

---

## XIX. Chemistry, High School

## High School Chemistry Test

The spring 2011 high school MCAS Chemistry test was based on learning standards in the Chemistry content strand of the Massachusetts *Science and Technology/Engineering Curriculum Framework* (2006). These learning standards appear on pages 69–73 of the *Framework*.

The *Science and Technology/Engineering Curriculum Framework* is available on the Department website at [www.doe.mass.edu/frameworks/current.html](http://www.doe.mass.edu/frameworks/current.html).

In test item analysis reports and on the Subject Area Subscore pages of the MCAS *School Reports* and *District Reports*, Chemistry test results are reported under the following four MCAS reporting categories:

- Atomic Structure and Periodicity
- Bonding and Reactions
- Properties of Matter and Thermochemistry
- Solutions, Equilibrium, and Acid-Base Theory

### Test Sessions

The MCAS high school Chemistry test included two separate test sessions, which were administered on consecutive days. Each session included multiple-choice and open-response questions.

### Reference Materials and Tools

Each student taking the high school Chemistry test was provided with a Chemistry Formula and Constants Sheet/Periodic Table of the Elements. Copies of both sides of this formula sheet follow the final question in this chapter.

Each student also had sole access to a calculator with at least four functions and a square-root key.

The use of bilingual word-to-word dictionaries was allowed for current and former limited English proficient students only, during both Chemistry test sessions. No other reference tools or materials were allowed.

### Cross-Reference Information

The table at the conclusion of this chapter indicates each item's reporting category and the framework learning standard it assesses. The correct answers for multiple-choice questions are also displayed in the table.

# Chemistry

## SESSION 1

### DIRECTIONS

This session contains twenty-one multiple-choice questions and two open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet. You may work out solutions to multiple-choice questions in the test booklet.

- 1 As heat is slowly added to a glass of ice water, the temperature remains at  $0^{\circ}\text{C}$ . Which of the following statements explains why the temperature of the mixture of ice and water remains constant as heat is added?
- A. Heat is stored in the solid ice.
  - B. Heat is stored in the liquid water.
  - C. Heat is used to turn the solid ice into liquid water.
  - D. Heat is absorbed equally by the solid ice and the liquid water.
- 2 Which statement below **best** describes what happens when sodium chloride,  $\text{NaCl}$ , is dissolved in water?
- A. The  $\text{NaCl}$  separates into  $\text{Na}^+$  and  $\text{Cl}^-$  ions.
  - B. The  $\text{NaCl}$  separates into uncharged  $\text{Na}$  and  $\text{Cl}$ .
  - C. The  $\text{NaCl}$  reacts with water to form  $\text{NaH}$  and  $\text{HCl}$ .
  - D. The  $\text{NaCl}$  reacts with water to form  $\text{NaOH}$  and  $\text{Cl}_2$ .
- 3 Which of the following statements explains why elements of the alkali metal family are highly reactive?
- A. Alkali metals are easily ionized.
  - B. Alkali metals are negatively charged.
  - C. Alkali metals have an odd number of protons.
  - D. Alkali metals have an odd number of electrons.
- 4 Black powder was used as a propellant for fireworks for centuries. One of the components of black powder is potassium nitrate ( $\text{KNO}_3$ ). Black powder containing 1 mol of  $\text{KNO}_3$  releases 289 kJ of heat during combustion. The molar mass of  $\text{KNO}_3$  is 101 g/mol. How much heat is released if a firework contains 250 g of  $\text{KNO}_3$ ?
- A. 117 kJ
  - B. 715 kJ
  - C. 29,189 kJ
  - D. 72,250 kJ

- 5 What is the percent by mass of carbon in carbon dioxide ( $\text{CO}_2$ )?
- A. 27%
  - B. 33%
  - C. 43%
  - D. 73%
- 6 A 0.50 L container at 305 K holds a 0.22 g sample of carbon dioxide gas ( $\text{CO}_2$ ). Assuming ideal gas behavior, what is the pressure, in kilopascals, exerted by the gas?
- A. 23 kPa
  - B. 25 kPa
  - C. 41 kPa
  - D. 67 kPa
- 7 Bismuth-210 ( $^{210}_{83}\text{Bi}$ ) decays directly to polonium-210 ( $^{210}_{84}\text{Po}$ ). Which of the following must be emitted during this radioactive decay?
- A. alpha particle
  - B. beta particle
  - C. neutron
  - D. proton

