MCAT-TEST[Q&As]

Medical College Admission Test: Verbal Reasoning, Biological Sciences, Physical Sciences, Writing Sample

QUESTION 1

Due to ever-increasing paranoia about the transmission of hepatitis and AIDS via blood transfusions and the frequent difficulty of procuring matching blood donors for patients, researchers have been working at a feverish pace to produce disease-free and easy-to-use blood substitutes. The difficulty most synthetic blood researches have had is in formulating a substance that combines qualities of sterility, high capacity for carrying oxygen to body tissues, and versatility within the human body. Three major substitute technologies have been developed to date; each has certain advantages and shortcomings.

"Red blood," the first of the blood substitute technologies, is derived from hemoglobin which has been recycled from old, dead, or worn-out red blood cells and modified so that it can carry oxygen outside the red blood cell. Hemoglobin, a complex protein, is the blood\\'s natural oxygen carrier and is attractive to scientists for use in synthetic blood because of its oxygen-carrying capacity. However, hemoglobin can sometimes constitute a two-fold threat to humans when it is extracted from the red blood cell and introduced to the body in its naked form. First, hemoglobin molecules are rarely sterile and often remain contaminated by viruses to which they were exposed in the cell. Second, naked hemoglobin is extremely dangerous to the kidneys, causing blood flow at these organs to shut down and leading, ultimately, to renal failure. Additional problems arise from the fact that hemoglobin is adapted to operate optimally within the intricate environment of the red blood cell. Stripped of the protection of the cell, the hemoglobin molecule tends to suffer breakdown within several hours. Although modification has produced more durable hemoglobin molecules which do not cause renal failure, undesired side effects continue to plague patients and hinder the development of hemoglobin-based blood substitutes.

Another synthetic blood alternative, "white blood," is dependent on laboratory synthesized chemicals called perfluorocarbons (PFCs). Unlike blood, PFCs are clear oil like liquids, yet they are capable of absorbing quantities of oxygen up to 50% of their volume, enough of an oxygen carrying potential for oxygen-dependent organisms to survive submerged in the liquid for hours by "breathing" it. Although PFCs imitate real blood by effectively absorbing oxygen, scientists are primarily interested in them as constituents of blood substitutes because they are inherently safer to use than hemoglobin-based substitutes. PFCs do not interact with any chemicals in the body and can be manufactured in near-perfect sterility. The primary pitfall of PFCs is in their tendency to form globules in plasma that can block circulation. Dissolving PFCs in solution can mitigate globulation; however, this procedure also seriously curtails the PFCs\\' oxygen capacity.

The final and perhaps most ambitious attempt to form a blood substitute involves the synthesis of a modified version of human hemoglobin by genetically-altered bacteria. Fortunately, this synthetic hemoglobin seems to closely mimic the qualities of sterility, and durability outside the cellular environment, and the oxygen-carrying efficiency of blood. Furthermore, researchers have found that if modified hemoglobin genes are added to bacterial DNA, the bacteria will produce the desired product in copious quantities. This procedure is extremely challenging, however, because it requires the isolation of the human gene for the production of hemoglobin, and the modification of the gene to express a molecule that works without support from a living cell.

While all the above technologies have serious drawbacks and difficulties, work to perfect an ideal blood substitute continues. Scientists hope that in the near future safe synthetic blood transfusions may ease blood shortages and resolve the unavailability of various blood types.

According to the passage, all of the following are reasons for research into the development of synthetic bloods EXCEPT:

A. dangerous diseases can be transmitted by conventional blood transfusions.

B. synthetic bloods have greater oxygen-carrying capacities than naturally-produced human blood.

C. donor blood is sometimes in short supply.

D. certain blood types are not readily available.

Correct Answer: B

This requires the recollection of the reasons for synthetic blood research, discussed in the first paragraph of the passage, and infer which of the answer choices is not a reason for such research. Choice (A) suggests that patients fear the transmission of dangerous diseases such as AIDS, via blood transfusions. This fear is mentioned in the opening sentence of the passage as one of the primary reasons for the desire to develop clean, sterile, blood substitutes. Choice (A), therefore, is a reasons for the development of synthetic bloods, and does not answer this question stem correctly. Choices (C) and (D) mention different aspects of the problem of procuring matching blood donors for patients, also described in the opening sentence as one of the reasons for the development of synthetic bloods. (C) and (D), then, do not correctly complete the question stem either. Choice (B) suggests that synthetic bloods have greater oxygen-carrying capacities than naturally-produced human blood. This is not supported anywhere in the passage. The passage emphasizes that synthetic bloods should have high oxygen-carrying capacities, but there is no suggestion that synthetic bloods have higher oxygen-carrying capacities than blood.

