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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, how much oxygen can be absorbed by a 300 cc sample of PFC?

A. 50 cc

B. 100 cc

C. 150 cc D. 300 cc

Correct Answer: C

This is an application question which requires you to apply information from the passage to solve a problem. The

passage mentions that PFCs are capable of absorbing quantities of oxygen up to 50% of their volume. Applying this information, then, a 300 cc sample of PFC can absorb up to 150 cc, 50% of 300 cc. The correct answer, then, is choice (C), 150 cc.

QUESTION 2

In 1972, Georges Ungar reported the discovery of a peptide that appeared to transfer learning. Ungar\\'s claim was based on experiments in which rats placed in a chamber with specially designed dark and light regions were trained to avoid

the dark regions of the chamber. Following their training, the rats were killed and brain extracts were prepared. These brain extracts were injected into naive rats which were then observed to acquire the fear of darkness without training. Two

hypotheses were proposed to explain these remarkable results:

Hypothesis 1

Ungar concluded that the extracts contained some chemical that transmitted the learned fear of darkness to the naive rats. A fifteen amino-acid polypeptide was isolated from the brain extracts and sequenced. Ungar claimed that this peptide,

called scotophobin, was a chemical transmitter of learning. The peptide had the primary structure shown below:

C-ser-asp-asn-arg-gln-gln-gly-lys-ser-ala-arg-gln-glygly-tyr-N Scotophobin

Hypothesis 2

Other researchers, who tested scotophobin but could not reproduce Ungar\\'s results, argued that scotophobin did not transfer the learned fear of darkness. Instead, they suggested that scotophobin, which is structurally similar to ACTH and

vasopressin, acted to increase stress in the rats. Since stress increases sympathetic nervous activity, rats injected with scotophobin would become hyperactive and tend to spend less time in the dark regions of the experimental chamber.

They argued that such stress responses in the rats could be misinterpreted as a fear of darkness. Ungar\\'s claim was further weakened by chemical analysis in which both the scotophobin extracts which Ungar had injected into the naive rats

and a sample of synthesized scotophobin peptide were subjected to SDS polyacrylamide gel electrophoresis, as shown in Figure 1.

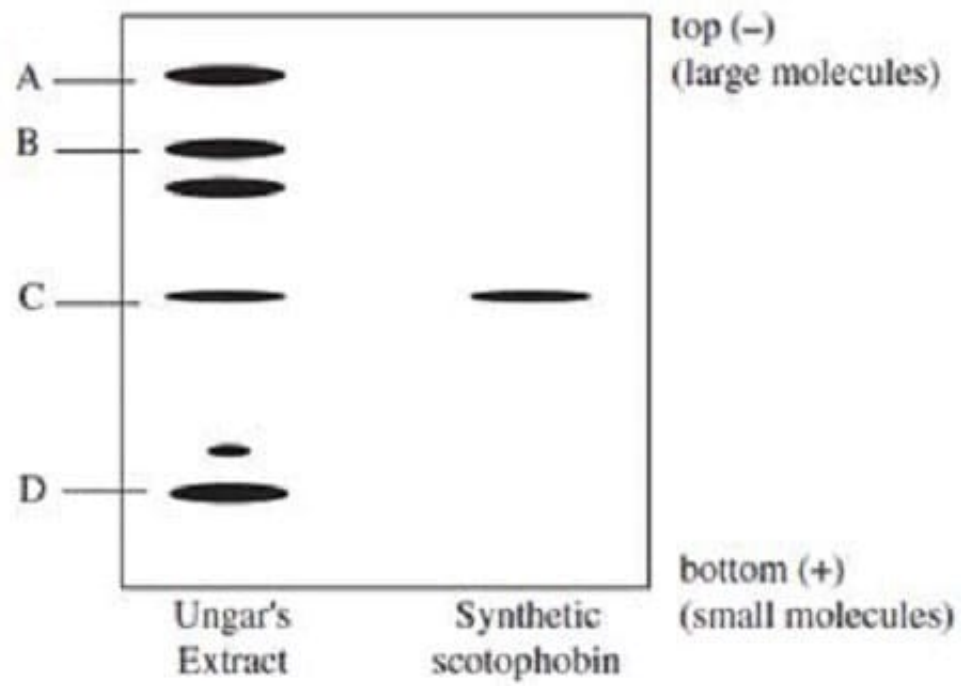

Figure 1

Researchers were interested in purifying a second protein (protein X) from Ungar\\'s extract. The gene segment encoding protein X was believed to consist of thirty nucleotides. According to Figure 1, which band could represent protein X?

A. Band A

B. Band B

C. Band C

D. Band D

Correct Answer: 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.

