STUDENT NAME _____
(please print)

Grade
11

New Jersey Student Learning Assessment–Science (NJSLA–S) Practice Test

FORM
A

Grade 11

Unit 1 Practice Test

Directions:

Today you will take Unit 1 of the Grade 11 New Jersey Student Learning Assessment - Science (NJSLA-S) Test.

Follow the directions to answer each question. Mark your answers by completely filling in the circles in your answer document. **Only answers you provide in your answer document will be scored.** Do not make any pencil marks outside the circles in your answer document. If you need to change an answer, be sure to erase your first answer completely.

If a question asks you to show or explain your work, you must do so to receive full credit. Write your response in the space provided in your answer document. Only responses written within the provided space will be scored.

If you do not know the answer to a question, you may go on to the next question. If you finish early, you may review your answers and any questions you did not answer in this unit **ONLY**. Do not go past the stop sign.

Use the information below to answer questions 1 and 2.

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.

Carbon is cycled through the atmosphere and hydrosphere by photosynthesis and cellular respiration, as shown in Figure 1.

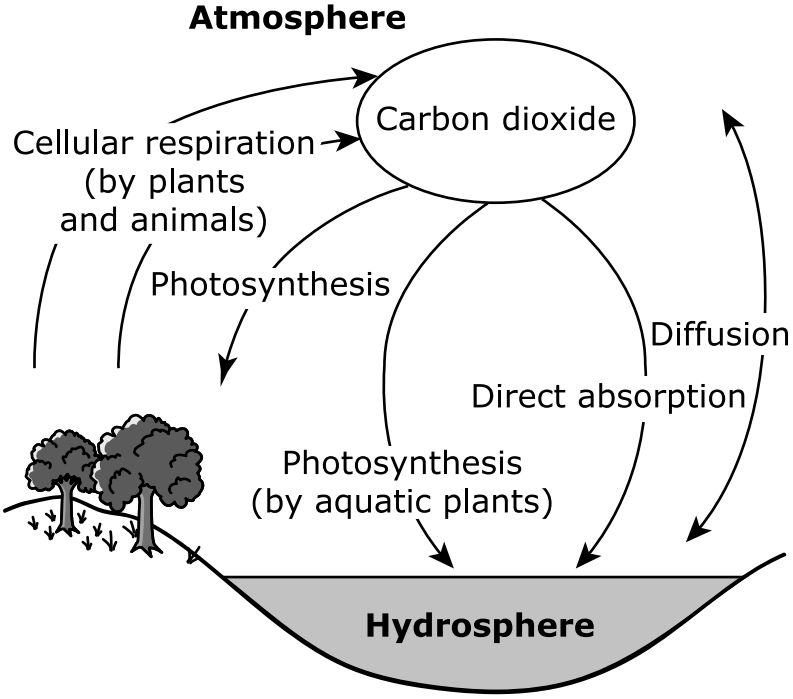


Figure 1. Carbon Cycle between Atmosphere and Hydrosphere

Figure 2 shows ocean acidity. Ocean acidity is expressed as a measure of the concentration of hydrogen ions present in a liter of ocean water, with higher concentrations indicating a higher acidity.

Ocean Acidity

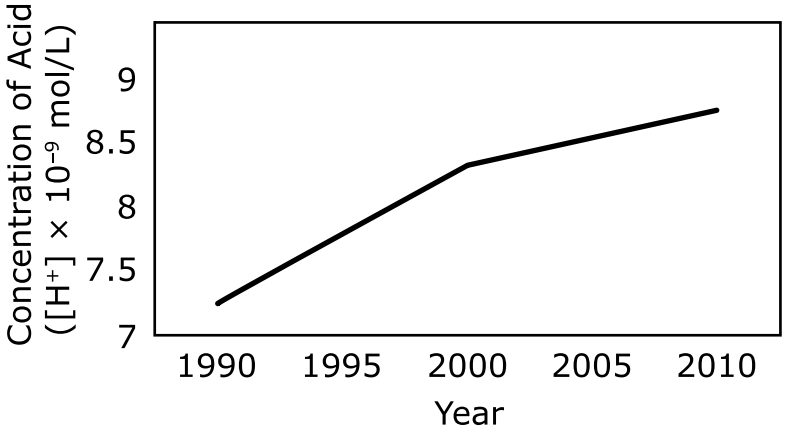


Figure 2.

GO ON →

Figure 3 shows the percentage of reef surface covered by live coral across the Great Barrier Reef from 1990 to 2010.

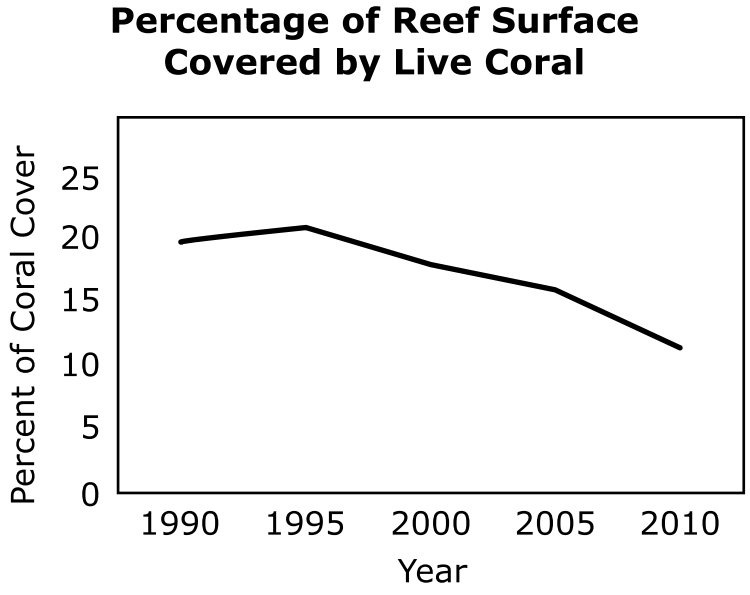


Figure 3.

Figure 4 shows the concentration of atmospheric carbon dioxide over the same span of time.

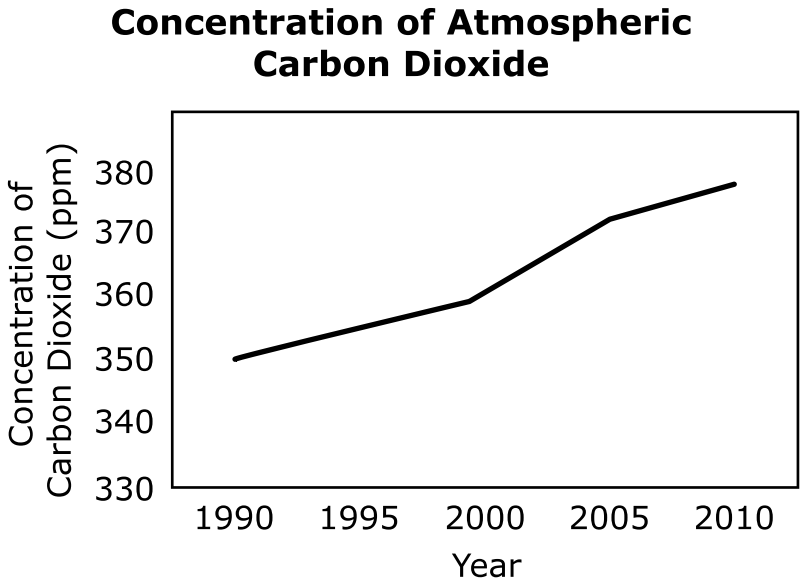


Figure 4.

GO ON →

1. Based on the data, which statement **best** describes the relationship causing the decreased biomass of the coral reef species in the hydrosphere?

A. Ocean acidity is increasing because atmospheric carbon dioxide and absorption in the hydrosphere are increasing.

B. Atmospheric carbon dioxide and absorption in the hydrosphere are increasing because ocean acidity is increasing.

C. Ocean acidity is decreasing because atmospheric carbon dioxide and absorption in the hydrosphere are increasing.

D. Atmospheric carbon dioxide and absorption in the hydrosphere are decreasing because ocean acidity is increasing.

2. Identify the relationships between Figure 2, Figure 3, and Figure 4.

A.

Figure 2 and Figure 3	Figure 2 and Figure 4	Figure 3 and Figure 4
Direct	Direct	Indirect

B.

Figure 2 and Figure 3	Figure 2 and Figure 4	Figure 3 and Figure 4
Indirect	Direct	Indirect

C.

Figure 2 and Figure 3	Figure 2 and Figure 4	Figure 3 and Figure 4
No Relationship	Direct	No Relationship

D.

Figure 2 and Figure 3	Figure 2 and Figure 4	Figure 3 and Figure 4
Indirect	Direct	No Relationship

Use the information below to answer questions 3–5.

Changes in the concentration of carbon dioxide in the atmosphere impacts global sea level.

Rising carbon dioxide (CO_2) levels are correlated with rising atmospheric temperatures. Researchers collected data, shown in Figures 1 and 2, on atmospheric carbon dioxide and global sea level.

Atmospheric Carbon Dioxide

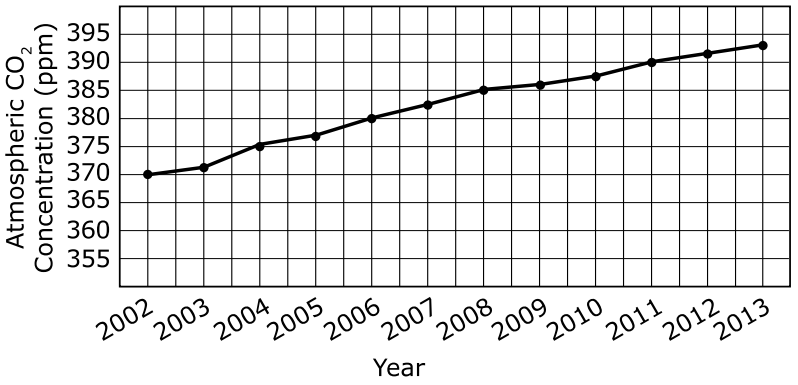


Figure 1.

Change of Global Sea Level

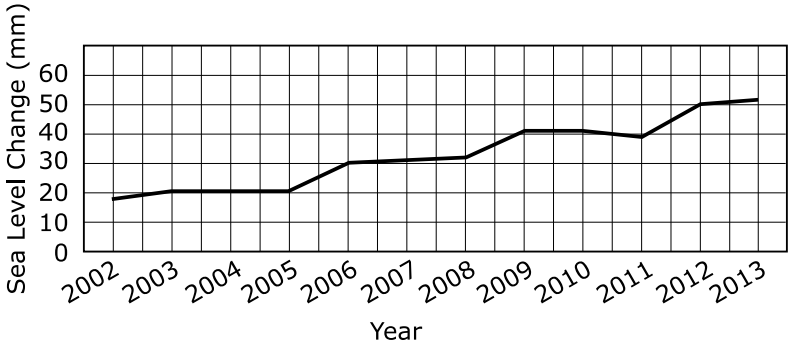


Figure 2.

Researchers also collected data on the Greenland ice sheet as shown in Figure 3. The Greenland ice sheet contains the second largest amount of land ice on the planet, after Antarctica. Together, these ice sheets hold more than 99% of the freshwater ice on Earth and have important impacts on global sea level and climate.

Change in Greenland Ice Sheet Mass

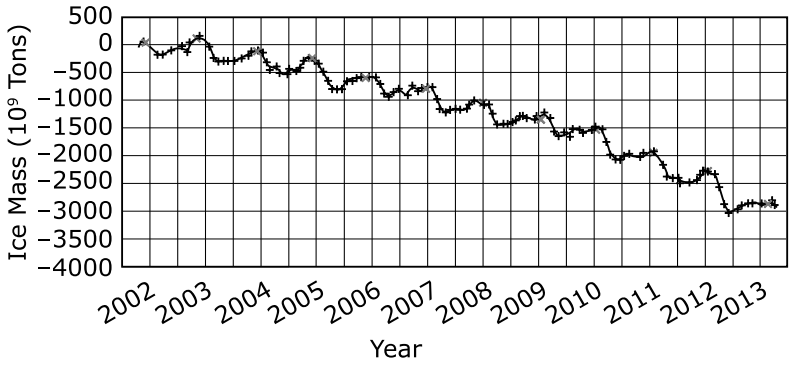


Figure 3.

GO ON →

3. Which question is **best** addressed by analyzing the data?

A. What is the surface area of the Greenland ice sheet?

B. How does the Greenland ice sheet affect climate?

C. Why is the Greenland ice sheet made out of freshwater?

D. What is causing the Greenland ice sheet mass to decrease?

4. Which statements are **best** supported by the data?

Select **two** of the six statements.

