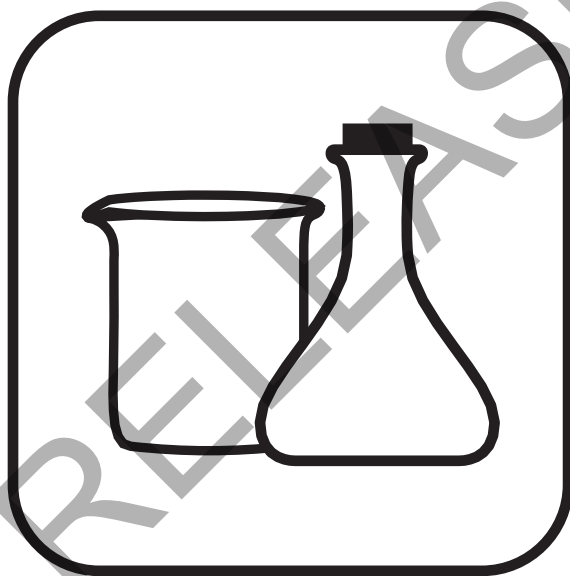


Released Items

Student Name: _____

Chemistry



2018–2019



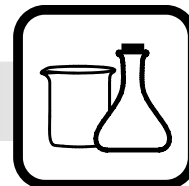
Public Schools of North Carolina
Department of Public Instruction | State Board of Education
Division of Accountability Services/North Carolina Testing Program

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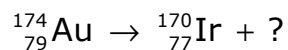
NC Final Exam



- 1 Which isotope has the greatest number of protons?
- A Pa-238
 - B U-240
 - C Np-238
 - D Pu-239
- 2 A neutral atom of a certain element has the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^4$. How many valence electrons does the atom have?
- A 4
 - B 6
 - C 11
 - D 16
- 3 What color of light does a hydrogen atom emit when an electron transitions from the $n=6$ energy level to the $n=2$ energy level?
- A orange
 - B yellow
 - C blue
 - D violet

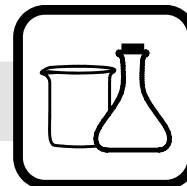


- 4 The equation below represents the radioactive decay of a gold isotope.



Which choice correctly completes this equation?

- A alpha particle
- B beta particle
- C photon
- D neutron
- 5 A neutral atom has a ground state electron configuration of $1s^2 2s^2 2p^6 3s^2$. The neutral atom becomes an ion during a chemical reaction. Which is the **most likely** charge of the ion?
- A 2+
- B 1+
- C 2-
- D 6-
- 6 How many electrons are in the outermost energy level of a neutral carbon atom?
- A 2
- B 4
- C 6
- D 8



- 7 The compound sodium chloride is placed in water and separates into ions. What are the correct names for these ions?
- A The chloride and sodium ions are cations.
 - B The chloride and sodium ions are anions.
 - C The sodium ion is the anion, and the chloride ion is the cation.
 - D The sodium ion is the cation, and the chloride ion is the anion.
- 8 Which element will form covalent bonds with chlorine?
- A carbon
 - B aluminum
 - C magnesium
 - D potassium
- 9 Which type of bonding or intermolecular forces is/are weakest?
- A London dispersion forces
 - B hydrogen bonding
 - C dipole-dipole forces
 - D covalent bonding



10 What is the chemical formula for chromium(III) oxide?

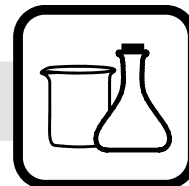
- A CrO
- B CrO₂
- C Cr₂O₃
- D Cr₃O₂

11 Test results on two white crystalline solids are shown in the table below:

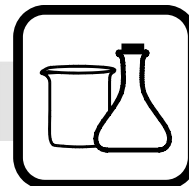
	Solid X	Solid Y
Melting Point	801°C	186°C
Solubility in Water (grams per 100.0 grams of water)	35.7	3.2
Electrical Conductivity (molten state)	good conductor	nonconductor

Based on the information in the table, what can be concluded?