QUESTION 2

The polymerase chain reaction (PCR) is a powerful biological tool that allows the rapid amplification of any fragment of DNA without purification. In PCR, DNA primers are made to flank the specific DNA sequence to be amplified. These primers are then extended to the end of the DNA molecule with the use of a heat- resistant DNA polymerase. The newly synthesized DNA strand is then used as the template to undergo another round of replication.

The 1st step in PCR is the melting of the target DNA into 2 single strands by heating the reaction mixture to approximately 94 oC, and then rapidly cooling the mixture to allow annealing of the DNA primers to their specific locations. Once the primer has annealed, the temperature is elevated to 72 oC to allow optimal activity of the DNA polymerase. The polymerase will continue to add nucleotides until the entire complimentary strand of the template is completed at which point the cycle is repeated (Figure 1)

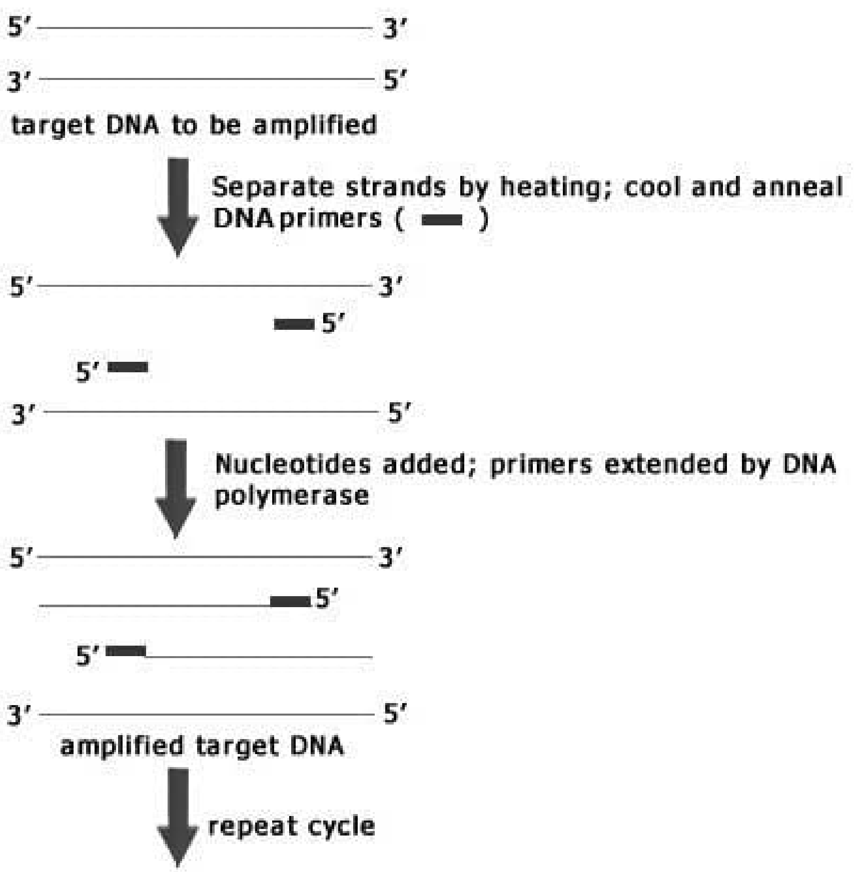


Figure 1

One of the uses of PCR is sex determination, which requires amplification of intron 1 of the amelogenin gene. This gene found on the X-Y homologous chromosomes has a 184 base pair deletion on the Y homologue. Therefore, by amplifying intron 1 females can be distinguished from males by the fact that males will have 2 different sizes of the amplified DNA while females will only have 1 unique fragment size.

Which of the following statements could be used to correctly describe the overall polymerase chain reaction?

