Glencoe CHEMISTRY
MATTER AND CHANGE

Reviewing Chemistry
Student Edition

Glencoe
CHEMISTRY
MATTER AND CHANGE

This booklet was written by The Princeton Review, the nation's leader in test preparation. The Princeton Review helps millions of students every year prepare for standardized assessments of all kinds. Through its association with Glencoe/McGraw-Hill, The Princeton Review offers the best way to help students excel on the *Chemistry: Matter and Change* Program.

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CHAPTER REVIEW QUESTIONS

Introduction to the Student

Welcome to *Reviewing Chemistry*

This workbook is designed to strengthen your knowledge of the NSCS (National Science Content Standards) and provide additional chapter content review of your Glencoe textbook, *Chemistry: Matter and Change*.

For each chapter in the Glencoe textbook, *Chemistry: Matter and Change*, two pages of chapter review questions have been provided. These questions are designed to test your comprehension of chapter content and provide you with practice in the related skills specified in the NSCS. All of the questions are in a multiple-choice format.

Your teacher will provide you with copies of an answer sheet to use when answering the questions provided for each chapter of your textbook. To keep track of your answers, you should always fill in the chapter number for the set of review questions you are answering. Every chapter has between eight and eleven review questions, so not every row of answer bubbles will always be used.

Remember, this workbook should not be used as an alternative to reviewing the material in your textbook. The questions are designed to ensure that you are fully tested on the NSCS objectives that relate to chemistry. This workbook will be of greatest advantage to you when used as a "refresher" after you have reviewed each chapter in the textbook. Your teacher should decide how this workbook could best be used to strengthen your skills and overall knowledge of chemistry.

Name: _____ **Date:** _____

Use the label below to answer question 1.

Nutrition Facts		
	Cereal (59 g)	Cereal with Nonfat Milk (250 mL)
Nutrient	% Daily Value*	% Daily Value*
Fat	2%	2%
Sodium	0%	3%
Potassium	6%	12%
Carbohydrate	16%	18%

*Percent Daily Values are based on a 2000-Calorie diet. Your daily values may be higher or lower, depending on your Calorie needs.

1 According to this label, which nutrient is NOT found in cereal?

   A Fat

   B Sodium

   C Potassium

   D Carbohydrate

2 For an experiment in which you are determining the freezing point of an unknown chemical, you record the temperature every minute for 20 minutes. In this example, time is the —

   A control

   B dependent variable

   C independent variable

   D hypothesis

3 Rocks brought back from the moon weighed more on Earth than they did on the moon because Earth has a greater —

   A atmospheric pressure

   B density

   C gravitational force

   D magnetic field

4 A police detective has confiscated as evidence some chicken soup that he suspects might contain poison. Which type of chemist would *most* likely assist him in determining the contents of the soup?

   A Analytical chemist

   B Biochemist

   C Organic chemist

   D Physical chemist

5 Which of these chemicals does NOT occur in nature?

   A Ammonia

   B Chlorofluorocarbon

   C Fluorine

   D Ozone

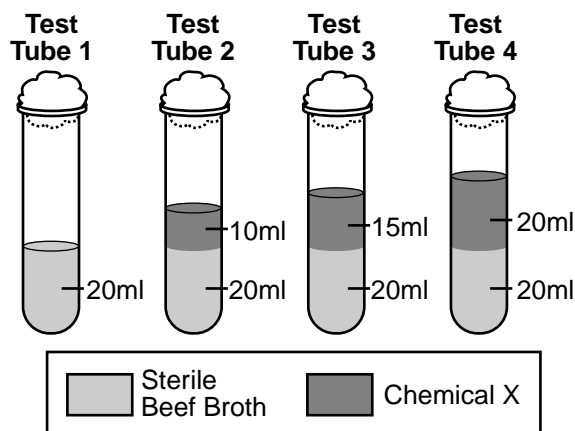**GO ON**

Name: _____   **Date:** _____

6 In the chemistry lab, chemicals that you are finished working with should be —

   A poured into the sink

   B returned to their original containers

   C mixed together and dumped in a designated container

   D disposed of as directed by your teacher

7 A scientist observes that the number of coyote sightings in suburban areas has increased over the last four years. In the process of forming a hypothesis as to why this number has increased, she would —

   A make a set of controlled observations

   B decide which variables can be controlled

   C pose a tentative hypothesis explaining what was observed

   D analyze data to explain what was observed

8 Which of these pieces of laboratory glassware should NEVER be heated with a Bunsen burner?

   A Beaker

   B Graduated cylinder

   C Flask

   D Test tube

9 Which of the following is an example of applied research?

   A Colliding nuclei to discover the smallest particles that make up matter

   B Using the results of DNA profiling as evidence in a court of law

   C Sending spacecraft to Mars to search for other life forms

   D Testing chemicals to replace CFCs in air conditioners and refrigerators

Test Tube 1 **Test Tube 2** **Test Tube 3** **Test Tube 4**

10ml   15ml   20ml
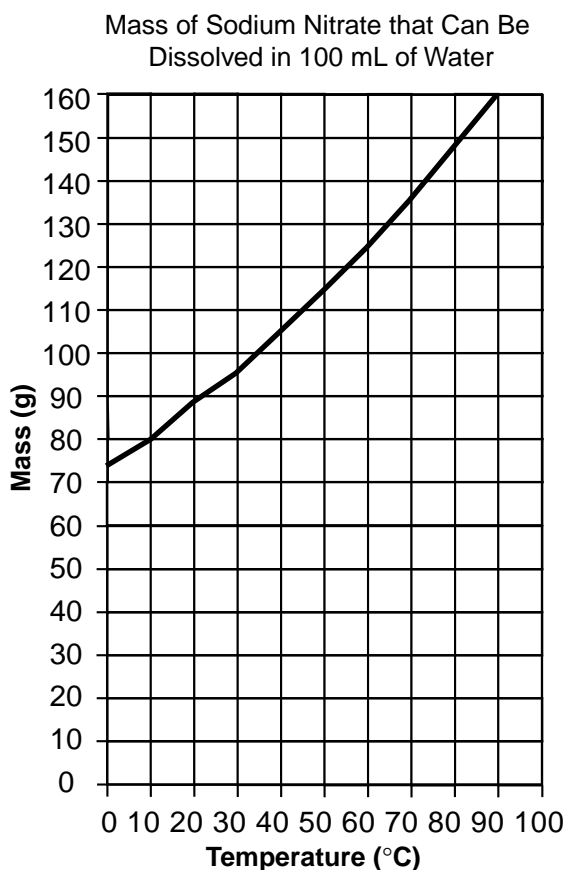20ml   20ml   20ml   20ml

Sterile Beef Broth   Chemical X

10 A biochemist is performing an experiment to determine the effects of Chemical X on the growth of bacteria. Which is the control?

   A Test tube 1

   B Test tube 2

   C Test tube 3

   D Test tube 4

STOP

Data Analysis

Name: ⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯ **Date:** ⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

Use the graph below to answer questions 1 and 2.

Mass of Sodium Nitrate that Can Be
Dissolved in 100 mL of Water

1 According to these data, what is the approximate number of grams of sodium nitrate that can be dissolved at a temperature of 50ºC?

   A 95 g

   B 105 g

   C 115 g

   D 125 g

2 Based on the information in the graph, what is the approximate number of grams of sodium nitrate that can be dissolved at a temperature of 90ºC?

   A 150 g

   B 155 g

   C 160 g

   D 165 g

3 In chemistry lab, a student was instructed to find the density of a rectangular piece of aluminum. After careful measurement, he recorded a mass of 31.44 g and a volume of 11.7 cm^3. Using the formula density = mass ÷ volume and a calculator, his answer was 2.6871794 g/cm^3. Which of these is the correct answer to report for the density of the aluminum?

   A 2.7 g/cm^3

   B 2.69 g/cm^3

   C 2.687 g/cm^3

   D 2.68 g/cm^3

GO ON

Name: _____ Date: _____

Use the table below to answer questions 4 and 5.

Boiling Point Data Collected by Student Groups				
	Group A	Group B	Group C	Group D
Trial 1	79°C	82°C	75°C	80°C
Trial 2	78°C	84.5°C	83°C	80.5°C
Trial 3	83.5°C	79°C	78.5°C	79.5°C
Average	80.2°C	81.8°C	78.8°C	80°C

4 The table shows the data obtained by four groups of students during a lab investigation designed to determine the boiling point of methanol. The accepted value for the boiling point of methanol is 78.5ºC. Whose data was the most accurate?

  A Group A

  B Group B

  C Group C

  D Group D

5 Whose data was the most precise?

  A Group A

  B Group B

  C Group C

  D Group D

6 Sandra has a recipe for cookies that calls for 4 tablespoons of peanut oil. If she wants to triple the recipe, which conversion factor would be helpful?

  A $\dfrac{3 \text{ teaspoons}}{1 \text{ tablespoon}}$

  B $\dfrac{3 \text{ tablespoons}}{2 \text{ teaspoons}}$

  C $\dfrac{4 \text{ tablespoons}}{1/4 \text{ cup}}$

  D $\dfrac{1/4 \text{ cup}}{4 \text{ tablespoons}}$

7 A student told the class that she takes 500 mg of vitamin C every day. What is this mass expressed in grams?

  A 0.05 g

  B 0.5 g

  C 5.0 g

  D 500,000 g

8 The density of carbon dioxide gas is 1.8×10^{-3} g/cm^3. This value can be expressed in ordinary notation as —

  A 0.0018 g/cm^3

  B 0.018 g/cm^3

  C 0.18 g/cm^3

  D 1.800 g/cm^3

STOP

Matter—Properties and Changes

Name: _____ **Date:** _____

Use the tables below to answer questions 1 and 2.

Baking Soda Analysis		
Element	Analysis by Mass	% by Mass
Oxygen	114.20 g	57.1%
Sodium	54.80 g	27.4%
Hydrogen	2.40 g	1.2%
Carbon	?	14.3%
Total	200.00 g	100%

Sodium Hydrogen Carbonate Analysis		
Element	Analysis by Mass	% by Mass
Oxygen	28.55 g	57.1%
Sodium	13.70 g	27.4%
Hydrogen	0.60 g	1.2%
Carbon	7.15 g	14.3%
Total	50.00 g	100%

1 The tables show the chemical analyses of two compounds: baking soda and sodium hydrogen carbonate. Because they have the same percent by mass, they must be the same compound according to the —

   A law of definite proportions

   B law of multiple proportions

   C law of conservation of energy

   D law of conservation of mass

2 If baking soda and sodium hydrogen carbonate are the same compound, then the mass of carbon in 200.00 g of baking soda should be —

   A 7.15 g

   B 14.30 g

   C 28.6 g

   D 57.20 g

3 Which of these phase changes does NOT involve the absorption of heat energy?

   A Boiling

   B Condensation

   C Melting

   D Vaporization

4 In the periodic table, a series of elements that is arranged in a horizontal row is called a —

   A cluster

   B family

   C period

   D group

5 Distillation is a separation technique that involves —

   A using a porous barrier to separate a solid from a liquid

   B separating dissolved substances based on their tendency to be drawn across a surface

   C the formation of pure, solid particles of a substance from a solution containing the dissolved substance

   D separating two or more liquids based on differences in their boiling points

GO ON

Name: _____   **Date:** _____

Use the diagram below to answer questions 6 and 7.

36.5 g		40.0 g		58.5 g		? g
HCl	**+**	**NaOH**	$\longrightarrow$	**NaCl**	**+**	**H$_2$O**
hydrochloric acid		sodium hydroxide		sodium chloride		water
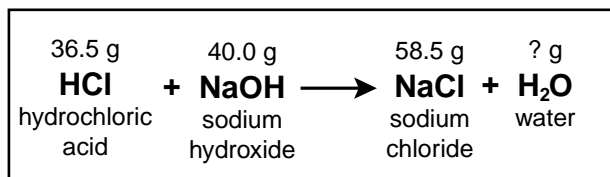
6 The diagram shows a chemical equation representing a chemical reaction. The name and mass of each substance involved in the chemical reaction are also shown. Which of these are the reactants?

A HCl and NaOH

**B** NaCl and H$_2$O

C HCl and H$_2$O

D NaOH and NaCl

7 According to the law of conservation of mass, mass is neither created nor destroyed during a chemical reaction. On the basis of this law, what mass of water was produced in this reaction?

A 16.0 g

B 18.0 g

C 20.0 g

D 22.0 g

8 Characteristics of a substance can be classified as physical properties or chemical properties. Which of the following is a chemical property?

