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

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.

Item 2

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

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

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

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:

When strontium forms a compound, it will have a [positive] charge with a magnitude (number) of [2] .

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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.