types. So the correct answer will differentiate between these two groups. Well, from this piece of information you can eliminate choice

D. If the viral antigens are too small to elicit an immune response, the virus would evade all immune systems, not just those of individuals with A or AB blood types. Choice C can also be eliminated since the presence of the Rh factor is independent of ABO blood type. So now we need to decide between choices A and

B. How do type A and type AB blood differ from type B and type O blood. Well, individuals with type A and AB blood express the A antigen on the surface of their red blood cells. These individuals will therefore NOT produce antibodies to the A antigen. On the other hand, individuals with type B and O blood do NOT express the A antigen, thus they will produce antibodies to the A antigen. Well if the virus' antigen mimicked the A antigen, then people who normally express the A antigen – that is, people with type A or type AB blood – would not recognize the virus as foreign. Thus, no immune response would be elicited, and the virus would be able to persist in these people. Thus, choice A is the correct answer. If the viral antigens mimicked the B antigen, as in choice B, then the virus would evade detection by the immune system in those individuals who normally expressed the B antigen – type B and type AB people, but would be detected by the immune system of those individuals who do not normally express the B antigen, namely, type A and type O people.

QUESTION NO: 11

One of the basic principles of ecology is that population size is to some extent a function of available food resources. Recent field experiments demonstrate that the interrelationship may be far more complex than hitherto imagined. Specifically, the browsing of certain rodents appears to trigger biochemical reactions in the plants they feed on that help regulate the size of the rodent populations. Two such examples of phytochemical regulation (regulation involving plant chemistry) have been reported so far.

Patricia Berger and her colleagues at the University of Utah have demonstrated that instrumentality of 6-methoxybenzoxazolinone (6-MBOA) in triggering reproductive behavior in the mountain vole (Microtus montanus), a small rodent resembling the field mouse. 6-MBOA forms in young mountain grasses in response to browsing by predators such as voles. The experimenters fed rolled oats coated with 6-MBOA to non-breeding winter populations of Microtus. After three weeks, the sample populations revealed a high incidence of pregnancy among the females and pronounced swelling of the testicles among the males. Control populations receiving no 6- MBOA revealed no such signs. Since the timing of reproductive effort is crucial to the short-lived vole in an environment in which the onset of vegetative growth can vary by as much as two months, the phytochemical triggering of copulatory behavior in Microtus represents a significant biological adaptation.

A distinct example is reported by John Bryant of the University of Alaska. In this case, plants seem to have adopted a form of phytochemical self-defense against the depredations of the snowshoe hare (Lepus americanus) of Canada and Alaska. Every ten years or so, for reasons that are not entirely understood, the Lepus population swells dramatically. The result is intense overbrowsing of early and mid-successional deciduous trees and shrubs. Bryant has shown that, as if in response, four common boreal forest trees favored by Lepus produce adventitious shoots high in terpene and phenolic resins which effectively discourage hare browsing. He treated mature, non-resinous willow twigs with resinous extracts from the adventitious shoots of other plants and placed treated and untreated bundles at hare feeding stations, weighing them at the end of each day. Bryant found that bundles containing only half the resin concentration of natural twigs were left untouched. The avoidance of these unpalatable resins, he concludes, may play a significant role in the subsequent decline in the Lepus population to its normal level.

These results suggest obvious areas for further research. For example, observational data should be reviewed to see whether the periodic population explosions among the prolific lemming (like the vole and the snowshoe hare, a small rodent in a marginal northern environment) occur during years in which there is an early onset of vegetative growth; if so, a triggering mechanism similar to that found in the vole may be involved.