A Boils at 56ºC

B Tastes sour

C Has a density of 2.9 g/cm^3

D Reacts with acid to produce hydrogen gas

Use the diagrams below to answer question 9.

Q   R   S   T
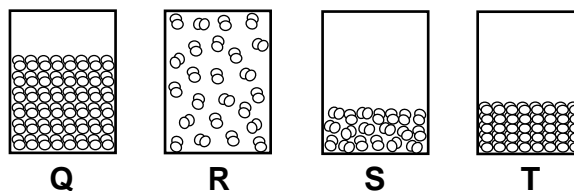
9 Each diagram shows the particles of a substance in a closed container. Which of these shows the substance that is most easily compressed?
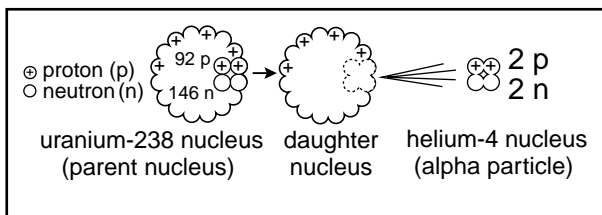
A Q

B R

C S

D T

STOP

The Structure of the Atom

Name: _____   Date: _____

Use the diagram below to answer question 1.

uranium-238 nucleus   daughter   helium-4 nucleus
(parent nucleus)   nucleus   (alpha particle)

1 The diagram above illustrates a nuclear reaction in which uranium-238 emits an alpha particle. How many protons and neutrons will the daughter nucleus have?

   A 90 p and 144 n

   B 92 p and 142 n

   C 92 p and 150 n

   D 94 p and 148 n

2 In his latest dig, Dr. Butrell found an abundance of lead (Pb) in some ancient artifacts. What is the atomic number of Pb?

   A 80

   B 81

   C 82

   D 83

Use the chart below to answer questions 3 and 4.

Element	Atomic #	Isotope	Atomic mass of isotope	% abundance
hydrogen	1	hydrogen-1	1.01 amu	99.985
		hydrogen-2	2.01 amu	0.015
carbon	6	carbon-12	12.00 amu	98.90
		carbon-13	13.00 amu	1.09
		carbon-14	14.00 amu	0.01
oxygen	8	oxygen-16	15.99 amu	98.90
		oxygen-17	17.00 amu	0.038
		oxygen-18	18.00 amu	0.200
copper	29	copper-63	62.94 amu	69.17
		copper-65	64.93 amu	30.83

3 The chart shows isotopes of some common elements. Which property is used to name the isotopes?

   A Atomic number

   B Atomic mass

   C Mass number

   D Percent natural occurrence

4 The atomic mass of an element is the weighted average mass of the isotopes of that element. Based on this definition, which of these does NOT show the correct atomic mass for an element?

   A Hydrogen: 1.008 amu

   B Carbon: 12.011 amu

   C Oxygen: 15.999 amu

   **D** Copper: 63.017 amu

GO ON

Name: _____ **Date:** _____

Use the diagram below to answer question 5.
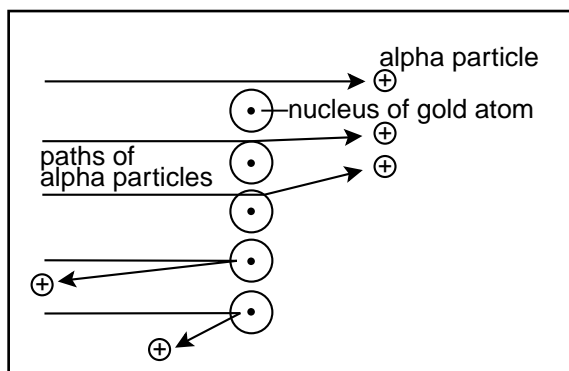
5   The diagram above shows the results of Rutherford's experiment in which he used a radioactive source to "shoot" alpha particles at a thin sheet of gold foil. Based on these results, what were Rutherford's conclusions?

   A   Atoms are solid matter with positive and negative charges scattered throughout.

   B   Atoms are solid, positively charged matter with negatively charged electrons scattered throughout.

   C   Atoms are mostly empty space with small, dense, positively charged centers.

   D   Atoms are mostly empty space with small, dense, negatively charged centers.

6   The cathode ray tube is a key component of which of the following revolutionary inventions?

   A   Automobile

   B   Fax machine

   C   Television

   D   Photocopier

Use the diagram below to answer question 7.
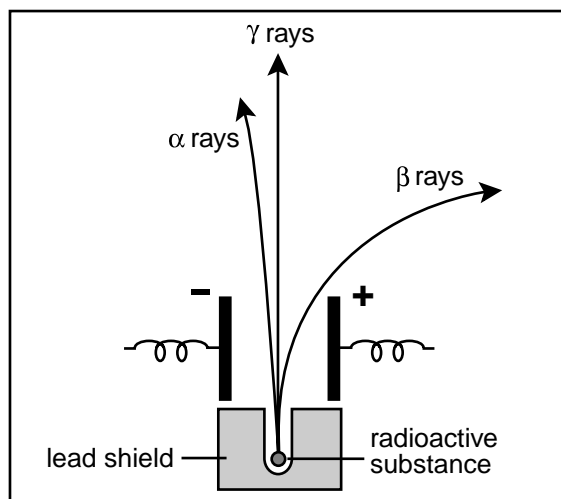
7   The diagram above shows how alpha, beta, and gamma rays are affected by two electrically charged plates. Based on the paths the rays follow, what are the respective charges of alpha, beta, and gamma rays?

   A   negative, positive, none

   B   positive, negative, none

   C   negative, none, positive

   D   positive, none, negative

8   In the fourth century BC, Greek scholars rejected Democritus's ideas about the atom. This rejection was most likely based on —

   A   experimentation

   B   government legislation

   C   religious beliefs
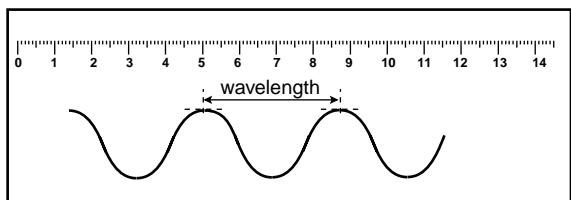
   D   the popularity of Aristotle's ideas on nature

STOP

Electrons in Atoms

Name: _____   **Date:** _____

In question 1, the speed of light, c, equals 3.00×10^8 m/s.

1   Yellow light has a wavelength of 5.60×10^{-7} meters. According to the formula, $c = \lambda\nu$, what is the frequency of this yellow light?

   A 5.36×10^{14} s^{-1}

   B 5.36×10^{16} s^{-1}

   C 1.87×10^{-15} s^{-1}

   D 1.87×10^{15} s^{-1}

Use the diagram below to answer question 2.

2   What is the wavelength of the wave shown above?

   A   3.2 cm

   B   3.5 cm

   C   3.7 cm

   D   4.0 cm

3   When a potassium compound is placed in a flame, energy is released and a violet color is produced. This energy release is due to —

   A   the release of gamma rays from the nucleus

   B   the return of excited electrons to lower energy levels

   C   the movement of electrons to higher energy levels

   D   the absorption of photons by the electrons

In question 4, Planck's constant, h, equals 6.626×10^{-34} J·s

4   According to Einstein, $E_{photon} = h\nu$. What is the energy of a photon if it has a frequency of 6.82×10^{14} s^{-1}?

   A 9.72×10^{-20} J

   B 1.03×10^{-20} J

   C 4.52×10^{-19} J

   D 4.52×10^{-20} J

GO ON

Name: _____ **Date:** _____

5 Which of these is the ground-state electron configuration for an atom of fluorine (atomic number = 9)?

   A $1s^2 2s^2$

   B $1s^2 2s^2 2p^3$

   C $1s^2 2s^2 2p^4$

   D $1s^2 2s^2 2p^5$

6 The electron configuration for an atom of iron is [Ar] $3d^6 4s^2$. Which of the following is the correct electron-dot structure for iron?

   A Fe •

   B Fe :

   C $\overset{..}{\underset{..}{Fe}}$:

   D : $\overset{..}{\underset{..}{Fe}}$:

7 Which of these orbital diagrams represents a chlorine atom in the ground state? Chlorine has an atomic number of 17.

   A
   1s 2s 2p

   B
   1s 2s 2p

   C
   1s 2s 2p 3s 3p

   D
   1s 2s 2p 3s 3p
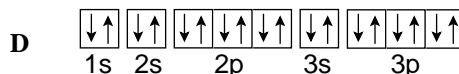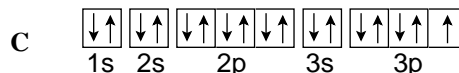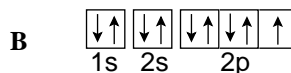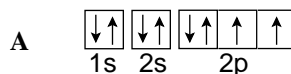
8 The arrangement of electrons in an atom of an element determines the chemical properties of that element. Our present-day understanding of how electrons are arranged in an atom is the result of all of these scientific contributions EXCEPT —

   A Rutherford's gold foil experiment that proved the existence of the nucleus

   B Bohr's orbits that explained hydrogen's quantized energy states

   C De Broglie's equation that led to thinking of electrons as both particles and waves

   D Schrödinger's wave equation that predicted atomic orbitals

STOP

Name: _____   **Date:** _____

Use the graph below to answer questions 1–3.
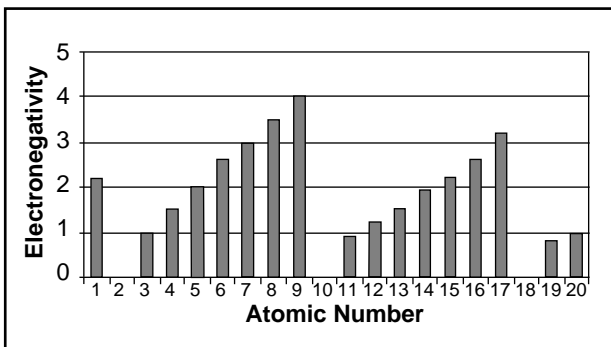

1 The electronegativity of an element indicates the relative ability of its atoms to attract electrons to form chemical bonds. According to the graph, as you move across a period in the periodic table —

  A the atomic number increases and the electronegativity increases

  B the atomic number increases and the electronegativity decreases

  C the atomic number decreases and the electronegativity increases

  D the atomic number decreases and the electronegativity decreases

2 According to the graph, which of the following elements has the strongest attraction for electrons?

  A Aluminum (atomic number = 13)

  B Boron (atomic number = 5)

  C Oxygen (atomic number = 8)

  D Sulfur (atomic number = 16)

3 Why are there no electronegativity values for the elements with atomic numbers 2, 10, and 18?

  A The noble gases form very few compounds because they are gases.

  B The noble gases form very few compounds because they are rare.

  C The noble gases form very few compounds because they are radioactive.

  D The noble gases form very few compounds because their electron configurations are very stable.

4 Metal is to malleable as nonmetal is to —

  A brittle

  B solid

  C dull

  D gaseous

5 Elements in the same group of the periodic table have similar chemical properties because they have —

  A the same number of orbitals

  B the same number of valence electrons

  C atomic numbers that are multiples of each other

  D the same principal energy levels

**GO ON**

Name: _____ **Date:** _____

Use the graph below to answer questions 6 and 7.
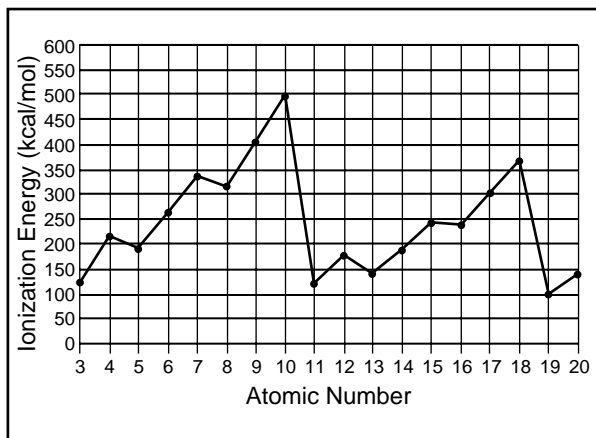
6 The graph shows the first ionization energy for elements with atomic numbers 3–20. According to the graph, what is the approximate first ionization energy for the element with atomic number 16?