- A Both solids contain only ionic bonds.
- B Both solids contain only covalent bonds.
- C Solid X contains only covalent bonds, and Solid Y contains only ionic bonds.
- D Solid X contains only ionic bonds, and Solid Y contains only covalent bonds.



- 12 What is the name of the compound with the chemical formula CoF_3 ?
- A fluorocobalt
 - B cobalt trifluoride
 - C cobalt(III) fluoride
 - D fluorine(III) cobalt
- 13 Which statement **best** compares how bond strengths affect the physical properties of iron and lead?
- A Iron has a higher melting point because the bonds in iron are stronger.
 - B Iron has a higher melting point because the bonds in iron are weaker.
 - C Lead has a higher density because the bonds in lead are stronger.
 - D Lead has a higher density because the bonds in lead are weaker.
- 14 How is copper (Cu) classified based on its location on the periodic table?
- A a nonmetal
 - B an alkaline earth metal
 - C a transition metal
 - D an alkali metal

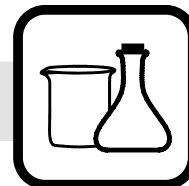


- 15 The table below shows the electron configurations of three elements.

Element	Electron Configuration
Element 1	$1s^2 2s^2 2p^2$
Element 2	$1s^2 2s^2 2p^5$
Element 3	$1s^2 2s^2 2p^4$

What is the order of the elements from **smallest** to **largest** atomic radius?

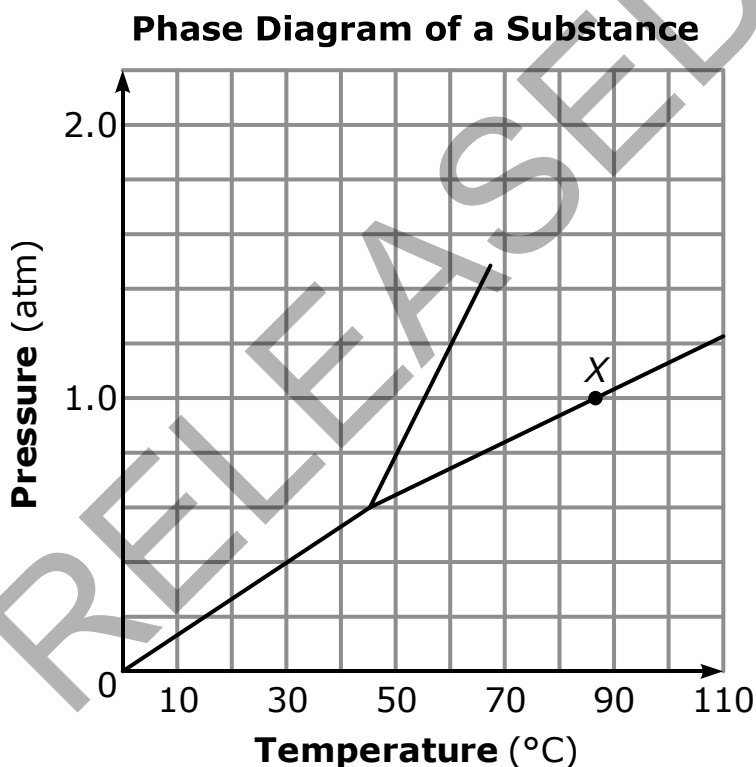
- A Element 1, Element 2, Element 3
- B Element 1, Element 3, Element 2
- C Element 2, Element 1, Element 3
- D Element 2, Element 3, Element 1
- 16 Which three elements are arranged according to **increasing** electronegativity values?
- A N, C, B
- B N, P, As
- C N, O, F
- D F, O, N
- 17 Which group of elements is arranged in order of increasing atomic radii?
- A O, S, Se, Te
- B Fe, Ni, Ag, Au
- C Rb, K, Na, Li
- D Y, Zr, Nb, Mo



18 Which statement describes equilibrium between liquid water and water vapor?

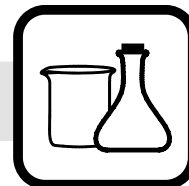
- A The rate of vaporization equals the rate of condensation.
- B The rate of vaporization is greater than the rate of condensation.
- C The rate of vaporization equals the rate of sublimation.
- D The rate of vaporization is greater than the rate of sublimation.

