NJSLA-S Online Practice Test Answer and Alignment Document
Science: High School

Items 1–2

Domain: Life Science

Phenomenon: Higher concentrations of atmospheric carbon dioxide have led to increased biomass of many species, while biomass of coral reefs has decreased across the Great Barrier Reef in the hydrosphere.

Item 1

Item Type: Multiple Choice

Standards Alignment: DCI: LS2.B; SEP: CEDS; CCC: SC

Key: A

Rationale:

Figure 4 shows an increase in atmospheric CO_2, Figure 1 shows how CO_2 is absorbed into the ocean through direct absorption from the atmosphere and photosynthesis, and Figure 2 shows the increase in acidity over the same time as Figure 4.

Answer B is invalid based on Figure 1. CO_2 is primarily being absorbed by the ocean, not emitted.

Answer C is invalid based on Figure 2.

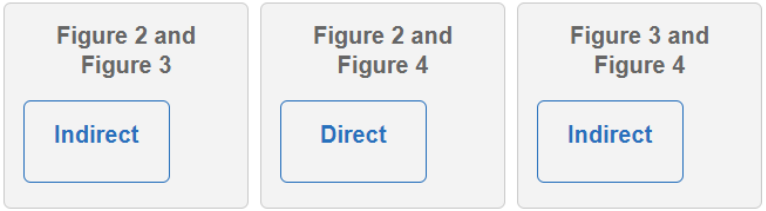
Answer D is invalid based on Figure 4.

Item 2

Item Type: Technology Enhanced

Standards Alignment: DCI: LS2.B; SEP: AID; CCC: SC

Key: A correct response will look like this:



Rationale:

In Figure 2, ocean acidity is increasing, and as it increases, the percentage of reef surface covered by live coral decreases, as shown in Figure 3. This suggests an indirect relationship. In Figure 2, ocean acidity is increasing, and as it increases, the concentration of atmospheric carbon dioxide is increasing, as shown in Figure 4. This suggests a direct relationship. In Figure 3, the percentage of reef surface covered by live coral is decreasing, while Figure 4 shows the concentration of atmospheric carbon dioxide increasing, which suggests an indirect relationship.

Items 3–5

Domain: Earth and Space Science
Phenomenon: Changes in the concentration of carbon dioxide in the atmosphere impacts global sea level.

Item 3

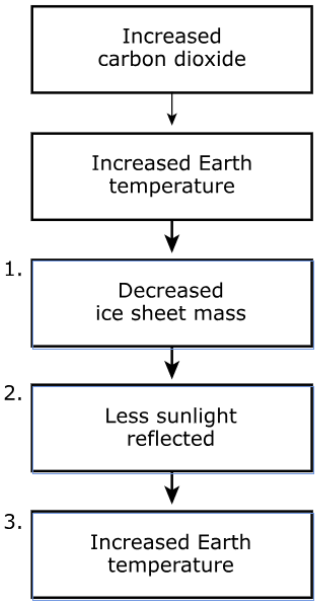
Item Type: Multiple Choice
Standards Alignment: DCI: ESS2.A; SEP: AQDP; CCC: SC
Key: D
Rationale:
Figure 1 shows the increase in atmospheric CO_2 over time. Figures 2 and 3 show the correlation to Figure 1. As the CO_2 increases, so does the global sea level, and the mass of the ice sheet decreases. Therefore, the data show why the Greenland ice sheet is changing, answer D.
Answer A is invalid because there is no information regarding the surface area of the ice sheet.
Answer B is invalid because the description explains that the climate is being affected not by the ice sheet but by the rising CO_2 levels.
Answer C is invalid because it does not correlate to Figures 1 or 2.

Item 4

Item Type: Technology Enhanced
Standards Alignment: DCI: ESS2.A; SEP: AID; CCC: C and E
Key: B and E
Rationale:
Figure 1 shows the increase in atmospheric CO_2 over time. Figures 2 and 3 show the correlation to Figure 1. As the CO_2 increases, so does the global sea level, and the mass of the ice sheet decreases. Therefore, statements B and E are best explained by the data.
Statement A is invalid because Figures 2 and 3 show the opposite phenomenon: as the ice sheet mass decreases, the sea level rises.
Statement C is invalid because Figures 1 and 2 show the opposite phenomenon: as the sea level rises, the CO_2 also rises.
Statements D and F are invalid because Figures 1 and 3 show the opposite phenomenon: as the atmospheric CO_2 rises, the ice sheet mass decreases.