   A 300 kcal/mol

   B 250 kcal/mol

   C 240 kcal/mol

   D 190 kcal/mol

7 Elements with atomic numbers 4, 12, and 20 are in the same group in the periodic table. As you move down a group —

   A the principal energy level increases and the first ionization energy increases

   B the principal energy level increases and the first ionization energy decreases

   C the principal energy level decreases and the first ionization energy increases

   D the principal energy level decreases and the first ionization energy decreases

8 Mendeleev left blank spaces in his periodic table where he thought elements that had not yet been discovered should go. He was able to predict the properties of these elements by —

   A studying the spectra of stars that contained them

   B testing their properties such as melting point, density, and valence

   C noting periodic trends in the properties of known elements that surrounded the blank spaces in the periodic table

   D studying the new elements produced by radioactive decay

Use the diagram below to answer question 9.
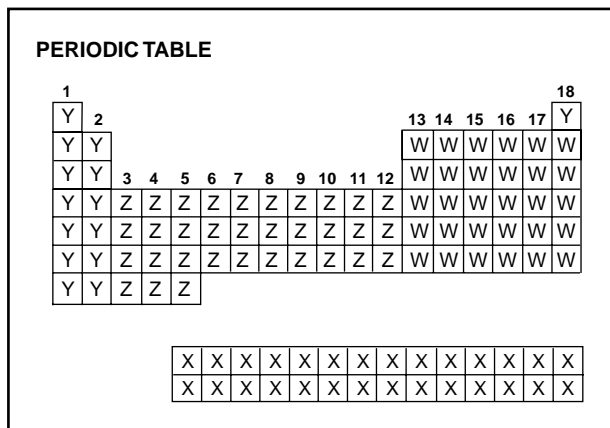
9 The periodic table has an unusual shape because it is divided into blocks representing the energy sublevel being filled with valence electrons. In the periodic table shown in the diagram, which sequence lists these blocks in **s-p-d-f** order?

   A Y, W, Z, X
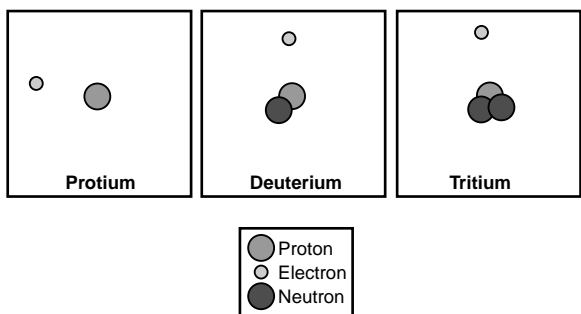
   B W, Y, X, Z

   C Y, Z, W, X

   D X, Y, Z, W

The Elements

Name: _____   **Date:** _____

Use the diagram below to answer question 1.

Protium   **Deuterium**   **Tritium**

◯ Proton
○ Electron
● Neutron

1 Some nuclear reactors use heavy water to slow down neutrons produced during nuclear fission. Heavy water contains deuterium, an isotope of hydrogen. What is the mass number of deuterium?

   A 1

   B 2

   C 3

   D 4

2 A family of colorless, inactive gases was unknown at the time Mendeleev conceived his periodic table. Eventually, these gases were discovered on Earth in the late 1890s. What group does this family occupy in the modern periodic table?

   A 5A

   B 6A

   C 7A

   D 8A

3 Scuba tanks usually contain compressed air, which is essentially a mixture of nitrogen (78%) and oxygen (21%). In order to avoid a painful condition called the "bends," deep-sea divers replace the nitrogen with the noble gas —

   A helium

   B argon

   C krypton

   D xenon

Use the diagram below to answer question 4.

4 Lithium (Li), an alkali metal, has properties similar to and has a diagonal relationship with —

   A hydrogen (H)

   B beryllium (Be)

   C sodium (Na)

   D magnesium (Mg)

GO ON

Name: _____ **Date:** _____

5 Iron is to hemoglobin as magnesium is to —

   A amino acid

   B chlorophyll

   C DNA

   D protein

6 Transition metals with unpaired valence electrons are attracted to a magnetic field. Which of these elements is NOT able to form a permanent magnet?

   A Cobalt

   B Copper

   C Nickel

   D Iron

7 In the periodic table, as you move from left to right across a period —

   A atomic radius increases and ionization energy increases

   B atomic radius increases and ionization energy decreases

   C atomic radius decreases and ionization energy increases

   D atomic radius decreases and ionization energy decreases

8 As you move from top to bottom down a group in the periodic table, which of the following happens?

   A Valence electrons move farther from the positively charged nucleus.

   B Valence electrons move farther from the negatively charged nucleus.

   C Valence electrons move closer to the positively charged nucleus.

   D Valence electrons move closer to the negatively charged nucleus.

9 More than three times as much energy is used to make a new aluminum can than to process a recycled one. The main reason for this difference is that—

   A aluminum is not an abundant element

   B aluminum has a high melting point

   C it is difficult to extract aluminum from its ore
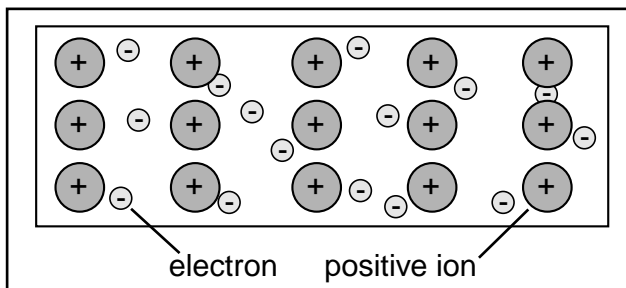
   D aluminum is not a reactive metal

STOP

Name: _____ **Date:** _____

1 Which of these is NOT a cation?

   A Na^+

   B Cl^-

   C Mg^{2+}

   D K^+

Use the diagram below to answer question 2.

electron   positive ion

2 The diagram represents the arrangement of atoms in a metallic solid. Scientists believe that electrons in the outer energy levels of the bonding metallic atoms are free to move from one atom to the next. Because they are free to move, these electrons are often referred to as —

   A delocalized electrons

   B lattice electrons

   C malleable electrons

   D valence electrons

3 An atom with the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$ is most likely —

   A a metal that forms a positive ion

   B a metal that forms a negative ion

   C a nonmetal that forms a positive ion

   D a nonmetal that forms a negative ion

Use the table below to answer question 4.

Compound	Lattice Energy (kJ/mol)
NaCl	−769
KBr	−671
LiF	−1030
MgO	−3795

4 The table shows the lattice energy for some ionic compounds. Based on these data, which of these compounds would require the most energy to separate the bonded ions?

   A NaCl

   B KBr

   C LiF

   D MgO

GO ON

Name: _____ **Date:** _____

Use the diagram below to answer question 5.
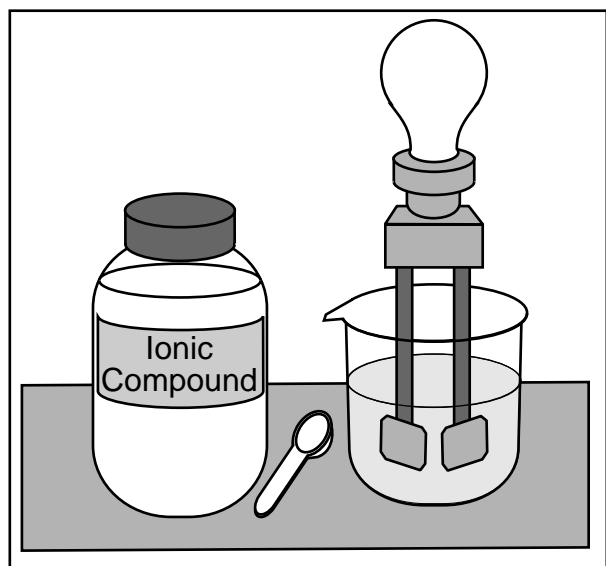
5 This apparatus was most likely designed to show that —

A the formation of an ionic compound is an exothermic reaction

B ionic compounds are electrolytes

C ions have an electrical charge

D water is a good conductor of electricity

6 When atoms of sodium (Na) and chlorine (Cl) combine to form salt (NaCl), an ionic crystal is formed. The Na^+ ion is smaller than the Na atom, while the Cl^- ion is larger than the Cl atom. Why?

A The Na and the Cl atoms both lost electrons.

B The Na and the Cl atoms both gained electrons.

C The Na atom lost an electron, while the Cl atom gained an electron.

D The Na atom gained an electron, while the Cl atom lost an electron.

7 What is the chemical formula for a compound formed from calcium ions (Ca^{2+}) and chloride ions (Cl^-)?

A CaCl

B Ca_2Cl

C $CaCl_2$

D Ca_2Cl_2

8 Most transition metals have more than one oxidation number because —

A they may lose d electrons when forming positive ions

B they may lose f electrons when forming ions

C their electron arrangements are unstable

D their electrons are closer to the nucleus

STOP

Name: _____ **Date:** _____

1 A molecule is formed when two or more atoms form a covalent bond. According to this definition, which of these is NOT a molecule?

A NaCl

B H_2

C HCl

D NH_3

Use the table below to answer question 2.

Number of Atoms	Prefix	Number of Atoms	Prefix
1	mono-	6	hexa-
2	di-	7	hepta-
3	tri-	8	octa-
4	tetra-	9	nona-
5	penta-	10	deca-

2 The table shows some of the prefixes used to name binary covalent compounds. What name would be given to the compound PBr_5?

A Phosphorus tetrabromide

B Monophosphorus pentabromide

C Phosphorus pentabromide

D Phosphorus hexabromide

3 In the polyatomic ion NH_4^+, the formation of a coordinate covalent bond between nitrogen and hydrogen involves —

A hydrogen transferring a pair of electrons to nitrogen

B nitrogen transferring a pair of electrons to hydrogen

C hydrogen donating a pair of electrons to be shared with nitrogen

D nitrogen donating a pair of electrons to be shared with hydrogen

4 When hydrogen and fluorine combine, a polar covalent bond is formed. Which of these formulas is the *best* way to express this relationship?
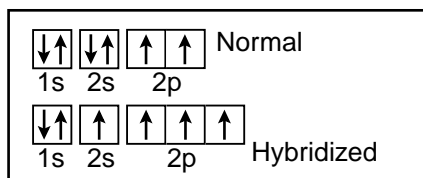
A $H-F$

B $\delta^+ H - F \delta^-$

C $H\!:\!F$

D $H\!:\!\overset{\cdot\cdot}{\underset{\cdot\cdot}{F}}\!:$

GO ON

Name: _____ **Date:** _____

5 At room temperature, iodine (I_2) is a solid and bromine (Br_2) is a liquid. These molecules have different melting points because of stronger —

A covalent bonds in iodine

B covalent bonds in bromine

C intermolecular forces in iodine

D intermolecular forces in bromine

7 Which of these is the chemical formula for sulfurous acid?

A H_2S

B H_2SO_3

C H_2SO_4

D H_2S

Use the diagram below to answer question 6.

| ↓↑ | ↓↑ | ↑ | ↑ | Normal |
| 1s | 2s | 2p | | |

| ↓↑ | ↑ | ↑ | ↑ | ↑ | |
| 1s | 2s | 2p | | | Hybridized |

6 The diagram shows the electron configuration of a normal carbon atom and the rearrangement of electrons to form four new identical orbits in a hybridized carbon atom. This type of hybrid orbital is called an —

**A** s^2 orbital

B sp orbital

C sp^2 orbital

D sp^3 orbital

8 The bond that holds two fluorine atoms together in an F_2 molecule would be classified as nonpolar covalent because —

A both atoms are different and the difference in electronegativity is large

B both atoms are different and the difference in electronegativity is zero

C both atoms are the same and the difference in electronegativity is large

D both atoms are the same and the difference in electronegativity is zero

STOP

Name: _____   **Date:** _____

Refer to the diagram below to answer questions 1–6.

$$Zn(s) + HCl(aq) \longrightarrow ZnCl_2(aq) + H_2(g)$$
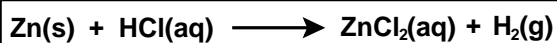
1 The skeleton equation represents a chemical reaction. Which of these are the reactants?

   A Zn and HCl

   B $ZnCl_2$ and H_2

   C HCl and $ZnCl_2$

   D Zn and H_2

2 The skeleton equation for this chemical reaction violates the law of conservation of mass. Which of these is the correct balanced chemical equation?

