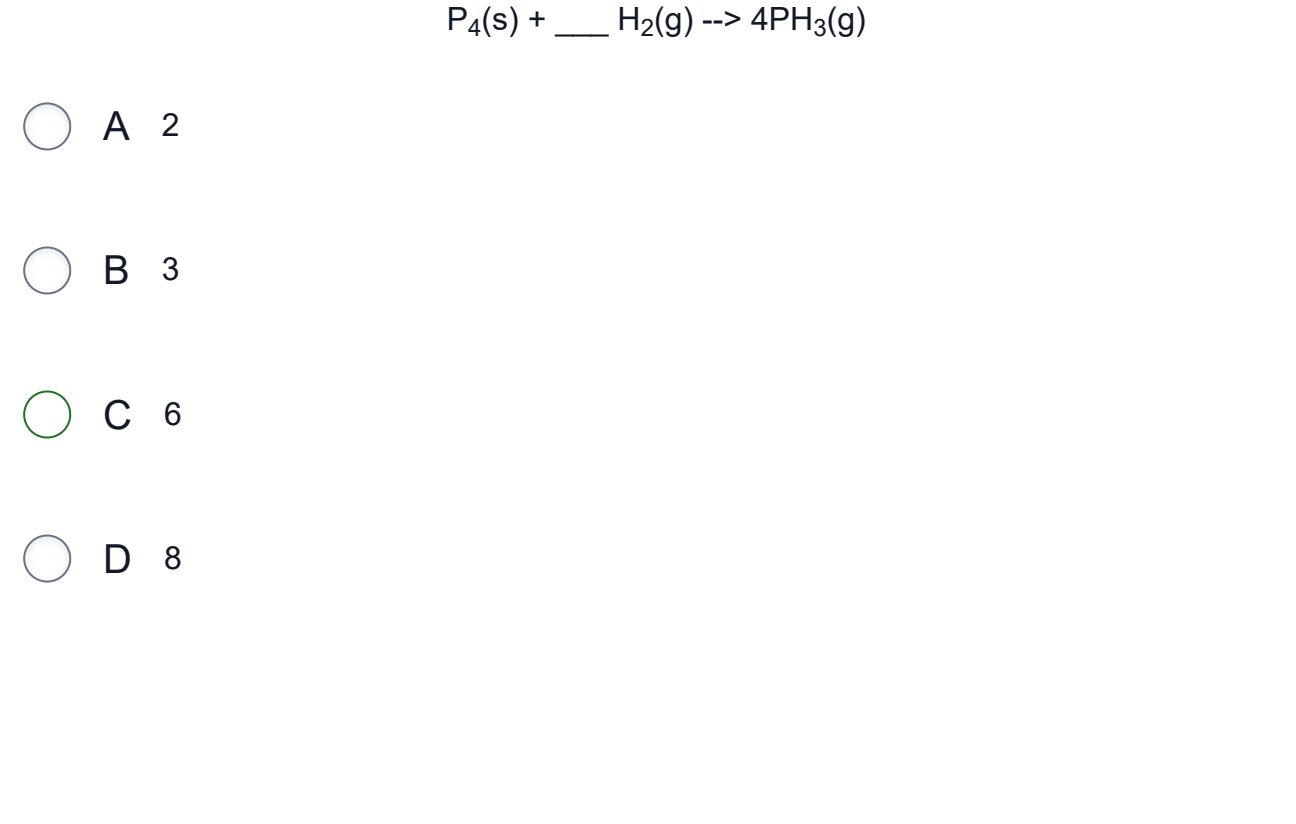
Form	BA - 2, Science, Chemistry with ESS, SY 24-25
Identifier	F-7ZWBC5_C64281

Item	BA-2_Chemistry with ESS_01
Identifier	I-SCI-F-S000026_C20135
Standards	SCI.9-12.HS-PS1-2

Hydrogen gas is found in nature as a diatomic molecule with the chemical formula of H2. In nature, two hydrogen atoms are bonded together to form a stable structure. A single hydrogen atom contains one proton and one electron. When two hydrogen atoms covalently bond, they share their valence electrons, filling their orbital with two electrons, thus becoming stable. The bond is easily broken, allowing hydrogen to react with many of the representative elements. Hydrogen can gain or lose electrons, forming a +1 or -1 charge depending on what main group element reacts with it.