Item 5

Item Type: Technology Enhanced
Standards Alignment: DCI: ESS2.D; SEP: DUM; CCC: C and E
Key: A correct response will look like this:



Rationale:
The stimulus states that rising carbon dioxide levels are correlated with rising atmospheric temperatures. Figure 1 shows carbon dioxide concentration in the atmosphere increasing; therefore, atmospheric temperatures must be increasing. Figure 2 shows global sea level rising, which is due to ice sheets melting because the temperature is increasing. Less ice will reduce the amount of sunlight reflected back to space, causing more heat to be retained, which will further increase atmospheric temperature.

Items 6–7

Domain: Life Science
Phenomenon: Peppered moths, *Biston betularia*, exhibit light- and dark-color variations. Over the years 1950–2000, changes to the trees inhabited by a population of peppered moths were observed.

Item 6

Item Type: Multiple Choice
Standards Alignment: DCI: LS4.C; SEP: EAE; CCC: PAT
Key: D
Rationale:
Figure 1 shows that tree color changed from soot-darkened in 1950 to lichen-covered and light by 2000. Figure 1 also provides an example of the two color varieties of peppered moths. Table 1 shows that the percentage of dark-colored moths decreased over the same time period, as the trees became lighter, while the percentage of light-colored moths increased as the trees became lighter. This supports a direct correlation between tree color and moth color.
Answers A and C are invalid because the tree color is not caused by the moths, but by soot or lichen.
Answer B is invalid because moth color is a genetic trait. Moths are either light- or dark-colored. Their percentages are a function of their ability to survive. One cannot turn into the other.

Item 7

Item Type: Technology Enhanced
Standards Alignment: DCI: LS2.C; SEP: UMCT; CCC: S, P, and Q
Key: 1960 or 60
Rationale:
The introduction states that in 1950, trees were dark as the result of soot coverage, and in 2000 they were light and lichen-covered. Information in the item stem further indicates that pollution control laws were enacted, and soot emissions by industries were reduced. Table 1 provides data on changes in dominant moth coloration in the population by decade from 1950–2000.

1950: dark 98.5% and light 1.5%
1960: dark 95.9% and light 3.1%
1970: dark 78.1% and light 21.9%
1980: dark 64.7% and light 35.3%
1990: dark 42.3% and light 57.7%
2000: dark 19.0% and light 81.0%

Based on Table 1, the first significant change in the percentage of dark and light-colored moths in the population occurred in 1970; therefore, pollution-control laws would have to have been enacted prior to 1970. Because there was no significant change in the percentage of dark- and light-colored moths in the population between 1950 and 1960, the laws must have been enacted sometime in the 1960s.

Items 8–10

Domain: Physical Science
Phenomenon: A clear marble made of a type of absorbent polymer is easily visible when held, but seems to disappear when placed in a glass of water.

Item 8

Item Type: Multiple Choice
Standards Alignment: DCI: PS4.A; SEP: UMCT; CCC: S & SM
Key: B
Rationale:
The introduction gives the frequency, *f,* and the formula for finding the velocity, *v*. Table 1 gives the velocity of the light through water. The formula for the wavelength λ is solved like this:

$$\nu = f\lambda$$

$$\lambda = \frac{\nu}{f} = \frac{2.25 \times 10^{8}}{5.60 \times 10^{14}} = 4.02 \times 10^{-7} m$$

Item 9

Item Type: Multiple Choice
Standards Alignment: DCI: PS4.A; SEP: AID; CCC: S & SM
Key: A correct response will look like this:

As the light passes from the air into the glass, the velocity of light
decreases. ▾ As the light passes from the glass to the water, the
wavelength increases. ▾ As the light passes from the water into the
polymer marble, the velocity of light stays the same. ▾

Rationale:
According to Table 1, the velocity of light decreases from 3.00×10^8 m/s in air to 2.00×10^8 m/s in glass. The velocity of light then increases as it passes from the glass into the water to a speed of 2.25×10^8 m/s. Since the frequency of light is being held constant and the wavelength changes as the light travels through different materials, the speed of light changes as well. As noted in the table, as the light travels from the water into the marble, the speed does not change.

Item 10

Item Type: Multiple Choice
Standards Alignment: DCI: PS4.A; SEP: OECI; CCC: C and E
Key: B
Rationale:
According to Table 1, the speed of light is the same in the polymer as in water, and slower than in air. This makes answer B valid and answer A invalid.
Answer C is invalid because there is no information regarding changing the frequency.
Answer D is invalid by using the information in Table 1 and the equation $v = f\lambda$. Since frequency is being held constant, if the velocity changes, then the wavelength must change proportionally.