   A $2Zn(s) + HCl(aq) \longrightarrow 2ZnCl_2(aq) + H_2(g)$

   B $Zn(s) + 2HCl(aq) \longrightarrow ZnCl_2(aq) + 2H_2(g)$

   C $Zn(s) + 2HCl(aq) \longrightarrow ZnCl_2(aq) + H_2(g)$

   D $2Zn(s) + 2HCl(aq) \longrightarrow 2ZnCl_2(aq) + H_2(g)$

3 The chemical reaction represented by the equation would be classified as a —

   A synthesis reaction

   B decomposition reaction

   C single-replacement reaction

   D double-replacement reaction

4 HCl(aq) and $ZnCl_2$(aq) both exist as ions in aqueous solutions. Which of these is the complete ionic equation for this chemical reaction?

   A $Zn(aq) + 2H^+(aq) + Cl^-(aq) \longrightarrow$
       $Zn^{2+}(aq) + Cl^-(aq) + H_2(g)$

   B $Zn(s) + 2H^+(aq) + 2Cl^-(aq) \longrightarrow$
       $Zn^{2+}(aq) + 2Cl^-(aq) + H_2(g)$

   C $2Zn(s) + H^+(aq) + Cl^-(aq) \longrightarrow$
       $2Zn^{2+}(aq) + Cl^-(aq) + H_2(g)$

   D $Zn(aq) + 2H^+(aq) + 2Cl^-(aq) \longrightarrow$
       $Zn^{2+}(s) + Cl^-(aq) + 2H_2(g)$

GO ON

Name: _____ **Date:** _____

5 Which of these is a spectator ion in this chemical reaction?

    A $Cl^-(aq)$

    B $H^+(aq)$

    C $H_2(g)$

    D $Zn^{2+}(aq)$

6 Which of these is the net ionic equation for this chemical reaction?

    A $Zn(s) + 2Cl^-(aq) \longrightarrow Zn^{2+}(aq) + 2Cl^-(aq)$

    B $Zn^{2+}(aq) + 2H^+(aq) \longrightarrow Zn(s) + H_2(g)$

    C $2H^+(aq) + 2Cl^-(aq) \longrightarrow 2HCl(aq)$

    D $Zn(s) + 2H^+(aq) \longrightarrow Zn^{2+}(aq) + H_2(g)$

7 Which of these is NOT evidence of a chemical reaction?

    A An iron nail changes to a brownish-orange color.

    B An ice cube melts into liquid water.

    C An antacid tablet produces bubbles of gas when placed in water.

    D A piece of zinc raises the temperature of an acid as it reacts with it.

Use the diagram below to answer question 8.

K
Ca
Na
Mg
Al
Zn
Fe
Pb
H
Cu
Ag

Increasing ease of discharge

OH
I
Br
Cl
NO_3
SO_4

Increasing ease of discharge
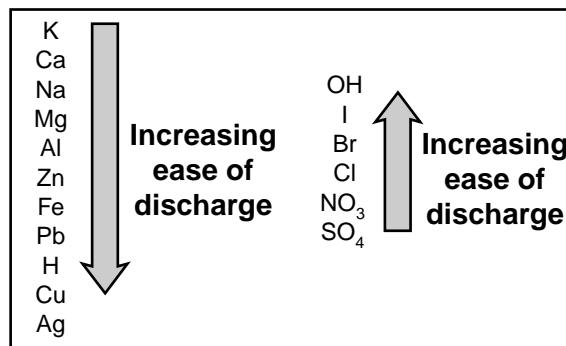
8 The diagram shows the activity series of some metals (left) and nonmetals (right). A student set up four beakers, each containing 100 mL of dilute hydrochloric acid (HCl[aq]). She added 5 g of a metal to each beaker in this order: aluminum (Al), copper (Cu), sodium (Na), and zinc (Zn). Which metal will NOT react with the acid?

    A Aluminum

    B Copper

    C Sodium

    D Zinc

STOP

The Mole

Name: _____ **Date:** _____

1 How many moles of nitrogen atoms are contained in one mole of $Ba(NO_3)_2$?

A   1

B   2

C   6

D   9

2 The molecular formula of a compound is X_6Y_3. What is the empirical formula for this compound?

A X_6Y

B XY_3

C X_2Y

D XY_2

3 Zinc is used as a coating on iron and steel to prevent corrosion. What is the mass, in grams, of 0.0650 mol Zn?

A   3.25 g

B   3.90 g

C   3.94 g

D   4.25 g

4 Mole is to atom as gram is to —

A   amu

B   mass

C   molecule

D   particle

5 What is the total number of atoms contained in 2.00 moles of helium?

A   15.999

B   32.0

C 6.02×10^{23}

D 1.20×10^{24}

6 A compound has the formula $MgSO_4 \cdot 7H_2O$. Its chemical name is —

A   aqueous magnesium sulfate

B   magnesium sulfate pentahydrate

C   magnesium sulfate heptahydrate

D   magnesium sulfate decahydrate

GO ON

Name: _____   Date: _____

7 Indium (In) is a relatively rare element that never occurs as a free metal. It is usually found in a compound that contains 70.48% In and 29.52% S. What is the empirical formula for this compound?

    A InS

    B In_2S_3

    C In_3S_5

    D In_6S_9

8 A student measures 10.0 g of hydrated sodium carbonate ($Na_2CO_3 \cdot xH_2O$) and places it in a crucible. After heating, 3.7 g of anhydrous sodium carbonate (Na_2CO_3) remains. What is the formula for the hydrate?

    A $Na_2CO_3 \cdot 2H2O$

    B $Na_2CO_3 \cdot 5H2O$

    C $Na_2CO_3 \cdot 8H_2O$

    D $Na_2CO_3 \cdot 10H_2O$

9 Potassium nitrate, also known as saltpeter, is used in matches. What is the percent by mass of potassium (K) in potassium nitrate (KNO_3)?

    A 38.67%

    B 45.94%

    C 55.71%

    D 56.58 %

10 Baking soda is the common name for sodium hydrogen carbonate ($NaHCO_3$). What is the mass in grams of 2.75 moles of sodium hydrogen carbonate?

    A 63.2 g

    B 84 g

    C 210 g

    D 231 g

11 A mole of $^{12}_{6}C$ atoms will have a total mass of —

    A 12 kg

    B 12 g

    C 12 amu

    D 6 amu

STOP

Stoichiometry

Name: _____ **Date:** _____

1 A chemist is about to synthesize tetraphosphorus decoxide by combining *X* grams of phosphorus with sufficient oxygen to react completely with the phosphorus. If he wants to determine the amount of tetraphosphorus decoxide that will be produced, all of the following need to be answered before initiating the experiment EXCEPT —

   A What is the balanced chemical equation for this reaction?

   B What are the number of moles for each reactant?

   C What is the mole ratio of the two reactants?

   D Which is the limiting reactant and which is the excess reactant?

2 Three atoms of iron (Fe) are to be combined with four molecules of oxygen (O_2). How many total iron atoms and oxygen molecules will be combined during the formation of Fe_3O_4?
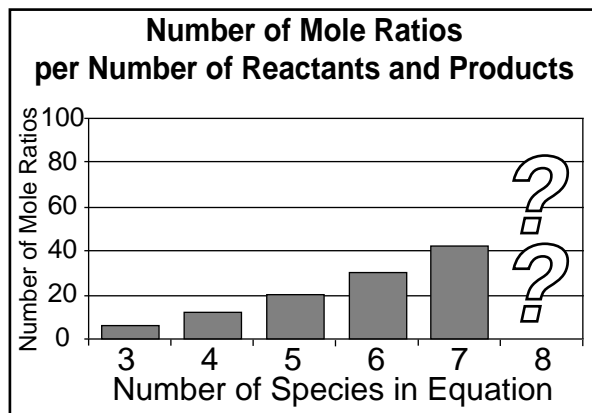
   A 3

   B 4

   C 7

   D 10

$$2Al(s) + 3Br_2(l) \times 2AlBr_3(s)$$
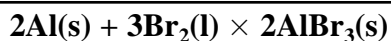
3 The above equation represents the reaction of aluminum and bromine to form aluminum bromide. Which of these is NOT a mole ratio for this reaction?

   A 2 mol Al:3 mol Br_2

   B 2 mol $AlBr_3$:2 mol $AlBr_3$

   C 3 mol Br_2:2 mol Al

   D 2 mol $AlBr_3$:3 mol Br_2

Use the graph below to answer question 4.

Number of Mole Ratios per Number of Reactants and Products

4 This graph shows the number of mole ratios that can be determined given the number of reactants and products of a chemical reaction. If this trend continues, how many mole ratios can be formed with a chemical reaction that has a sum of eight reactants and products?

   A 54

   B 56

   C 58

   D 60

5 Chemists normally use an excess of one reactant in a chemical reaction because —

   A the reaction will continue until all of the limiting reactant is consumed

   B the reaction will continue until all of the excess reactant is consumed

   C reactions do not take place unless there are unequal amounts of reactants

   D reactions occur too quickly if equal amounts of reactants are used

GO ON

Name: _____   Date: _____

Use the graph below to answer question 6.
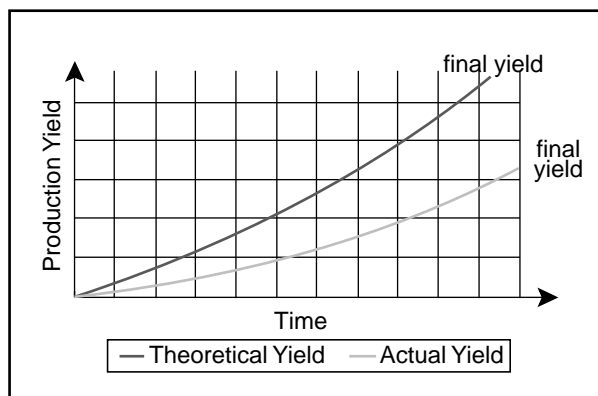
6 According to this graph, during a chemical reaction —

   A the actual yield is higher than the theoretical yield

   B the calculated percent yield of product will be less than 100%

   C the theoretical and actual yields are equal

   D the percent yield of product is more than 100%

7 Stoichiometry is the study of quantitative relationships between amounts of —

   A the reactants and products of a chemical reaction relative to time

   B the products of a chemical reaction only

   C the reactants and products of a chemical reaction

   D the reactants of a chemical reaction only

8 Which piece of information about an element on the periodic table is most necessary in order to compute the mass of a given molecule?

   A The symbol of the elements in the molecule

   B The atomic number of each element in the molecule

   C The number of electrons at each energy level for each element

   D The average atomic mass of one atom of each element in the molecule

9 Three moles of carbon dioxide are produced when one mole of propane gas is burned. How many moles of carbon dioxide will be produced if 30 moles of propane gas are burned?

   A 10 moles

   B 30 moles

   C 90 moles

   D 120 moles

10 In the movie *The Wacky World of Chemistry,* a chemist wrote down the following equation on a chalkboard: $Ti + C + 2Cl_2 \longrightarrow TiCl_3 + C$. This equation is NOT correct because —

   A the titanium atoms are not equal on both sides of the equation

   B there are not enough chlorine atoms on the right side of the equation

   C the carbon atoms are equal on both sides of the equation

   **D** the right side of the equation should have a greater number of atoms than the left side

STOP

States of Matter

Name: _____   **Date:** _____

1 Which of the following is defined as a measure of the average kinetic energy of particles in a given sample of matter?

    A   Velocity

    B   Diffusion

    C   Temperature

    D   Partial pressure

2 Energy release is to condensation as energy input is to —

    A   deposition

    B   sublimation

    C   freezing

    D   dispersion

3 Which of the following is NOT a characteristic of liquids?

    A   No significant attraction between particles

    B   Less fluid than gases

    C   More dense than gases

    D   Exhibits viscosity

4 Marta and her father often skip stones across a pond. What type of intermolecular force creates the surface tension that allows the stones to skip?