A. As ice sheet mass increases, sea level rises.

B. As atmospheric carbon dioxide increases, sea level rises.

C. As sea level rises, atmospheric carbon dioxide decreases.

D. As atmospheric carbon dioxide decreases, ice sheet mass decreases.

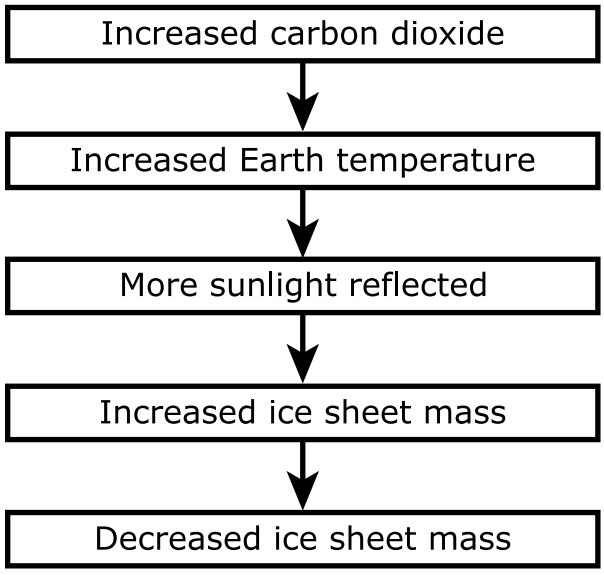
E. As atmospheric carbon dioxide increases, ice sheet mass decreases.

F. As ice sheet mass decreases, atmospheric carbon dioxide decreases.

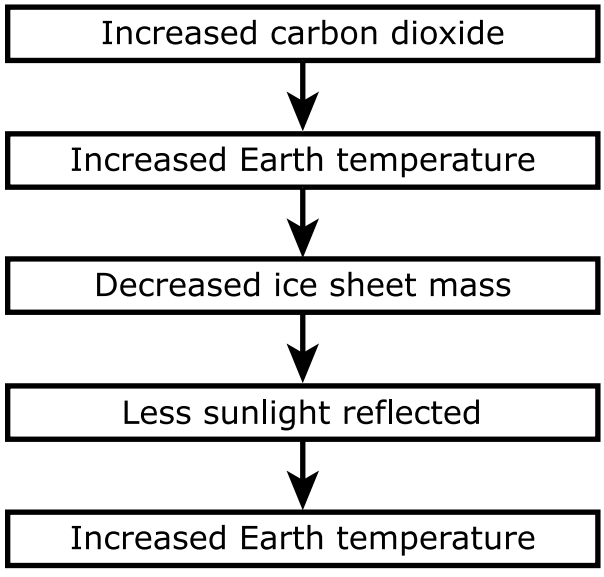
5. The ice sheets reflect energy from sunlight back into space and allow the Earth to stay cooler. If the ice sheets melt, the amount of energy reflected will change, and thus the temperature of the Earth can change.

Based on the data, complete the model to show how a change in the ice sheets leads to changes in other Earth systems.

A.

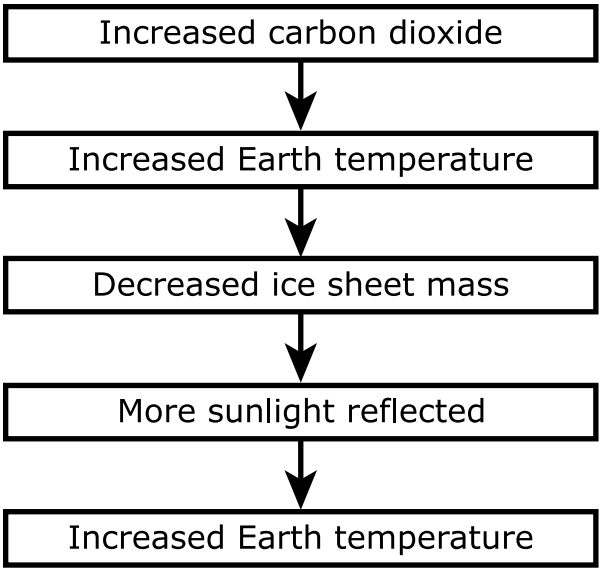


B.

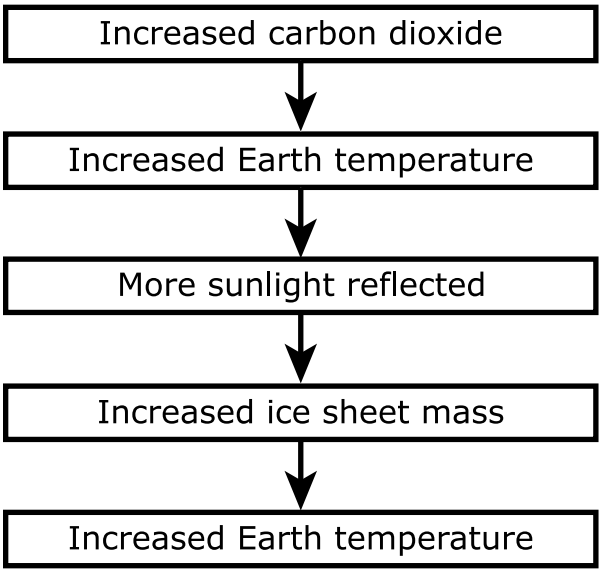


(Item 5 continued)

C.



D.



Use the information below to answer questions 6 and 7.

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.

In 1950, trees were primarily dark and covered in soot, as shown in Figure 1A. In 2000, trees in the same areas were primarily light and covered in lichen, as shown in 1B. Light- and dark-colored moths are shown on each tree.

Figure 1A

Figure 1B

Figure 1. Dark Soot-Covered Oak Tree and Light Lichen-Covered Oak Tree

Table 1 shows percentages of dark and light moths in the population from 1950 to 2000.

Table 1. Dark and Light Moths in the Population

Year	Dark (%)	Light (%)
1950	98.5	1.5
1960	95.9	3.1
1970	78.1	21.9
1980	64.7	35.3
1990	42.3	57.7
2000	19.0	81.0

Table 2 shows the survival percentages of dark and light moths in different environments.

Table 2. Survival Percentages of Dark and Light Peppered Moths in Different Environments

	Survival Percentage of Each Color Variation	
Environment	**Dark (%)**	**Light (%)**
Darker	5.7	1.5
Lighter	4.7	13.7

6. Which correlation between the peppered moth population and its environment is **best** supported by the data provided?

A. When dark-colored moths migrated out of the population, tree color changed from mostly dark to mostly light.

B. Dark-colored moths turned into light-colored moths when tree color changed from mostly dark to mostly light.

C. When light-colored moths outcompeted dark-colored moths, tree color changed from mostly dark to mostly light.

D. Light-colored moths became more common than dark-colored moths when tree color changed from mostly dark to mostly light.

7. The environmental change that occurred was due to the enactment of pollution-control laws. These laws significantly reduced the amount of smoke being released into the environment by some industries.

Based on the data in Table 1, during which decade were these laws **most likely** first enacted?

A. 1950

B. 1960

C. 1970

D. 1980

E. 1990

F. 2000

Use the information below to answer questions 8–10.

A clear marble made of a type of absorbent polymer (a type of plastic) is easily visible when held, but seems to disappear when placed in a glass of water.

Light with a frequency of 5.60×10^{14} Hz (Hertz) is used to test the behavior of light through the different substances. The velocity of light (v) is measured as the product of frequency (f) and wavelength (λ):

$$v = f\lambda$$

Figure 1 shows a polymer marble before and after it is dropped into a glass of distilled water. As indicated, the light changes velocity when it passes through each substance.

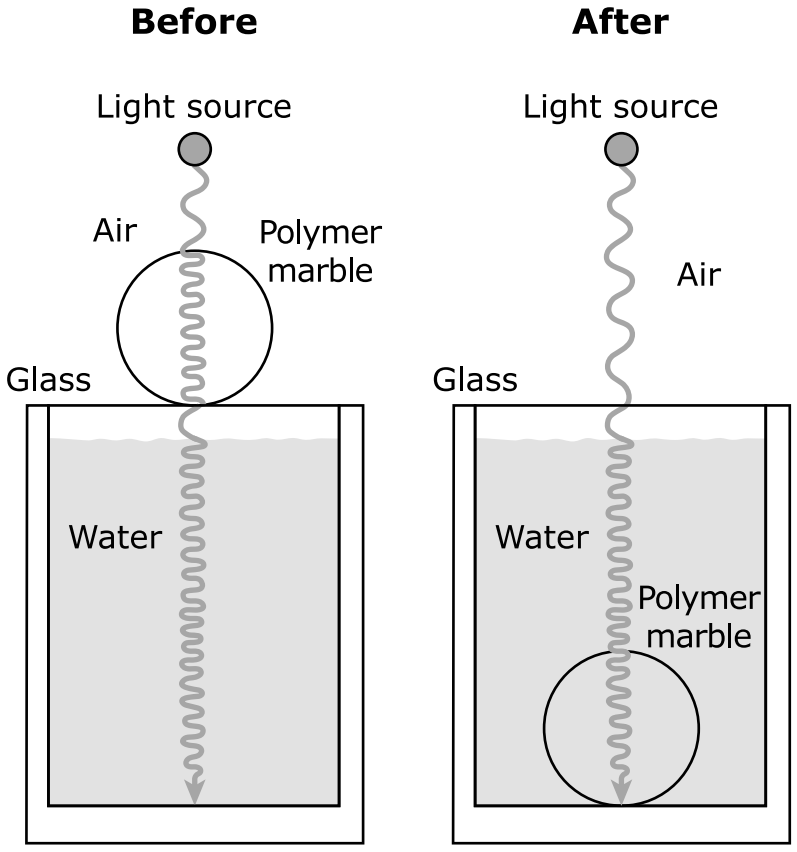


Figure 1. Model of Polymer Marble Before and After Being Placed Into a Glass of Clear Water (Not to Scale)

Table 1 shows light velocity data, in meters per second (m/s), for various substances.

Table 1. Velocity of Light through Different Substances

	Air	Water	Polymer	Glass
Velocity ($\times 10^8$ m/s)	3.00	2.25	2.25	2.00

GO ON →

8. Which wavelength (λ) of the light results as it passes from water into the polymer ball?

A. 3.57×10^{-7} m

B. 4.02×10^{-7} m

C. 5.35×10^{-7} m

D. 7.12×10^{-7} m

9. The polymer marble is placed in a glass full of water. A beam of light passes through the different materials, as shown in Figure 2.

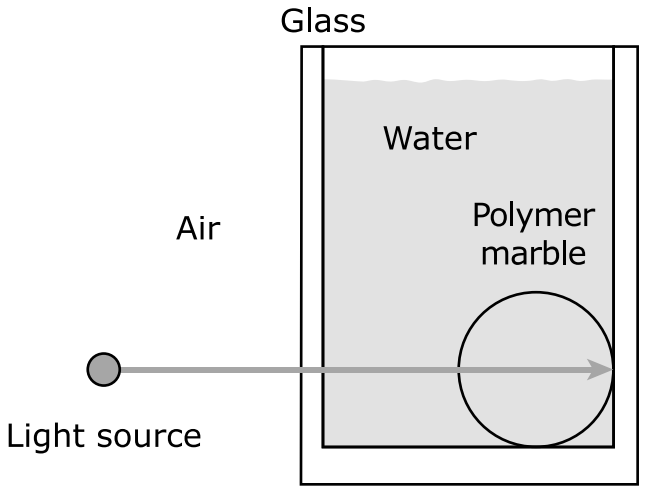


Figure 2. Light Beam Passing Through a Water Glass

Select the correct word or phrase from each box to complete the statements that describe the behavior of light as it passes through the different materials.

As the light passes from the air into the glass, the velocity of light [X]. As the light passes from the glass to the water, the wavelength [Y]. As the light passes from the water into the polymer marble, the velocity of light [Z].

Box X

A. increases

B. decreases

C. stays the same

Box Y

A. increases

B. decreases

C. stays the same

(Item 9 continued)

Box Z

A. increases

B. decreases

C. stays the same

10. Which observations are consistent with the given information and diagrams, and could help explain why the polymer ball is visible in air but invisible in water?

A. The speed of light is the same in the polymer and air, but different in water.

B. The speed of light is the same in the polymer and water, but different in air.

C. The frequency of light is the same in the polymer and water, but different in air.

D. The wavelength of light is the same in the polymer and air, but different in the water.

Use the information below to answer questions 11 and 12.

There are over one million more solar power installations than fossil fuel plants in America. However, fossil fuels generate the most electricity, and solar power contributes the least.

Construction and use of electrical power plants produce carbon dioxide, which is a greenhouse gas (GHG). Building new power plants that maximize power production but minimize GHG emission is a current engineering challenge. One approach used in the United States is to construct power plants that use renewable energy.

Characteristics of electrical plants that use certain renewable or nonrenewable sources of energy are listed in Table 1.