A. It is an anabolic reaction that breaks down new DNA strands.

B. It is an anabolic reaction that synthesizes new DNA strands.

C. It is a catabolic reaction that breaks down new DNA strands.

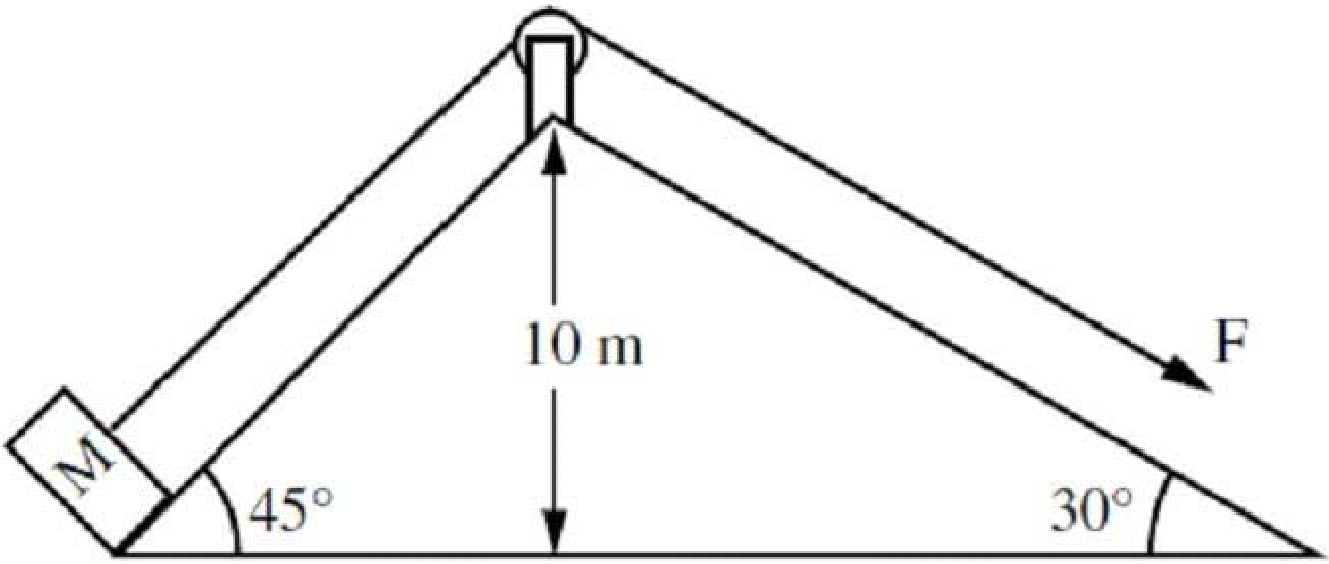
D. It is a catabolic reaction that synthesizes new DNA strands.

Correct Answer: B

This question requires knowledge of the definition of anabolism and catabolism. A catabolic reaction involves the breakdown of macromolecules, whereas an anabolic reaction involves the synthesis of macromolecules from individual building blocks. PCR entails the synthesis (amplification) of a new DNA strand using a DNA template and free nucleotides, therefore, it is an anabolic reaction that synthesizes new DNA strands.

QUESTION 3

A5-kg mass M is being raised from the ground to the top of the inclined plane using the set-up shown in the diagram below. Assuming that the inclined plane is frictionless, what is the work done by the force F?