    A   Metallic forces

    B   Dipole–dipole forces

    C   Dispersion forces

    D   Hydrogen bonding

5 For a substance to reach its boiling point, a substantial amount of energy must be added. The boiling point occurs when the —

    A   temperature increases

    B   vapor pressure equals atmospheric pressure

    C   particle velocity equals the boiling point

    D   vapor pressure reaches the critical point

6 During evaporation, certain liquid molecules become vapor molecules because they have greater than average —

    A   lattice energy

    B   viscosity

    C   kinetic energy

    D   fluidity

GO ON

Name: _____ **Date:** _____

7 Ionic solids such as sodium chloride are easily shattered, but metallic solids such as copper can be easily bent and shaped. This difference occurs because —

A ionic solids have low melting points

B atoms in metallic solids are not arranged in a regular pattern

C covalent bonding between sodium and chlorine keeps the solid rigid

D mobile electrons in the copper can shift without disrupting the solid

8 The process of hydrogen bonding involves hydrogen atoms bonding with —

A either oxygen, carbon, or silicon

B either nitrogen, boron, or hydrogen

C either fluorine, oxygen, or nitrogen

D either fluorine, hydrogen, or sodium

9 Diffusion is the term used to describe the movement of one material through another. The diffusion of gases can be explained by —

A relative molar masses

B differences in volume

C evaporation

D random motion

Use the diagram below to answer question 10.


steam   liquid water   ice
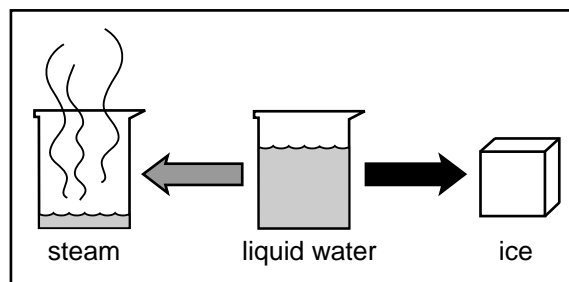
10 The diagram shows how liquid water is transformed into a solid and a vapor. Which of these labels should be placed above each of the arrows in the diagram?

F *Energy added* over the gray arrow; *energy released* over the black arrow

G *Particle velocity decreased* over the gray arrow; *particle velocity increased* over the black arrow

H *Energy released* over the gray arrow; *energy added* over the black arrow

J *Density decreased* over the gray arrow; *density increased* over the black arrow

STOP

Gases

Name: _____   **Date:** _____

1 Charles's Law explains the relationship between the temperature and volume of a gas. Which graph best represents this relationship?

A

Volume vs. Temperature (K)

B

Volume vs. Temperature (K)

C

Volume vs. Temperature (K)

D

Volume vs. Temperature (K)
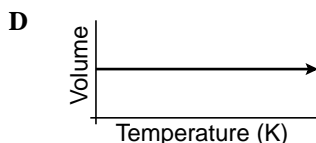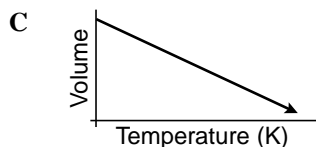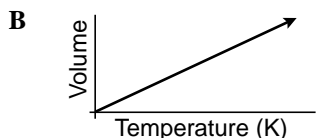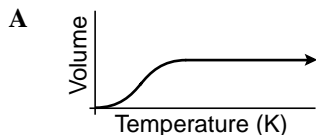
2 The kinetic-molecular theory of gases explains the behavior of gases at the molecular level. All of the following are part of this theory EXCEPT —

A gas molecules experience completely elastic collisions

B all gas molecules have the same average kinetic energy at the same temperature

C gas particles are in constant, random motion

D gas molecules are incompressible

3 Which of these *decreases* as a given volume of gas increases?

A Number of gas particles

B Temperature

C Pressure

D Kinetic energy

4 You are given a balloon filled with a known volume of helium gas. You place the balloon inside a freezer for an hour. How will the balloon look after being in the freezer?

A

B

C

D

GO ON
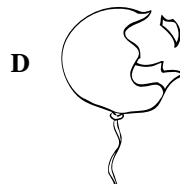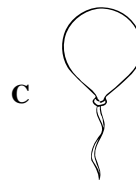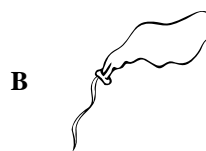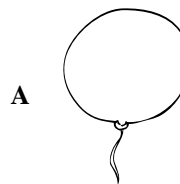
Name: _____ **Date:** _____

5 Physicians can use liquid nitrogen to freeze and destroy warts and other skin growths. Knowing the assumptions of the universal gas law, this should surprise you *most* because —

A if a gas can liquefy, that would imply that gases experience intermolecular forces

B all gases are volatile and can't be used indoors

C gas particles are too small to be condensed

D if a gas can freeze, that would imply that gases can be kept at cold temperatures

6 David has two containers of two different gases at the same temperature and pressure. David could assume all of following EXCEPT —

A when the temperature is increased, the volume of both containers will increase

B when the pressure is increased, the volume of both containers will decrease

C both containers contain the same number of gas particles

D when the pressure is decreased, the temperature of both containers will increase

7 Which of the following is a gas–gas behavior relationship?

A Helium gas is heated and its volume increases.

B Oxygen gas is compressed and its temperature increases.

C Nitrogen gas is placed in a container and the molecules settle to the bottom.

D Hydrogen gas is cooled and its pressure increases.

8 Which question cannot be answered scientifically?

A How many particles do two gases at the same temperature and pressure contain?

B What happens to a gas at standard temperature and pressure?

C How does a gas react when heated to 100ºC?

D What happens to a sample of gas at absolute zero?

9 Air bags, which act as safety devices in cars, contain solid sodium azide. On impact, the sodium azide releases nitrogen gas, which expands the air bag. The main benefit of using a gas instead of another type of matter is that —

A gas molecules are subject to ionic bonding

B the separation of gas molecules is much greater than the volume they occupy

C gases won't explode the bag on very hot days

D gas molecules don't transfer excess kinetic energy

STOP

Name: _____ **Date:** _____

1 A beaker contains a saturated solution of water and NaCl at 25ºC. How could the amount of NaCl that can be dissolved in the solution be increased?

    A Add more NaCl.

    B Heat the solution.

    C Add a second salt.

    D Transfer the solution to a larger beaker.

2 Which of these decreases as the amount of solute particles in a solution increases?

    A Boiling point

    B Osmotic pressure

    C Freezing point

    D Molality

3 Breaking a large solid into smaller pieces increases its rate of solvation in a solvent. This process accelerates the rate because —

    A greater surface area increases the likelihood of collisions

    B it makes the solid immiscible

    C greater surface area decreases the likelihood of collisions

    D it creates an adiabatic environment

4 Which of the following is the most unstable type of solution?

    A Saturated

    B Supersaturated

    C Unsaturated

    D Concentrated

Use the table below to answer question 5.

Solute Effect on Water's Boiling Point

Solute	Quantity	Boiling point evaluation
NaCl	1 mol	?
$KMnO_4$	1 mol	?
Na_2CO_3	1 mol	?
$C_6H_{12}O_6$	1 mol	?

5 The table above shows the effects of various solutes in a given volume of water. Without knowing the actual values, which of these is the most likely reason that the Na_2CO_3 will cause the greatest boiling point elevation?

    A Na_2CO_3 is the only solute that exhibits the Tyndall effect.

    B Na_2CO_3 produces the smallest number of moles in solution.

    C Na_2CO_3 has the greatest heat of enthalpy.

    D Na_2CO_3 produces the largest number of solute particles in solution.

GO ON

Name: _____   **Date:** _____

6 A red blood cell's swelling in a cup of pure water is its response to —

A decreased rate of solvation

B increased osmotic pressure

C decreased osmotic pressure

D increased ionic concentration

7 Janet wants to dissolve carbon dioxide in water. The rate of solvation could be most improved by —

A decreasing the temperature and increasing the pressure

B increasing the temperature and decreasing the pressure

C decreasing the temperature and decreasing the pressure

D increasing the temperature and increasing the pressure

8 If the molality of a solute is increased, the freezing point of the solution will —

A be increased

B remain constant

C fluctuate

D be depressed

9 Which of the following is required in order for a solute to achieve maximum solubility in a solvent?

A The crystallization rate must exceed the rate of solvation.

B The colligative properties of the solute must be at a maximum.

C The solvation rate must exceed the rate of crystallization.

D Seed crystals must be added to the solvent.

10 Ionic solutes readily interact with water molecules because —

A the forces of attraction between the ionic particles are nonexistent

B the forces of attraction between the ions and the water are greater than those between the ions in the solute

C solvation only occurs between unlike solutes and solvents

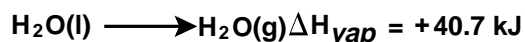**D** the surface area of ionic solutes is greater than that of water molecules

STOP

Energy and Chemical Change

Name: _____   **Date:** _____

1 Which of these increases when the sign of ΔS is negative?

  A Disorder

  B Temperature

  C Order

  D Kinetic energy

2 When you eat a slice of pizza, the crust is often less hot than the toppings or sauce. This most likely occurs because the toppings and sauce have a greater —

  A molar enthalpy of formation

  B specific heat

  C heat of fusion

  D mass

Use the equation below to answer question 3.

$$H_2O(l) \longrightarrow H_2O(g) \quad \Delta H_{vap} = +40.7 \text{ kJ}$$

3 The equation shows the change in enthalpy when one mole of liquid water vaporizes into water vapor. This is called the molar heat of vaporization. Given this information, which of these is the proper value for the molar heat of condensation?

  A $\Delta H_{cond} = -40.7$ kJ

  B $\Delta H_{cond} = 0$ kJ

  C $\Delta H_{cond} = -571.6$ kJ

  D $\Delta H_{cond} = +571.6$ kJ

4 Which of these is required for a reaction to be called exothermic?

  A The enthalpy of the reactants must be less than that of the products.

  B The sign of the change in enthalpy for the reaction must be positive.

  C The enthalpy of the products must be less than that of the reactants.

  D Heat must flow from the surroundings into the system.

5 Leila is given a sealed flask of sugar water at room temperature. She places it over a Bunsen burner for a few minutes and notes condensation on the sides. Then she places the flask in an ice bath for ten minutes, and notices that ice crystals begin to form. Leila knows that the one statement that cannot be true is that —

  A the kinetic energy of the sugar water at the end of the experiment is less than at the beginning of the experiment

  B the total energy in the sugar water at the end of the experiment is less than at the beginning of the experiment

  C the entropy of the sugar water at the beginning of the experiment is greater than at the end of the experiment

  D the total energy in the sugar water at the beginning of the experiment is greater than at the end of the experiment

GO ON

Name: ——————————————————— **Date:** ———————————————

6 Fusion, or melting, is an endothermic process because it —

   A requires heat to be transferred from system to surroundings and has a ΔH that is negative

   B requires heat to be transferred from surroundings to system and has a ΔH that is positive

   C involves a decrease in entropy

   D involves a decrease in kinetic energy

7 Which of the following is NOT a variable in the Gibbs free energy equation, which determines reaction spontaneity?

   A Entropy

   B Endothermy

   C Temperature

   D Enthalpy

8 Professor Bothwell determined from the wrapper the number of calories in a candy bar. He then burned the entire candy bar and measured the amount of heat released. His experiment was most likely designed to demonstrate —

   A the law of conservation of matter

   B the law of disorder

   C the law of conservation of energy

   D the law of constant composition

9 Which of these would always be called a spontaneous reaction?

   A A reaction with a $-\Delta S$ and a $+\Delta H$

   B A reaction with a $-\Delta H$ and a $-\Delta S$

   C A reaction with a $+\Delta H$ and a $+\Delta S$

   D A reaction with a $+\Delta S$ and a $-\Delta H$

10 Which of the following reactions is a spontaneous process at 25ºC?

   A $2Fe_2O_3(s) \longrightarrow 4Fe(s) + 3O_2(g)$ $\Delta H = 1625$ kJ

   B $H_2O(l) \longrightarrow H_2O(s)$ $\Delta H = -6.01$ kJ

   C $4Fe(s) + 3O_2(g) \longrightarrow 2Fe_2O_3(s)$ $\Delta H = -1625$ kJ

   D $CO_2(g) + 2H_2O(l) \longrightarrow CH_4(g) + 2O_2(g)$ $\Delta H = 891$ kJ

11 The Gibb's free energy equation is $\Delta G_{system} = \Delta H_{system} - T\Delta S_{system}$. Which of the following combinations of factors must be true for a reaction to be nonspontaneous?