Table 1. Energy Sources and Characteristics

Energy Sources	Renewable			Nonrenewable	
	Solar Power	Wind Power	Hydropower	Nuclear	Fossil Fuels
GHG Emissions Intensity (grams of CO_2 per kilowatt hour produced)	97	30	27	30	506
Cost (cents per kilowatt hour produced)	6	6	2	9.5	≤7.5
Number of Facilities (installations, turbines, or plants)	1.5 million	52,343	1,440	62	3,288
Electricity Generated in 2016	0.9%	5.6%	6.5%	20%	65%

11. Which statement correctly answers the question of whether electrical plants that use wind power instead of fossil fuels would maximize power production and minimize GHG emissions?

A. No, using wind power costs more than using fossil fuels.

B. Yes, using wind power costs less than using fossil fuels.

C. No, using wind power creates a higher GHG emission intensity than using fossil fuels.

D. Yes, using wind power produces a lower GHG emission intensity than using fossil fuels.

12. Choose the option that shows the energy sources that have been arranged from the **greatest** (top) to the **least** (bottom) amount of electricity produced per facility.

A. nuclear energy
hydropower
wind power
solar power
fossil fuels

B. nuclear energy
fossil fuels
hydropower
wind power
solar power

C. fossil fuels
nuclear energy
wind power
hydropower
solar power

D. fossil fuels
nuclear energy
solar power
wind power
hydropower

Use the information below to answer questions 13–15.

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.

Scientists studied four areas in Canada's Banff National Park to determine habitat suitability for bison.

Table 1. Characteristics of Bison Areas

Area	Size (km^2)	Amount of Grassland (km^2)	Total Grass Available (millions of kg)	Average Snow Depth (cm)
1	435	130	6.53	110
2	424	148	7.42	80
3	286	57	2.86	100
4	245	74	3.68	60

Table 2 provides data for the different classes of bison. Bison individually consume an average of 2,300 kilograms of grass and require an average of 0.05 square kilometers of grassland during the entire winter period.

Table 2. Bison Data

Age Group	Average Body Mass (kg)	Average Rate of Grass Consumption (kg/day)	Proportion of Herd Population
Adult male	800	20.0	0.3
Adult female	440	12.1	0.5
Juvenile	220	6.60	0.2

13. Based on the estimates of total grass available in the study areas and average grass consumption of an individual bison, which study areas could support a herd of 2,000 bison over the winter?

A. 1 or 2

B. 2 or 3

C. 3 or 4

D. 1 or 4

14. Scientists plan to introduce a 100-bison herd into a potential habitat area. Which estimate for how much grass all of the juvenile bison in the herd will eat over a period of 30 days is supported by Table 2?

A. 132 kg

B. 198 kg

C. 3,960 kg

D. 19,800 kg

15. After introducing bison herds into the park, the scientists observed that the bison prefer to occupy study areas 4, 2, 3, and 1, in that order. Based on the data in Table 1, select the correct word or phrase from each box to complete the statements explaining the bisons' preference.

In Banff National Park, bison preference is based on [Y]. Higher carrying capacity [Z] a factor in bison preference for the study areas

Box Y

A. habitat size

B. amount of grassland

C. total grass available

D. average snow depth

Box Z

A. is

B. is not

Use the information below to answer questions 16–18.

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

Figure 1 models conditions at plate boundaries that create various types of surface features. Each separate plate is marked with a letter, with arrows showing the plates' directions of movement: moving toward or away from each other, or sliding past each other.

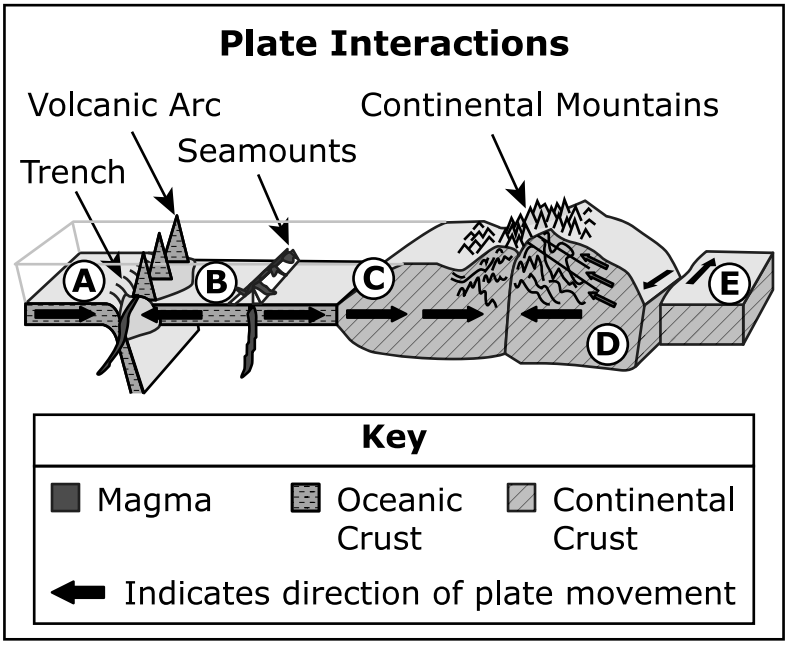


Figure 1.

Table 1 describes types of plate boundaries and the interactions between them.

Table 1. Plate Boundaries

Boundary Type	Tectonic Process	Resulting Surface Feature
Convergent with no subduction[1]	Compression and uplift	Mountain
Convergent with subduction	Volcanism, compression, and uplift	Mountain and/or volcano
Divergent	Volcanism, rifting, and sea floor spreading	Seamount
Transform	Side-to-side motion	None

[1]subduction—the process of one plate being forced beneath another plate

GO ON →

16. Describe the formation of seamounts.

Complete the sentence by choosing the correct answers from each box.

Seamounts form where [X] plates [Y] each other and magma [Z] between them.

Box X

A. continental

B. oceanic

Box Y

A. collide into

B. separate from

C. slip past

Box Z

A. rises

B. descends

17. Figure 2 shows tectonic plate boundaries on Earth, with areas labeled W, X, Y, and Z.

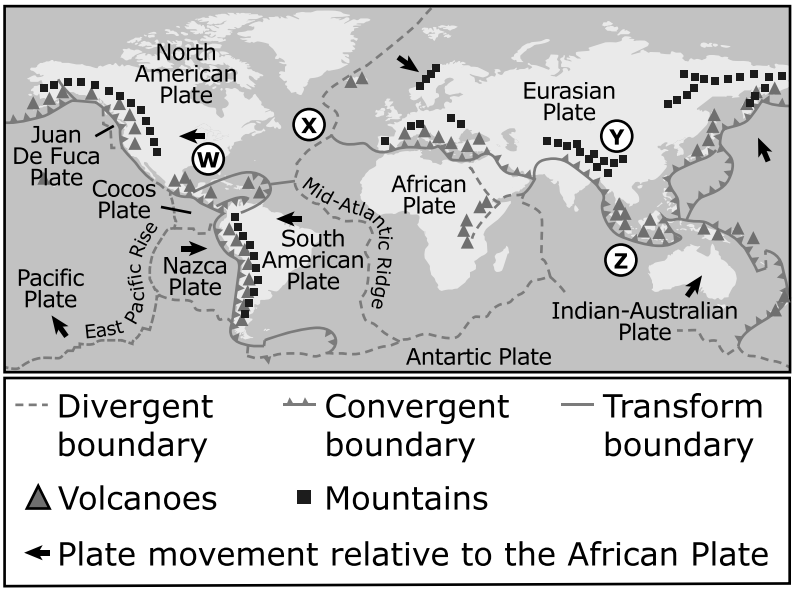


Figure 2. Tectonic Plate Boundaries

Identify the location in Figure 2 that best represents the boundary between plates C and D in Figure 1.

Select the correct location from the four options.

A. Area W

B. Area X

C. Area Y

D. Area Z

18. Based on Figure 1, describe where trenches are found.

Complete the sentences by choosing the correct answers from from each box.

A trench is a feature that is associated with a [Y] plate boundary. It is created when one plate [Z] another plate.

Box Y

A. transform

B. convergent

C. divergent

Box Z

A. moves laterally against

B. is forced underneath

C. moves away from

Use the information below to answer questions 19–23.

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.

Hard disk drives were first introduced in 1954 and remained a dominant technology for over 50 years.

An electromagnetic wave is generated when the direction of current is repeatedly reversed. This wave creates an alternating magnetic field. Hard disk drives use a part called a write head to store information as bits. When current goes through the write head, it becomes magnetic, which magnetizes the grains. This magnetic interaction allows information to be stored in the magnetized grains of the disk as either a "0" or a "1," with each 0 or 1 being considered a single bit. This system of using zeros and ones to store information is known as binary code. Bits are shown as downward- or upward-pointing arrows in Figure 1.

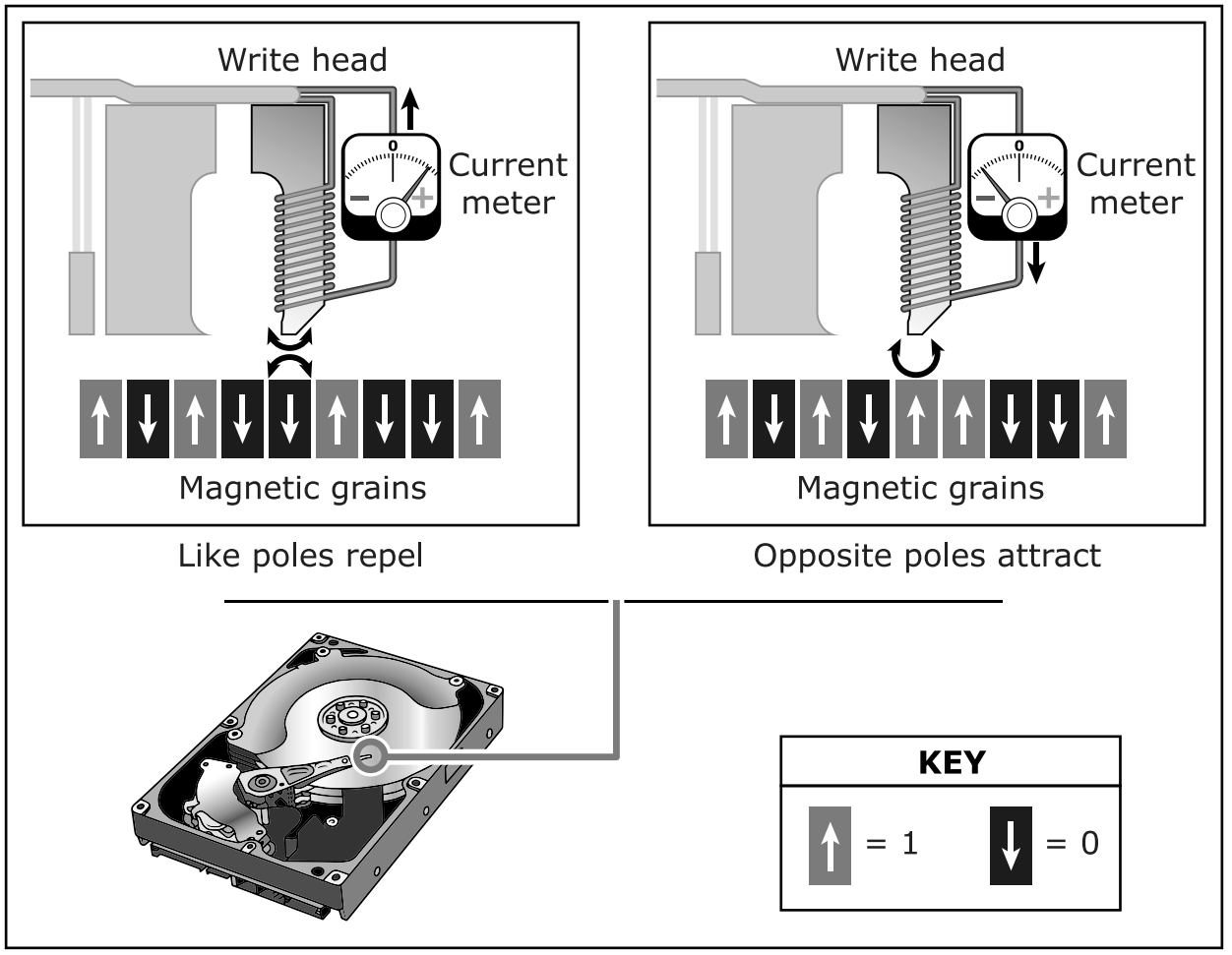


Figure 1. Hard Disk Drives Store Information

Information is stored in larger groups of bits, as shown in Table 1.

Table 1. The Number of Bits in Larger Units

Unit	Value
1 bit	one "0" **OR** one "1"
1 byte	8 bits
1 kB	1,000 bytes
1 MB	1,000,000 bytes
1 GB	1,000,000,000 bytes

19. What is **most** important to the process of storing information on a hard disk drive?

Select **two** of the five statements.

A. the sign of the current

B. the size of the hard disk drive

C. how fast the write head moves

D. the different magnetic field directions

E. how many previously written bits there are

20. How many bits are required to store an image of 1 MB?

A. 1

B. 8

C. 1,000,000

D. 8,000,000

21. The letter "Z" is written as "01011010" in binary code.

Select the option that shows the correct combination of signs on the current meter to write the letter "Z."