A.
490 J

B.
$490\sqrt{3}\text{ J}$

C.
$490\sqrt{2}\text{ J}$

D.
$\frac{490}{\sqrt{2}}\text{ J}$
$\sqrt{2}\text{ J}$

A. Option A

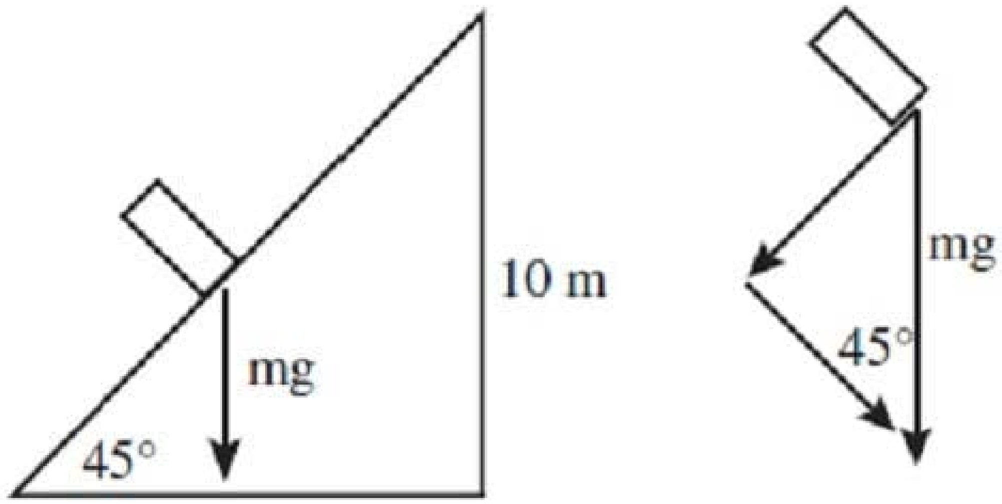
B. Option B

C. Option C

D. Option D

Correct Answer: 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) = 500J. 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.



$$\frac{\sqrt{2}}{2}mg = \frac{\sqrt{2}}{2}(5)(10) = 25\sqrt{2}\text{N}.$$

$$\sqrt{10^2 + 10^2} = \sqrt{200} = 10\sqrt{2}.$$

The force required to move the box is equal to The distance travelled by the box up the incline is given by the pythagorean equation. Distance =

$$\text{Work} = \text{Distance} \times \text{force} = 10\sqrt{2} \times 25\sqrt{2} = 500\text{J}$$

QUESTION 4

...Until last year many people -- but not most economists -- thought that the economic data told a simple tale. On one side, productivity -- the average output of an average worker -- was rising. And although the rate of productivity increase was very slow during the 1970\\'s and early 1980\\'s, the official numbers said that it had accelerated significantly in the 1990\\'s. By 1994 an average worker was producing about 20 percent more than his or her counterpart in 1978. On the other hand, other statistics said that real, inflation- adjusted wages had not been rising at anything like the same rate. In fact, some of the most commonly cited numbers showed real wages actually falling over the last 25 years. Those who did their homework knew that the gloomiest numbers overstated the case....Still, even the most optimistic measure, the total hourly compensation of the average worker, rose only 3 percent between 1978 and 1994.... ...But now the experts are telling us that the whole thing may have been a figment of our statistical imaginations.... a blue-ribbon panel of economists headed by Michael Boskin of Stanford declared that the Consumer Price Index [C.P.I.] had been systematically overstating inflation, probably by more than 1 percent per year for the last two decades, mainly failing to take account of changes in the patterns of consumption and improvements in product quality.... ...The Boskin report, in particular, is not an official document -- it will be quite a while before the Government actually issues a revised C.P.I., and the eventual revision may be smaller than Boskin and his colleagues propose. Still, the general outline of the resolution is pretty clear. When all the revisions are taken into account, productivity growth will probably look somewhat higher than it did before, because some of the revisions being proposed to the way we measure consumer prices will also affect the way we calculate growth. But 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. In other words, the whole story about workers not sharing in productivity gains will turn out to have been based on a statistical illusion. It is important not to go overboard on this point. There are real problems in America, and our previous concerns were by no means pure hypochondria. For one thing, 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. Even if Boskin\\'s numbers are right, the income of the median family -- which officially has experienced virtually no gain since 1973 -- has risen by only about 35 percent over the past 25 years, compared with 100 percent over the previous 25. Furthermore, it is quite likely that if we "Boskinized" the old data -- that is, if we tried to adjust the C.P.I. for the 50\\'s and 60\\'s 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.... ...Moreover, while workers as a group have shared fully in national productivity gains, they have not done so equally. The 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. It is still true that families in the bottom fifth, who had 5.4 percent of total income in 1970, had only 4.2 percent in 1994; and that over the same period the share of the top 5 percent went from 15.6 to 20.1. And it is still true that corporate C.E.O.\\'s, who used to make about 35 times as much as their employees, now make 120 times as much or more.... ...While these are real and serious problems, however, one thing is now clear: the truth about what is happening in America is more subtle than the simplistic morality play about greedy capitalists and oppressed workers that so many would- be sophisticates accepted only a few months ago. There was little excuse for buying into that simplistic view then; there is no excuse now.... Which of the situations below best reflects public perception regarding the economy prior to the release of Boskin\\'s report?