- 8 A chemical reaction is shown below.  
$$\text{Zn(s)} + 2\text{H}^+(\text{aq}) \rightarrow \text{Zn}^{2+}(\text{aq}) + \text{H}_2(\text{g})$$

Which of the following statements **best** explains why this chemical reaction is an oxidation-reduction reaction?

- A. Zn reacts under basic conditions.
- B. Zn dissolves in an aqueous solution.
- C. Zn and  $\text{H}^+$  undergo a change of state.
- D. Zn loses electrons and  $\text{H}^+$  gains electrons.

- 9 Which of the following statements describes the role of a buffer?

- A. It increases the rate of a reaction.
- B. It keeps the pH of a solution within a small range.
- C. It changes the oxidation states of elements in a compound.
- D. It shifts the reaction equilibrium to favor more product formation.

- 10 How many grams of KCl are dissolved in 2.00 L of a 0.200 M solution of KCl?

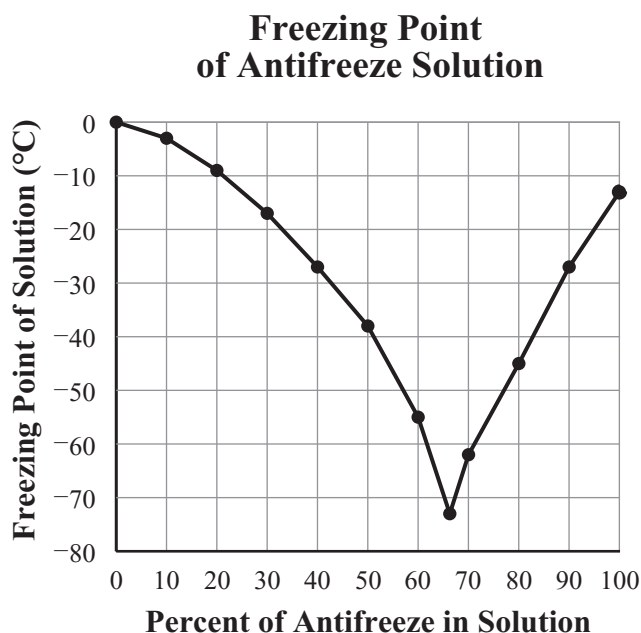
- A. 0.400 g
- B. 14.9 g
- C. 29.8 g
- D. 400 g

Question 11 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 11 in the space provided in your Student Answer Booklet.

- 11 Antifreeze is mixed with water in a car's radiator to help keep the solution from freezing. The graph below shows how the freezing point of a solution of antifreeze and water changes based on the percent of antifreeze in the solution.



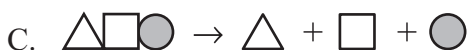
- Based on the graph, estimate the percent of antifreeze in a solution of antifreeze and water that has the **lowest** freezing point.
- Compare the freezing point of 1 L of 40% antifreeze solution with the freezing point of 10 L of 40% antifreeze solution. Explain the reasoning for your answer.
- A car mechanic stated that a 50% antifreeze solution provides better protection for the radiator of a car than a 90% antifreeze solution. Is the mechanic's statement correct or incorrect? Include data from the graph to support your answer.

Mark your answers to multiple-choice questions 12 through 22 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet, but you may work out solutions to multiple-choice questions in the test booklet.

- 12 A sample of nitrogen ( $\text{N}_2$ ) gas in a 10.0 L container has a pressure of 1.0 atm at 297 K. Assuming ideal gas behavior, what will the pressure be if the same amount of nitrogen gas is put into a 5.0 L container at 297 K?

A. 0.40 atm  
B. 0.50 atm  
C. 2.0 atm  
D. 2.5 atm

- 13 Which of the following diagrams represents a single displacement (replacement) reaction?