A.

Bit Number	Sign on the Current Meter	
	Positive	Negative
Bit #1		X
Bit #2	X	
Bit #3		X
Bit #4	X	
Bit #5	X	
Bit #6		X
Bit #7	X	
Bit #8		X

B.

Bit Number	Sign on the Current Meter	
	Positive	Negative
Bit #1	X	
Bit #2		X
Bit #3	X	
Bit #4		X
Bit #5		X
Bit #6	X	
Bit #7		X
Bit #8	X	

(Item 21 continued)

C.

Bit Number	Sign on the Current Meter	
	Positive	Negative
Bit #1	X	
Bit #2		X
Bit #3		X
Bit #4	X	
Bit #5		X
Bit #6	X	
Bit #7		X
Bit #8	X	

D.

Bit Number	Sign on the Current Meter	
	Positive	Negative
Bit #1		X
Bit #2	X	
Bit #3	X	
Bit #4		X
Bit #5	X	
Bit #6		X
Bit #7	X	
Bit #8		X

22. Each capital English letter is represented by a one-byte string that contains eight bits, as shown in the table. Each byte is read from left to right.

Table 2. 8-Bit Strings Representing English Capital Letters

Letter	Bit String
A	01000001
B	01000010
C	01000011
D	01000100
E	01000101
F	01000110
G	01000111
H	01001000
I	01001001
J	01001010
K	01001011
L	01001100

(Item 22 continued)

The following bit string was recovered from a corrupted hard disk drive by measuring the magnetic interactions stored by the magnetic grains.

Bit Number	Magnetic Interaction
Bit 1	repulsive
Bit 2	attractive
Bit 3	repulsive
Bit 4	repulsive
Bit 5	attractive
Bit 6	repulsive
Bit 7	attractive
Bit 8	repulsive

Which capital letter was recovered?

A. H

B. I

C. J

D. K

E. L

23. Each capital English letter is stored by a sequence of magnetic interactions between the write head and the magnetic grains, as shown in the table. A bit string is obtained by writing bits 1–8 from left to right.

Table 3. 8-Bit Strings Representing Two English Capital Letters

Bit Number	Magnetic Interaction Sequence	
	Letter "O"	**Letter "R"**
1	repulsive	repulsive
2	attractive	attractive
3	repulsive	repulsive
4	repulsive	attractive
5	attractive	repulsive
6	attractive	repulsive
7	attractive	attractive
8	attractive	repulsive

Construct an explanation about how wave interactions store information on a hard disk drive.

Enter your response in your answer document. Support your answer with evidence from the information in Figure 1.

Use an English letter from Table 3 to construct an explanation about how the sequence of the magnetic interactions between the write head and the magnetic grains are used to store information.

Enter your response in your answer document. Support your answer with evidence from the information in Figure 1.

(Item 23 continued)

Make a claim about:

- the type of magnetic interaction that is produced when a current is applied to the write head;
- why this magnetic interaction is produced, and
- the bit that results from this interaction.

Enter your response in your answer document. Support your answer with evidence from the information in Figure 1.

Unit 2 Practice Test

Directions:

Today you will take Unit 2 of the Grade 11 New Jersey Student Learning Assessment - Science (NJSLA-S) Test.

Follow the directions to answer each question. Mark your answers by completely filling in the circles in your answer document. **Only answers you provide in your answer document will be scored.** Do not make any pencil marks outside the circles in your answer document. If you need to change an answer, be sure to erase your first answer completely.

If a question asks you to show or explain your work, you must do so to receive full credit. Write your response in the space provided in your answer document. Only responses written within the provided space will be scored.

If you do not know the answer to a question, you may go on to the next question. If you finish early, you may review your answers and any questions you did not answer in this unit **ONLY**. Do not go past the stop sign.

Use the information below to answer questions 1-3.

Information about Earth's early history may be contained in materials from Mars, the Moon, and meteorites.

Various theories have been presented to explain the formation of the Moon during the early history of Earth:

Fission Theory: The Moon formed when a small, outer portion of the spinning Earth separated from the larger body and moved into space.

Capture Theory: The Moon formed elsewhere in the solar system, but in a similar manner to Earth. It then moved toward Earth and was captured by Earth's gravity.

Condensation Theory: The Moon formed separately from Earth, but in a similar manner and in the same vicinity.

Impact Theory: The Moon formed following a violent impact between Earth and a Mars-sized object. The impact caused the outer portion of molten Earth to be ejected. Gravity caused the debris to attract and eventually combine to form the Moon.

1. The comparison of certain types of atoms, called isotopes, found on the Moon and elsewhere in the solar system may provide information about how the Moon formed. Ratios of specific oxygen isotopes present in rock vary with location in the solar system. The figure shows the oxygen isotope distribution trends in rock samples from the surfaces of Earth, Mars, the Moon, and Vesta.

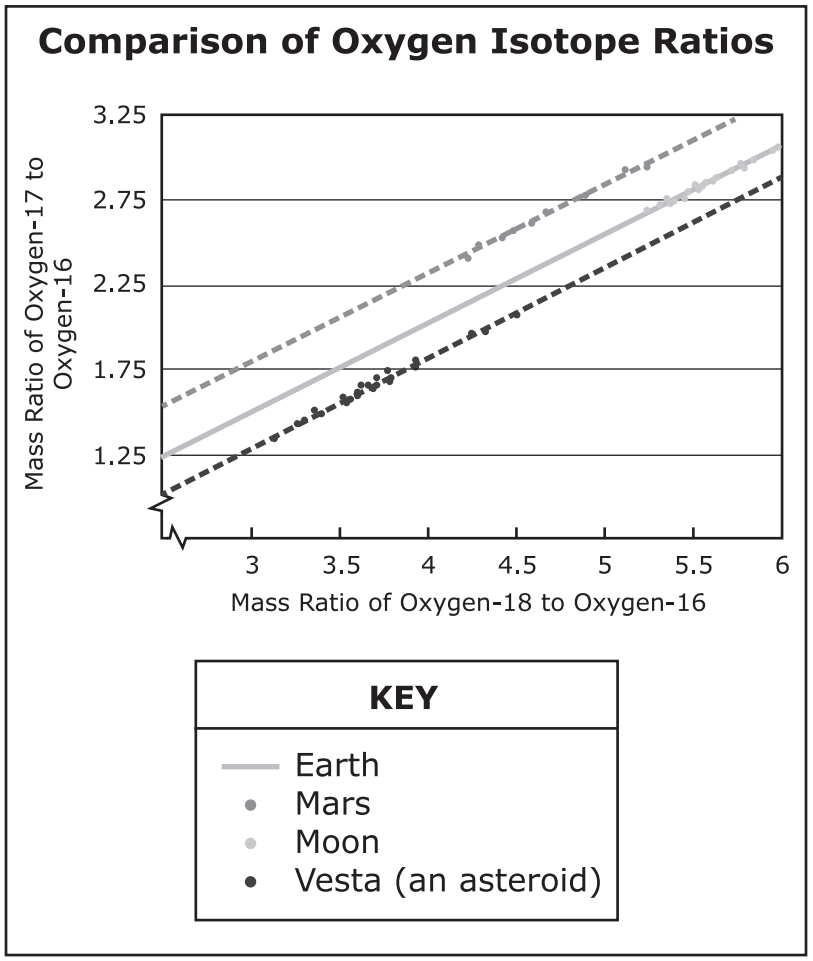


Figure 1.

GO ON →

(Item 1 continued)

Complete the statement that explains how oxygen isotope evidence could support the Fission or Impact theory.

Complete the sentence by choosing the correct answer from each box.

Based on Figure 1, for the Fission or Impact theory to be plausible, the composition of the foreign body would have had to be **Y** that of **Z**.

Box Y

A. very different from

B. nearly identical to

Box Z

A. Earth

B. Mars

C. Vesta

2. Though Earth and the Moon have numerous common elements in their compositions, the Moon has fewer volatile materials. Scientist believe that temperatures on the Moon reached at least 1,400 °C at the time of its formation.

Table 2. Elements on Earth Also Found on the Moon

Element	Boiling Point (°C)
Potassium	765
Sodium	883
Zinc	910

Based on Table 2, correctly complete the statement that identifies which theory best accounts for the lack of volatile elements on the Moon.

Complete the sentence by choosing the correct answer from each box.

The **Y** theory best explains the lack of volatile elements on the Moon because the tremendous **Z** in pressure associated with this theory would generate the heat necessary to volatilize some elements.

Box Y

A. Fission

B. Capture

C. Impact

Box Z

A. increase

B. decrease

3. Every planetary body in the solar system has a specific composition and density. Based on the data, indicate which statement would support each formation theory.

Complete the table by selecting the correct answer from each box.

Theory	Statement
Fission	W
Capture	X
Condensation	Y
Impact	Z

Box W

A. Earth and the Moon have similar compositions.

B. Earth and the Moon have different compositions.

Box X

A. Earth and the Moon have similar compositions.

B. Earth and the Moon have different compositions.

Box Y

A. Earth and the Moon have similar compositions.

B. Earth and the Moon have different compositions.

Box Z

A. Earth and the Moon have similar compositions.

B. Earth and the Moon have different compositions.

Use the information below to answer questions 4-6.

Rubidium and bromine, elements located on opposite sides of the periodic table, readily form a product when combined, as shown in the equation.

$$2Rb + Br_2 \rightarrow 2RbBr$$

Atomic properties of an element can be related to the position of the element on the periodic table as shown in Figure 1.

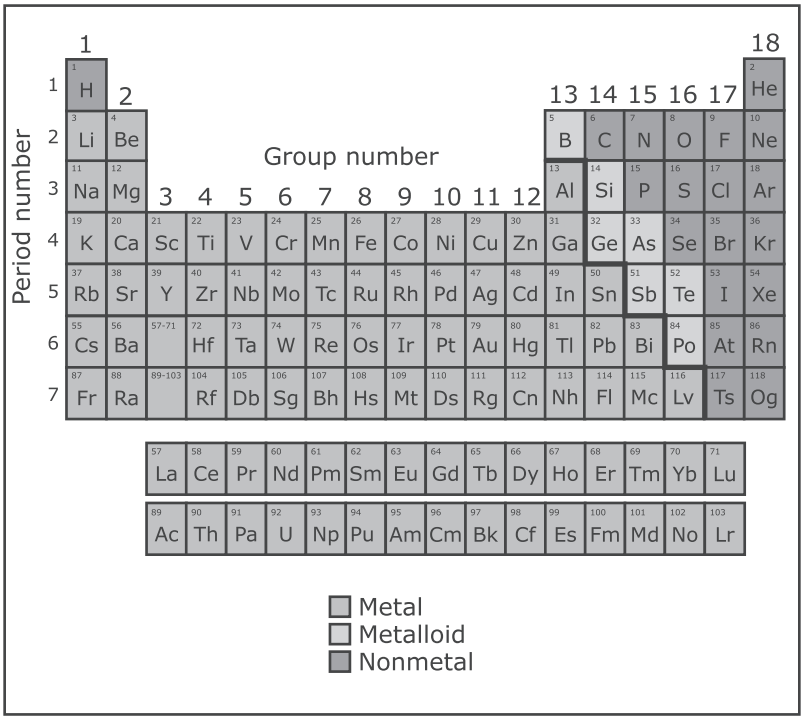


Figure 1. Periodic Table of the Elements

4. Which piece of information found in Figure 1 is **most** useful in determining the number of outer electrons present in an atom?

A. group number

B. period number

C. type of element

D. metal or nonmetal

5. Based on its position on the periodic table, predict the charge that strontium (Sr) will take when forming a compound.

Complete the sentence by choosing the correct answer from each box.

When strontium forms a compound, it will have a **Y** charge with a magnitude (number) of **Z**.

Box Y

A. positive

B. negative

Box Z

A. 1

B. 2

C. 3

6. Which is the correct formula for strontium chloride, based on the placement of each element in the periodic table?

A. SrCl

B. Sr_2Cl

C. $SrCl_2$

D. Sr_2Cl_3

Use the information below to answer questions 7-9.

Large male salmon have the highest rates of reproduction, yet only small male salmon are observed mating in one river.

In male salmon, reproductive success is a measure of advantageous traits and fitness in terms of natural selection. Table 1 shows data on percentages of successful matings by adult male salmon from five different regions in Alaska.

Table 1. Reproductive Success (%) in Different Regions, by Size of Male Salmon

Region	Salmon Body Size (millimeters)				
	150 mm	200 mm	250 mm	300 mm	350 mm
A	13	20	30	40	66
B	20	23	30	43	66
C	23	27	33	43	70
D	27	27	37	43	70
E	33	37	37	47	77

The graph shows data on the probability of predation for male salmon in a fished Alaskan river and in a non-fished Alaskan river.