A. Productivity has increased at a much higher rate than employee compensation since 1970.

B. The rate of growth of productivity was approximately that of wages.

C. The distribution of income to labor has radically changed over the last fifteen years.

D. Economic progress has been steady since 1945.

Correct Answer: A

That the perception existed that there was a large gap between productivity and wages can be inferred in paragraph four 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.

QUESTION 5

Gauguin\\'s attitude toward art marked a break from the past and a beginning to modern art. Like all Post- Impressionist artists, he passed through an Impressionist phase but became quickly dissatisfied with the limitations of the style, and went on to discover a new style that had the directness and universality of a symbol and that concentrated on impressions, ideas and experiences. The beginning of his modern tradition lay in his rejection of Impressionism. He considered naturalism an error to be avoided. He was preoccupied with suggestion rather than description, seeking to portray not the exterior, but the essence of things in their purest, simplest, and most primitive form, which could only be achieved through simplification of the form. He firmly believed throughout his life that "art is an abstraction" and that "this abstraction [must be derived] from nature while dreaming before it." One must think of the creation that will result rather than the model, and not try to render the model exactly as one sees it. This was the birth of "Synthetism" or rather Synthetist-Symbolic, as Gauguin referred to it, using the term "symbolic" to indicate that the forms and patterns in his pictures were meant to suggest mental images or ideas and not simply to record visual experience.

Symbolism flourished around the period of 1885 to 1910 and can be defined as the rejection of direct, literal representation in favor of evocation and suggestion. Painters tried to give a visual expression to emotional experiences, and therefore the movement was a reaction against the naturalistic aims of Impressionism. Satisfying the need for a more spiritual or emotional approach in art, Symbolism is characterized by the desire to seek refuge in a dreamworld of beauty and the belief that color and line in themselves could express ideas. Stylistically, the tendency was towards flattened forms and broad areas of color, and features of the movement were an intense religious feeling and an interest in subjects of death, disease, and sin.

Similarly, "Synthetism" involved the simplification of forms into large-scale patterns and the expressive purification of colors. Form and color had to be simplified for the sake of expression. This style reacted against the "formlessness" of Impressionism and favored painting subjectively and expressing one\\'s ideas rather than relying on external objects as subject matters. It was characterized by areas of pure colors, very defined contours, an emphasis on pattern and decorative qualities, and a relative absence of shadows.

Gauguin\\'s new art form merged these two movements and succeeded in freeing color, form, and line, bringing it to express the artists\\' emotions, sensibilities, and personal experiences of the world around them. His style created a break with the old tradition of descriptive naturalism and favored the synthesis of observation and imagination. Gauguin sustained that forms are not discovered in nature but in one\\'s wild imagination, and it was in himself that he searched rather than in his surroundings. For this reason, he scorned the Impressionists for their lack of imagination and their mere scientific reasoning. Furthermore, Gauguin used color unnaturalistically for its decorative or emotional effect and reintroduced emphatic outlines. "Synthetism" signified for him that the forms of his pictures were constructed from symbolic patterns of color and linear rhythms and were not mere scientific reproductions of what is seen by the eye.

Dempsey, A., and Dempsey, A. (2010). Styles, Schools and Movements: The Essential Encyclopaedic Guide to Modern Art. London: Thames and Hudson.

According to the passage, Gauguin rejected Impressionism for a number of reasons. Which of the following reasons CANNOT be inferred to have been a motive of this rejection?

A. Lack of flexibility within the style of Impressionism

B. Lack of intense feelings and emotions in Impressionism

C. Lack of beauty in Impressionism

D. Lack of imagination in Impressionism

Correct Answer: C

To answer this Reasoning-Within-the-Text question, look closely at what the passage says about impressionism. The author never implies that Impressionist paintings were not beautiful. A ?incorrect. Paragraph 1 states that Gauguin

abandoned Impressionism due to the limitations of the style.

B ?incorrect. The passage states that Symbolists wanted painting to "express the artists\\' emotions, sensibilities, and personal experiences of the world around them" (paragraph 4), suggesting that they would reject unemotional works.

D ?incorrect. The Symbolists\\' "rejection of direct, literal representation" (paragraph 2) suggests they saw imagination as important.