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QUESTION 1

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 have 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.

Correct Answer: C

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 2



The two molecules above can best be described as:

- A. Structural isomers
- B. Diastereomers
- C. Enantiomers
- D. Conformational isomers

Correct Answer: D

Explanation: The molecule on the left is trans 1, 2-diiodocyclohexane. The molecule on the right is cis 1, 2-diiodocyclohexane. Cis and trans molecules are a type of diastereomer called geometric isomers.

A: Structural isomers have fundamentally different connectivity between the atoms. So for example if the iodine were on carbons 1 and 3 and then in the other molecule on carbons 1 and 4, that would be structural isomers.

C: Enantiomers are mirror image reflections of each other, which these molecules are not.

D: Conformations isomers allow you to freely interconvert between the molecules without breaking any bonds. The classic example is chair and boat cyclohexane. Here, to flip the one iodine from R to S configuration would require breaking a bond in the ring, rotating, and then re-attaching. That requirement for bond-breaking means these are not conformers.

QUESTION 3

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.

Given the passage's discussion of Synthetist-Symbolism, and some undiscussed remarks about how Japanese art influenced Gauguin's work, which of these features of Japanese painting can be reasonably assumed to characterize Gauguin's art form?

- A. Use of strong colors and compositional freedom
- B. Use of fluid curved lines
- C. Use of animals and landscapes as subjects
- D. Use of narrative elements to express ideas

Correct Answer: A

This Reasoning-Beyond-the-Text question asks you to infer connections between Japanese painting and Gauguin's Synthetist-Symbolist art. Even without prior knowledge of Japanese art nor any discussions of it in the passage, the question itself implies that a reasonable assumption can be made using the descriptions provided in the passage. Since Synthetist-Symbolism was described as "characterized by the desire to seek refuge in a dreamworld of beauty and the belief that color and line in themselves could express ideas," it could be inferred that the use of strong colors and compositional freedom might characterize both types of art.

Most of these descriptions are found in paragraph 4, particularly about how Gauguin used colors freely and "unnaturalistically for its decorative or emotional effect. . . the forms of his pictures were constructed from symbolic patterns of color and linear rhythms." B ?incorrect. The passage does state that Gauguin used outlines but does not suggest the importance of fluidity or of curved vs. straight lines. Hence, there were no indications that this option might be correct. C ?incorrect. Paragraph 2 states that Symbolism, one of the two movements from which Gauguin formed his "new" art, has death, disease, and sin as its typical subjects. No reference is made to animals and landscapes as motives. In paragraph 4 it is stated that "it was in himself that he searched rather than in his surroundings." Hence, it could be inferred that this option was likely incorrect. D ?incorrect. Gauguin was particularly interested in suggesting mental images and ideas in an art work as opposed to merely representing visual reality. Nothing in the passage mentions narrative as a factor in his artistic process or form. Hence, there were no indications that this option might be correct.