The experiments described in the passage involved all of the following EXCEPT:

A. measuring physiological changes in reproductive organs after a specific compound was ingested.

B. testing whether breeding behavior could be induced in normally non-breeding animals by a change in diet.

C. measuring an animal's consumption of treated and untreated foods.

D. measuring changes in the growth cycle 6-MBOAproducing mountain grasses.

ANSWER: D

Explanation:

In this All-Esxcept question, you have to identify the choice that is not an element of either experiment. Choice A is mentioned in the middle of Paragraph 2 as part of the mountain vole experiment. Choice B was part of that experiment as well, as indicated at the beginning of Paragraph 2. Measuring consumption of treated and untreated foods (Choice C) was the method used in the experiment on hares.

Choice D is the one choice that was not an element of either experiment discussed in the passage. The passage does discuss the use of a control group in the 6-MBOA experiment, but this experiment was not measuring changes in the birth rate of the animals, so D is the correct answer.

QUESTION NO: 12

The anthropomorphic bias of those who would relegate marsupials to an inferior evolutionary status is most apparent in their recourse to data on brain structure and behavior. Unlike humans and other placentals, marsupials lack the corpus callosum, which facilitates inter-hemisphere transfer of data acquired through the senses. Yet it cannot be inferred that marsupials are thus deprived of such function. Didelphis Virginiana, one of the opossums, makes use of the anterior commissure, an adaptation that is also found in reptiles and monotremes. Diprodontons, including kangaroos and koalas, supplement the anterior commissure with the fasciculus aberrans. While the modes of neocortical interconnection may be diverse, the work of Johnson, Heath and Jones points to the conclusion that, functionally speaking the cortices and neocortices of both groups of mammals exhibit parallel connections. Parker also notes "a similar range of brain size to body weight ratios and of neocortical expansion".

Another stigma borne by marsupials is the consensus that they are less intelligent than placentals. Yet Williams argues that, all else being equal, natural selection will favor instinctive over learned behavior as being more biologically efficient and that

it is the accidental death of the young that is the prime selective pressure for the evolution of intelligence. Seen in this light, marsupials have a competitive edge; their gestation period is brief and the young remain in the pouch for an extended period exposed only to those dangers which also affect the mother. There they are directly exposed to the mother's food supply and can observe her behavior at leisure. Placentals, on the other hand, not only have a longer gestation period but, once their young are born, must often leave while foraging. Such absences increase the risk of mortality and decrease the opportunity to learn. Thus, among placentals, selection would favor the apparent intelligence in the young and protective behavior in the mother.

Marsupials are not known to exhibit maternal protective behavior. In fact, Serventy has reported that frightened female kangaroos will drop their pouch-young as they flee, drawing a predator's attention to the less able offspring while the adult escapes. This behavior, whether purposeful or accidental, instantaneously relieves the female marsupial of the mechanical difficulties of pregnancy with which her placental counterpart would be burdened, while marsupials can replace any lost young quickly. Thus, in the absence of any need for close maternal supervision, sacrificing their offspring in this manner may well have been favored in selection. Pointing to the absence of the "virtue" of maternal protectiveness in marsupials is an instance of how mistaken are those theorists who see similarities with humans as marks of evolutionary sophistication.

According to the passage, similarities between marsupials and placentals will most likely be found in:

A. brain function.

B. brain anatomy.

C. maternal behavior.

D. selection for intelligence.

ANSWER: A

Explanation:

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.

QUESTION NO: 13

In an SDS-PAGE procedure, the SDS serves as a detergent.

Why are the proteins treated with a detergent before being run through the electrophoresis gel?

A. To coat the proteins with a large positive charge, since amino acid side chains may have positive, negative, or neutral charges, and a large uniform charge is necessary to get good separation in the gel.

B. To allow the electrophoresis to separate the proteins solely on the basis of the length of the primary sequence.

C. To prevent the protein from denaturing so that the electrophoresis can accurately resolve the proteins on the basis of tertiary structure.

D. To break the intramolecular bonds holding the tertiary and primary structure of the protein together, thereby generating linear fragments that may be sorted on size.