19 A phase diagram is shown below.



Which choice describes the state of the substance at X?

- A A boiling liquid is in equilibrium with its vapor.
- B A subliming solid is in equilibrium with its vapor.
- C A freezing liquid is in equilibrium with its solid.
- D A melting solid is in equilibrium with its liquid.

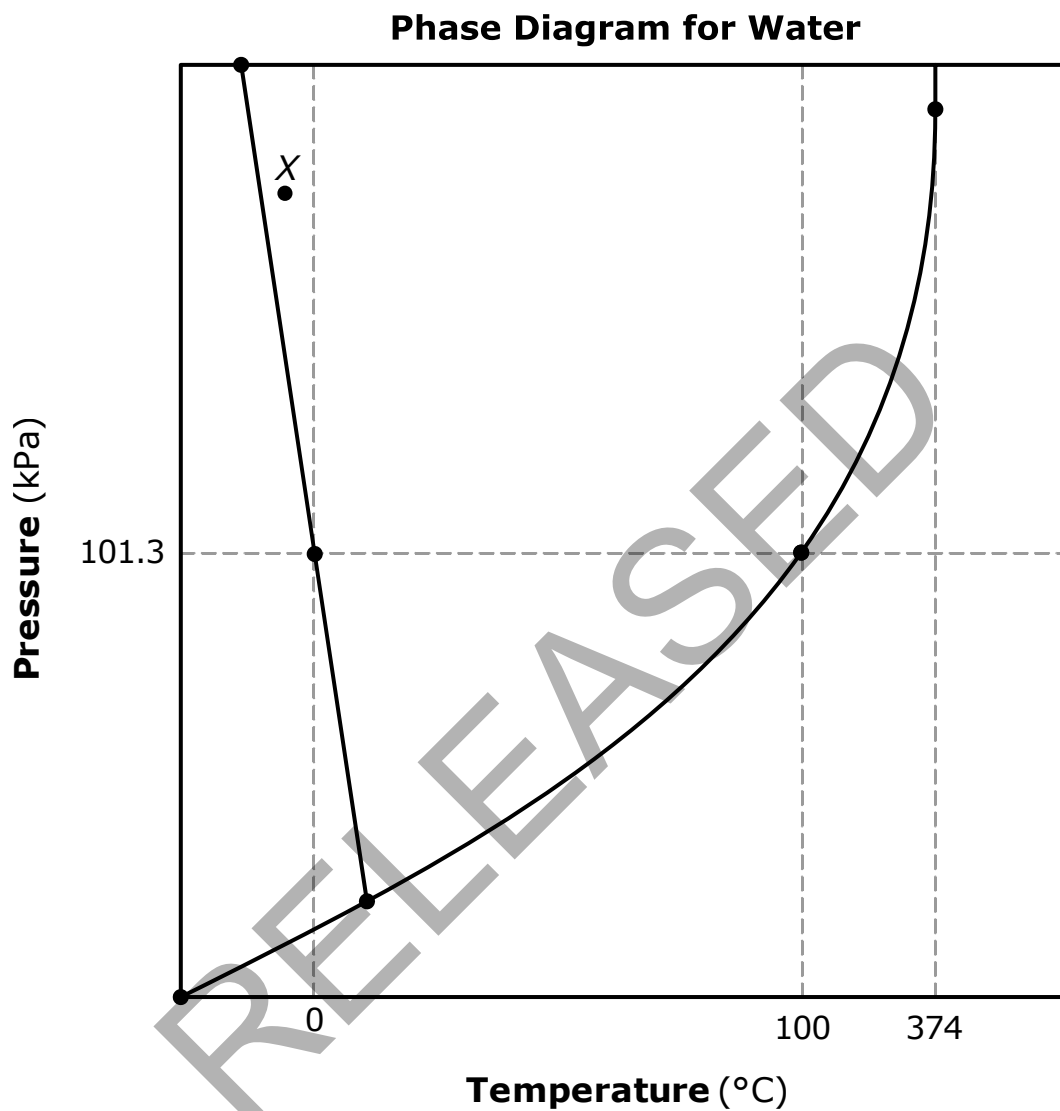


- 20 A sample of metal has a mass of 5.2 g and absorbs 20.0 J of energy as it is heated from 30.0°C to 40.0°C. What is the identity of the metal?
- A iron
 - B gold
 - C copper
 - D magnesium
- 21 A 2.0-liter closed container holds 1.0 mole of an ideal gas at a certain temperature and pressure. Which closed container will hold 3.0 moles of this ideal gas at the same temperature and pressure?
- A a 3.0-liter container
 - B a 6.0-liter container