   A ΔG_{system} negative, $\Delta S_{universe}$ positive

   B ΔG_{system} positive, $\Delta S_{universe}$ positive

   C ΔG_{system} negative, $\Delta S_{universe}$ negative

   D ΔG_{system} positive, $\Delta S_{universe}$ negative

**STOP**

Reaction Rates

Name: _____ **Date:** _____

1 Which of these is required to calculate the rate of a reaction?

A The change in enthalpy over time for the reaction

B The time it takes for the reaction to go halfway to completion

C The change in concentration of either the product or reactant over time

D The change in temperature for the reaction over time

2 Which of these decreases as the activation energy for a reaction increases?

A Number of inactivated complexes

B Entropy

C Amount of reactants

D Reaction rate

3 The collision theory explains why reactions occur and how certain factors increase or decrease the rate of reaction. The collision theory involves all of the following EXCEPT that —

A reacting substances must collide with the correct orientation

B reacting substances must collide

C reacting substances must collide spontaneously

D reacting substances must collide with enough energy to form the activated complex

Use the diagram below to answer question 4.
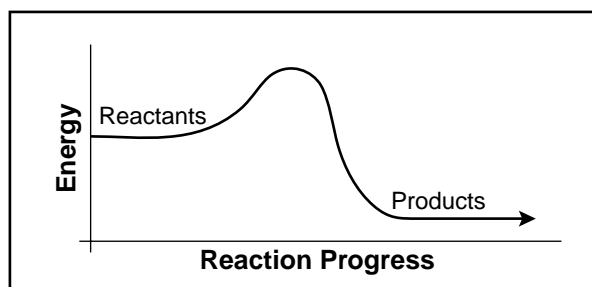
4 How would the addition of a catalyst affect this reaction?

A The presence of a catalyst would decrease the activation energy.

B The catalyst would increase the activation energy.

C The presence of a catalyst would make the reaction more spontaneous.

D The catalyst would be consumed during the reaction and make more product.

5 Which of these will NOT appear in the net chemical equation that describes a complex reaction?

A Coefficients

B Intermediates

C Limiting reactants

D State of matter

GO ON

Name: _____ **Date:** _____

Use the formula below to answer question 6.

$$\text{Rate} = k[\text{NO}]^2[\text{Cl}_2]$$

6 The formula shows the rate law for a certain reaction. Which of the following gives the correct result when the concentration of NO is doubled?

  A The reaction rate is unaffected.

  B The reaction rate doubles.

  C The reaction rate triples.

  D The reaction rate quadruples.

7 The rate of reaction can never proceed faster than that of the rate-determining step because —

  A the rate-determining step must exceed the rate of reaction

  B all rate-determining steps require a catalyst

  C the rate-determining step is always the first step in any reaction

  D the rate of reaction is always limited by the slowest overall step

8 Reactions may be classified with an overall order, as well as orders with respect to the individual substances reacting. Which of these is classified as third order overall?

  A Rate = $k[\text{A}]^2[\text{B}][\text{C}]$

  B Rate = $k[\text{A}]^3[\text{B}]$

  C Rate = $k[\text{A}]^2[\text{B}]$

  D Rate = $k[\text{B}]^3[\text{C}]$

Use the table below to answer question 9.

| Student	Sample size	Temperature (C°)
Hema	10 g Sugar cube	0°C
Aaron	15 g Sugar crystals	30°C
Nikki	25 g Sugar cube	100°C
Erick	20 g Sugar crystals	95°C

9 The table above shows the various conditions used when four students dissolved sugar. The student whose sample will dissolve the fastest is most likely —

  A Hema

  B Aaron

  C Nikki

  D Erick

10 Which of the following would NOT increase the rate of a reaction?

  A an increase in the concentration of reactants

  B the removal of a catalyst

  C an increase in solvent volume

  D an increase in temperature

STOP

Name: _____ **Date:** _____

1 Which statement most accurately describes the state of a reaction after it has reached chemical equilibrium?

A At chemical equilibrium, equal amounts of products and reactants are present.

B The forward and reverse reactions are producing equal concentrations.

C The forward and reverse reactions are occurring at equal rates.

D At equilibrium, the reaction is continuing in either the forward or reverse direction.

Use the equation below to answer question 2.

$$Cu(OH)_2(s) \rightleftharpoons Cu^{2+}(aq) + 2OH^-(aq)$$
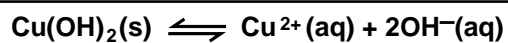
2 Which of these is the correct way to express the equilibrium constant expression for the reaction above?

A $K = [Cu^{2+}][OH^-]^2$

B $K = [Cu^{2+}][OH^-]^2 \div [Cu(OH)^2]$

C $K = [Cu^{2+}][OH_2^-]$

D $K = [Cu^{2+}][OH_2^-] \div [Cu(OH_2)]$

Use the equation below to answer question 3.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) \quad \Delta H°rxn = -198 \text{ kJ}$$

3 The reaction above is exothermic. To produce less product, what experimental change would be most effective?

A Decrease volume

B Decrease the temperature

C Increase pressure

D Increase the temperature

Use the table below to answer question 4.

Solubility Product Constants at 298K

Compound	K_{sp} Value
$PbBr_2$	6.6×10^{-6}
Ag_2S	8.0×10^{-51}
$PbCl_2$	1.7×10^{-5}
$MgCO_3$	6.8×10^{-6}

4 According to this table, which compound has the greatest solubility in pure water?

A $PbBr_2$

B Ag_2S

C $PbCl_2$

D $MgCO_3$

GO ON

Name: _____   **Date:** _____

5 K_{sp} values can be compared with the ion product, Q_{sp}, to determine whether or not a precipitate will form for a given solution. How would you describe a solution of AgCl with $Q_{sp} = 1.4 \times 10^{-10}$ and $K_{sp} = 1.8 \times 10^{-10}$?

  A Supersaturated

  B Unsaturated

  C Saturated

  D Precipitated

6 The common ion effect alters the amount of solid that will dissociate in solution. The addition of solid silver chromate to an aqueous solution of potassium chromate will affect the silver chromate's solubility because —

  A solids are always subject to the common ion effect in solution

  B the ion chromate is common to both solutions and will decrease silver chromate's solubility

  C the combination of two common metals, silver and potassium, will decrease solubility

  D the ion chromate is common to both solutions and will increase solubility

7 Le Châtelier's principle demonstrates the effect of disturbances on chemical equilibrium. Le Châtelier's principle can also help predict whether or not disturbances will affect the equilibrium constant, K_{eq}. None of these will affect the equilibrium constant EXCEPT the —

  A addition of more product

  B decrease in volume

  C increase in pressure

  D increase in temperature

Use the equation below to answer question 8.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

8 Which experimental disturbance will produce more NH_3 (ammonia) in the above reaction?

  A Decrease in pressure

  B Addition of more ammonia

  C Decrease in volume

  D Addition of a catalyst

STOP

Acids and Bases

Name: _____ **Date:** _____

1   Which of these decreases as the pH of a solution increases?

   A   The basicity of a solution

   B   Number of hydrogen ions

   C   The value of K_w

   D   Number of hydroxide ions

2   Acid rain is extremely harmful to the environment. All of the following are ways that acid rain affects the environment EXCEPT —

   A   eroding buildings

   B   promoting hydroxide deposits

   C   leaching mineral ions from the soil

   D   altering biological molecules necessary for aquatic life

3   A Brønsted-Lowry base is to a hydrogen-ion acceptor as a Brønsted-Lowry acid is to —

   A   a hydroxide-ion producer

   B   a hydroxide-ion donor

   C   an electron-pair donor

   D   a hydrogen-ion donor

4   Strong acids or bases make the best electrolytes because they —

   A   do not ionize in solution

   B   react in an equilibrating manner

   C   ionize completely in solution

   D   have extremely small ionization constants

5   The neutralization of a strong acid by a strong base always involves the products —

   A   water and a salt

   B   an anion and a salt

   C   water and an ion

   D   a weak acid and a strong base

6   Black coffee has a pH of approximately 5.0. What is the pOH of black coffee?

   A   7.0

   B   19.0

   C   3.0

   D   9.0

GO ON

Name: _____   **Date:** _____

Use the table below to answer question 7.

pH of Various Solutions

Solution	pH
Gastric Juice	1.5
Vinegar	2.8
Human Blood	7.4
Baking Soda	8.5

7 The pH scale is used to rank the hydronium ion concentration of a given substance. Which of the following sequences shows these solutions from least acidic to most acidic?

A Gastric juice, vinegar, human blood, baking soda

B Baking soda, human blood, vinegar, gastric juice

C Baking soda, vinegar, human blood, gastric juice

D Gastric juice, human blood, vinegar, baking soda

8 Buffers in your body are constantly working to prevent harmful increases or decreases in the pH of your blood, urine, and other fluids. In order to resist such changes, a buffer is composed of —

A a strong acid and a strong base

B a weak acid and its conjugate base, or a weak base and its conjugate acid

C a strong base and a weak acid

D a strong acid and a weak base

Use the equation below to answer question 9.

$$HBr(aq) + NH_3(aq) \rightleftharpoons NH_4^+(aq) + Br^-(aq)$$
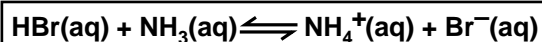
9 According to this chemical equation, which of the following represents a conjugate acid–base pair?

A $NH_4^+(aq)$ and $Br^-(aq)$

B $HBr(aq)$ and $NH_4^+(aq)$

C $NH_3(aq)$ and $HBr(aq)$

D $HBr(aq)$ and $Br^-(aq)$

10 Which of the following does NOT represent a balanced equation for an acid–base neutralization reaction?

A $HCl + NaOH \longrightarrow NaCl + H_2O$

B $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$

C $2HBr + Ca(OH)_2 \longrightarrow 2H_2O + CaBr_2$

D $Mg(OH)_2 + 2HCl \longrightarrow MgCl_2 + 2H_2O$

STOP

Redox Reactions

Name: _____   **Date:** _____

1 Which of the following characterizes the oxidation–reduction relationship?

   A Element losing electrons is losing oxygen, element gaining electrons is gaining oxygen.

   B Element gaining electrons is oxidized, element losing electrons is reduced.

   C Element gaining electrons is losing hydrogen, element losing electrons is gaining hydrogen.

   D Element losing electrons is oxidized, element gaining electrons is reduced.

Use the formula below to answer question 2.

$$H_3PO_4$$

2 The formula above represents phosphoric acid. Which of these is the proper oxidation number for phosphorus?

   A +3

   B +5

   C –8

   D –4

Use the equation below to answer question 3.

$$Zn(s) \longrightarrow Zn^{2+}(aq) + 2e^-$$

3 The chemical equation above shows a corrosive half-reaction for zinc. Which of these best represents what is occurring?

   A Zinc is reduced and is acting as the oxidizing agent.

   B Zinc is oxidized and is losing electrons.

   C Zinc is reduced and is losing electrons.

   D Zinc is oxidized and is gaining electrons.

Use the equation below to answer question 4.

$$2Mg(s) + O_2(g) \longrightarrow 2MgO(s)$$
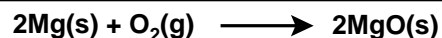
4 The chemical equation above shows a redox reaction. Which of these best represents what has occurred?

   A Magnesium is the oxidizing agent and was reduced.

   B Oxygen is the reducing agent and was oxidized.

   C Magnesium is the reducing agent and was oxidized.

   D Oxygen is the oxidizing agent and was oxidized.

GO ON

Name: _____ **Date:** _____

Use the equation below to answer question 5.

$$Si(s) + 2Cl_2(g) \longrightarrow SiCl_4(l)$$

5 The redox reaction above can be used to determine the change in oxidation numbers for chlorine and silicon. According to this equation, what changes occurred?

A Silicon went from +1 to +4, and chlorine went from +2 to –4.

B Silicon went from 0 to –4, and chlorine went from 0 to +1.

C Silicon went from +1 to –4, and chlorine went from +4 to –4.

D Silicon went from 0 to +4, and chlorine went from 0 to –1.

6 Corrosion, a type of redox reaction, can cause cars and buildings to rust. Rusting happens when iron is oxidized by oxygen in the air. This process happens when —

A oxygen acts as the reducing agent and gains electrons

B iron acts as the reducing agent and loses electrons

C oxygen acts as the oxidizing agent and loses electrons

D iron acts as the oxidizing agent and gains electrons

7 Which of these decreases as the oxidation number of an atom increases?

A Number of electrons

B Formal charge

C Number of protons

D Ionic charge

Use the formula below to answer question 8.

$$MnO_4^-$$

8 The formula above represents the polyatomic permanganate ion. Which of these is the proper oxidation number to assign to manganese?

A –2

B +7

**C** –7

D +8

STOP

Name: _____   **Date:** _____

1 After a voltaic cell has been set up with a zinc anode, copper cathode, and a salt bridge, which way will electron flow proceed?