ANSWER: B

Explanation:

SDS is a detergent which denatures the tertiary and secondary structure of a protein. It also coats the protein with a very large negative charge. This electrostatic repulsion pushes the protein in a single long rod shape, allowing the gel to sort various proteins on the basis of primary structure length. Thus (B) is the right answer.

A: This answer choice is right except is says positive charge. SDS creates a negative charge.

C: Detergents cause denaturing, rather than preventing it.

D: SDS will break down tertiary and secondary structure, not primary.

QUESTION NO: 14

The mind, just like the body, has its needs. The needs of the body are the foundations of society; those of the mind are its amenities. While government and laws provide for the safety and wellbeing of men when they gather together, the sciences and the arts, which are less despotic but perhaps more powerful, spread garlands of flowers over the iron chains that bind them, stifle in them the sense for that original liberty for which they seem to have been born, cause them to love their own enslavement, and turn them into so-called “civilized people.” Necessity raised thrones; the sciences and the arts have strengthened them. O earthly powers: cherish talents and protect those who cultivate them. O civilized people, cultivate them: you happy slaves owe to them that delicate and refined taste of which you are so proud, that gentleness of character and urbanity of manner which make relations among you so amiable and easy – in other words, that semblance of all the virtues, none of which you actually possess…

…How pleasant it would be to live among us, if our external appearance were always a reflection of what is in our hearts, if decency were virtue, if our maxims served as our rules, and if true philosophy were inseparable from the title of philosopher! But so many qualities are seldom found together, and virtue hardly ever walks in such great pomp. Richness of adornment may be the mark of a man of taste, but a healthy, robust man is known by other signs: it is beneath the rustic clothes of a farmer, and not the gilt of a courtier, that strength and vigor of the body will be found. Ornamentation is just as foreign to virtue, which is the strength and vigor of the soul. The good man is an athlete who prefers to compete in the nude: he disdains all those vile ornaments which would hinder the use of his strength, ornaments which were for the most part invented only to hide some deformity.

Before art had molded our manners and taught our passions to speak an affected language, our customs were rustic but natural, and differences in conduct revealed clearly differences in character. Human nature, basically, was no better, but men found security in being able to see through each other easily, and this advantage, which we no longer appreciate, spared them many vices.

Now that more subtle refinements and more delicate taste have reduced the art of pleasing to set rules, a base and deceptive uniformity prevails in our behavior, and all minds seem to have been cast in the same mold. Incessantly politeness and propriety make demands on us, and incessantly we follow usage but never our own inclinations. We no longer dare to appear as we are, and under this perpetual constraint, the men who form this herd called society, when placed in the same circumstances, will all act similarly unless stronger motives direct them to do otherwise. Therefore we will never know well those with whom we deal, for to know our friends we will have to wait for some crises to arise – which is to say that we will have to wait until it is too late, as it is for these very crises that it is essential to know one’s friends well.

What vice would not accompany this uncertainty? No more sincere friendships, no more genuine esteem, no more well-based confidence. Suspicion, offenses, fears, coldness, reserve, hatred and betrayal will constantly hide under the same false veil of politeness, under that much touted urbanity which we owe to the enlightenment of our times. The name of the Master of the Universe will no longer be profaned by swearing, but insulted by blasphemies that will not offend our scrupulous ears. Men will not boast of their own merits, but belittle those of others. An enemy will not be crudely insulted, but adroitly slandered. National hatreds will die, but so will patriotism. A dangerous skepticism will take the place of the scorning of ignorance. Some excesses will be forbidden, some vices dishonored, but others will be dignified with the name of virtues,

and one must either have them or feign them. Let those who want to praise the sobriety of the sages of our time do so; as for me, I see in it only a refinement of intemperance that is as unworthy of my praise as their hypocritical simplicity.

Based on the opinions professed in the passage, the author would most likely believe that “well-based confidence” (line 59) would most likely arise from:

A. the uncertainty of not knowing another’s true feelings.

B. knowledge of the true content of another’s character.

C. the parity between appearance and true virtue.

D. knowledge of the absence of truth in the “veil” of politeness.

ANSWER: B

Explanation:

“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.”