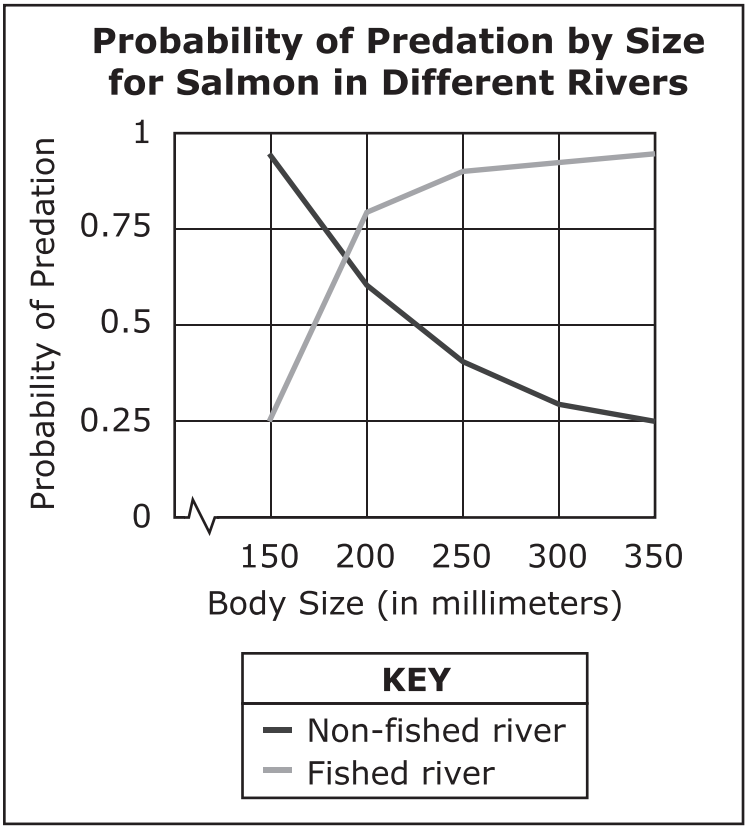
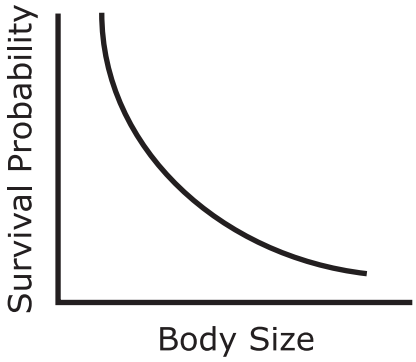


Figure 1.

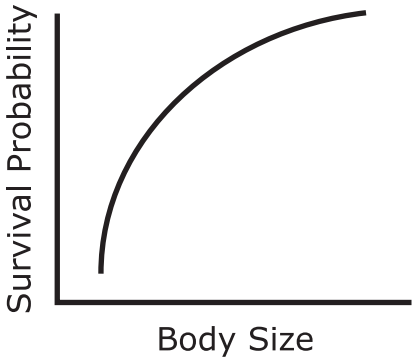
GO ON →

7. Based on Figure 1, which model describes the survival of salmon in the river where people do not fish?

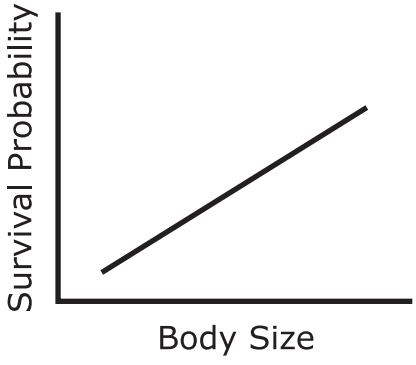
A.



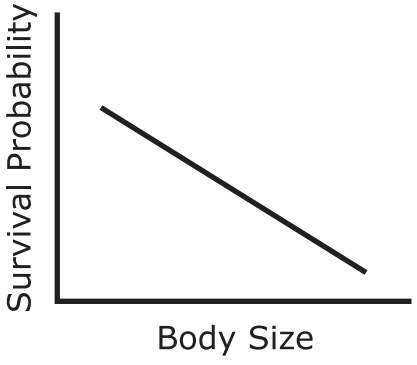
B.



C.



D.



8. Which **best** explains the selective pressure for size in the male salmon populations in the fished and non-fished rivers?

Select **two** of the five statements.

A. In both rivers, there is selective pressure for medium-sized fish.

B. In the river where people do not go fishing, reproductive success selects for larger fish.

C. In the river where people do not go fishing, reproductive success selects for smaller fish.

D. In the river where people catch fish, commercial fishing selects for the survival of larger fish.

E. In the river where people catch fish, commercial fishing selects for the survival of smaller fish.

9. In many species of fish, sexual selection primarily drives natural selection. Based on Table 1, predict how body size will change over time.

Complete the sentences by choosing the correct answer from each box.

Female salmon from [Y] regions preferred to reproduce with the largest males. Unless conditions change, salmon size in these populations is most likely to [Z].

Box Y

A. no

B. all

C. some

Box Z

A. decrease

B. increase

C. stay the same

Use the information below to answer questions 10-12.

A bicycle tire is filled with air. As the tire approaches its maximum volume, it begins to feel noticeably warmer and the pump handle becomes harder to push down as more air is added.

The figure illustrates a bicycle tire being inflated with air. The bicycle pump adds more gas molecules from the air to the tire each time the handle is pushed down.

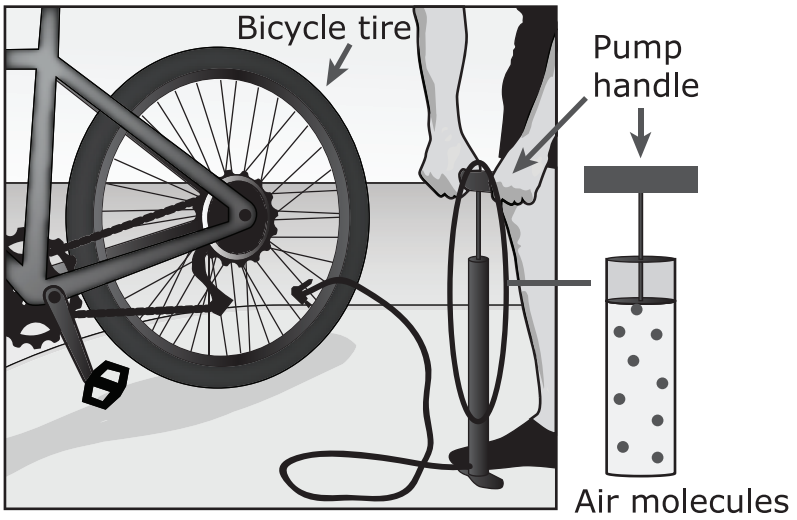


Figure 1. Filling a Bicycle Tire with Air

10. Which question, if answered, would **best** support an explanation of why the tire gets warmer as air is added?

A. How does adding more gas molecules affect the total chemical energy?

B. How does adding more gas molecules affect the total gravitational potential energy?

C. How does adding more gas molecules affect the total kinetic energy?

D. How does adding more gas molecules affect the total potential energy?

11. Identify the variables that should be measured to determine the relative change in energy within a bicycle tire if air molecules continue to be added once the pump handle becomes harder to push down.

Select **two** of the five variables.

A. the change in tire pressure

B. the volume of the bicycle tire

C. the shape of the air molecules

D. the dimensions of the bicycle pump

E. the change in temperature of the tire

12. Select from each box to correctly compare each given factor before and after air molecules are pumped into a bicycle tire.

Complete the table by choosing the correct answer from each box.

Factor	Before	After
Number of air molecules per unit volume	U	V
Total energy of air molecules in the tire	W	X
Number of collisions per second between the gas molecules and the tire	Y	Z

(Item 12 continued)

Box U

A. lower

B. higher

Box V

A. lower

B. higher

Box W

A. lower

B. higher

Box X

A. lower

B. higher

Box Y

A. lower

B. higher

Box Z

A. lower

B. higher

Use the information below to answer questions 13-15.

Traditional mining techniques used to extract materials such as copper are being abandoned in some cases in favor of other techniques that also produce these materials.

Removal of copper from Earth's crust through mining has reduced this nonrenewable resource over time. Increased use of improved technologies, such as solvent extraction and electrowinning shown in Figure 1, has reduced the reliance on standard raw copper ore. These technologies are used in a process to extract copper from waste materials previously produced from traditional mining. The amount of waste available from previous mining makes the use of these technologies efficient for many years.

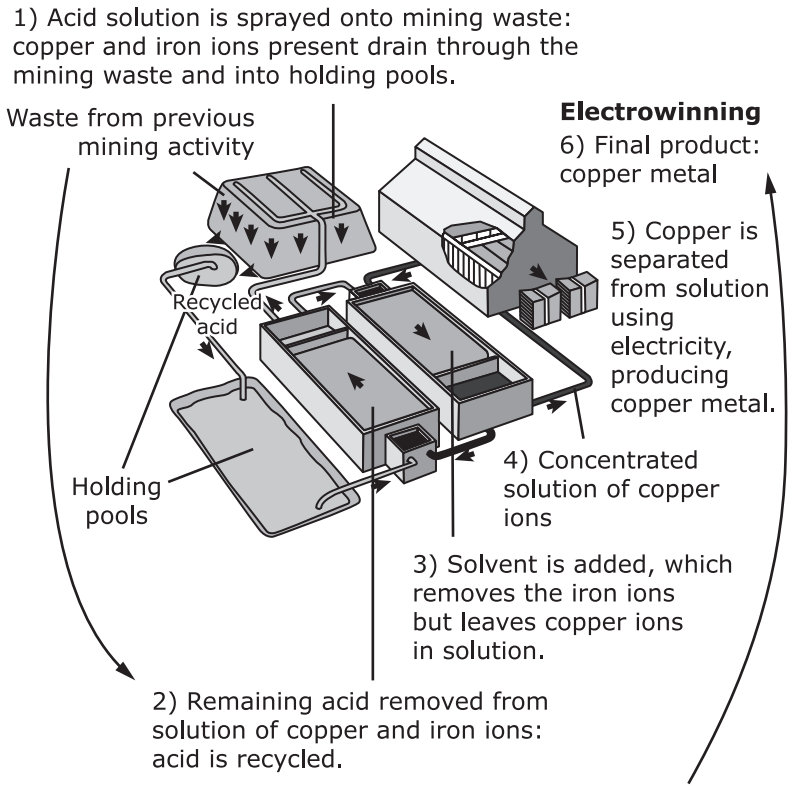


Figure 1. Solvent Extraction and Electrowinning of Copper

GO ON →

13. Based on Figure 1, which questions, if answered, would **best** help scientists determine the long-term economic and environmental impacts of using this process for extracting copper?

Select **two** of the six questions.

A. Which part of the process is most energy efficient?

B. Will this process eventually be automated?

C. Can the products made from copper extracted with this process be recycled?

D. Does this process minimize the amount of pollution through recycling?

E. Does this process increase the supply of copper without the cost of additional mining?

F. Does this process recover metals other than copper and iron from the mining waste?

14. The solvent extraction-electrowinning technology has improved over time. Approximately 2.2 million tons of high-quality copper were produced using this technology in the year 2000. Table 1 shows the advancement of this technology, which includes how the solvent that extracts the copper has changed.

Table 1. Changes in Solvent Technology over Time

Property	1965	1970	1980	2000
Ability of solvent to remove copper ions from acid	Poor	Poor	Good	Excellent
Separation of copper ions from iron ions	Poor	Good	Good	Excellent
Speed of copper ion removal	Slow	Medium	Fast	Fast
Stability against decomposition	Excellent	Excellent	Good	Poor
Generation of impurities	Medium	Low	Medium	Low
Ability to chemically modify solvent to extract different metal ions	Poor	Fair	Good	Excellent

Which property of the solvent may be a limitation of the advancement of this technology in the future?

A. speed of copper ion removal

B. stability against decomposition

C. separation of copper ions from iron ions

D. ability to chemically modify solvent to extract different metal ions

15. Along with using new technology to extract copper, conserving copper through recycling also has long-lasting benefits.

Table 2. Economic Benefits of Recycling Copper

	Extraction	Recycling
Energy Required (gigajoules per metric ton)	100	10
Cost (dollars per metric ton)	$16,200	$14,600
Air Pollution (metric tons per year)	400,000	56,000

Indicate which claims about the potential benefits of recycling copper are supported by Table 2 and which are not supported by Table 2.

Complete the table by choosing the correct answer from each box.

Claim	Supported or Not Supported
Extracted copper produces more energy.	V
Recycled copper is worth 10% more than raw copper ore.	W
Recycling requires only 10% of the energy needed for extraction.	X
It is cheaper to recycle old copper than to mine and extract new copper.	Y
Recycled copper produces the same amount of air pollution as raw copper ore.	Z

(Item 15 continued)

Box V

A. Supported

B. Not Supported

Box W

A. Supported

B. Not Supported

Box X

A. Supported

B. Not Supported

Box Y

A. Supported

B. Not Supported

Box Z

A. Supported

B. Not Supported

Use the information below to answer questions 16-18.