 - C a 9.0-liter container
 - D a 12.0-liter container

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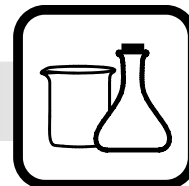


22 A phase diagram is shown below.



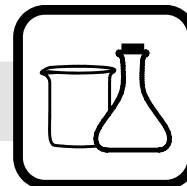
What is the condition of the sample at point X?

- A The sample is in a gaseous state.
- B The sample is in a liquid state.
- C The sample is at its critical point.
- D The sample is at its triple point.

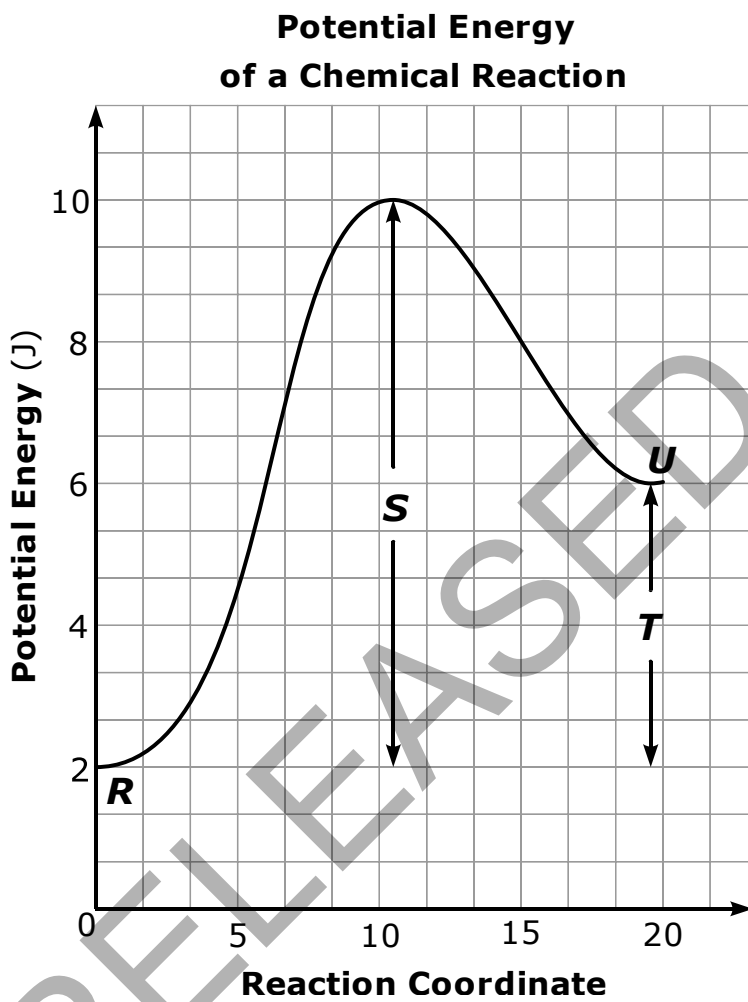


- 23 What is the **approximate** temperature of 1.4 moles of a gas with a pressure of 3.25 atmospheres in a 4.738-liter container?
- A 180 K
 - B 170 K
 - C 150 K
 - D 130 K

RELEASED



24 A potential energy diagram of a chemical reaction is shown below.



Which choice would be changed by the addition of a catalyst to the reaction?