QUESTION NO: 15

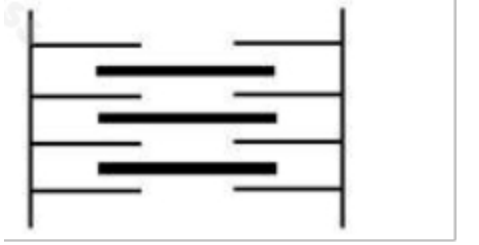
Which of the following best illustrates the contracted state of the sarcomere shown below?

A.

B.

C.

D.



A. Option A

B. Option B

C. Option C

D. Option D

ANSWER: C

Explanation:

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.

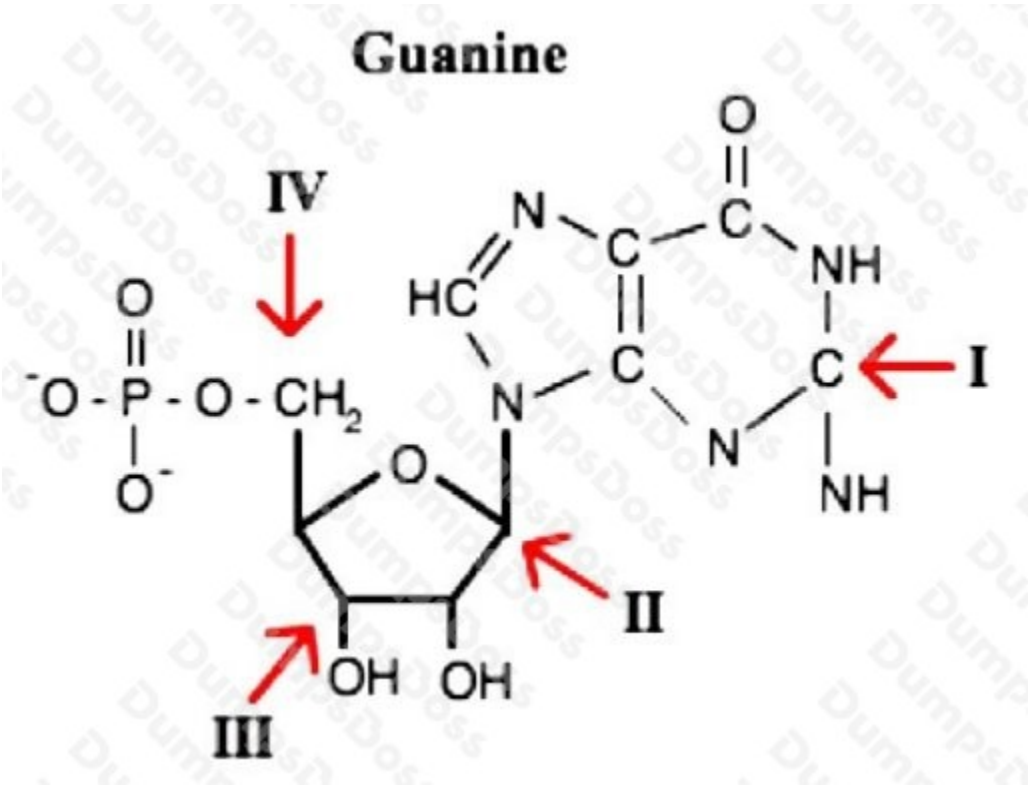
Choice A is incorrect because it indicates that the thick filaments have shortened.

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.

QUESTION NO: 16

DNA and RNA are composed of long chains of monomers known as nucleotides. On the guanine molecule shown below, which arrow best indicates the 5' end of the subunit?