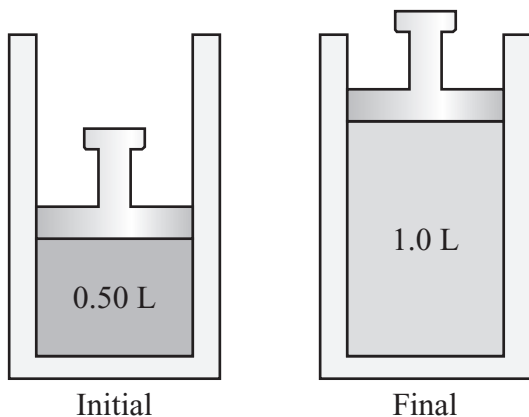
- 14 The equation below shows a reaction at equilibrium.



What happens to the equilibrium if the temperature is increased?

A. A new product will form.  
B. More  $\text{NO}_2$  will be formed.  
C. More  $\text{N}_2\text{O}_4$  will be formed.  
D. The equilibrium will remain the same.

- 15 The illustrations below represent the expansion of a gas in a cylinder of an engine. The piston moves as the gas volume changes.



What could have been done to the gas in the cylinder to bring about this change in volume?

- A. Half of the molecules were released.
- B. The Kelvin temperature was doubled.
- C. The condensation rate for the gas was doubled.
- D. The amount of heat in the gas was reduced by one half.

- 16 What is the chemical formula for ammonium sulfate?

- A.  $\text{NH}_4\text{SO}_4$
- B.  $\text{NH}_4(\text{SO}_4)_2$
- C.  $\text{NH}_4(\text{SO}_4)_3$
- D.  $(\text{NH}_4)_2\text{SO}_4$

- 17 The atomic theories of Dalton, Thomson, Rutherford, and Bohr **all** support which of the following statements?

- A. Atoms are mostly composed of empty space.
- B. All matter is composed of tiny, discrete particles called atoms.
- C. Electrons orbit the nucleus of an atom at distinct energy levels.
- D. Atoms are composed of positively and negatively charged particles.

- 18 A leaf gently floats on a pond. Which of the following statements **best** explains why the leaf stays on top of the water?
- A. The leaf has nonpolar covalent bonds between its atoms.
  - B. The density of the leaf is greater than the density of the water.
  - C. The water molecules are held tightly together by hydrogen bonding.
  - D. The hydrogen and oxygen atoms in the water are chemically bonded.
- 19 Silver (Ag) has 47 protons in each atom. Based on this information, which of the following also describes an atom of silver?
- A. It has no neutrons.
  - B. It has 47 electrons.
  - C. It has 23 neutrons and 24 electrons.
  - D. It has a total of 94 neutrons and electrons.
- 20 In a hydrogen fluoride (HF) molecule, a hydrogen atom and a fluorine atom are held together by a polar covalent bond. Which of the following **best** explains why this bond is polar?
- A. the large difference in the atomic radii of hydrogen and fluorine atoms
  - B. the large difference in the atomic masses of hydrogen and fluorine atoms
  - C. the large difference in the electronegativities of hydrogen and fluorine atoms
  - D. the large difference in the number of electrons of hydrogen and fluorine atoms

- 21 Which of the following occurs in an ionic bond?
- A. Two ions share protons.
  - B. Two ions share electrons.
  - C. Similarly charged ions attract.
  - D. Oppositely charged ions attract.
- 22 Which of the following lists three states of water in order of **increasing** entropy?
- A. ice, liquid, vapor
  - B. liquid, ice, vapor
  - C. ice, vapor, liquid
  - D. vapor, liquid, ice

Question 23 is an open-response question.