    A From the copper cathode to the zinc anode

    B From the salt bridge to the zinc anode

    C From the zinc anode to the copper cathode

    D From the copper cathode to the salt bridge

2 In order to develop building materials that are resistant to corrosion, manufacturers must be aware of ways to promote —

    A anodic inhibition, which prevents the reduction of the metal

    B cathodic reactions, which allow reduction of the metal

    C anodic inhibition, which prevents the oxidation of the metal

    D cathodic reactions, which allows oxidation of the metal

3 Which of these is NOT a trait of a secondary battery?

    A Generates electrical current by a chemical reaction

    B Uses a redox reaction that cannot easily be reversed

    C Recharges by reversing the net cell reaction

    D Is also referred to as a storage battery

**Use the diagram below to answer question 4.**
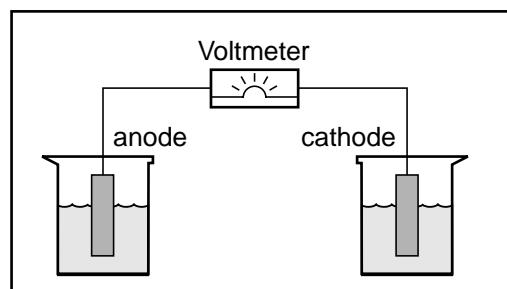
4 The diagram shows a student's setup for a voltaic cell. Which change would help ensure that electron flow would continue indefinitely?

    A The student should place a salt bridge between the two beakers.

    B Both electrodes should be made of the same metal.

    C The student should connect the voltmeter to a salt bridge.

    D The anode should be in the same beaker as the cathode.

GO ON

Name: _____   **Date:** _____

5 Which of these is required for electric charge to flow in an electrochemical cell?

    A   Galvanic difference

    B   Electroplating difference

    C   Concentration difference

    D   Electric potential difference

6 Some silverware is not made entirely of silver but is electroplated, or coated, with silver. The process of electroplating a fork would involve the migration of —

    A   silver ions oxidized at the anode and depositing on the fork, which acts as the cathode

    B   ions oxidized from the fork (cathode) and depositing on the silver metal (anode)

    C   silver ions reduced at the anode and depositing on the fork, which acts as the cathode

    D   ions oxidized from the fork (anode) and depositing on the silver metal (cathode)

7 Electrolysis can be used to drive nonspontaneous redox reactions because it —

    A   uses chemical energy to cause an electrical reaction

    B   equilibrates the electromotive force

    C   uses electrical energy to cause a chemical reaction

    D   acts as a sacrificial anode

Use the equation below to answer question 8.

$$Cu(s) + Zn^{2+}(aq) \longrightarrow Cu^{2+}(aq) + Zn(s)$$
$$E^0 = -1.10V$$
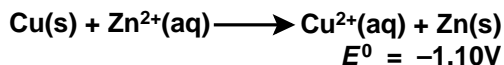
8 According to this information, this reaction —

    A   is spontaneous

    B   requires heat

    C   is nonspontaneous

    D   gives off heat

STOP

Name: _____   **Date:** _____

1   Chemists have identified a substance in a laboratory as decane. How many hydrogen atoms can be found bonded to the carbon atoms in the sample of decane?

   A   10

   **B**   20

   C   22

   D   24

2   Which of these is NOT an example of an unsaturated hydrocarbon?

   A   propylene

   B   4,6-dimethyl-2-heptene

   C   2-butyne

   D   1,2,2,4-tetramethylcyclohexane

3   Before Friedrich Wohler, chemists believed that organic compounds created by living organisms could not be synthesized in the laboratory. They believed that organisms possessed a mysterious force that enabled them to create carbon compounds. This idea that chemists accepted was called —

   A   organism force theory

   B   vitalism

   C   hydrocarbonism

   D   vivalism

Use the structural formula below to answer question 4.
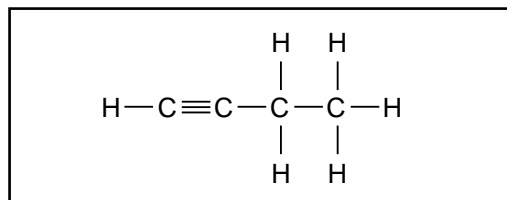
4   The model shows the structural formula of 1-butyne. Which of these is the proper condensed structural formula for 1-butyne?

   A $CH \equiv CCH_2CH_3$

   B $CH_2 = CHCH_2CH_3$

   C $CH_3C \equiv CCH_3$

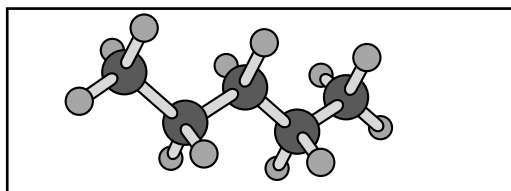   **D** $CH_3C \equiv CH$

5   The process of fractional distillation involves boiling crude oil in order to —

   A   increase its stored energy

   B   separate it into its usable components

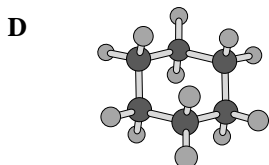   **C**   create petroleum oil

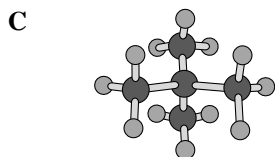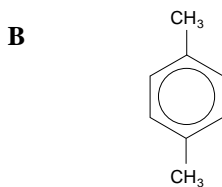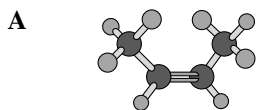   **D**   change its viscosity

GO ON

Name: _____   **Date:** _____

6 Many aromatic compounds, such as benzopyrene, are carcinogenic, meaning that —

    A they may cause tuberculosis

    B they are not very water soluble

    C they may cause cancer

    D their molecular structure is similar to that of human genes

8 When lubricating oil is poured into water, the two liquids separate almost instantly. This happens because the lubricating oil molecules have greater —

    A attraction toward the water molecules

    B mass weight than the water molecules

    C attraction toward other lubricating oil molecules

    D charge than the water molecules

Use the diagram below to answer question 7.

7 Which of these is a structural isomer of this molecule?

    A

    B

    C

    D

Use the compound below to answer question 9.
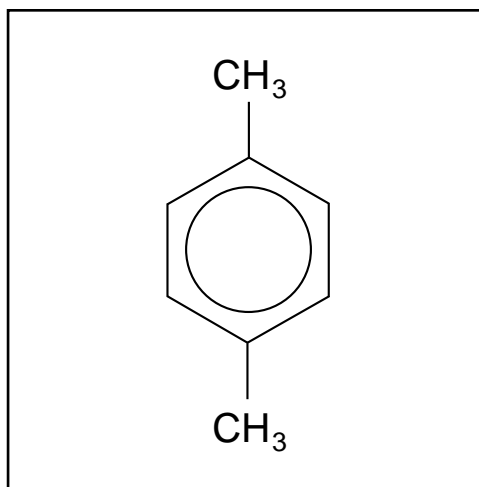
9 This compound may be classified as aromatic because —

    A it has two methyl groups

    B it contains a propene ring

    C it has 10 carbon atoms

    D it has a benzene ring

STOP

Name: ——————————————————————— **Date:** ————————————

**1** A chemist performed some experiments with alkyl halides, comparing their boiling point temperatures. All of the following elements may have influenced the results of his experiments EXCEPT —

   A Cl

   B F

   C Pb

   D Br

2 Which of these is NOT an example of a hydrocarbon or substituted hydrocarbon with a boiling point above 0°C?

   A Pentane

   B Ethanol

   C Chloroethane

   D Ethane

Use the structural formula below to answer question 3.

$$H-\underset{\underset{H}{|}}{\overset{\overset{Br}{|}}{C_1}}-\underset{\underset{H}{|}}{\overset{\overset{F}{|}}{C_2}}-\underset{\underset{H}{|}}{\overset{\overset{Cl}{|}}{C_3}}-\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C_4}}-H$$

3 The model shows the structural formula of a specific substituted hydrocarbon. Which of these is the proper name for this compound?

   A Bromo-chloro-fluorobutane

   B 1-bromo-3-chloro-2-fluorobutane

   C 1-dibromo-3-trichloro-2-tetrafluorobutane

   D 3-bromo-1-chloro-2-fluorobutane

4 Chlorofluorocarbons have been replaced with hydrofluorocarbons in refrigerators and air conditioners because of CFC's potential to —

   A interfere with Earth's gravity

   B create noxious gas fumes

   C damage the ozone layer

   D contaminate ground water

5 –OH is to alcohols as $-NH_2$ is to —

   A ethers

   B aldehydes

   C ketones

   D amines

6 Which of the following is a condensation polymer?

   A Polyvinyl chloride

   B Polypropylene

   C Polyethylene

   D Nylon

GO ON

Name: ⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯ **Date:** ⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

Use the diagram below to answer question 7.


Addition Reaction with Alkenes
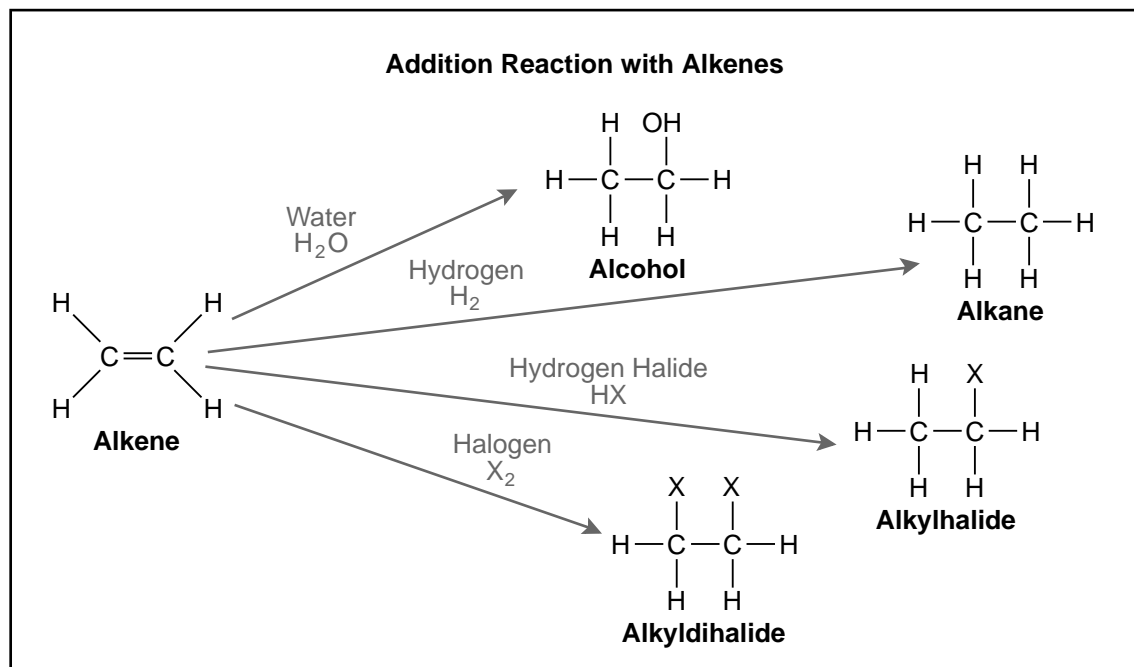
7 According to this information, which of these is NOT necessary for these addition reactions to take place?

   A Water

   B Alkyldihalide

   C Hydrogen halide

   D Hydrogen

8 The process of polymerization involves the bonding together of —

   A simple organic molecules called monomers

   B nylon and dacron

   C alcohol and water

   D a polymer and a monomer

9 Thermosetting polymers are more difficult to recycle than thermoplastic polymers because —

   A they can be melted and remolded

   B they become single, large molecules when cooled

   C thermoplastic polymers are derived from petroleum

   D thermoplastic polymers form bonds in all directions when cooled
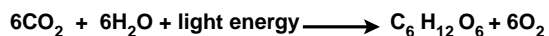
STOP

Name: _____ **Date:** _____

Use the diagram below to answer question 1.
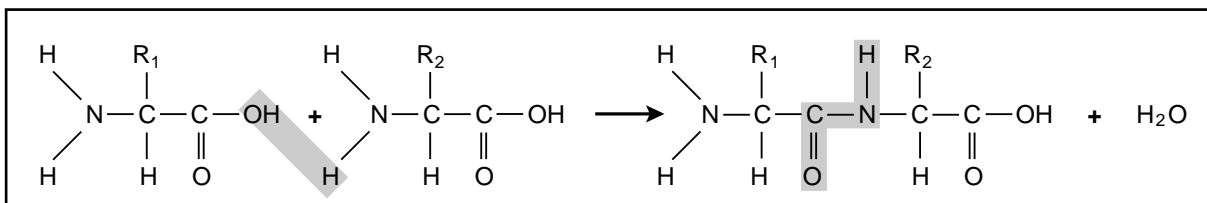
1 Which of these two groups provide the bonding sites when the two amino acids shown above combine?