While planes fly in refueling formation as shown in the figure, the pilot of the tanker aircraft never adjusts the throttle[1], but the pilot of the receiver aircraft must constantly increase the throttle to keep up with the tanker aircraft.

Air-to-air refueling is used to increase the distance an aircraft can fly. Fuel flows from a tanker aircraft to a receiver aircraft through a device called a boom, as shown in the figure.

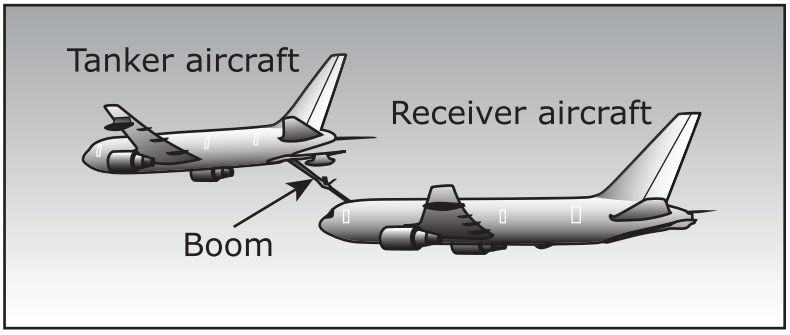


Figure 1. Air-to-Air Refueling

[1]throttle—A device that controls the flow of fuel or power to an engine.

16. Using Newton's second law ($F = ma$), select the option that best completes the table to describe the relationships between force, mass, and acceleration of airplanes.

Force ($\times 10^3$ N*)	Mass ($\times 10^3$ kg)	Acceleration (m/s^2)
500	125	?

***1 newton = 1 kg × 1 m/s^2**

A. 1

B. 2

C. 3

D. 4

17. According to Newton's second law ($F = ma$), which statement **best** explains why the pilot of the receiver aircraft must increase the throttle to keep up with the tanker aircraft?

A. The tanker aircraft is losing mass, resulting in increased acceleration.

B. The tanker aircraft is losing mass, resulting in decreased acceleration.

C. The tanker aircraft is gaining mass, resulting in increased acceleration.

D. The tanker aircraft is gaining mass, resulting in decreased acceleration.

18. The receiver aircraft has a mass of 110,000 kg and has an acceleration of 4.5 m/s^2 prior to refueling in flight. The receiver aircraft then receives 30,000 kg of fuel from the tanker aircraft. According to Newton's second law ($F = ma$), select the correct word or phrase from each box to correctly complete the statement.

After refueling in flight, acceleration of the receiver aircraft [Y], from 4.5 m/s^2 to [Z] m/s^2.

Box Y

A. increases

B. decreases

C. remains the same

Box Z

A. greater than 4.5

B. 4.5

C. less than 4.5

Use the information below to answer questions 19-23.

Two marathon runners of similar athletic capabilities are running a marathon. Runner 1 ate a large meal of pasta the night before the race. Runner 2 ate tuna fish and salad. After 100 minutes of the race, one runner is farther ahead than the other runner.

Proteins, carbohydrates, and fats are dietary components that are the three basic nutritional building blocks of food. All of these can be converted to glucose, which is the body's primary energy source.

Glucose can also be converted to glycogen, which is used as a source of energy while running when it is available, and stored in liver and muscle tissue.

Figure 1 shows the glycogen levels of the two runners and the distances they traveled during the first 100 minutes of the race.

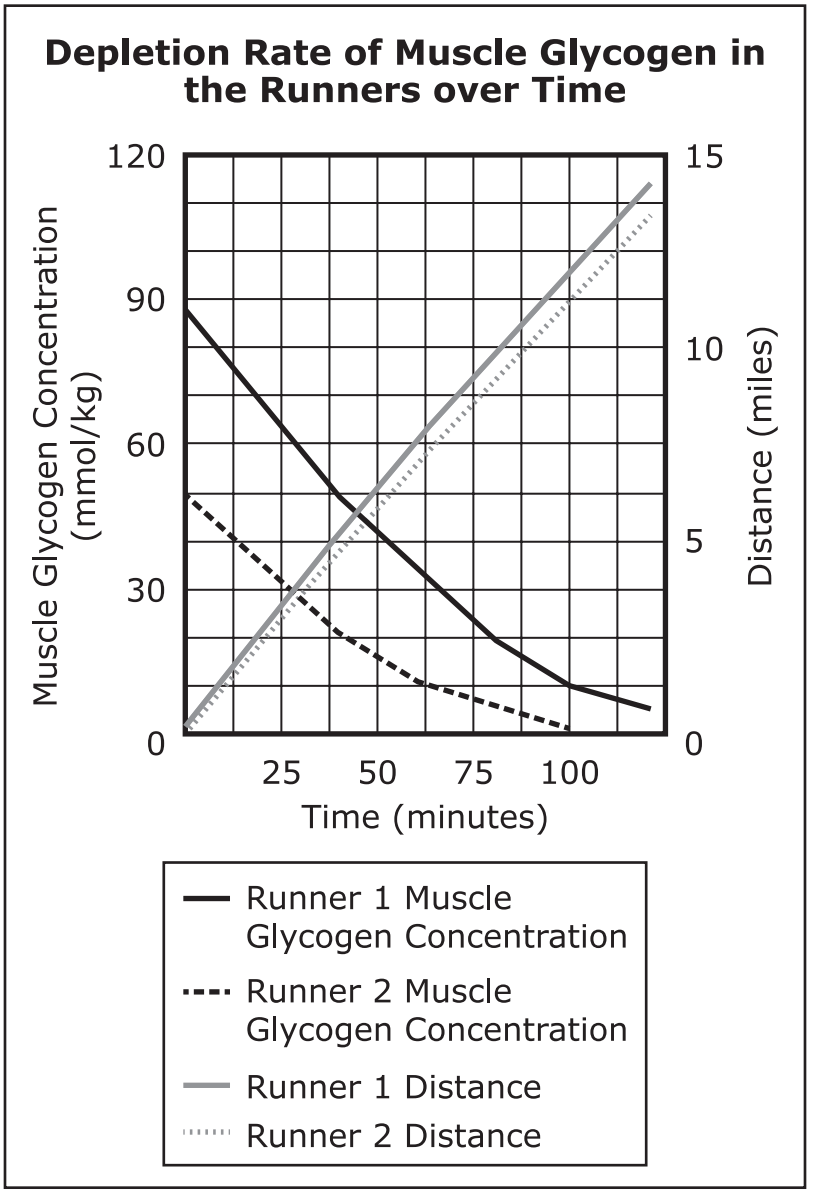


Figure 1.

GO ON →

The glycemic load of a food indicates how much blood glucose is produced by eating that food. A higher glycemic load represents a food having more carbohydrates. One unit of glycemic load approximates the effect of eating one gram of glucose. Table 1 and Table 2 show the glycemic load of each runners' meal.

Table 1. Glycemic Load of Runner 1's Meal

Food	Glycemic Load
Macaroni	23
Sauce	1
Cheese	2
Apple	3

Table 2. Glycemic Load of Runner 2's Meal

Food	Glycemic Load
Tuna fish	0
Lettuce	0
Tomato	3
Salad dressing	2

19. Based on Figure 1, which questions would **best** describe why the two runners' meals caused them to run different distances?

Select **two** of the five questions.

A. Why do runners use so much energy?

B. How much energy does each dietary component contain?

C. How much of each dietary component did each runner eat?

D. Which dietary components are found in the majority of foods?

E. Why do some foods have more of each dietary component than others?

20. Based on the data, explain how the change in glycogen levels was different for each runner in the first 100 minutes of the race.

Enter your response in your answer document. Support your answer with information from the data.

Based on the data, identify the runner who traveled the greater distance, and describe how the food the runners ate correlates with the difference in distance traveled over 100 minutes.

Enter your response in your answer document. Support your answer with information from the data.

Based on the data, predict if the rate of running for Runner 2 will be maintained after 100 minutes, and explain why.

Enter your response in your answer document. Support your answer with information from the data.

21. Cellular respiration can be represented by the following equation:

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{Energy}$$

Based on Figure 1 and the cellular respiration equation, over the course of the race, identify how the inputs and outputs of cellular respiration change.

Complete the table by selecting the correct answer from each box.

Change	Increases or Decreases
Total Energy Production	W
Runner's Body Heat	X
Oxygen Consumption	Y
Glycogen Stored in Muscles	Z

Box W

A. Increases

B. Decreases

Box X

A. Increases

B. Decreases

Box Y

A. Increases

B. Decreases

Box Z

A. Increases

B. Decreases

22. Table 3 shows the nutrient content of the food eaten by the runners before the marathon.

Table 3. Nutrient Content of Runners' Food

	Protein (g)	Fat (g)	Carbohydrate (g)	Calories
Runner 1	18	12	40	?
Runner 2	38	14	16	?

1 gram of protein = 4 calories
1 gram of fat = 9 calories
1 gram of carbohydrate = 4 calories

A student claims that the amount of muscle glycogen is only based on the amount of calories consumed, not the type of food. Based on Figure 1 and Table 3, support or refute the student's claim.

Complete the sentence by choosing the correct answer from each box.

The runner that consumed more calories had [X] muscle glycogen concentration compared to the other runner. This means that when different types of food are digested and broken down, they are reassembled into [Y] products, which [Z] the claim.

Box X

A. a lower

B. a higher

C. the same

Box Y

A. the same

B. different

Box Z

A. refutes

B. supports

23. Table 4 shows the glycemic load of the meal a third runner ate before the race.

Table 4. Glycemic Load of Runner 3's Meal

Food	Glycemic Load
Chicken	0
Sweet Potatoes	10
Broccoli	0

Based on the data, predict how Runner 3 would be doing compared to Runners 1 and 2 after 100 minutes of the race.

Complete the sentences by choosing the correct answer from each box.

Runner 3's distance was **Y** Runner 1's distance.

Runner 3's distance was **Z** Runner 2's distance.

Box Y

A. >

B. <

C. =

Box Z

A. >

B. <

C. =

NJSLA–S Practice Test Answer and Alignment Document
Science: High School – Unit 1

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

UIN: HS18010_04[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

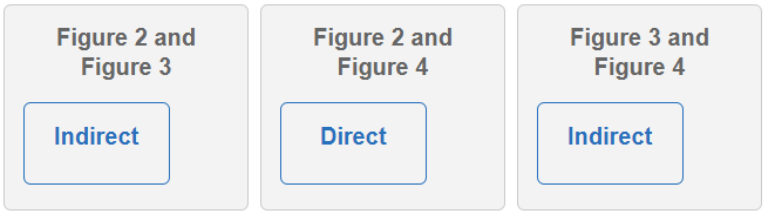
UIN: HS18010_07

Item Type: Technology Enhanced

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

Screen Reader (SR)/Assistive Technology (AT)/Paper Key: B

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.

[1] The UIN (Unique Identification Number) can be used to find an item in the New Jersey Digital Item Library (https://nj.digitalitemlibrary.com/)

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

UIN: HS18048_01

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

UIN: HS18048_03

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.

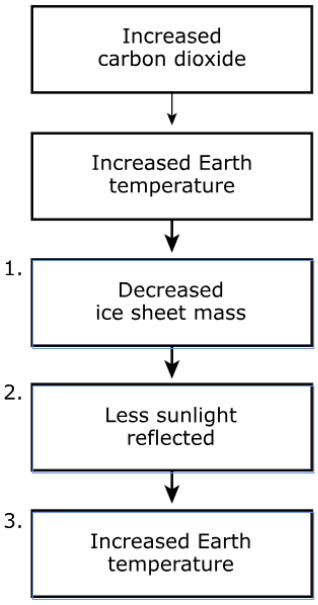
Statement A is invalid because Figures 2 and 3 show the opposite phenomenon: as the ice sheet mass decreases, the sea level rises.

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

UIN: HS18048_05
Item Type: Technology Enhanced
Standards Alignment: DCI: ESS2.D; SEP: DUM; CCC: C and E
SR/AT/Paper Key: B
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

UIN: HS18042_01
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

UIN: HS18042_08
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

UIN: HS18009_03
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

UIN: HS18009_07
Item Type: Multiple Choice
Standards Alignment: DCI: PS4.A; SEP: AID; CCC: S & SM
SR/AT/Paper Key: Box X: B; Box Y: A; Box Z: C
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

UIN: HS18009_09
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

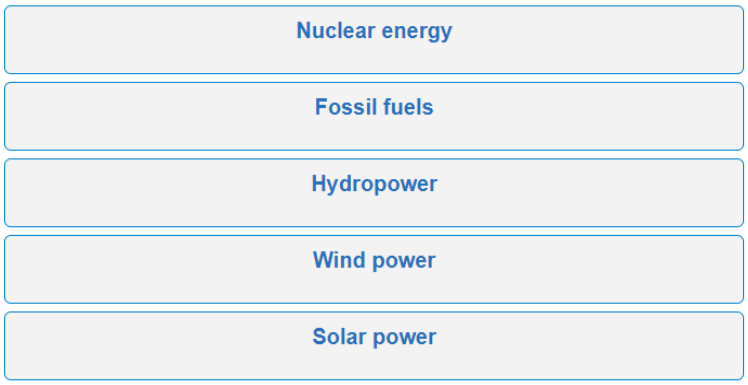
Domain: Earth and Space Science
Phenomenon: There are over a million more solar power installations than fossil fuel plants in America. However, fossil fuels generate the most electricity, and solar power contributes the least.