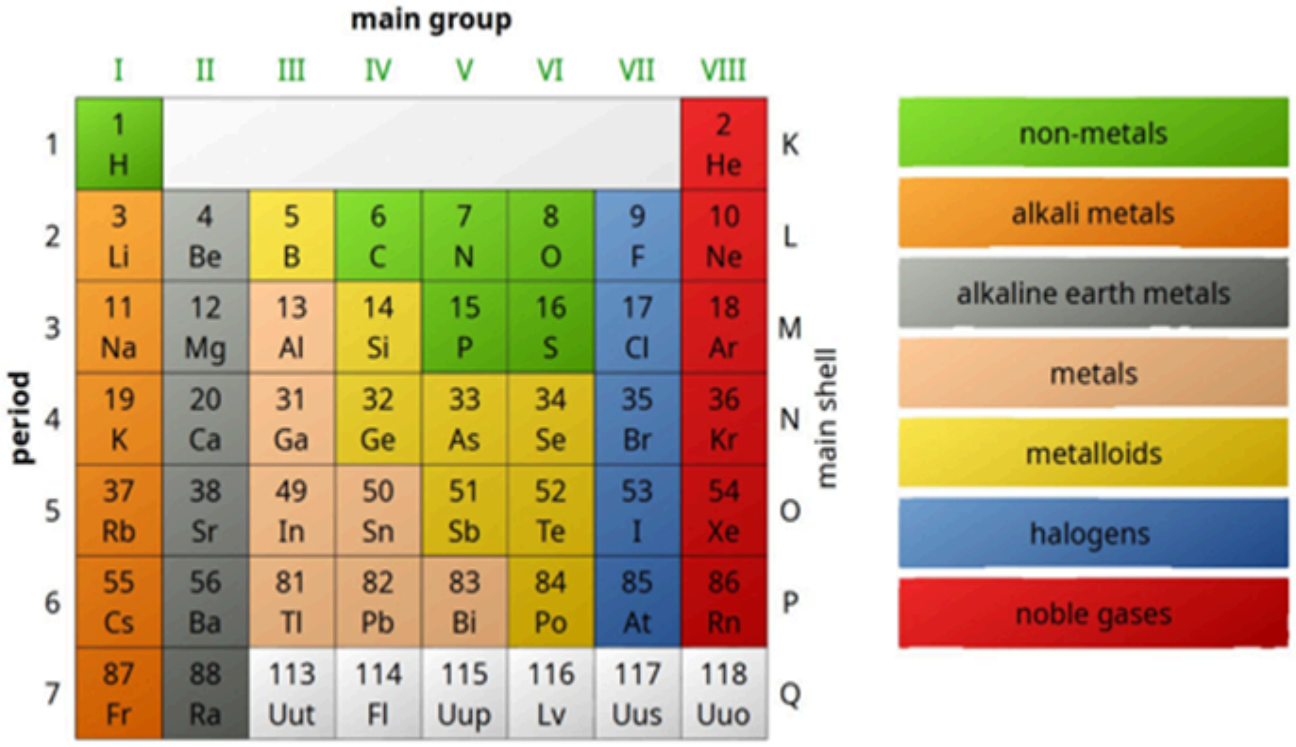
When hydrogen reacts with an element from group V, such as phosphorus, what is the coefficient needed for hydrogen when it combines with phosphorous to form phosphine?

$$P_4(s) + ___ H_2(g) \dashrightarrow 4PH_3(g)$$

- A 2
- B 3
- C 6
- D 8

Item	BA-2_Chemistry with ESS_02
Identifier	I-SCI-F-S000026_C69840
Standards	SCI.9-12.HS-PS1-2

Hydrogen gas is found in nature as a diatomic molecule with the chemical formula of H2. In nature, two hydrogen atoms are bonded together to form a stable structure. A single hydrogen atom contains one proton and one electron. When two hydrogen atoms covalently bond, they share their valence electrons, filling their orbital with two electrons, thus becoming stable. The bond is easily broken, allowing hydrogen to react with many of the representative elements. Hydrogen can gain or lose electrons, forming a +1 or -1 charge depending on what main group element reacts with it.