Items 11–12

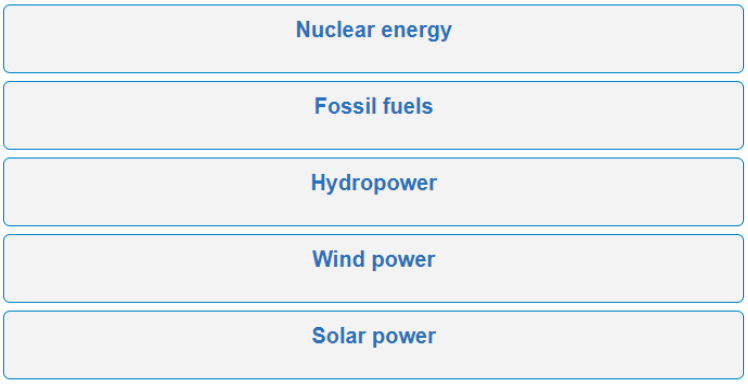
Domain: Earth and Space Science
Phenomenon: There are over a million more solar power installations than fossil fuel plants in America. However, fossil fuels generate the most electricity, and solar power contributes the least.

Item 11

Item Type: Multiple Choice
Standards Alignment: DCI: ESS3.C; SEP: OECI; CCC: S,P, and Q
Key: D
Rationale:
Table 1 shows that electrical plants that use wind power generated 30 grams of CO_2 per kilowatt hour produced, while fossil fuel-based power plants generated 506 grams of CO_2 per kilowatt hour produced. Therefore, using wind power would maximize power production and minimize GHG emissions.
Answers A and B are invalid because the question asks about power production, not cost comparison.
Answer C is invalid because the table lists the GHG emission of wind power (30) as less than that of fossil fuels (506).

Item 12

Item Type: Technology Enhanced
Standards Alignment: DCI: ESS3.C; SEP: UMCT; CCC: S,P, and Q
Key: A correct response will look like this:



Rationale:
Table 1 shows that 1,500,000 solar power installation facilities generated 0.9% of the electricity in America; 52,343 wind turbine facilities generated 5.6%; 1,440 hydropower facilities generated 6.5% of the electricity; 62 nuclear power plant facilities generated 20% of the electricity; and 3,288 fossil fuel power plant facilities generated 65% of the electricity. To determine the amount of electricity generated per facility, the percentage (%) of energy generated must be divided by the number of facilities.

Solar power: $0.9\% \div 1{,}500{,}000 = 6.0 \times 10^{-7}$ % per facility
Wind power: $5.6\% \div 52{,}343 = 1.1 \times 10^{-4}$ % per facility
Hydropower: $6.5\% \div 1{,}440 = 4.5 \times 10^{-3}$ % per facility
Nuclear energy: $20\% \div 62 = 3.2 \times 10^{-1}$ % per facility
Fossil fuels: $65\% \div 3288 = 1.9 \times 10^{-2}$ % per facility

Item 13–15

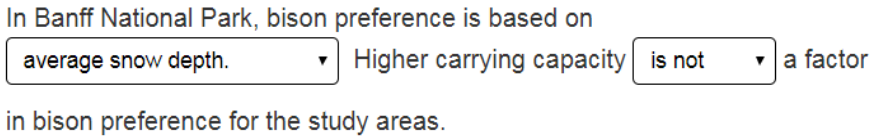
Domain: Life Science
Phenomenon: Even though bison generally require large, open areas with dense grass coverage to survive, they are sometimes observed living in small areas with sparse grass coverage.

Item 13

Item Type: Multiple Choice
Standards Alignment: DCI: LS2.A; SEP: AID; CCC: S,P, and Q
Key: A
Rationale:
The description explains that on average, each bison consumes 2,300 kg of grass over the winter; therefore, a herd of 2,000 bison will need at least 4.6 million kg of grass. Areas 1 and 2 both exceed this minimum, while areas 3 and 4 do not even reach this threshold. Additionally, the description states that each bison requires 0.05 sq km of grassland. A herd of 2,000 bison would require 100 sq km of grassland. Therefore, only areas 1 and 2 would be able to support a 2,000 head herd, making answer A the correct answer.
Answers B, C, and D have either area 3 or 4 as an option, and therefore cannot be valid.