A. I

B. II

C. III

D. IV

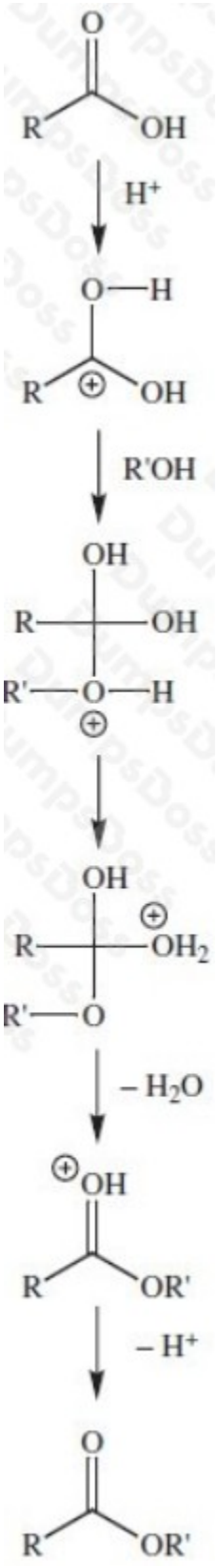
ANSWER: D

Explanation:

This question is testing your familiarity of nucleotide structures found in DNA and RNA. Nucleotides are monomers, or subunits, that are the building blocks of DNA and RNA molecules. Each nucleotide consists of a phosphate group, a pentose ring, and a nitrogenous base. In the case of the guanine nucleotide shown, the 5' end corresponds to the phosphate group attached to the fifth carbon on the pentose ring, indicated by the arrow labeled IV. This phosphodiester bond represents the 5' of a nucleotide making choice D the best answer. The arrow labeled III corresponds to the third carbon in the pentose ring. The hydroxyl group attached to the third carbon represents the 3' end of a nucleotide. The arrow labeled II represents the first labeled carbon. Lastly, arrow I points to the nitrogenous base of guanine.

QUESTION NO: 17

The mechanism for the acid-catalyzed esterification of a carboxylic acid, carried out with R'OH, is shown below. The tagged alcohol R'18OH is used to study the reaction mechanism. The resulting ester is separated from the reaction mixture; the water from the reaction mixture is then distilled off completely and collected as a separate fraction.



Another method for forming esters is:

$RCOO^- + RX \rightarrow RCOOR' + X^-$

Why does this reaction occur?

A. The halide is a poor leaving group.

B. The halide acts as a good nucleophile.

C. The halide is an electron-donating group.

D. The carboxylate anion is highly nucleophilic.

ANSWER: D

Explanation:

This question asks you to explain why a reaction occurs between carboxylic acids and alkyl halides. This reaction is an example of a nucleophilic substitution reaction with the carboxylate ion serving as the nucleophile and the leaving group. On the basis of this information, choice D is the correct response. Choice A is wrong because, in this case, the halide is a very good leaving group. Choice B is wrong because the halide is not the nucleophile but the leaving group. And finally, choice C is incorrect because the leaving group is an electron withdrawing group by virtue of its electronegativity.

QUESTION NO: 18

Today's new urban Asia is just as sophisticated and in many ways more exciting than Western cities. Urban Asian consumers are knowledgeable, modern, and keen to embrace the global lifestyle. Young, urban Asians have grown up accustomed to many things that originated in the West. They have, for example, completely embraced pizza, some even claiming that it is a part of their heritage. The story is told about a young Singaporean boy who was taken by his father to Rome. "Hey, look, Dad," the little boy exclaimed, "they have pizza here too!" On sampling the product, the boy decided that it was not as good as the original back home.

Nury Vitachi, who writes for the South China Post and the Far Eastern Economic Review, describes the Asian middle-class phenomenon: "Executives in Asia have become rich at warp speed by taking full control of their own lives. They invest a great deal of time in their work, they use strategy to scramble up the corporate ladder, and they demand payment in cash – so they can make their money work as hard as they do."