- A *R*
- B *S*
- C *T*
- D *U*



- 25 A student conducts the following demonstration:
- A 15-g sample of NaHCO_3 is placed in a test tube.
 - The bottom of the test tube is heated with an open flame.
 - Condensation forms on the inside walls of the test tube.
 - A burning splint is extinguished when placed at the mouth of the test tube.

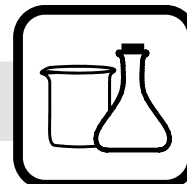
What can the student conclude after conducting this demonstration?

- A The burning splint was extinguished because of a lack of CO_2 in the test tube.
- B The burning splint was extinguished because of a lack of H_2O vapor.
- C Decomposition produced CO_2 and H_2O .
- D Combustion produced O_2 and H_2O .
- 26 A chemical equation is shown below.

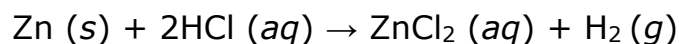


What will be the coefficient of CaBr_2 when the equation is balanced using the smallest possible whole-number coefficients?

- A 2
- B 3
- C 4
- D 5

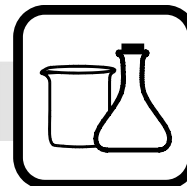


- 27 The equation below represents a chemical reaction.



A 5.00-g sample of zinc is added to hydrochloric acid. The amount of hydrochloric acid is sufficient to allow the zinc to react completely. What mass of hydrogen gas does this reaction produce?

- A 0.0308 g
B 0.0771 g
C 0.121 g
D 0.154 g
- 28 What is the molecular formula of a compound with the empirical formula CH_2O and a molecular mass of 60 g/mol?
- A CH_2O
B $\text{C}_2\text{H}_4\text{O}_2$
C $\text{C}_2\text{H}_4\text{O}_4$
D $\text{C}_2\text{H}_2\text{O}_2$



- 29 A student experimented with magnesium ribbon and hydrochloric acid.
- The student placed a piece of solid magnesium ribbon in a test tube containing hydrochloric acid solution.
 - The student observed that vigorous bubbling occurred.
 - The student collected some of the gas generated by the bubbles in a test tube.
 - The student tested the gas produced with a burning wood splint, which ignited quickly with a popping sound.

What can the student conclude about the experiment?

- A A chemical reaction occurred because new atoms were created.
- B A chemical reaction occurred because a new substance was formed.
- C The popping sound provided evidence that the acid changed physical states.
- D The popping sound provided evidence that the magnesium atoms were destroyed.
- 30 How many O_2 particles are in 2.50 moles of O_2 at Standard Temperature and Pressure (STP)?
- A 4.15×10^{22} particles
- B 2.41×10^{23} particles
- C 5.02×10^{23} particles
- D 1.51×10^{24} particles



- 31 Why does an increase in temperature usually increase the rate of a chemical reaction?
- A because the activation energy of the reaction increases
 - B because the surface area of reacting particles increases
 - C because the proper orientation of reacting particles improves
 - D because the number of effective collisions between reacting particles increases

- 32 The chemical equation below represents a reaction at equilibrium in a closed flask.

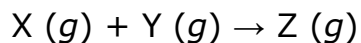


Which action will cause the reaction to shift to the left?

- A heating the flask with a hot plate
- B placing the flask in an ice bath
- C removing H_2O from the flask
- D adding CO to the flask



- 33 In a hypothetical reaction, reactants X and Y are combined in an evacuated vessel and allowed to come to equilibrium with product Z at a temperature of 200K.



After equilibrium is established, the temperature is slowly raised, and additional values of K_{eq} are determined as shown in this data table:

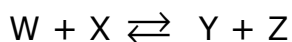
Temperature	K_{eq}
200K	3×10^{-2}
300K	1×10^{-2}
400K	4×10^{-3}
500K	5×10^{-4}

Which temperature has the greatest concentration of product Z?