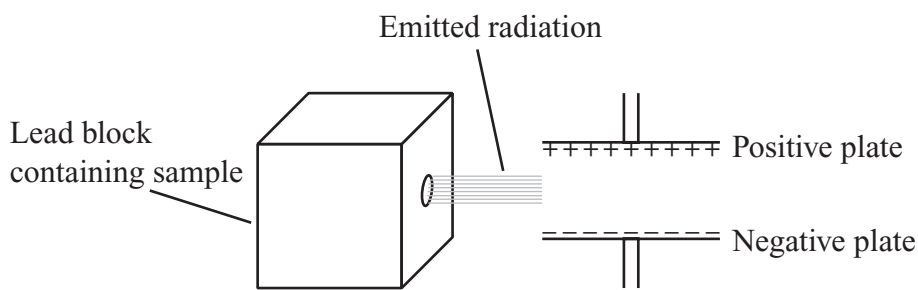
- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 23 in the space provided in your Student Answer Booklet.

**23** Radium-223 is part of a radioactive decay series that gives off alpha, beta, and gamma radiation.

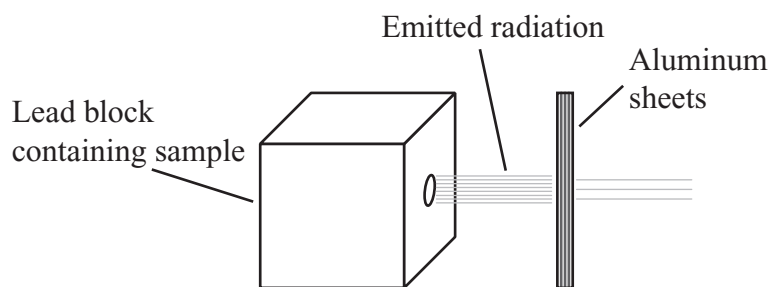
- a. Identify the charges on alpha radiation, beta radiation, and gamma radiation.

A sample of radium-223 is placed in a lead block and the emitted radiation passes between charged plates, as shown below.



- b. Describe the path of **each** type of radiation as it passes between the charged plates.

If several sheets of aluminum are placed in the path of the radiation emitted from the sample of radium-223, as shown below, some radiation would be blocked.



- c. Identify which type of radiation the aluminum sheets would **least likely** block. Explain your answer.

# Chemistry

## SESSION 2

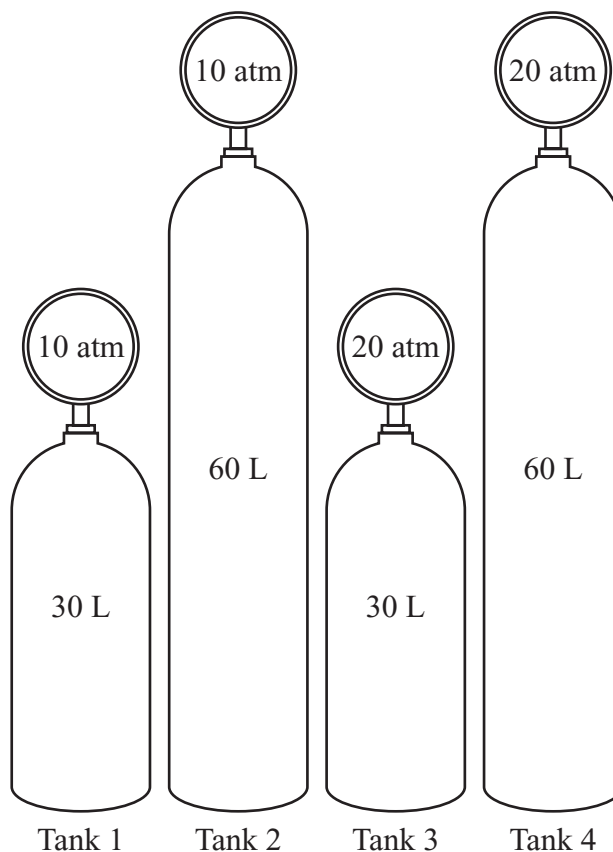
### DIRECTIONS

This session contains nineteen multiple-choice questions and three open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet. You may work out solutions to multiple-choice questions in the test booklet.

24 Which of the following activities could cause liquid molecules to overcome intermolecular attractive forces and become gas molecules?

- A. adding a solute to the liquid
- B. adding a catalyst to the liquid
- C. increasing the temperature of the liquid
- D. increasing the air pressure above the liquid

25 The four tanks shown in the diagram below contain compressed nitrogen gas. The temperature of the gas is the same in each tank.