QUESTION 4

At a recent meeting of the American Public Transit Association, the Environmental Protection Agency unveiled stringent new standards for pollution control. The transit authorities were particularly concerned about the implementation of a proposed "Clean Air Act." They believed the provisions of the Clean Air Act could severely affect basic services to their local communities. Many transit agencies were concerned that it would be difficult to comply with the pollution and emissions control standards while continuing to operate within realistic budgets. The aim of the Clean Air Act is to assure that by the year 2000, there will be a reduction of at least 10 million tons of sulfur dioxide from 1980 levels. The bill also calls for a reduction in pollutants that contribute to the depletion of ozone. Strict regulations of toxic air emissions would have to be established and enforced. Additionally, the Clean Air Act would establish specific acid-rain reduction quotas and enforce severe penalties for transgressors of any of the new clean air regulations. There is little doubt that mass-transit suppliers will be considerably affected by this new legislation, just as the chemical and petroleum industries have already been affected by similar legislation. Transit authorities are challenged to strike a difficult balance between complying with the government's new standards and developing an official concern for the environment, while continuing to fulfill the transportation needs of the general population. Among the areas addressed by the Clean Air Act, the topic of mobile resources is of particular interest to mass transit authorities. Provisions contained in the Act under this title are aimed at encouraging the development and practical use of alternative fuel sources, like solar energy and methane fuel. The goal of this section of the Act is to eradicate toxic fuel emissions in order to provide cleaner air and a more favorable environment. The Act even goes so far as to declare that in cities like New York, Los Angeles and Houston -- where air quality is particularly noxious and toxins exceed the limits of federal regulations -- forms of mass transit should run on so-called "clean-burning fuels" by the year 2000. Such fuels include reformulated gasoline, propane, electricity, natural gas, ethanol, methanol, or any similar type of low-emission fuel. In addition, the Act proposes that, by 1994, all new urban buses in cities with populations exceeding one million must operate solely on clean-burning fuels. The topics of alternative fuels and alternative fuel vehicles represent, by far, the most controversial issue in the Clean Air Act. President Bush has called alternative fuels "bold and innovative" means to control pollution, but according to many transportation experts, the Act's proposals on alternative fuel usage are unrealistic. The transit authorities recognize that concern for the environment and health hazards like pollution are global issues. However, most transit officials concur that inventing and developing new ways to fuel mass transit will take at least 50 years to realize. They point out that the Act does not mention the political and social ramifications of usurping the role of the petroleum industries. The Act does not mention if or how the thousands of people employed by the oil industry will get retrained to produce and implement the use of "clean" fuel. No one disputes the fact that people need some form of transportation to get from place to place. Preserving the environment should be a priority, yet we need to remember that even if toxic emissions are completely eliminated sometime in the future, the challenge of moving mass numbers of people where they want to go will still exist and must remain a priority. Transit authorities contend that unless the Clean Air Act also acknowledges this, and develops a way to encourage mass transit over personal transportation, the problems of pollution might not be significantly altered. They suggest that there are many areas in this country that have little or no mass transit and that, if the Clean Air Act's goal is to reduce pollution, perhaps the most practical and realistic means to achieve that goal is to encourage the development and maintenance of mass transit systems. Transit authorities feel that the Act errs in NOT:

- A. sufficiently discussing the problems of lead emissions in the atmosphere.
- B. adequately acknowledging the environmental benefits of mass transportation.
- C. offering financial incentives to induce private automobile owners to use mass transit instead.
- D. adequately emphasizing the role and responsibility of private industry in the current global warming crisis.

Correct Answer: B

Look at the first two sentences of the last paragraph. Transit authorities contend that unless the Act acknowledges the need for some form of public transportation and takes steps to encourage mass transit, pollution levels might not be significantly altered by the Act. Choice B is therefore the correct response. Nothing is said in the passage about lead emissions, financial incentives to encourage the use of mass transit, or the role of private industry in the global warming crisis, so A, C, and D can all be eliminated.

QUESTION 5

A continuous spectrum of light, sometimes called blackbody radiation, is emitted from a region of the Sun called the photosphere. Although the continuous spectrum contains light of all wavelengths, the intensity of the emitted light is much greater at some wavelengths than at others. The relationship between the most intense wavelength of blackbody radiation and the temperature of the emitting body is given by Wien's law, $\lambda = 2.9 \times 10^6/T$, where λ is the wavelength in nanometers and T is the temperature in kelvins.

As the blackbody radiation from the Sun passes through the cooler gases in the Sun's atmosphere, some of the photons are absorbed by the atoms in these gases. A photon will be absorbed if it has just enough energy to excite an electron from a lower energy state to a higher one. The absorbed photon will have an energy equal to the energy difference between these two states. The energy of a photon is given by $E = hf = hc/\lambda$ where $h = 6.63 \times 10^{-34} \text{ J}\cdot\text{s}$, Planck's constant, and $c = 3 \times 10^8 \text{ m/s}$, the speed of light in a vacuum.

The Sun is composed primarily of hydrogen. Electron transitions in the hydrogen atom from energy state $n = 2$ to higher energy states are listed below along with the energy of the absorbed photon:

Final Energy State Energy ($\times 10^{-19} \text{ J}$) $n = 3$

3.02

$n = 4$

4.08

$n = 5$

4.57 $n = 6$

4.84 $n = ?$

5.44

Based on the data in the table, what is the approximate wavelength of a photon emitted in the electron transition from energy state $n = 4$ to energy state $n = 3$?

- A. 5 nm
- B. 30 nm
- C. 100 nm
- D. 2,000 nm

Correct Answer: D

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