Signs of affluence are everywhere, but don't get carried away. Traveling around Asia, no matter how rich the Asians become, signs of their frugal nature are still apparent. And they are very costconscious. Shopkeepers in many Asian cities, most notably in Hong Kong, demand payments for discounted merchandise in cash instead of plastic, and many Asians are accustomed to that. Most people save the increases in their income, and many prefer to put it into fixed or other income-generating assets. Stock, land, and property are their favorites.

Many affluent Asians still regard financial security as the most important form of security, and they are confident that Asia is the place to be to achieve that. While many have begun to savor the good life, they are not letting go of their top priority of education for their children. Education is looked upon as the most important contributing factor to success in life. And in many of Asia's competitive urban centers, there is a rush to acquire a second degree and other forms of professional qualification to ensure personal competitiveness in the workplace. There are extraordinary opportunities in Asia for education and training programs from language to software programming.

Despite the rise in their assertiveness, Asians still look to the United States and not so much to Europe for ideas and trends. In general, except for those in Hong Kong and Japan, they are not particularly concerned with being fashionable. For today's Asia, Japan and Hong Kong are the sources of Asian fashion ideas, but as Asia becomes more affluent, there is a great opportunity to develop an indigenous fashion industry. For example, a huge market potential exists in introducing new materials and simplified but fashionable designs for countries in tropical Asia with a hot humid climate throughout the year.

The population density and lack of space in urban areas has prohibited Asians from exercising frequently and few indulge in outdoor activities. This is changing. Most Asians consider themselves in good health. Compared with Americans, few are overweight – largely as a result of their Asian diet. But now health clubs are becoming popular among younger Asians. Potential for indoor exercise equipment holds great promise. It is also important to dress for the gym, and younger Asians are serious about looking good, complete with makeup, sunglasses, designer exercise shoes and outfits, and a gym bag.

In trying to hit Asia's moving targets, regardless of what you are selling, it is a good idea to stick with market density – not country by country, but, mostly, city by city. Asian markets can be a marketer's dream in that their densities are among the highest in the world. Java, Indonesia's main island, has 115 million people. On Nanjing Road, Shanghai's busiest street, businesses are open twelve hours a day almost every day of the year. More than 1.5 million people visit the shops there and spend more than $50 million every day.

Someone said that you can only become rich if you sell to the rich. I would add that you can become rich faster if you sell to the new rich. For investors in the West, watch for Western companies that are preparing a big push in Asia. The world has not yet seen anything like it before, and you can reap handsome dividends if you back those stocks that are going eastward.

In the passage, the author does all of the following EXCEPT:

A. resolve a seeming economic paradox.

B. offer an interpretation of an observed trend.

C. project consequences of current developments.

D. make the information presented relevant to the reader.

ANSWER: A

Explanation:

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.

QUESTION NO: 19

In an acetyl molecule, two atoms of carbon are bonded by:

A. two sigma bonds and two pi (π) bond.

B. one sigma bond and one pi (π) bond.

C. two sigma bonds and one pi (π) bond.

D. one sigma bonds and two pi (π) bond.

ANSWER: D

QUESTION NO: 20

Hemoglobin (Hb) and myoglobin (Mb) are the O2-carrying proteins in vertebrates. Hb, which is contained within red blood cells, serves as the O2 carrier in blood and also plays a vital role in the transport of CO2 and H+. Vertebrate Hb consists of four polypeptides (subunits) each with a heme group. The four chains are held together by noncovalent attractions. The affinity of Hb for O2 varies between species and within species depending on such factors as blood pH, stage of development, and body size. For example, small mammals give up O2 more readily than large mammals because small mammals have a higher metabolic rate and require more O2 per gram of tissue.

The binding of O2 to Hb is also dependent on the cooperativity of the Hb subunits. That is, binding at one heme facilitates the binding of O2 at the other hemes within the Hb molecule by altering the conformation of the entire molecule. This conformational change makes subsequent binding of O2 more energetically favorable. Conversely, the unloading of O2 at one heme facilitates the unloading of O2 at the others by a similar mechanism.