Item 14
Item Type: Multiple Choice
Standards Alignment: DCI: LS2.A; SEP: UMCT; CCC: S, P, and Q
Key: C
Rationale:
To determine how much grass juvenile bison in a 100-bison herd will eat in 30 days, first the number of juveniles must be calculated. Table 2 shows that the proportion of juveniles in a herd is approximately .2 so 100 bison multiplied by .2 is 20 juveniles, which is multiplied by 6.6 kg of grass per day, which equals 132 kg daily, multiplied by 30 days, which equals 3,960 kg of grass consumed by the juveniles in a 30-day period. Choice A gives the daily amount of grass consumed by the juveniles (forgetting to multiply by 30 days), Choice B give the daily rate of consumption for 30 days by one juvenile (forgetting to multiply 100 × .2 to get the total number of juveniles), and Choice D gives the amount of grass consumed in 30 days by 100 juvenile bison (forgetting to multiply the total herd of 100 by the proportion that are juveniles, .2).

Item 15
Item Type: Technology Enhanced
Standards Alignment: DCI: LS2.A; SEP: AID; CCC: PAT
Key: A correct response will look like this:



Rationale:
Area 4 has the lowest average snow depth and the second-lowest total amount of grass available and amount of grassland available. It is also the second-smallest area, yet it is the most popular for the bison to live on. Area 1, on the other hand, is the largest area with the second-most amount of grassland and total grass available, but the deepest snow, and is least popular for the bison. Therefore, it can be concluded that snow depth played a major factor in where the bison want to live, and the overall size and amount of grassland is not an important factor.

Item 16–18

Domain: Earth and Space Science

Phenomenon: Tectonic plates interact in different ways, but most interactions result in some type of mountain formation.

Item 16

Item Type: Technology Enhanced

Standards Alignment: DCI: ESS2.B; SEP: DUM; CCC: C and E

Key: A correct response will look like this:

Seamounts form where [oceanic] plates [separate from]
each other and magma [rises] between them.

Rationale:

Figure 1 shows that seamounts form along a mid-ocean ridge between plate (B) and plate (C) which are moving apart, as indicated by the direction of the arrows in the oceanic crust, and that magma rises in this area. No continental crust occurs where seamounts are shown to form; arrows indicate clearly that plates are neither colliding (between C and D) nor slipping past each other (between D and E) and that magma is rising up through the ridge, adding new material.

Item 17

Item Type: Technology Enhanced

Standards Alignment: DCI: ESS2.B; SEP: AID; CCC: PAT

Key: A correct response will look like this:

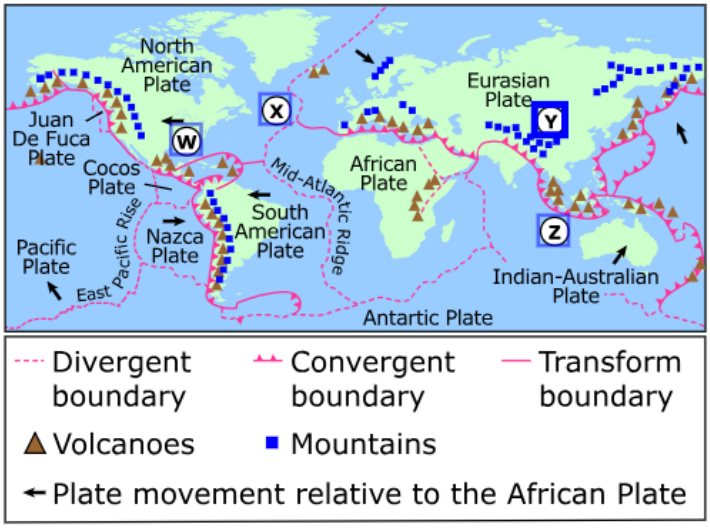


Figure 2. Tectonic Plate Boundaries

Rationale:

According to Figure 1, mountains are associated with the boundary between plates C and D, which are being pushed together. There is a mountain chain in area Y, as indicated by the blue dots; therefore, this area is representative of the boundary between plates C and D. Area W is positioned near a transform boundary where no mountains occur. Area X is located at a divergent boundary where the plates are moving in opposite directions, away from one another. Area Z is located south of a convergent boundary on the ocean floor, where there does not appear to be active mountain building.

Item 18

Item Type: Technology Enhanced
Standards Alignment: DCI: ESS2.B; SEP: AID; CCC: PAT
Key: A correct response will look like this:

A trench is a feature that is associated with a [convergent ▾] plate boundary. It is created when one plate [is forced underneath ▾] another plate.

Rationale:
Figure 1 shows a trench between oceanic plates (A) and (B). The arrows indicate these two plates are moving together (converging) and plate (A) is being forced beneath plate (B). At transform boundaries, plates slip past each other; this is not happening between (A) and (B). At divergent boundaries, the plates move away from each other; this is not happening between (A) and (B). The only lateral movement shown in Figure 1 is between plates (D) and (E), and the only area of divergence is shown at the spreading center (ridge) on plate (B).