Hydrogen reacts with metals from Group I and Group II. Look at the two chemical reactions shown, using lithium (Li) and beryllium (Be) to represent Groups I and II. Which of the following chemical reactions would be correct?

A $2Li + H_2 \rightarrow 2LiH$

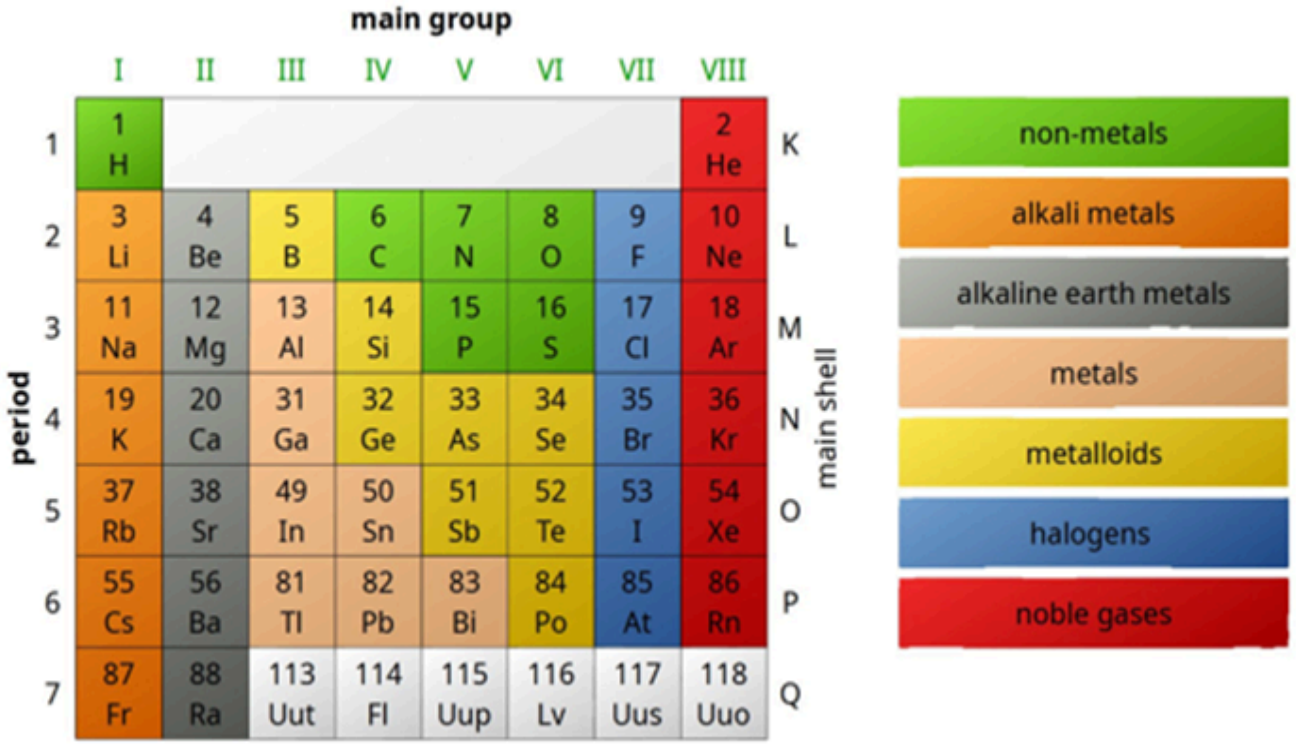
B $2Be + 2H \rightarrow 2BeH$

C $Li_2 + 2H \rightarrow 4LiH$

D $Be + H \rightarrow BeH$

Item	BA-2_Chemistry with ESS_03
Identifier	I-SCI-F-S000026_C53130
Standards	SCI.9-12.HS-PS1-2