- A 200K
- B 300K
- C 400K
- D 500K



- 34 An equilibrium is established between substances W, X, Y, and Z.

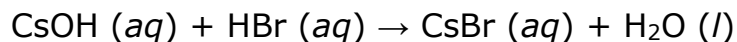


How would the conditions of equilibrium be affected by decreasing the concentration of substance W?

- A Substances X and Y would react to replace substance W, and the position of equilibrium would shift to the right.
- B Substances Y and Z would react to replace substance W, and the position of equilibrium would shift to the left.
- C This would increase pressure, causing only substance Y to replace substance W and shifting the equilibrium to the right.
- D This would decrease temperature, causing only substance Z to replace substance W and shifting the equilibrium to the left.
- 35 A solution has a pOH of 12. Which **best** describes the solution?
- A It has a pH of 2 and is a base.
- B It has a pH of 12 and is a base.
- C It has a pH of 2 and is an acid.
- D It has a pH of 12 and is an acid.
- 36 A student describes a liquid as feeling slippery. The student places red litmus paper into the liquid, and the paper turns blue. What can the student conclude from these observations?
- A The substance is likely a nonmetal.
- B The substance is likely a metal.
- C The substance is likely a base.
- D The substance is likely an acid.

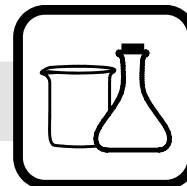


- 37 An acid-base titration is represented by the chemical equation below.

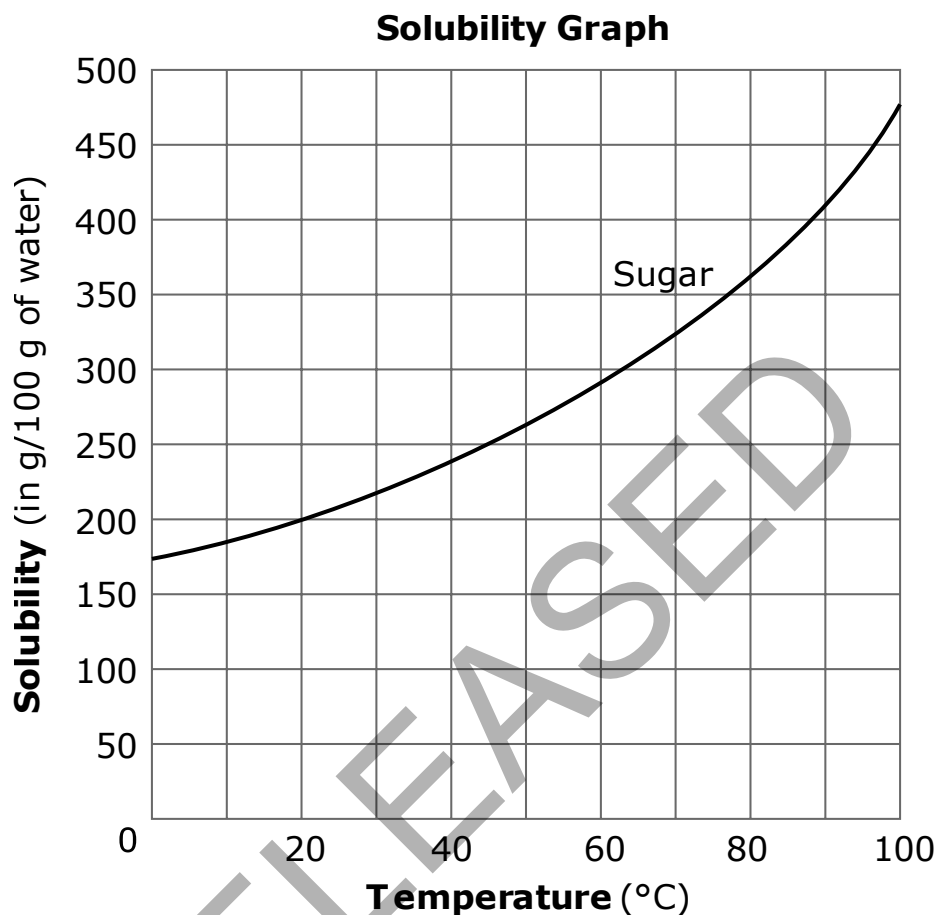


In the titration, 15.0 mL of CsOH solution is neutralized by 38.2 mL of 0.250 *M* HBr solution. What is the molarity of the CsOH solution?