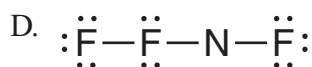
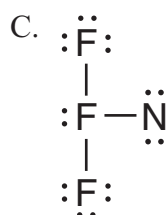
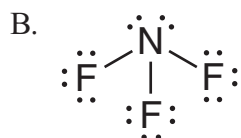
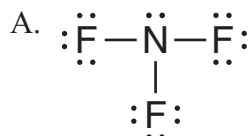
Which of the tanks contains the greatest number of gas particles?

- A. tank 1
- B. tank 2
- C. tank 3
- D. tank 4

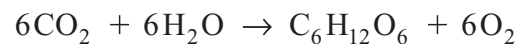
- 26 Two compounds that contain the elements carbon and chlorine are carbon tetrachloride ( $\text{CCl}_4$ ) and chloroform ( $\text{CHCl}_3$ ). Which of the following statements describes the geometry around carbon in these two compounds?
- A.  $\text{CCl}_4$  and  $\text{CHCl}_3$  have bent geometries.
  - B.  $\text{CCl}_4$  and  $\text{CHCl}_3$  have tetrahedral geometries.
  - C.  $\text{CCl}_4$  has linear geometry and  $\text{CHCl}_3$  has bent geometry.
  - D.  $\text{CCl}_4$  has tetrahedral geometry and  $\text{CHCl}_3$  has trigonal planar geometry.
- 27 Which of the following is the balanced equation for the decomposition of hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) into water and oxygen gas?
- A.  $\text{H}_2\text{O}_2 \rightarrow 2\text{H} + 2\text{O}$
  - B.  $\text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{O} + \text{O}_2$
  - C.  $2\text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{O} + 2\text{O}_2$
  - D.  $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$
- 28 Which of the following observed properties is **most** reliable in classifying a substance as a metal?
- A. good conductor of heat
  - B. low melting temperature
  - C. unreactive with other elements
  - D. crumbles when hit by a hammer
- 29 Which of the following are most directly involved in chemical bonding?
- A. protons
  - B. neutrons
  - C. alpha particles
  - D. valence electrons

- 30 Which of the following statements describes an exothermic reaction but **not** an endothermic reaction?
- Energy is destroyed during the reaction.
  - Energy is used to form chemical bonds.
  - Energy is used to break chemical bonds.
  - Energy is released as heat during the reaction.

- 31 What is the Lewis dot structure for nitrogen trifluoride (NF<sub>3</sub>)?



- 32 The photosynthesis reaction involves the formation of glucose from carbon dioxide and water.



What is the molecular mass of glucose?

- 24 g
- 72 g
- 180 g
- 364 g

Question 33 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 33 in the space provided in your Student Answer Booklet.

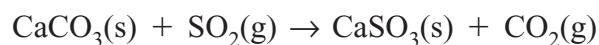
- 33 A student determines that a sample of an unidentified compound contains 0.8 mol sulfur and 2.4 mol oxygen. The student concludes that the chemical formula for the unidentified compound is  $S_{0.8}O_{2.4}$ . The student's teacher explains that this chemical formula is not possible.
- Explain why the chemical formula  $S_{0.8}O_{2.4}$  is not possible.
  - Identify the **most likely** chemical formula for the unidentified compound, assuming that the molar ratio is correct. Show or explain your reasoning.

A second student determines that another sample contains 0.5 mol sulfur and 1.0 mol oxygen.

- Determine whether the two students' samples are the same compound. Explain your answer.

Mark your answers to multiple-choice questions 34 through 43 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet, but you may work out solutions to multiple-choice questions in the test booklet.

- 34 Sulfur dioxide ( $\text{SO}_2$ ) emissions from smokestacks are reduced by a “scrubbing” mechanism in which  $\text{SO}_2$  gas reacts with crushed limestone ( $\text{CaCO}_3$ ) to produce a removable solid waste. The equation for the balanced reaction and the molar masses of the reactants are shown below.