Hydrogen gas is found in nature as a diatomic molecule with the chemical formula of H2. In nature, two hydrogen atoms are bonded together to form a stable structure. A single hydrogen atom contains one proton and one electron. When two hydrogen atoms covalently bond, they share their valence electrons, filling their orbital with two electrons, thus becoming stable. The bond is easily broken, allowing hydrogen to react with many of the representative elements. Hydrogen can gain or lose electrons, forming a +1 or -1 charge depending on what main group element reacts with it.



Which of the following best describes the outcome of a chemical reaction between sodium (Na) and chlorine (Cl)?

A Sodium gains an electron and chlorine loses an electron.

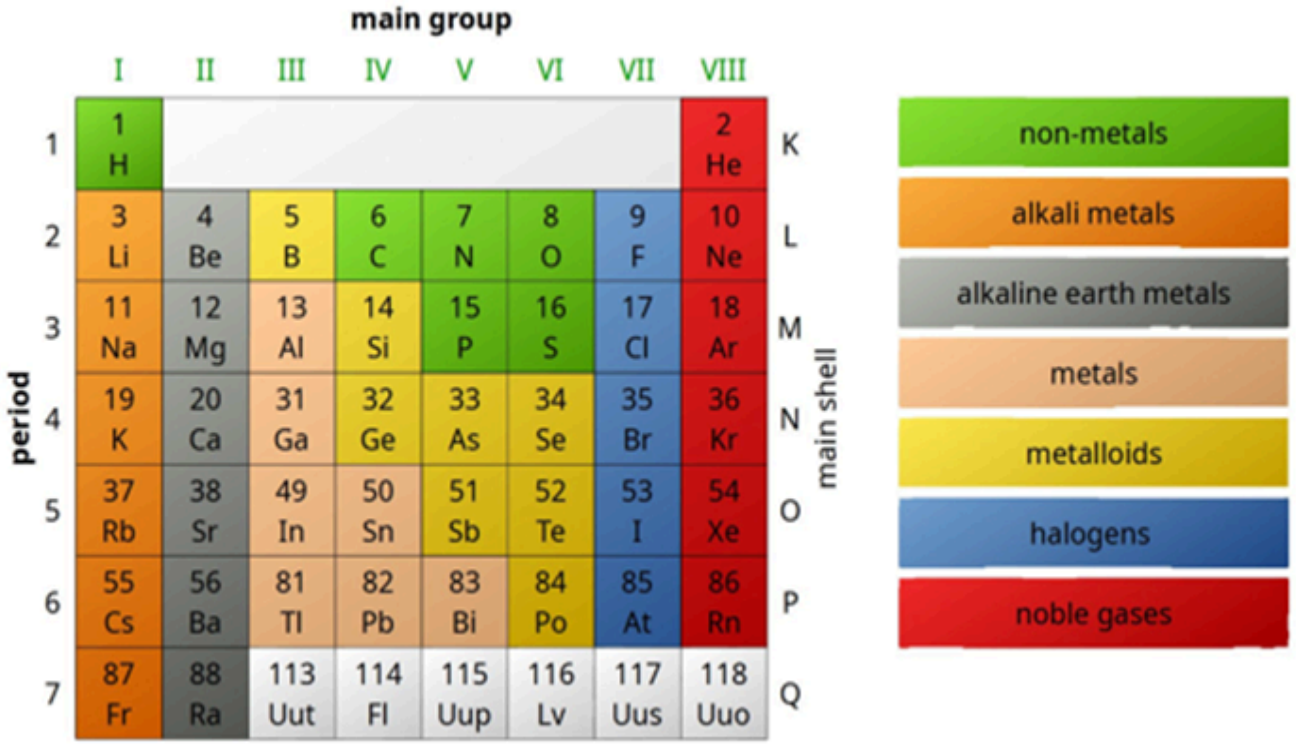
B Sodium loses an electron and chlorine gains an electron.

