Preparing for the ACT (2009-2010)

Science

Passage I

1) D) According to Figure 1, 125° from the focus of the earthquake falls in between 103° and 142° in the shadow zone that receives neither type of wave.

2) G) Figure 1 shows that when p-waves reach the boundary separating the mantle and the core, they enter the core but change the direction of their trajectory, which indicates that they are refracted. The fact that the line representing these waves remains a solid line as it enters the core indicates that the waves remain p-waves.

3) D) This is an extrapolation problem, which means you must extend the lines of the graph beyond the boundaries of the graph. Extend the lines of the s-waves and p-waves beyond the graph in Figure 3 to the point that would represent 10,500 km on the x-axis. The p-waves line up with approximately 14 minutes at 10,500 km, while the s-waves line up with approximately 25 minutes at 10,500 km, so the first p-waves arrive about 11 minutes before the first s-waves.

4) F) The "time earthquake starts at focus" from Figure 2 corresponds with point (0km, 0 min) in Figure 3. When the earthquake starts, it will be felt only at its focus (0km on the x-axis) and will take no time to be felt at that point (0 min on the y-axis).

5) A) This is the rare science question (typically 1-3 per test) that requires a bit of outside knowledge, in that you are expected to know what amplitude refers to. Amplitude is a measure of the vertical size of the wave equal to half the difference between its maximum and its minimum. Simply put, waves with larger amplitudes are taller than waves with smaller amplitudes. Therefore the p-waves depicted in Figure 2 have a smaller amplitude than the s-waves depicted in Figure 2.

Passage II

6) F) The lake clay layer is represented by the light gray uppermost layer of Figure 2. This layer is thinner at Winnipeg than it is at Site 1, Site 2, or Grand Forks.

7) C) The smallest 18O value is represented in Figure 3 by the furthest left values on the graphs. In all three graphs, this smallest 18O value occurs at a depth between 25 and 30 m.

8) J) Moving left across the graph in Figure 2 from Grand Forks to Site 3, the glacial till layer decreases in thickness.

9) C) The top of the glacial till layer is represented by the boundary between the glacial till layer (represented by the diagonal lines) and the lake clay layer (represented by the light gray). Among Sites 1, 2, and 3, this boundary is highest in Site 2, second highest in Site 1, and lowest in Site 3.

10) J) If precipitation "reaches the groundwater table about 3 m below the surface," water within 3 m of the surface is precipitation that has not yet been mixed with groundwater. Water within 3 m of the surface is represented by the furthest right points on each of the three graphs in Figure 3. Each of these points corresponds with an 18O value of about -15, so -15 represents the 18O value of present day precipitation.

Passage III

11) B) The students likely used a plastic bottle rather than aluminum can in Experiment 3 so that they could see the bubbles in the liquid. Experiment 3 describes the students visually examining the bottle for the presence of bubbles, which would not have been possible with an opaque aluminum can. A is incorrect because Experiment 3 does not involve timing how long the bottles took to roll down the incline. C is incorrect because both the plastic bottle and the aluminum bottle from the previous experiments were filled with one liter of liquid. D is incorrect because there was minimal risk of either container breaking.

12) J) Trials 3 and 5 both show a roll time of 1.75 seconds before shaking. If the roll times in these trials were the same, the average speeds of the cans must have been the same as well.

13) D) Shaking the can had the effect of increasing the roll time, since in both Trial 4 and Trial 5, the role time is higher after shaking than before shaking.

14) H) In Trial 5, the can containing the flat tasting beverage has been left to sit for two hours before being rolled down the incline. Experiment 3 shows that a bottle containing a flat tasting beverage that has been shaken and then left to sit for two hours will no longer contain any bubbles after the two hours. Therefore, the can from Trial 5 likely contains no bubbles.

15) A) The roll time would have most likely been less than 1.86 seconds. Specifically, the roll time would be likely to be near 1.75 seconds, the before shaking roll time for Trial 5, since this trial similarly represents a wait of two hours since the bottle was shaken before the can was rolled down the incline.

16) H) The before shaking roll time from Trial 4 (1.86 sec) represents a 15 min. wait since the can had last been shaken. The before shaking roll time for Trial 5 (1.75 sec) represents a two hour wait since the can had last been shaken. Because these two roll times are different, you can conclude that the bubbles from the shaking are having some effect on the role time after a wait of 15 minutes. Experiment 3 indicates that two hours after shaking, all the bubbles are gone, so they must have disappeared completely sometime between 15 minutes and two hours after shaking.