Compound	Molar Mass (g/mol)
$\text{CaCO}_3$	100.1
$\text{SO}_2$	64.1

How many grams of  $\text{CaCO}_3$  are needed to completely react 1250 g of  $\text{SO}_2$ ?

- A. 625 g
- B. 800 g
- C. 1952 g
- D. 2500 g

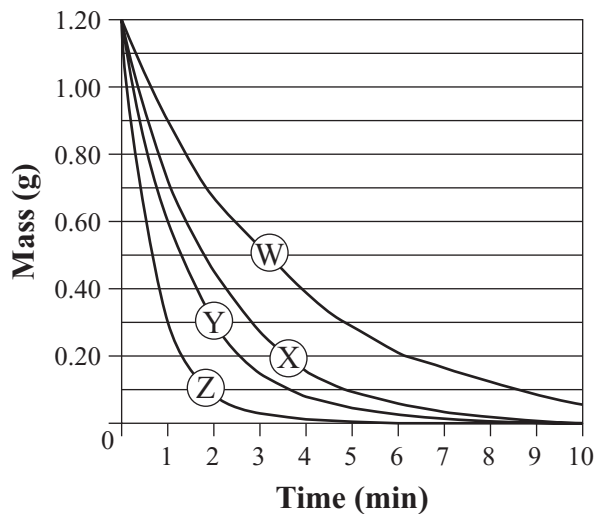
- 35 Which of the following statements explains why oxygen is classified as a pure substance and air is classified as a mixture?
- A. Oxygen is more reactive than air.
  - B. Oxygen has a higher density than air.
  - C. Oxygen undergoes phase changes, whereas air is always a gas.
  - D. Oxygen contains only one substance, but air contains several substances.
- 36 Why is sulfuric acid ( $\text{H}_2\text{SO}_4$ ) considered a Brønsted acid?
- A. It has a pH greater than 7.
  - B. It is able to donate protons.
  - C. It contains a hydroxide ion.
  - D. It reacts with hydronium ions.

- 37 The table below lists the conditions for four trials in a student's solubility rate experiment. In each trial, a 1.20 g sample of a sodium salt was dissolved in 10.0 mL water.

Trial	Size of Crystals (mm)	Temperature (°C)
1	0.1–0.2	20.0
2	0.1–0.2	40.0
3	0.5–1.0	10.0
4	0.5–1.0	20.0

During each trial, the student determined the mass of the undissolved salt and the time that had elapsed. The data were used to plot the curves on the graph below.

**Mass of Undissolved Salt vs. Time Elapsed**



Which curve on the graph **most likely** represents trial 2?

- A. curve W
- B. curve X
- C. curve Y
- D. curve Z

- 38 The pH of milk is 6.4. Based on this information, which of the following statements **best** describes milk?

- A. It is very basic.
- B. It is very acidic.
- C. It is slightly basic.
- D. It is slightly acidic.

- 39 A hospital buys a compound that contains an isotope of barium. Several months later, most of the barium has changed to the element lanthanum.

Which of the following is responsible for this change?

- A. exposure to air
- B. radioactive decay
- C. reactions with the container wall
- D. absorption of moisture from the air

- 40 A student made a homogeneous mixture of water and salt. Which of the following statements applies to this homogeneous mixture?

- A. This mixture is a solution.
- B. This mixture is a pure substance.
- C. The salt is not evenly distributed throughout this mixture.
- D. The salt chemically combines with the water in this mixture.

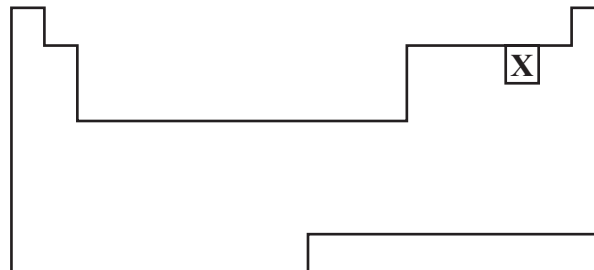
41 Which of the following statements **best** explains why elements in the same family of the periodic table have similar bonding properties?