C Sodium and chlorine share electrons equally.

D Sodium and chlorine do not participate in electron exchange.

Item	BA-2_Chemistry with ESS_04
Identifier	I-SCI-F-S000026_C01208
Standards	SCI.9-12.HS-PS1-2

Hydrogen gas is found in nature as a diatomic molecule with the chemical formula of H2. In nature, two hydrogen atoms are bonded together to form a stable structure. A single hydrogen atom contains one proton and one electron. When two hydrogen atoms covalently bond, they share their valence electrons, filling their orbital with two electrons, thus becoming stable. The bond is easily broken, allowing hydrogen to react with many of the representative elements. Hydrogen can gain or lose electrons, forming a +1 or -1 charge depending on what main group element reacts with it.



What property of carbon (C) allows it to readily form bonds with oxygen (O) in a chemical reaction?

A Carbon's electronegativity

B Carbon's atomic number

C Carbon's electron configuration

D Carbon's mass number

Item	BA-2_Chemistry with ESS_05
Identifier	I-SCI-F-S000026_C04943
Standards	SCI.9-12.HS-PS1-7

A scientific study was conducted to investigate the conservation of atoms and mass in a chemical reaction involving the formation of water (H_2O) from hydrogen gas ($H_{2)}$ and oxygen gas (O_2). The balanced chemical equation for this reaction is as follows:
$2H_2 + O_2 \rightarrow 2H_2O$

The initial quantities of hydrogen gas and oxygen gas used in the reaction were measured as 4 grams and 32 grams, respectively, with all other conditions held constant.

According to the law of conservation of mass, what should be the total mass of the products (water) after the chemical reaction?

- A 4 grams
- B 28 grams
- C 32 grams
- D 36 grams

Item	BA-2_Chemistry with ESS_06
Identifier	I-SCI-F-S000026_C12243
Standards	SCI.9-12.HS-PS1-7

A scientific study was conducted to investigate the conservation of atoms and mass in a chemical reaction involving the formation of water (H_2O) from hydrogen gas ($H_{2)}$ and oxygen gas (O_2). The balanced chemical equation for this reaction is as follows:
$2H_2 + O_2 \rightarrow 2H_2O$

The initial quantities of hydrogen gas and oxygen gas used in the reaction were measured as 4 grams and 32 grams, respectively, with all other conditions held constant.

How many moles of hydrogen gas (H_2) were present initially in the reaction?

- A 1
- B 2
- C 3
- D 0

Item	BA-2_Chemistry with ESS_07
Identifier	I-SCI-F-S000026_C26690
Standards	SCI.9-12.HS-PS1-7

A scientific study was conducted to investigate the conservation of atoms and mass in a chemical reaction involving the formation of water (H_2O) from hydrogen gas ($H_{2)}$ and oxygen gas (O_2). The balanced chemical equation for this reaction is as follows:
$2H_2 + O_2 \rightarrow 2H_2O$

The initial quantities of hydrogen gas and oxygen gas used in the reaction were measured as 4 grams and 32 grams, respectively, with all other conditions held constant.

If the mass of the oxygen gas (O_2) used in the reaction was doubled, what effect would this have on the mass of the water produced at the end of the reaction?

A It would double the amount of water produced.

B It would increase the amount of water produced by 32 grams.

C It would have no effect of the amount of water produced as no additional hydrogen was added.

D It would reduce the amount of water produced as extra oxygen would bond with hydrogen.