Passage IV

17) A) On this question, you must cross reference between Figure 1 and Table 1. First, use Figure 1 to find the wavelength of light with the highest absorption by chlorophyll b. Chlorophyll b is represented by the solid line on the graph, so its highest absorption occurs at a wavelength of around 480 nm. Now, match this wavelength with the color using Table 1. A wavelength of 480 nm corresponds with blue light.

18) F) This is the rare science question (typically 1-3 per test) that requires a bit of outside knowledge, in that you are expected to know that photosynthesis occurs within chloroplasts. If you did not know this, it still would have been somewhat doable, since the passage is discussing light being absorbed by chlorophyll. Because of the similarity in spelling between chlorophyll and chloroplasts, it would be reasonable to assume that the chemical reactions of photosynthesis occur within chloroplasts.

19) B) According to Figure 2, the rate of photosynthesis at 670 nm is 100%. You can get this either by lining up a wavelength of 670 nm on the x-axis with the corresponding value of 100 on the y-axis or simply by reading the label of the y-axis which indicates that the rate of photosynthesis is given “as a % of the rate at 670 nm.” Either way, you need to find a wavelength that has a rate of photosynthesis above 100 on the y-axis. Of the options given, 430 nm is the only wavelength with a rate of photosynthesis above 100; it has a rate of photosynthesis of approximately 105.

20) G) This is the rare science question (typically 1-3 per test) that requires a bit of outside knowledge, in that you are expected to know that the $C_6H_{12}O_6$ from the chemical equation in the passage is a sugar. If you did not recognize this based simply on its chemical composition, you could have figured it out if you knew that photosynthesis produced sugar. Even if you only knew that photosynthesis was how plants made their food, you may have been able to get this question correct, since plants are not known for their high fat or protein contents, and nucleic acid is genetic material not food.

21) C) On this question, you must cross reference between Figure 1 and Figure 2. Figure 2 shows that the highest rate of photosynthesis occurs at a wavelength of 440 nm. Figure 1 shows that a wavelength of 440 nm corresponds with the highest relative absorbance of chlorophyll a.

Passage V

22) G) The density of ethanol is found by looking at the density of the sample that is composed purely of ethanol, the sample for which the mass of ethanol is equal to the total mass, which is Sample 1.

23) C) Based on Table 3, PA-11 stays at the bottom in Liquid 5 but rises in Liquid 6. Therefore, its density must be in between that of Liquid 5 and Liquid 6. According to Table 1, Liquid 5 has a density of .999 g/mL, and according to Table 2, Liquid 6 has a density of 1.05 g/mL. Therefore, the density of PA-11 must be in between .999 and 1.05 g/mL.

24) H) This is an extrapolation question, meaning that you must project beyond the given values. You are given that the "mass of the solution in the graduated cylinder was 67.54 g." In Table 2, this value would go right below the value of 64.64 g of Liquid 10. Examining the mass of solution in graduated cylinder for each of the liquids in Table 2, you can see that an increase in mass of approximately 2-4 g corresponds with an increase in density of approximately .04-.06 g/mL. Therefore, the solution in the question, with a mass of 67.54 g, would have a density of .04-.06 g/mL greater than that of Liquid 10, with a mass of 64.64 g. This corresponds with a density of 1.33-1.35 g/mL.

25) B) Watch out for the "NOT." This question could be answered quickly and easily even without an understanding of what Table 3 means. None of the plastics in Table 3 feature any S's to the right of any R's, so answer choice B appears to be inconsistent with the results of the table. This is the case because, as shown by Tables 1 and 2, the density of the liquids increases from Liquid 1 to Liquid 10, or from left to right in Figure 3. Because an S represents that the bead stayed on the bottom and an R represents that the bead rose, no bead can have an S to the right of an R because that would indicate that it stayed on the bottom in a liquid that is denser than a liquid in which it rose to the top.

26) F) In the text of the Experiment 1, taring a scale defined as resetting it so that it reads 0.000 g. The text indicates that this was done after the graduated cylinder was put on the scale. If the scale was reset to 0.000 after the graduated cylinder was put on it, the obvious intent is that the reading of the scale would be a measure only of "the mass of the substances added to the graduated cylinder," which should not include the mass of the graduated cylinder itself.

27) B) Table 3 shows that polycarbonate is in fact more dense than PA-6, since polycarbonate stayed at the bottom in Liquid 8 while PA-6 rose in Liquid 8. If polycarbonate stayed at the bottom and PA-6 rose in the same liquid, polycarbonate must be more dense than PA-6.

Passage VI

28) H) Table 1 in Experiment 1 indicates the presence or absence of CO_2 and acid. To determine what information this gives you about fermentation, you must consult the text. The initial paragraph of the passage states the production of acid and CO_2 is the indicative of one fermentation pathway, while the production of acid alone is indicative of another fermentation pathway. Therefore, the presence of acid alone or acid and CO_2 is enough to conclude that fermentation has taken place, so according to Table 1, only Species B and Species D fermented lactose.