Items 19–23

Domain: Physical Science
Phenomenon: A single hard disk drive can contain all the information from many libraries. When putting the information onto the disk, the disk does not change in size or composition.

Item 19

Item Type: Multiple Choice
Standards Alignment: DCI: PS4.C; SEP: OECI; CCC: SF
Key: D, A
Rationale:
The introduction explains how data is stored on a hard disk by reversing the electrical current going through a wire, flipping the magnetic polarity on the disk. This implies that the two most important factors for storing information on the hard disk are the sign of the current and the direction of the magnetic polarity (answers A and D).
Answer B is invalid because the introduction explains that the size of the disks has not changed.
There is no information regarding the speed of the write head or the effect of previous data stored, making answers C and E invalid.

Item 20

Item Type: Technology Enhanced
Standards Alignment: DCI: PS4.C; SEP: UMCT; CCC: S,P, and Q
Key: 8,000,000
Rationale:
According to the table, there are 8 bits in a byte and 1 million bytes in a MB:

8 bits = 1 byte 10^6 bytes = 1 MB 8×10^6 bits = 1 MB

Item 21

Item Type: Technology Enhanced
Standards Alignment: DCI: PS4.A; SEP: AID; CCC: SF
Key: A correct response will look like this:

Bit Number	Current Meter = Positive	Current Meter = Negative
Bit #1	●	○
Bit #2	○	●
Bit #3	●	○
Bit #4	○	●
Bit #5	○	●
Bit #6	●	○
Bit #7	○	●
Bit #8	●	○

Rationale:
In Figure 1, the diagram shows that when the current is positive, a down or “0” is recorded, and when the current is negative, an up or “1” is recorded. Using that information and the binary code provided in the question, the code can be deciphered.

Item 22

Item Type: Technology Enhanced
Standards Alignment: DCI: PS4.C; SEP: AID; CCC: SF
Key: J
Rationale:
In Figure 1, the diagram shows that the positive current gives a down or “0” from a repulsive interaction because like poles repel, which is stated below image of the positive current. Also, in Figure 1, the diagram shows that the negative current gives an up or “1” from an attractive interaction because opposite poles attract, which is stated below the image of the negative current. With that information and the table, the binary code should read 01001010. Referring to Table 2, 01001010 corresponds to the letter “J.”

Item 23

Item Type: Constructed Response

Standards Alignment: DCI: PS4.A; SEP: CEDS; CCC: SF

Sample student response:

A) The current running through the coil creates a magnetic field around the write head. When the current changes direction, it also changes the direction of the magnetic field created. The magnetic field then magnetizes the grains on the hard disk. As seen in Figure 1, when the current is positive, the magnetic field causes the grain to magnetize downward and stores this as a 0 on the grain. When the current is negative, the magnetic field causes the grain to magnetize upward and stores this as a 1 on the grain. These 1s and 0s are the stored information.

B) The write head magnetizes each grain on the hard drive to store either a 1 or 0. For the letter R, the write head needs to magnetize 8 grains. Per Table 3, the 1st, 3rd, 5th, 6th, and 8th grain have repulsive magnetic interactions, and thus must be magnetized in the downward direction; while the 2nd, 4th, and 7th grain have attractive magnetic interactions, and thus must be magnetized in the upward direction according to Figure 1. This magnetization caused by the write head stores an 8-bit sequence of 01010010 on the hard drive to save the letter R on the hard drive.

C) When a current is applied to the write head, the write head becomes magnetized and causes a magnetic interaction with each grain of the hard drive. According to Figure 1, when the current is positive, the magnetic interaction between the write head and the grain is repulsive and stores a bit of 0 on the grain, seen as a downward arrow. Also based on Figure 1, when the current is negative, the magnetic interaction between the write head and the grain is attractive and stores a bit of 1 on the grain, seen as an upward arrow.

Key:

This item has 4 quality points:

- 1 point for explaining that the conversion from current to magnetism is required to store information.
- 1 point for using a letter from Table 3 to construct a correct bit stream.
- 1 point for giving the correct combination of polarity (+/-), attraction (attract/repel), and bit (0/1).
- 1 point for supporting all previous explanations using evidence from Figure 1.

Rationale:

- This information is given in the third paragraph of the introduction, along with the diagram in Figure 1.
- In Figure 1, the diagram shows that the positive current gives a down or “0” from a repulsive interaction because like poles repel, which is stated below image of the positive current. Also in Figure 1, the diagram shows that the negative current gives an up or “1” from an attractive interaction because opposite poles attract, which is stated below the image of the negative current. With that information and the table, students should be able to create a binary code for any of the given letters.