- A. The elements have similar atomic sizes.
- B. The elements have similar atomic masses.
- C. The elements have similar numbers of protons.
- D. The elements have similar valence electron configurations.

42 Palmitic acid, a component of most animal fats, has the molecular formula  $\text{CH}_3(\text{CH}_2)_{14}\text{COOH}$ . Which of the following is the empirical formula for palmitic acid?

- A.  $\text{CHO}$
- B.  $\text{C}_3\text{H}_6\text{O}_2$
- C.  $\text{C}_8\text{H}_{16}\text{O}$
- D.  $\text{C}_{16}\text{H}_{32}\text{O}_2$

43 The figure below shows a periodic table with the position of one element indicated by an X.



How would the element in position X be classified?

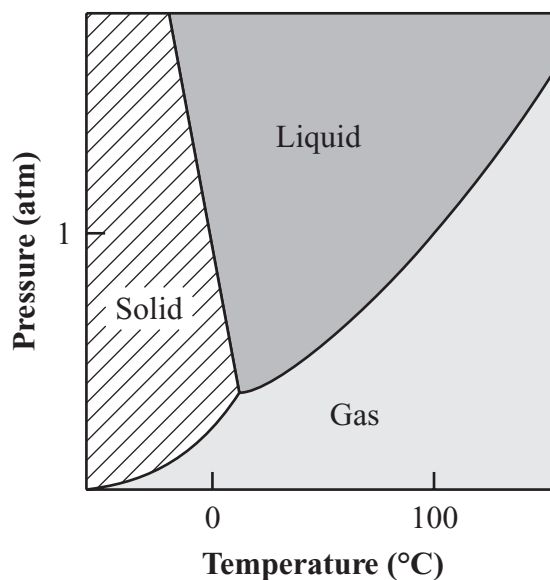
- A. halogen
- B. metalloid
- C. noble gas
- D. nonmetal

Questions 44 and 45 are open-response questions.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF EACH QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 44 in the space provided in your Student Answer Booklet.

- 44 At sea level, water boils at  $100^{\circ}\text{C}$ . The boiling point of water varies with changes in air pressure, as shown in the diagram below.



- Based on the diagram, describe what happens to the boiling point of water as air pressure decreases.
- Use the kinetic molecular theory to describe the process of boiling.
- Use the kinetic molecular theory to explain why the boiling point of water is affected by pressure.

Write your answer to question 45 in the space provided in your Student Answer Booklet.

45 Carbon forms covalent bonds with many different elements.

- Describe the difference between a nonpolar covalent bond and a polar covalent bond.
- Using electronegativity trends in the periodic table, rank the three covalent bonds shown below in order from least polar to most polar. Explain your reasoning.



- Identify one covalent bond from part (b) in which the carbon atom has a partial positive charge. Explain your answer.

## Massachusetts Comprehensive Assessment System Chemistry Formula and Constants Sheet

### Common Polyatomic Ions

Ion	Ionic Formula
Ammonium	$\text{NH}_4^+$
Carbonate	$\text{CO}_3^{2-}$
Hydroxide	$\text{OH}^-$
Nitrate	$\text{NO}_3^-$
Phosphate	$\text{PO}_4^{3-}$
Sulfate	$\text{SO}_4^{2-}$

**Combined Gas Law:**  $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

**Ideal Gas Law:**  $PV = nRT$

**Dilution Formula:**  $M_1 V_1 = M_2 V_2$

**Molar Volume of Ideal Gas at STP:** 22.4 L/mol

**Ideal Gas Constant:**  $R = 0.0821 \text{ L} \cdot \text{atm/mol} \cdot \text{K} = 8.31 \text{ L} \cdot \text{kPa/mol} \cdot \text{K}$

**STP:** 1 atm (101.3 kPa), 273 K (0°C)

**Absolute Temperature Conversion:**  $\text{K} = ^\circ\text{C} + 273$

**Definition of pH:**  $\text{pH} = -\log [\text{H}_3\text{O}^+] = -\log [\text{H}^+]$

**Avogadro's Number:**  $6.02 \times 10^{23}$  particles/mol

### Nuclear Symbols

Name	Symbol
Alpha particle	$\alpha$ or ${}^4_2\text{He}$
Beta particle	$\beta$ or ${}^0_{-1}e$
Gamma ray	$\gamma$
Neutron	${}^1_0n$