 A Carboxyl and hydrogen

 B Aldehyde and amino

 C Ketone and amino

 D Amino and carboxyl

Use the equation below to answer question 2.

$$6CO_2 + 6H_2O + \text{light energy} \longrightarrow C_6H_{12}O_6 + 6O_2$$

2 This chemical equation shows the process of —

 A catabolism

 B fermentation

 C photosynthesis

 D cellular respiration

3 Which of these is NOT a protein?

 A Hemoglobin

 B Insulin

 C Lysine

 D Collagen

4 The process of alcoholic fermentation involves the breaking down of glucose. This reaction produces —

 A fructose, carbon dioxide, and energy

 B oxygen, ethanol, and benzene

 C ethanol, carbon dioxide, and energy

 D lysine, ethanol, and carbon dioxide

GO ON

Name: _____   **Date:** _____

5 Which of these is required for cellular respiration to occur?

A Glucose

B DNA

C Triglyceride

D Water

6 Lipids contain saturated and unsaturated fatty acids and can be either liquid or solid. Which of these lipids is an example of a triglyceride mixture that contains mostly saturated fatty acids?

A Corn oil

B Butter

C Olive oil

D Peanut oil

7 When we exercise strenuously, we sometimes feel pain in our muscles because our muscles cells produce —

A carbon monoxide

B lactic acid

C ethanol

D energy

8 How does anabolism help us to survive?

A It helps produce ATP.

B It helps us break down complex biological molecules such as proteins.

C It helps to synthesize complex proteins from amino acids.

D It helps the body extract energy from nutrients.

9 In 1953, James Watson and Francis Crick determined that the structure of DNA was a double helix. This discovery best helped them —

A determine that the sequence of nitrogen bases in DNA is different for every organism

B identify the nitrogen bases contained in DNA

C determine that RNA contains the sugar ribose

D understand how DNA copies genetic information

STOP

Nuclear Chemistry

Name: ——————————————————— **Date:** ——————————

Use the graph below to answer question 1.
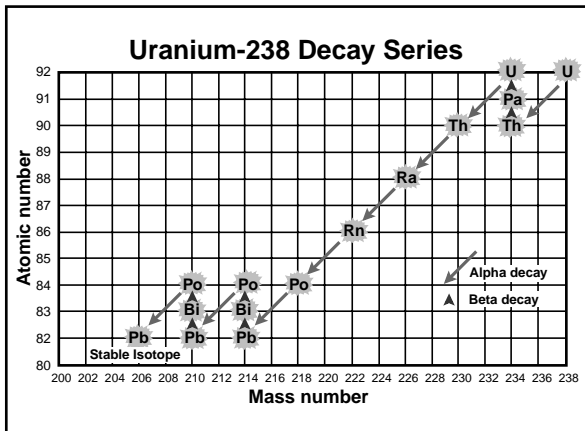
1 According to the graph above, an element such as uranium-238 decays —

A until its nucleus no longer contains any protons

B until its nucleus becomes stable

C until its neutron-to-proton ratio is approximately 1:1.5

D until it reaches a state of instability

2 Which of these is NOT a type of radiation?

A Alpha radiation

B Beta radiation

C Gamma radiation

D Delta radiation

Use the diagram below to answer question 3.
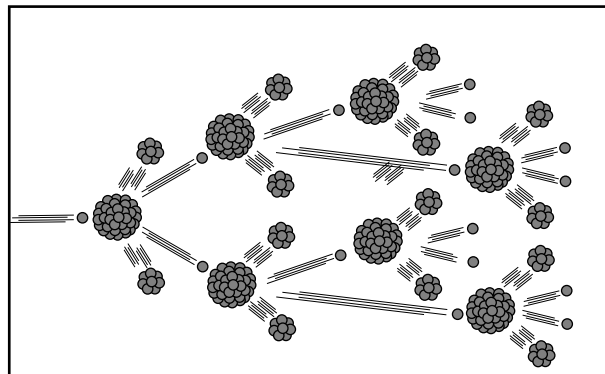
3 According to the diagram above, how would you describe this uranium-235 sample?

A The sample has subcritical mass.

B The sample is extremely stable.

C The sample has critical mass.

D The sample is not releasing much energy.

4 The process of nuclear fusion involves the —

A splitting up of a nucleus into smaller fragments

B combining of atomic nuclei

C splitting up of electrons into smaller fragments

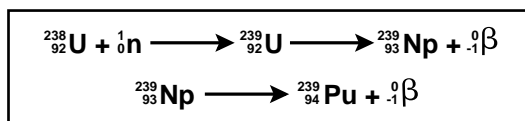**D** combining of highly unstable nuclei

GO ON

Name: _____   Date: _____

Use the graph below to answer question 5.

Half-Life of Element X

Time	Amount of sample
0 days	200.0 grams
20 days	100.0 grams
40 days	50.0 grams
60 days	25.0 grams
80 days	? ?
100 days	? ?

5 If the trend in the table shown above continues, how much of element X will be left after 100 days of decay?

    A 5.25 g

    B 6.25 g

    C 8.50 g

    D 12.50 g

Use the nuclear equation below to answer question 6.

$$^{238}_{92}U + ^{1}_{0}n \longrightarrow ^{239}_{92}U \longrightarrow ^{239}_{93}Np + ^{0}_{-1}\beta$$

$$^{239}_{93}Np \longrightarrow ^{239}_{94}Pu + ^{0}_{-1}\beta$$

6 The end product of the reaction shown above may be classified as —

    A a posturanium element

    B a nuclear fusion element

    C a transuranium element

    D a chain reaction element

7 In order to radiochemically date a human skeleton, scientists need to compare the ratio of carbon-14 to carbon-12 in the skeleton with —

    A the amount of uranium decay in the skeleton

    B the ratio of carbon-14 to carbon-12 in the atmosphere

    C the amount of nitrogen and oxygen in the atmosphere

    D the amount of carbon-14 in the atmosphere

8 A sample of polonium ($^{210}_{84}$Po) spontaneously decays into lead ($^{206}_{82}$Pb). The neutron-to-proton ratio of the polonium before it began to decay was —

    A 1:1

    B 1.33:1

    C 1.50:1

    D 1.75:1

9 Nuclear waste disposal is a major problem for society. The waste is very difficult to properly dispose of because —

    A it has a very short half-life

    B its proton-to-neutron ratio is 1:1

    C it has a very long half-life

    D it explodes when it comes into contact with oxygen

STOP

Chemistry in the Environment
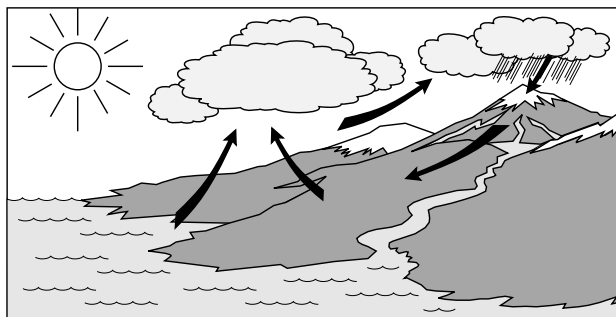
Name: ⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯   **Date:** ⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

1 The process of photodissociation involves the formation of atomic oxygen after oxygen gas molecules absorb —

  A other oxygen molecules

  B nuclear energy

  C high-energy ultraviolet radiation

  D carbon dioxide molecules

2 Which of these is most necessary for the formation of ozone?

  A SO_3

  B H_2

  C N_2

  D O_2

3 Which of these decreases as the number of CFCs in the environment increases?

  A Ultraviolet radiation reaching Earth

  B Ozone molecules

  C Chlorine molecules

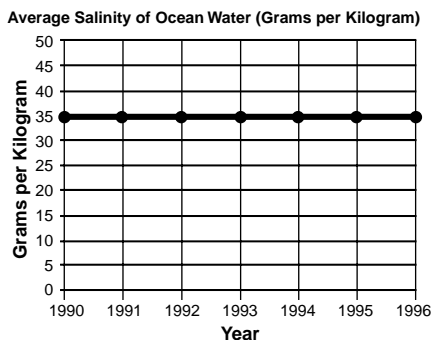 **D** Risk of cancer and other diseases

Use the diagram below to answer question 4.

4 In what state does water rise from Earth to form clouds?

  A Liquid

  B Solid

  C Gas

  D Plasma

5 Which of these generally does NOT contaminate our freshwater sources?

  A Phosphorus

  B Herbicides

  C Nitrogen

  D Oxygen

GO ON

Name: _____   Date: _____

Use the graph below to answer question 6.

Average Salinity of Ocean Water (Grams per Kilogram)

8 Which of these models best illustrates the composition of seawater?

A

Cl^- Cl^- Cl^- Cl^- Cl^- Cl^- Na^+ Na^+ Na^+
Cl^- Cl^- Cl^- Cl^- Cl^- Na^+ Na^+ Na^+
SO_4^{2-} SO_4^{2-} Mg^{2+}
ⓧ ⓧ ⓧ ⓧ ⓧ ⓧ ⓧ ⓧ ⓧ ⓧ ⓧ

B

Cl^- Cl^- Cl^- Na^+ Na^+ Na^+ Na^+ Na^+ Na^+
Cl^- Cl^- Cl^- Na^+ Na^+ Na^+ Na^+ Na^+
SO_4^{2-} SO_4^{2-} Mg^{2+}
ⓧ ⓧ ⓧ ⓧ ⓧ ⓧ ⓧ ⓧ ⓧ ⓧ ⓧ

C

Cl^- Cl^- Cl^- Cl^- Cl^- Cl^-
Cl^- Cl^- Cl^- Cl^- Cl^-
ⓧ ⓧ ⓧ ⓧ ⓧ ⓧ ⓧ ⓧ ⓧ ⓧ

D

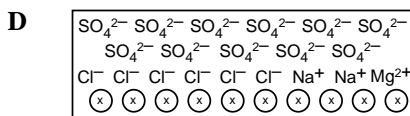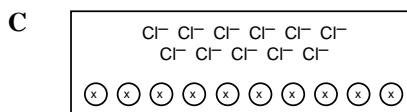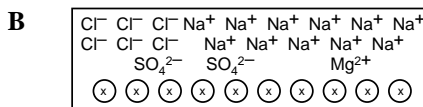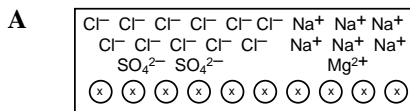| SO_4^{2-} SO_4^{2-} SO_4^{2-} SO_4^{2-} SO_4^{2-} SO_4^{2-} |
|---|
| SO_4^{2-} SO_4^{2-} SO_4^{2-} SO_4^{2-} SO_4^{2-} |
| Cl^- Cl^- Cl^- Cl^- Cl^- Cl^- Na^+ Na^+ Mg^{2+} |
| ⓧ ⓧ ⓧ ⓧ ⓧ ⓧ ⓧ ⓧ ⓧ ⓧ ⓧ |

6 The graph shows the average salinity of Earth's oceans over time. According to these data, which of the following statements is true?

   A The concentration of salt decreases over time.

   B The average salinity of Earth's oceans remains fairly constant over time.

   C The salt content in Earth's oceans is unstable.

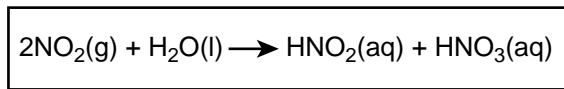   **D** The average salinity of Earth's oceans is 50 g/kg.

7 In order to reduce the problem of global warming, society needs to find alternative sources of energy. The problem with burning fossil fuels is that they release too much —

   A O_2

   B CO_2

   C Mg

   D Cl

Use the equation below to answer question 9.

$$2NO_2(g) + H_2O(l) \longrightarrow HNO_2(aq) + HNO_3(aq)$$

9 This chemical equation is an example of —

   A oxidation

   B a reaction in the nitrogen cycle

   C the carbon cycle

   D photoionization

STOP

Reviewing Chemistry