Figure 1 depicts the O2-dissociation curves of Hb (Curves A, B, and C) and myoglobin (Curve D), where saturation, Y, is the fractional occupancy of the O2-binding sites. The fraction of O2 that is transferred from Hb as the blood passes through the tissue capillaries is called the utilization coefficient. A normal value is approximately 0.25.

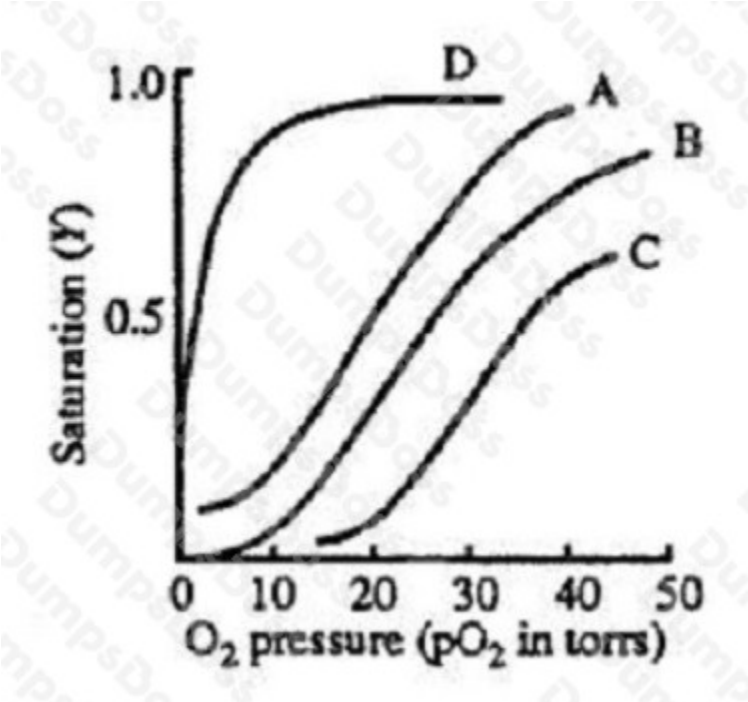


Figure 1

Myoglobin facilitates transport in muscle and serves as a reserve store of O2. Mb is a single polypeptide chain containing a heme group, with a molecular weight of 18 kd. As can be seen in Figure 1, Mb (Curve D) has a greater affinity for than Hb.

If Curve B represents the O2-dissociation curve for human adult Hb, which of the following best explains why Curve A most closely resembles the curve for fetal Hb?

A. Fetal tissue has a higher metabolic rate than adult tissue.

B. Fetal tissue has a lower metabolic rate than adult tissue.

C. Fetal Hb has a higher affinity for than adult Hb.

D. Fetal Hb has a lower affinity for than adult Hb.

ANSWER: C

Explanation:

Fetuses are 100% dependent on their mothers for all of their nutritional needs, oxygen being one of them. Oxygen is delivered to the fetus by way of diffusion across the placenta. According to the question stem, Curve A most closely resembles the oxygen-dissociation curve for fetal hemoglobin assuming that Curve B is the curve for adult hemoglobin. This means that a given oxygen pressure, fetal hemoglobin is more saturated with oxygen than adult hemoglobin is. This implies that fetal hemoglobin has a greater affinity for oxygen than adult hemoglobin. In fact, at low partial pressures of oxygen, fetal hemoglobin has a 20-30% greater affinity for oxygen than adult hemoglobin. That is why oxygen binds preferentially to fetal hemoglobin in the capillaries of the placenta. Thus, choice C is correct and choices A, B, and D are wrong. In addition, fetal blood has a 50% higher concentration of hemoglobin than maternal blood, which increases the amount of oxygen that enters fetal circulation.