QUESTION 3

When Gwendolyn Brooks published her first collection of poetry A Street In Bronzeville in 1945 most reviewers recognized Brooks\\' versatility and craft as a poet. Yet, while noting her stylistic successes few of her contemporaries discussed the critical question of Brooks\\' relationship to the Harlem Renaissance. How had she addressed herself, as a poet, to the literary movement\\'s assertion of the folk and African culture, and its promotion of the arts as the agent to define racial integrity? The New Negro poets of the Harlem Renaissance expressed a deep pride in being Black; they found reasons for this pride in ethnic identity and heritage; and they shared a common faith in the fine arts as a means of defining and reinforcing racial pride. But in the literal expression of this impulse, the poets were either romantics, or realists and, quite often within the same poem, both. The realistic impulse, as defined best in the poems of McKay\\'s Harlem Shadows (1922), was a sober reflection upon Blacks as second class citizens, segregated from the mainstream of American socio-economic life, and largely unable to realize the wealth and opportunity that America promised. The romantic impulse, on the other hand, as defined in the poems of Sterling Brown\\'s Southern Road (1932), often found these unrealized dreams in the collective strength and will of the folk masses. In comparing the poems in A Street in Bronzeville with various poems from the Renaissance, it becomes apparent that Brooks brings many unique contributions to bear on this tradition. The first clue that A Street In Bronzeville was, at its time of publication, unlike any other book of poems by a Black American is its insistent emphasis on demystifying romantic love between Black men and women. During the Renaissance, ethnic or racial pride was often focused with romantic idealization upon the Black woman. A casual streetwalker in Hughes\\' poem, "When Sue Wears Red," for example, is magically transformed into an Egyptian Queen. In A Street In Bronzeville, this romantic impulse runs headlong into the biting ironies of racial discrimination. There are poems in which Hughes, McKay and Brown recognize the realistic underside of urban life for Black women. But for Brooks, unlike the Renaissance poets, the victimization of poor Black women becomes not simply a minor chord but a predominant theme. ...Brooks\\' relationship with the Harlem Renaissance poets, as A Street in Bronzeville ably demonstrates, was hardly imitative. As one of the important links with the Black poetic tradition of the 1920s and 1930s, she enlarged the element of realism that was an important part of the Renaissance world-view. Although her poetry is often conditioned by the optimism that was also a legacy of the period, Brooks rejects outright their romantic prescriptions for the lives of Black women. And in this regard, she serves as a vital link with the Black Arts Movement of the 1960s that, while it witnessed the flowering of Black women as poets and social activists as well as the rise of Black feminist aesthetics in the 1970s, brought about a curious revival of romanticism in the Renaissance mode.

Suppose that a recently-discovered collection of Gwendolyn Brooks\\' poems contained female protagonists that embodied the ideal woman. This information would:

A. support the author\\'s contention that women poets were self-serving.

B. negate the author\\'s view that black poets presented women and men with inequality.

C. contradict the author\\'s opinion that Gwendolyn Brooks allowed readers to experience a more accurate description of the modern Black woman.

D. neither support nor contradict the author\\'s claim that Brooks served as an integral link between Harlem Renaissance poets and the Black Arts Movement poets.

Correct Answer: 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 selfserving, 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.

QUESTION 4

Studies of photosynthesis began in the late eighteenth century. One scientist found that green plants produce a substance (later shown to be oxygen) that supports the flame of a candle in a closed container. Several years later it was discovered that a plant must be exposed to light in order to replenish this flame- sustaining "substance." Soon another discovery showed that the oxygen is formed at the expense of another gas, carbon dioxide.

In 1804, de Saussure conducted experiments revealing that equal volumes of carbon dioxide and oxygen are exchanged between a plant and the air surrounding it. De Saussure determined that the weight gained by a plant grown in a pot equals the sum of the weights of carbon derived from absorbed carbon dioxide and water absorbed through plant roots. Using this information, de Saussure was able to postulate that in photosynthesis carbon dioxide and water combine using energy in the form of light to produce carbohydrates, water, and free oxygen. Much later, in 1845, scientists\\' increased understanding of concepts of chemical energy led them to perceive that, through photosynthesis, light energy is transformed and stored as chemical energy.

In the twentieth century, studies comparing photosynthesis in green plants and in certain sulfur bacteria yielded important information about the photosynthetic process. Because water is both a reactant and a product in the central reaction, it had long been assumed that the oxygen released by photosynthesis comes from splitting the carbon dioxide molecule. In the 1930s, however, this popular view was decisively altered by the studies of C. B. Van Niel. Van Niel studied sulfur bacteria, which use hydrogen sulfide for photosynthesis in the same way that green plants use water, and produce sulfur instead of oxygen. Van Niel saw that the use of carbon dioxide to form carbohydrates was similar in the two types of organisms. He reasoned that the oxygen produced by green plants must derive from water -- rather than carbon dioxide, as previously assumed -- in the same way that the sulfur produced by the bacteria derives from hydrogen sulfide. Van Niel\\'s finding was important because the earlier belief had been that oxygen was split off from carbon dioxide, and that carbon then combined with water to form carbohydrates. The new postulate was that, with green plants, hydrogen is removed from water and then combines with carbon dioxide to form the carbohydrates needed by the organism.

Later, Van Niel\\'s assertions were strongly backed by scientists who used water marked with a radioactive isotope of oxygen in order to follow photosynthetic reactions. When the photosynthetically-produced free oxygen was analyzed, the isotope was found to be present.

Which of the following can be inferred about the scientists discussed in the passage?

A. They relied on abstract reasoning in the absence of physical data.

B. They never came to understand the role of light in photosynthesis.

C. Each contributed to our understanding of the production of oxygen by plants.

D. They tended to undervalue previous scientific findings.

Correct Answer: C

This is an inference question regarding the scientists discussed in the passage. The unnamed eighteenth century scientists in paragraph 1 laid the groundwork for understanding the role of oxygen; de Saussure postulated the production of free oxygen during photosynthesis; Van Niel\\'s conclusions revised our understanding of the actual source of oxygen in the photosynthetic reaction, and his findings were subsequently verified by other scientists. The generalization in choice

(C) is thus accurate. Physical data are referred to throughout the passage, in all four paragraphs, so choice (A) is contradicted. Nothing suggests choice (B); the second paragraph makes it clear that de Saussure hypothesized that light energized the photosynthetic process, and then that scientists in 1845 added to our understanding by realizing that light energy is converted to chemical energy. Similarly, choice (D) is implicitly contradicted: all the scientists mentioned apparently benefited from and built on the work of previous scientists.

QUESTION 5

How many electrons can fit into the third shell of an atom?

A. 16

B. 4

C. 2

D. 18

Correct Answer: D

The first shell can contain only 2 electrons, the second shell can hold up to 8, and third can contain up to 18.