29) C) Table 1 shows that Species C produces both acid and CO_2 in a sucrose broth and that Species B produces both acid and CO_2 and a lactose broth. Therefore, a combination of both species will produce both acid and CO_2 in both the sucrose broth and the lactose broth.

30) G) Table 1 indicates that Species B is the only one of the four species that produces neither acid nor CO_2 in a sucrose broth and both acid and CO_2 in a lactose broth.

31) D) As will typically be the case if there's a word you don't know, synergism is defined in the text, and it is italicized so it is easy to find. The definition is located in Experiment 2, and it is described as "when 2 bacterial species act together to ferment a sugar by using a pathway that neither species can use alone." By this definition, Species C and D do act synergistically in Experiment 2 because they produce CO_2 in lactose broth when added together in Experiment 2, and neither Species C nor Species D produced CO_2 in lactose broth by itself in Table 1. If they are producing CO_2 in lactose broth together but not alone, they must be acting synergistically, according to the above definition.

32) G) Looking at your answer choices, you can see that you have to make two choices: 1) gas bubble or no gas bubble and 2) red or yellow broth. Whenever you are asked to make two choices on a science problem, it is best to consider each one individually. First, consider the gas bubble. Table 1 indicates that Species D does not produce CO_2 in sucrose broth. Therefore, there should be no gas bubble, so you can eliminate answer choices H and J. Now, you must decide if the broth should be red or yellow. Consult the text for clarification on the meaning of red versus yellow broth. The initial text of Experiment 1 states that yellow is indicative of a pH below seven, and the initial text of the passage indicates that acidity involves a lowering of the pH. Because the test tubes all start out with the pH of seven, the broth will become yellow if and only if acid is produced. Because acid is produced by Species D in sucrose broth, the solution will be yellow, so the answer is G.

33) D) As will typically be the case if there's a word you don't know, synergism is defined in the text, and it is italicized so it is easy to find. The definition is located in Experiment 2, and it is described as "when 2 bacterial species act together to ferment a sugar by using a pathway that neither species can use alone." By this definition, Species A and C do not act synergistically in Experiment 2. When together in Experiment 2, they produce both acid and CO_2 in sucrose broth and neither acid nor CO_2 in lactose broth. When each species is alone in Experiment 1, Species A produces neither acid nor CO_2 in sucrose broth and neither acid nor CO_2 and lactose broth, while Species C produces both acid and CO_2 in sucrose broth and neither acid nor CO_2 in lactose broth. Therefore, when put together, they do not produce any byproducts of fermentation that they didn't produce on their own, so they must not be acting synergistically, according to the above definition.

Passage VII

34) H) The second paragraph of the *DNA Hypothesis* indicates that, within a cell, the amount of DNA is directly proportional to the number of chromosomes, and the first paragraph of the *DNA Hypothesis* states that DNA is only present in the nucleus of a cell. Therefore, H is the correct answer.

35) D) According to the initial text of the passage (remember that the text before any hypothesis is presented is agreed upon by all parties), both hypotheses agree that chromosomes, which are located exclusively in the cell nucleus, hold all of a cell's genetic material. Therefore, if DNA is also found only in the nucleus, it supports the *DNA Hypothesis*, that DNA is the only component of genes.

36) J) The initial text of the passage, right below the diagram, states that amino acids are the subunits of proteins and nucleotides are the subunits of DNA, so J is the correct answer. If you were low on time at this point, you could have answered this question correctly simply by using a little common sense. What in nature is not composed of smaller subunits?

37) A) Answer choice A summarizes the main argument of the *Protein Hypothesis* that genes are composed of proteins rather than DNA. The *Protein Hypothesis* argues that this small number of nucleotides would be insufficient to contain all of the cell's hereditary information, and that the 20 amino acids found in proteins would be much better able to do the job.

38) F) The first two sentences of the *DNA Hypothesis* state, "Genes are made only of DNA. DNA is found exclusively in the cell's nucleus." The finding of genes in mitochondria would contradict this statement, because if DNA is the only component of genes, then this finding shows the presence of DNA outside a cell's nucleus.

39) B) The *DNA Hypothesis* implies that the different amounts of protein found in different types of cells of a given organism indicate that protein does not contain genetic material, because each cell within a given organism (with the exception of gametes) should contain the same genetic information and therefore the same amount of genetic material.

40) J) The initial text of the passage indicates that DNA is composed of nucleotides, not amino acids.