Item	BA-2_Chemistry with ESS_08
Identifier	I-SCI-F-S000026_C35331
Standards	SCI.9-12.HS-PS1-7

When iron (Fe) reacts with oxygen gas (O_2) to form iron oxide ($Fe2O_3$), the masses of the reactants and products can be represented as follows:

Reactants	Products
Iron (Fe): 56g (molar mass)	**Iron (III) Oxide (Fe_2O_3): 160g (molar mass)**
Oxygen (O_2): 32g (molar mass)	

Using the balanced equation for the formation of iron oxide, $4Fe + 3O_2 \rightarrow 2Fe2O_3$, how many moles of Fe are needed to react completely with 3 moles of O_2?

- A 12 moles
- B 9 moles
- C 7 moles
- D 4 moles

Item	BA-2_Chemistry with ESS_09
Identifier	I-SCI-F-S000026_C01670
Standards	SCI.9-12.HS-PS3-1

Imani pours herself a hot cup of soup into a glass cup. The cup was room temperature (20^{o}C) but quickly became warm in her hands. She wondered how much thermal energy the hot soup transferred to the cup. The soup is made using hot water.

A standard cup holds 170 mL (or grams) of liquid. The specific heat capacity, c, of hot water is 4.186 J/g^{o}C. Thermal energy, Q, can be calculated by multiplying the mass, m, of the soup by its specific heat c, and multiplying that by the change in temperature (T_{final} -$T_{initial}$).

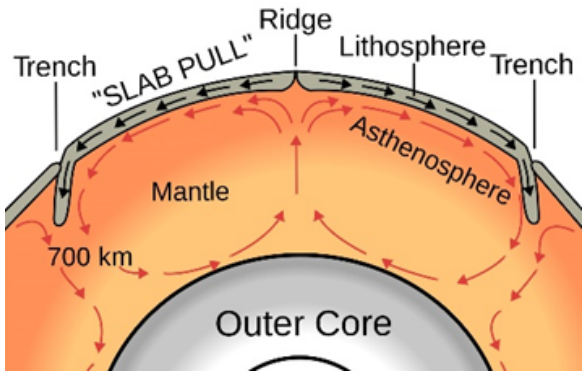
The formula is: $Q = m\ c\ (T_{final} - T_{initial})$

The water was poured into the cup when it was 70^{o}C, and it cooled to 50^{o}C before Imani drank it. What change in thermal energy did the cup of soup experience?

- A -14,232 joules
- B 14, 232 joules
- C -1.432 joules
- D 1.432 joules

Item	BA-2_Chemistry with ESS_10
Identifier	I-SCI-F-S000026_C21165
Standards	SCI.9-12.HS-PS3-1

Jada is studying how tectonic plates move on Earth's surface due to convection currents in the mantle. She is applying what she understands about thermal energy transfer to the cycling of matter in Earth’s interior. The diagram shown below is a model that scientists use to explain how thermal convection in Earth’s mantle could cause tectonic plate movement.



Jada learns that the temperature of rock in Earth’s mantle varies depending on its location. Rock located close to the lithosphere is about 1,000 °C, and rock located close to the outer core is about 3,700 °C. Jada uses the formula shown below to calculate the amount of heat that needs to be added to a 5 g piece of rock to raise its temperature from 1,000 °C to 3,700 °C. She uses 0.79 J/g °C for the specific heat of the rock.

$$q = mC\Delta T$$

q = amount of heat m = mass C = specific heat ΔT = change in temperature

What is the amount of heat, in joules, which needs to be added to the piece of rock?

A 2,706 joules

B 3,950 joules

C 10,665 joules

D 14,615 joules.

Item	BA-2_Chemistry with ESS_11
Identifier	I-SCI-F-S000026_C23668
Standards	SCI.9-12.HS-PS3-1

In a closed system, component X loses 250 J of energy while component Y gains 250 J of energy. What is the total energy change in the system?