**High School Chemistry**  
**Spring 2011 Released Items:**  
**Reporting Categories, Standards, and Correct Answers\***

Item No.	Page No.	Reporting Category	Standard	Correct Answer (MC)*
1	329	<i>Properties of Matter and Thermochemistry</i>	1.3	C
2	329	<i>Solutions, Equilibrium and Acid Base Theory</i>	7.1	A
3	329	<i>Atomic Structure and Periodicity</i>	3.4	A
4	329	<i>Bonding and Reactions</i>	5.3	B
5	330	<i>Bonding and Reactions</i>	5.4	A
6	330	<i>Properties of Matter and Thermochemistry</i>	6.2	B
7	330	<i>Atomic Structure and Periodicity</i>	2.5	B
8	331	<i>Bonding and Reactions</i>	8.4	D
9	331	<i>Solutions, Equilibrium and Acid Base Theory</i>	8.3	B
10	331	<i>Solutions, Equilibrium and Acid Base Theory</i>	7.2	C
11	332	<i>Solutions, Equilibrium and Acid Base Theory</i>	7.4	
12	333	<i>Properties of Matter and Thermochemistry</i>	6.1	C
13	333	<i>Bonding and Reactions</i>	5.2	D
14	333	<i>Solutions, Equilibrium and Acid Base Theory</i>	7.6	B
15	334	<i>Properties of Matter and Thermochemistry</i>	6.1	B
16	334	<i>Bonding and Reactions</i>	4.6	D
17	334	<i>Atomic Structure and Periodicity</i>	2.1	B
18	335	<i>Bonding and Reactions</i>	4.5	C
19	335	<i>Atomic Structure and Periodicity</i>	2.2	B
20	335	<i>Bonding and Reactions</i>	4.3	C
21	336	<i>Bonding and Reactions</i>	4.1	D
22	336	<i>Properties of Matter and Thermochemistry</i>	6.5	A
23	337	<i>Atomic Structure and Periodicity</i>	2.5	
24	338	<i>Properties of Matter and Thermochemistry</i>	1.3	C
25	338	<i>Properties of Matter and Thermochemistry</i>	6.2	D
26	339	<i>Bonding and Reactions</i>	4.4	B
27	339	<i>Bonding and Reactions</i>	5.1	D
28	339	<i>Properties of Matter and Thermochemistry</i>	1.1	A
29	339	<i>Bonding and Reactions</i>	4.1	D
30	340	<i>Properties of Matter and Thermochemistry</i>	6.4	D
31	340	<i>Bonding and Reactions</i>	4.2	A
32	340	<i>Bonding and Reactions</i>	5.3	C
33	341	<i>Atomic Structure and Periodicity</i>	2.3	
34	342	<i>Bonding and Reactions</i>	5.5	C
35	342	<i>Properties of Matter and Thermochemistry</i>	1.2	D
36	342	<i>Solutions, Equilibrium and Acid Base Theory</i>	8.1	B
37	343	<i>Solutions, Equilibrium and Acid Base Theory</i>	7.3	D
38	343	<i>Solutions, Equilibrium and Acid Base Theory</i>	8.2	D
39	344	<i>Atomic Structure and Periodicity</i>	2.6	B
40	344	<i>Properties of Matter and Thermochemistry</i>	1.2	A

Item No.	Page No.	Reporting Category	Standard	Correct Answer (MC)*
41	345	<i>Atomic Structure and Periodicity</i>	3.3	D
42	345	<i>Bonding and Reactions</i>	5.4	C
43	345	<i>Atomic Structure and Periodicity</i>	3.2	D
44	346	<i>Properties of Matter and Thermochemistry</i>	6.3	
45	347	<i>Bonding and Reactions</i>	4.3	

\* Answers are provided here for multiple-choice items only. Sample responses and scoring guidelines for open-response items, which are indicated by shaded cells, will be posted to the Department's website later this year.