Item 11

UIN: HS18002_01
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

UIN: HS18002_03
Item Type: Technology Enhanced
Standards Alignment: DCI: ESS3.C; SEP: UMCT; CCC: S,P, and Q
SR/AT/Paper Key: B
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

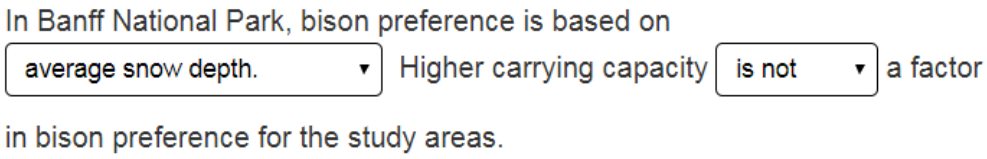
UIN: HS18035_01
Item Type: Multiple Choice
Standards Alignment: DCI: LS2.A; SEP: AID; CCC: S,P, and Q
Key: A
Rationale:
The description explains that on average, each bison consumes 2,300 kg of grass over the winter; therefore, a herd of 2,000 bison will need at least 4.6 million kg of grass. Areas 1 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

UIN: HS18035_03
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

UIN: HS18035_07
Item Type: Technology Enhanced
Standards Alignment: DCI: LS2.A; SEP: AID; CCC: PAT
SR/AT/Paper Key: Box Y: D; Box Z: B
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

UIN: HS18086_03

Item Type: Technology Enhanced

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

SR/AT/Paper Key: Box X: B; Box Y: B; Box Z: A

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

UIN: HS18086_05

Item Type: Technology Enhanced

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

SR/AT/Paper Key: C

Key: A correct response will look like this:

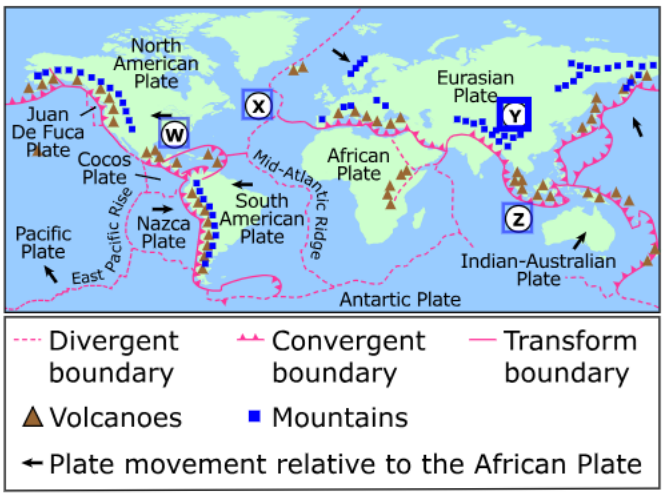


Figure 2. Tectonic Plate Boundaries

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

UIN: HS18086_07
Item Type: Technology Enhanced
Standards Alignment: DCI: ESS2.B; SEP: AID; CCC: PAT
SR/AT/Paper Key: Box Y: B; Box Z: B
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

UIN: HS19002_01a
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

UIN: HS19002_03a
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

UIN: HS19002_05a
Item Type: Technology Enhanced
Standards Alignment: DCI: PS4.A; SEP: AID; CCC: SF
SR/AT/Paper Key: B
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

UIN: HS19002_07a
Item Type: Technology Enhanced
Standards Alignment: DCI: PS4.C; SEP: AID; CCC: SF
SR/AT/Paper Key: C
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

UIN: HS19002_09a

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.

NJSLA-S Online Practice Test Answer and Alignment Document
Science: Grade 11 – Unit 2

Items 1–3

Domain: Earth and Space Science
Phenomenon: Information about Earth's early history may be contained in materials from Mars, the Moon, and meteorites.

Item 1

UIN: HS18066_03[1]
Item Type: Technology Enhanced
Standards Alignment: DCI: ESS1.C; SEP: AID; CCC: PAT
SR/AT/Paper Key: Box Y: B, Box Z: A
Key: A correct response will look like this:

Based on Figure 1, for the Fission or Impact theory to be plausible, the composition of the foreign body would have had to be [nearly identical to ▾] that of [Earth ▾].

Rationale:
Figure 1 shows that the oxygen isotope ratio of the Moon and Earth are nearly identical. This indicates that the Moon and Earth formed in the same location in the Solar System, thereby supporting the theory that the Moon may once have been a part of Earth that somehow separated during the Solar System's early formation. The oxygen isotope ratio of both Mars and Vesta vary significantly from that of the Moon and Earth, suggesting that they formed elsewhere in the solar system.

[1] The UIN (Unique Identification Number) can be used to find an item in the New Jersey Digital Item Library (https://nj.digitalitemlibrary.com/)

Item 2

UIN: HS18066_06
Item Type: Technology Enhanced
Standards Alignment: DCI: ESS1.C; SEP: EAE; CCC: S,P, and Q
SR/AT/Paper Key: Box Y: C; Box Z: A
Key: A correct response will look like this:

The [Impact] theory best explains the lack of volatile elements on the Moon because the tremendous [increase] in pressure associated with this theory would generate the heat necessary to volatilize some elements.

Rationale:
The impact theory states that a Mars-sized object slammed into Earth as it was forming, causing material, some of which ultimately became the Moon, to be ejected. The tremendous amount of heat and pressure created by such an impact could have allowed volatile materials to escape, explaining the lack of these materials on the Moon. The fission theory states that the Moon was originally a part of Earth that somehow separated and the capture theory states that the Moon was "captured" by Earth's gravitational pull. Neither the fission nor capture theories could have generated the heat and pressure necessary for volatiles to escape.

Item 3

UIN: HS18066_07
Item Type: Technology Enhanced
Standards Alignment: DCI: ESS1.C; SEP: AID; CCC: C and E
SR/AT/Paper Key: Box W: A; Box X: B; Box Y: A; Box Z: A
Key: A correct response will look like this:

Statement	Fission	Capture	Condensation	Impact
Earth and the Moon have similar compositions.	◉	○	◉	◉
Earth and the Moon have different compositions.	○	◉	○	○

Rationale:
The fission theory states that the Moon was once part of Earth, the condensation theory states that the Moon and Earth formed from the same material, and the impact theory states that the Moon formed from material ejected from Earth during a giant collision with another celestial body. In all of these cases, the Moon and Earth would have a similar composition. The capture theory states that the Moon formed elsewhere in the solar system and was captured by Earth's gravity; in that case, the Moon would likely have a somewhat different composition than Earth.

Items 4–6

Domain: Physical Science

Phenomenon: Some substances such as gold and copper can be found as pure elements in nature, but other substances such as rubidium and bromine are always combined with other elements when found in nature.

Item 4

UIN: HS18004_01

Item Type: Multiple Choice

Standards Alignment: DCI: PS1.A; SEP: OECI; CCC: PAT

Key: A

Rationale:

The columns of the periodic table represent groups and the group number represents the number of electrons in the element's outermost shell.

Answer B is invalid because period number represents the number of atomic orbitals, not how many electrons are in the outer orbit.

Answer C is invalid because while the position of an element in the periodic table does describe its type, an element's type is not a definitive indicator of the number of outer electrons an atom of the element has.

Answer D is invalid because while the position of an element in the periodic table does show that an element is a metal or nonmetal, the position does not indicate the number of outer electrons an atom has.

Item 5

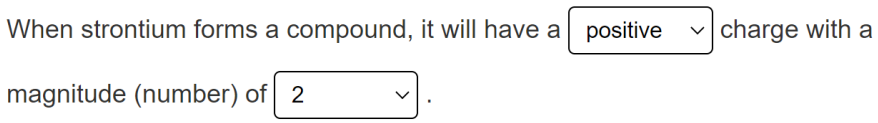
UIN: HS18004_06

Item Type: Technology Enhanced

Standards Alignment: DCI: PS1.A; SEP: EAE; CCC: S & SM

SR/AT/Paper Key: Box Y: A; Box Z: B

Key: A correct response will look like this:



Rationale:

Strontium is an alkaline earth metal in the second group. All elements in Group 2 have two more protons than electrons, giving a net charge +2.

Item 6

UIN: HS18004_05
Item Type: Multiple Choice
Standards Alignment: DCI: PS1.A; SEP: DUM; CCC: S & SM
Key: C
Rationale:
The strontium ion has a +2 charge and the chlorine ion has a -1 charge. Therefore, two chlorine ions are needed to balance the one strontium ion creating $SrCl_2$.
Answer A is invalid because bonding only occurs when the net charge is zero. SrCl would have a net charge of +1.
Answer B is invalid because bonding only occurs when the net charge is zero. Sr_2Cl would have a net charge of +3.
Answer D is invalid because bonding only occurs when the net charge is zero. Sr_2Cl_3 would have a net charge of +1.

Items 7–9

Domain: Life Science
Phenomenon: Large male salmon have the highest rates of reproduction, yet only small male salmon are observed mating in one river.

Item 7

UIN: HS18011_05
Item Type: Multiple Choice
Standards Alignment: DCI: LS4.C; SEP: DUM; CCC: PAT
Key: B
Rationale:
Figure 1 shows that in a non-fished river, the probability of predation decreases as body size increases. The line is nonlinear, with a greater reduction in predation between 105–250 mm and a smaller reduction from 250–350 mm. Choice B shows that salmon survival increases as body size increases and the line is nonlinear, leveling off at the largest sizes. Therefore, Choice B is supported by the data.
Answer A is invalid because it shows survival probability decreasing with increasing size.
Answer C is invalid because it shows survival probability increasing at a constant rate (linear) as body size increases and it does not level off as is indicated in the data.
Answer D is invalid because it shows survival probability decreasing at a constant rate (linear) as body size increases.

Item 8

UIN: HS18011_06
Item Type: Technology Enhanced
Standards Alignment: DCI: LS4.B; SEP: CEDS; CCC: C and E
Key: E, B
Rationale:
Answer A is invalid because medium-sized fish are neither most abundant nor least abundant in fished and/or non-fish rivers.
Answer B is valid because the probability of predation declines with increasing body size in non-fished rivers, therefore larger fish are selected for.
Answer C is invalid because the probability of predation declines with increasing body size in fished rivers, therefore smaller fish are selected against.
Answer D is invalid because in the fished river commercial fishing selectively culls larger fish and predation is higher on larger fish, therefore larger fish are selected against.
Answer E is valid because in the fished river commercial fishing selectively culls larger fish and predation is higher on larger fish, therefore smaller fish are selected for.

Item 9

UIN: HS18011_07
Item Type: Technology Enhanced
Standards Alignment: DCI: LS4.B; SEP: PACI; CCC: C and E
SR/AT/Paper Key: Box Y: B; Box Z: B
Key: A correct response will look like this:

Female salmon from [all] regions preferred to reproduce with the largest males. Unless conditions change, salmon size in these populations is most likely to [increase].

Rationale:
Based on Table 1, the largest sized salmon in each region had the highest probability of reproductive success. This leads to a higher percentage of larger salmon in future generations under stable environmental conditions.

Items 10–12

Domain: Physical Science

Phenomenon: As a bicycle tire is filled with air, more effort is required to push the pump handle down, and the tire becomes warmer.

Item 10

UIN: HS18040_01

Item Type: Multiple Choice

Standards Alignment: DCI: PS3.A; SEP: AQDP; CCC: E&M

Key: C

Rationale:

As pressure increases on a gas, so does temperature. This is because as more air is added to the confined volume of the tire, more collisions between the air molecules occur. These collisions cause the molecules to increase in speed, causing the kinetic energy inside the tire to increase. Increased kinetic energy is thus expressed as heat.

Answer A is invalid because a chemical reaction does not occur, nor are bonds being broken while air is added to the tire and therefore chemical energy does not change.

Answer B is invalid because the tire does not come from off of the ground and thus does not gain or lose any gravitational potential energy.

Answer D is invalid because potential energy is stored energy, while kinetic energy is based on movement. Potential energy within molecules is chemical energy and the chemical energy does not change while air is added to the tire.

Item 11

UIN: HS18040_03

Item Type: Technology Enhanced

Standards Alignment: DCI: PS3.A; SEP: PACI; CCC: C and E

Key: A, E

Rationale:

Energy is added with each air molecule that is pumped into the tire. To increase tire pressure, more molecules must be added. Temperature is associated with the average kinetic energy of the particles.