A -500 J

B 0 J

C -250 J

D 500 J

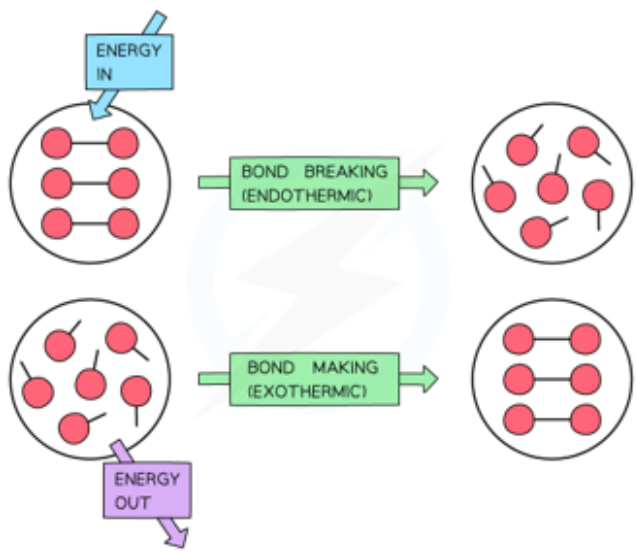
Item	BA-2_Chemistry with ESS_12
Identifier	I-SCI-F-S000026_C72538
Standards	SCI.9-12.HS-PS3-1

A ball with a mass of 2 kg is lifted to a height of 10 meters. Given that the gravitational potential energy (GPE) is calculated by the formula GPE = mgh (where m = mass, g = gravitational acceleration = 9.8 m/s^2, and h = height), what is the change in gravitational potential energy?

- A 19.6 J
- B 98 J
- C 196 J
- D 980 J

Item	BA-2_Chemistry with ESS_13
Identifier	I-SCI-F-S000026_C13150
Standards	SCI.9-12.HS-PS1-4

Hakeem was asked to develop a diagrammatic model to show the flow of thermal energy during a chemical reaction. His model is shown below.



Which claim regarding the bonding of atoms to form a stable molecule is **BEST** supported by Hakeem's model?

A A stable molecule has less energy than the individual atoms.

B A stable molecule has more inertia than the individual atoms.

C A stable molecule has more energy than the individual atoms.

D A stable molecule has less momentum than the individual atoms.

Item	BA-2_Chemistry with ESS_14
Identifier	I-SCI-F-S000026_C47082
Standards	SCI.9-12.HS-PS1-4

A hand warmer is a small packet that people can put into their gloves or mittens to keep their hands warm during freezing weather.

Sasha learns that iron powder in a hand warmer undergoes one of the chemical reactions in her model when exposed to air.

Choose **TWO** statements that explain why Sasha's hands stay warm when he holds a hand warmer.

- [ ] A — More energy is released from the chemical reaction system than was absorbed.
- [ ] B — Potential energy changes into kinetic energy when the chemical bonds between iron and oxygen are broken.
- [ ] C — The compound formed during the chemical reaction has more energy than the atoms of iron and oxygen have individually.
- [ ] D — The potential energy in the hand warmers is transferred to kinetic energy during molecular collisions, producing heat.
- [ ] E — The amount of energy transferred to the surroundings is greater than the total energy change of the chemical reaction system.

Item	BA-2_Chemistry with ESS_15
Identifier	I-SCI-F-S000026_C70248
Standards	SCI.9-12.HS-PS1-4

Which statement best describes the energy change in a chemical reaction where the bonds in the products are stronger than the bonds in the reactants?

A Energy is absorbed by the system.

B Energy is converted into mass.

C There is no energy change.

D Energy is released by the system.

Item	BA-2_Chemistry with ESS_16
Identifier	I-SCI-F-S000026_C18807
Standards	SCI.9-12.HS-PS1-4

Which of the following graph descriptions **BEST** illustrates an endothermic reaction?

- A A graph where the energy of the products is higher than the energy of the reactants.
- B A graph where the energy of the products is higher than the energy of the reactants.
- C A graph where the energy of the reactants and products are equal.
- D A graph with fluctuating energy levels with no clear trend.

Item	BA-2_Chemistry with ESS_17
Identifier	I-SCI-F-S000026_C53494
Standards	SCI.9-12.HS-LS1-7

Carter, Assad, and Isabella design an experiment where they place yeast, sugar, and warn water in a plastic water bottle. They observe over time that the balloon begins to expand and becomes more inflated the more time goes by.

Based on the evidence, how can Carter, Assad, and Isabella explain the relationship between the ingredients in the bottle and the expansion of the balloon?

- A. The chemical reaction between the ingredients in the bottle caused a release of thermal energy which caused the water to boil and inflate the balloon.
- B. The yeast began to photosynthesize and thus began producing oxygen which then inflated the balloon.
- C. The yeast entered a logarithmic growth phase because it was warm and had food. As the yeast got larger and larger, they expanded out into the balloon.
- D. The molecules of sugar were broken down by the yeast using aerobic respiration which formed carbon dioxide which filled the balloon.

Item	BA-2_Chemistry with ESS_18
Identifier	I-SCI-F-S000026_C97805
Standards	SCI.9-12.HS-LS1-7

A study was conducted to investigate the process of cellular respiration in Elodea canadensis, commonly known as Canadian waterweed, a species of aquatic plant found in freshwater habitats. The experiment involved placing the plant in a sealed container with an abundance of oxygen gas. Over a period of time, the researchers observed changes in the levels of carbon dioxide, water, and energy within the container. The data collected is summarized in the table below:

Energy Transfer in Cellular Respiration

Time (minutes)	Carbon Dioxide Produced (mL)	Water Produced (mL)	Energy Released (kJ)
0	0	0	0
10	5	2	15
20	10	4	30
30	15	6	45
40	20	8	60

Based on the data provided, what is the relationship between time and the amount of energy released during cellular respiration in Elodea canadensis?

- A Energy release decreases over time
- B Energy release remains constant over time
- C Energy release increases linearly over time
- D Energy release fluctuates randomly over time

Item	BA-2_Chemistry with ESS_19
Identifier	I-SCI-F-S000026_C56217
Standards	SCI.9-12.HS-LS1-7

A study was conducted to investigate the process of cellular respiration in Elodea canadensis, commonly known as Canadian waterweed, a species of aquatic plant found in freshwater habitats. The experiment involved placing the plant in a sealed container with an abundance of oxygen gas. Over a period of time, the researchers observed changes in the levels of carbon dioxide, water, and energy within the container. The data collected is summarized in the table below:

Energy Transfer in Cellular Respiration

Time (minutes)	Carbon Dioxide Produced (mL)	Water Produced (mL)	Energy Released (kJ)
0	0	0	0
10	5	2	15
20	10	4	30
30	15	6	45
40	20	8	60

Which of the following **BEST** describes the role of oxygen in the cellular respiration process observed in Elodea canadensis?

A Oxygen is produced as a byproduct.

B Oxygen is used to break down glucose and release energy.

C Oxygen is not involved in cellular respiration.

D Oxygen is converted into glucose.

Item	BA-2_Chemistry with ESS_20
Identifier	I-SCI-F-S000026_C25463
Standards	SCI.9-12.HS-LS1-7

A study was conducted to investigate the process of cellular respiration in Elodea canadensis, commonly known as Canadian waterweed, a species of aquatic plant found in freshwater habitats. The experiment involved placing the plant in a sealed container with an abundance of oxygen gas. Over a period of time, the researchers observed changes in the levels of carbon dioxide, water, and energy within the container. The data collected is summarized in the table below:

Energy Transfer in Cellular Respiration

Time (minutes)	Carbon Dioxide Produced (mL)	Water Produced (mL)	Energy Released (kJ)
0	0	0	0
10	5	2	15
20	10	4	30
30	15	6	45
40	20	8	60

If the trend observed in the experiment continues, how much energy would be released after 60 minutes?

- A 60 kJ
- B 75 kJ
- C 90 kJ
- D 105 kJ