Answer B is invalid because while the volume inside the bicycle tire does increase some, there is only a limited amount of space inside the tire and will not accurately reflect the increase in kinetic energy.

Answer C is invalid because the shape of the air molecules does not change.

Answer D is invalid because the dimensions of the bicycle pump do not change.

Item 12

UIN: HS18040_04
Item Type: Technology Enhanced
Standards Alignment: DCI: PS3.A; SEP: PACI; CCC: C and E
SR/AT/Paper Key: Box U: A; Box V: B; Box W: A; Box X: B; Box Y: A; Box Z: B
Key: A correct response will look like this:

Factor	Before	After
Number of air molecules per unit volume	lower	higher
Total energy of air molecules in the tire	lower	higher
Number of collisions per second between the gas molecules and the tire	lower	higher

Rationale:
To increase tire pressure, more molecules must be added. Energy is added with each air molecule that is pumped into the tire. As air molecules are pumped into the tire, the number of collisions per second increases.

Items 13–15

Domain: Earth and Space Science
Phenomenon: Traditional mining techniques used to extract materials such as copper are being abandoned in some cases, in favor of other techniques that also produce these materials.

Item 13

UIN: HS18089_01
Item Type: Technology Enhanced
Standards Alignment: DCI: ESS3.A; SEP: AQDP; CCC: SC
Key: E, D
Rationale:
Figure 1 shows the steps involved in solvent extraction and electrowinning of copper, including all the components/materials. Answers to questions D and E would provide relevant information that could help to determine the long-term economic and environmental impacts of using this process to extract copper.
Question A is invalid, as it addresses the energy efficiency of the process itself and would provide no relevant information regarding the long-term economic and/or environmental impacts of using this process.
Question B is invalid, as it addresses the possibility of automating the process and would provide no relevant information regarding the long-term economic and/or environmental impacts of using this process.
Question C is invalid, as it addresses whether or not the products made from copper produced by this process can be recycled, but would provide no relevant information regarding the long-term economic and/or environmental impacts of using this process.

Item 14

UIN: HS18089_04
Item Type: Multiple Choice
Standards Alignment: DCI: ESS3.A; SEP: AID; CCC: SC
Key: B
Rationale:
Table 1 shows how the properties of the solvent used in the copper extraction process have changed over time. The only property that shows a consistent decline in quality is stability against decomposition, therefore choice B is supported.
A is invalid because the speed of copper ion removal has improved over time.
C is invalid because the separation of copper ions from iron ions has improved over time.
D is invalid because the ability to chemical modify solvent to extract different metal ions has improved over time.

Item 15

UIN: HS18089_07
Item Type: Technology Enhanced
Standards Alignment: DCI: ESS3.A; SEP: EAE; CCC: SC
SR/AT/Paper Key: Box V: B; Box W: B; Box X: A; Box Y: A; Box Z: B
Key: A correct response will look like this:

Claim	Supported	Not Supported
Extracted copper produces more energy.	○	●
Recycled copper is worth 10% more than raw copper ore.	○	●
Recycling requires only 10% of the energy needed for extraction.	●	○
It is cheaper to recycle old copper than to mine and extract new copper	●	○
Recycled copper produces the same amount of air pollution as raw copper ore.	○	●

Rationale:
Table 2 shows the economic benefits of recycling copper in terms of energy requirements, cost, and air pollution produced. Recycling uses only 10 gigajoules per metric ton compared to 100 gigajoules for extraction, supporting the claim that recycling requires only 10% of the energy needed for extraction. Recycling costs $1,600 less per metric ton than extraction, supporting the claim that it is cheaper to recycle old copper than to mine and extract new copper.
The claim that extracted copper produces more energy is not supported because the table provides no information regarding the amount of energy produced by extracted and recycled copper.
The claim that recycled copper is worth 10% more than raw copper ore is not supported because the table provides no information regarding the value of copper.
The claim that recycled copper produces the same amount of air pollution as raw copper is not supported because the table shows that recycling copper produces 56,000 metric tons of air pollution annually while extracting copper ore produces 400,000 metric tons of air pollution annually.

Items 16–18

Domain: Physical Science

Phenomenon: While planes fly in refueling formation as shown in the figure, the pilot of the tanker aircraft never touches the throttle, but the pilot of the receiver aircraft must constantly increase power.

Item 16

UIN: HS18001_02

Item Type: Technology Enhanced

Standards Alignment: DCI: PS2.A; SEP: UMCT; CCC: C and E

SR/AT/Paper Key: D

Key: 4

Rationale:

Force equals mass times acceleration. Therefore, acceleration equals force divided by mass. The force is 500,000 N and the mass is 125,000 kg. So the acceleration is 500,000 m/s^2 divided by 125,000 m/s^2, which comes to 4 m/s^2.

Item 17

UIN: HS18001_05

Item Type: Multiple Choice

Standards Alignment: DCI: PS2.A; SEP: CEDS; CCC: C and E

Key: A

Rationale:

As the tanker aircraft is transferring fuel to the receiver aircraft, the tanker aircraft is losing mass, while the receiver aircraft is gaining mass. The throttle indicates the force moving the plane through the air. Since the tanker aircraft never adjusts its throttle, the tanker aircraft's acceleration will increase as its mass decreases. If the receiver aircraft does not adjust its throttle, its acceleration will decrease as its mass increases, creating more distance between the tanker aircraft and the receiver aircraft.

Answer B is invalid, because while it is true that the tanker aircraft is losing mass, it will increase in acceleration, not decrease.

Answer C is invalid, because while it is true that the tanker aircraft will increase in acceleration, it is because the tanker is losing mass, not gaining mass.

Answer D is invalid, because while it is true that if the tanker aircraft gained mass, it would decrease in acceleration, the tanker aircraft is losing mass as fuel exits.

Item 18

UIN: HS18001_08
Item Type: Technology Enhanced
Standards Alignment: DCI: PS2.A; SEP: UMCT; CCC: SC
SR/AT/Paper Key: Box Y: B; Box Z: C
Key: A correct response will look like this:

After refueling in flight, acceleration of the receiver aircraft [decreases] , from 4.5 m/s^2 to [less than 4.5] m/s^2.

Rationale:
Force equals mass times acceleration. Therefore, acceleration equals force divided by mass. With increased mass, the acceleration of the aircraft will decrease, since the throttle remains the same. Therefore, the acceleration will be less than the 4.5 m/s^2 it was before the refueling.

Items 19–23

Domain: Life Science
Phenomenon: Two marathon runners of similar athletic capabilities are running a marathon. Runner 1 ate a large meal of pasta the night before training. Runner 2 ate tuna fish and salad. After 100 minutes of the race, one runner is farther ahead than the other runner.

Item 19

UIN: HS19007_01a
Item Type: Technology Enhanced
Standards Alignment: DCI: LS1.C; SEP: AQDP; CCC: E&M
Key: B,C
Rationale:
The introduction to Figure 1 explains that different dietary components can be converted into glucose, which is the body's primary energy source. This energy allows the runners to race, since there is a difference in energy and performance, the difference must be due to the amount and types of dietary components consumed by the runners.
Choice A is incorrect because it does not answer the question why did the runners run different distances.
Choice B is correct because it seeks information about the energy in dietary components.
Choice C is correct because it seeks information about the amount of food consumed.
Choice D is incorrect because the average diet is not relevant to the runners' specific diets.
Choice E is incorrect because why some foods have different chemical structures does not relate to the runners' diets.

Item 20

UIN: HS19007_07a
Item Type: Constructed Response
Standards Alignment: DCI: LS1.C; SEP: OECI; CCC: E&M
Sample Student Response:
(4pts)

1. Runner 1 started with higher muscle glycogen levels and those levels decreased faster over the first 100 minutes of the race compared to Runner 2.
2. Runner 1 traveled a greater distance than Runner 2. Runner 1 ate a meal with a high glycemic load, which means their body had easier access to sources rich in carbohydrates. This diet allowed Runner 1 to store more energy, which let them run further and faster than Runner 2 in the first 100 minutes.
3. Runner 2 will most likely slow down after the first 100 minutes. Muscle glycogen is used as energy to run, once that storage is depleted, there will likely be less energy for movement.

Key:
This item has 4 quality points:

- After 100 minutes of running, Runner 1 had a muscle glycogen concentration of about 10 mMol/kg, and Runner 2 had a muscle glycogen concentration of 0 mMol/kg. (1 pt)
- Runner 1 ran farther (1 pt) because Runner 1's diet provided a better source of glucose, leading to higher muscle glycogen which gave them more energy to run further (1 pt).
- Runner 2 will slow down because they will run out of energy (muscle glycogen) (1 pt).

Rationale:

- Part 1: Figure 1 shows the difference in muscle glycogen concentrations and the distance run in the first 100 minutes of a race. Based on Figure 1, Runner 1 starts with 90 mmol/kg of muscle glycogen, which decreases to 10 mmol/kg by 100 minutes, a rate of .8 per minute. Runner 2 starts with 50 mmol/kg of muscle glycogen, which decreases to 0 by 100 minutes, a rate of .5 per minute.
- Part 2: Figure 1 shows the difference in muscle glycogen concentrations and the distance run in the first 100 minutes of a race. Figure 1 shows that Runner 1 traveled a further distance than Runner 2 in the same amount of time. Figure 1 also shows that Runner 1 had higher glycogen muscle concentrations and used more muscle glycogen in the same time as Runner 2. Tables 1 and 2 show the glycemic load of the two runners' meals. Runner 1's meal had a higher glycemic load, which provides higher amounts of carbohydrates and glucose. This type of meal correlates with Runner 1's higher starting muscle glycogen levels, which correlates with the further distance traveled compared to Runner 2.
- Part 3: Figure 1 shows the difference in muscle glycogen concentrations and the distance run in the first 100 minutes of a race. Muscle glycogen concentration is used to represent the amount of available energy to muscles. Since energy is required to run, and Figure 1 shows that Runner 2 has minimal muscle glycogen stored after 100 minutes, it is likely that they will slow down, unable to maintain the same pace.

Item 21

UIN: HS19007_09a
Item Type: Technology Enhanced
Standards Alignment: DCI: LS1.C; SEP: DUM; CCC: E&M
SR/AT/Paper Key: Box W: A; Box X: A, Box Y: A, Box Z: B
Key: A correct response will look like this:

Change	Increases	Decreases
Total Energy Production	◉	○
Runner's Body Heat	◉	○
Oxygen Consumption	◉	○
Glycogen Stored in Muscles	○	◉

Rationale:
Figure 1 shows the glycogen muscle content and how it decreases over the course of a race. The cellular respiration equation shows that glucose reacts with oxygen to produce carbon dioxide, water and energy.
Total energy production increases, because based on the equation, as glucose is consumed, it releases energy which is used by the runners.
Runner's body heat increases, because based on the equation, as the runner produces more energy, some of that energy will go towards increasing the runner's body temperature.
Oxygen consumption increases, because based on the equation, oxygen is required to react with glucose to produce energy. As more glucose is consumed, so is more oxygen.
Glycogen stored in the muscles will decrease because, based on Figure 1, there is a limited amount of glycogen, which is a measurement of available glucose, in the muscles. Based on the equation, to produce energy for movement, glucose must be broken down.

Item 22

UIN: HS19007_11a
Item Type: Technology Enhanced
Standards Alignment: DCI: LS1.C; SEP: DUM; CCC: E&M
SR/AT/Paper Key: Box X: A, Box Y: B, Box Z: A
Key: A correct response will look like this:

The runner that consumed more calories had a [lower] muscle glycogen concentration compared to the other runner. This means that when different types of food are digested and broken down, it is reassembled into [different] products, which [refutes] the claim.

Rationale:
Table 3 shows the calorie content of different macronutrients and how much of each the runners consumed. Figure 1 shows the amount of muscle glycogen each runner has stored before the race. Runner 1 had the higher muscle glycogen concentration based on Figure 1, and based on Table 3, consumed fewer calories (18*4+12*9+40*4=340) compared to Runner 2 (38*4+14*9+16*4=342). Since higher calories did not correlate with higher stored glycogen, the different food types must be broken down and reassembled into different products, which is contrary to the student's claim, thus, refuting it.

Item 23

UIN: HS19007_13a
Item Type: Technology Enhanced
Standards Alignment: DCI: LS1.C; SEP: PACI; CCC: C and E
SR/AT/Paper Key: Box X: A, Box Y: B, Box Z: A
Key: A correct response will look like this:

Runner 3's distance [<] Runner 1's distance

Runner 3's distance [>] Runner 2's distance

Rationale:
The meal Runner 3 had contained a glycemic load between that of Runner 1 and Runner 2. The higher the glycemic load, the higher the muscle glycogen concentration the runner has before the race. The higher the muscle glycogen concentration before the race, the more energy the runner has and the farther the runner can go in a shorter amount of time. Therefore, Runner 1 travels farthest in the 100 minutes, then Runner 3, and then Runner 2.