- A 0.0982 *M*
- B 0.637 *M*
- C 1.36 *M*
- D 10.2 *M*
- 38 What type of solution is formed when solid sodium hydroxide (NaOH) is dissolved in water?
- A an electrolytic solution, because NaOH will dissociate into ions
- B an electrolytic solution, because NaOH will not dissociate into ions
- C a nonelectrolytic solution, because NaOH will dissociate into ions
- D a nonelectrolytic solution, because NaOH will not dissociate into ions

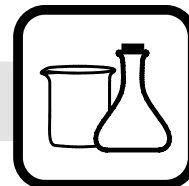


39 The diagram below shows the solubility of sugar in water.



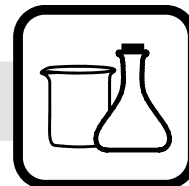
A student dissolves 300 g of sugar in 100 g of water at 80°C. The solution is then allowed to cool to 40°C. The appearance of the solution does not change during the cooling. Which term accurately describes the solution at 40°C?

- A suspension
- B colloid
- C supersaturated
- D unsaturated



- 40 Which statement explains what happens when potassium chloride (KCl) dissolves in water?
- A Water molecules surround the potassium chloride but do not exert forces of attraction strong enough to break any bonds.
 - B Water molecules exert forces of attraction that break the potassium chloride apart into potassium ions and chloride ions.
 - C Water molecules exert forces of attraction that break the potassium chloride apart into neutral atoms of potassium and neutral atoms of chlorine.
 - D Water molecules exert forces of attraction that break the potassium chloride apart into potassium atoms and diatomic chlorine gas.

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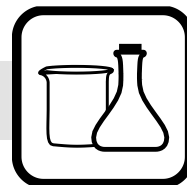


This is the end of Chemistry Released Items.

Directions:

- 1. Look back over your answers for the test questions.**
- 2. Make sure all your answers are entered on the answer sheet. Only what is entered on your answer sheet will be scored.**
- 3. Put all of your papers inside your test book and close the test book.**
- 4. Place your calculator on top of the test book.**
- 5. Stay quietly in your seat until your teacher tells you that testing is finished.**
- 6. Remember, teachers are not allowed to discuss items from the test with you, and you are not allowed to discuss with others any of the test questions or information contained within the test.**

RELEASED



**Chemistry
RELEASED Items¹
2018–2019
Answer Key**

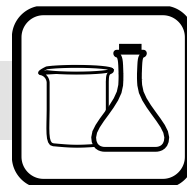
Question Number	Question Type	Correct Answer	Percent Correct ²	Objective
1	MC	D	63%	Chm.1.1.1
2	MC	B	58%	Chm.1.1.2
3	MC	D	65%	Chm.1.1.3
4	MC	A	64%	Chm.1.1.4
5	MC	A	71%	Chm.1.1.1
6	MC	B	59%	Chm.1.1.2
7	MC	D	64%	Chm.1.2.1
8	MC	A	65%	Chm.1.2.2
9	MC	A	34%	Chm.1.2.3
10	MC	C	66%	Chm.1.2.4
11	MC	D	66%	Chm.1.2.5
12	MC	C	72%	Chm.1.2.4
13	MC	A	61%	Chm.1.2.5
14	MC	C	84%	Chm.1.3.1
15	MC	D	36%	Chm.1.3.2
16	MC	C	73%	Chm.1.3.3

CHEMISTRY — RELEASED ITEMS



Question Number	Question Type	Correct Answer	Percent Correct ²	Objective
17	MC	A	65%	Chm.1.3.2
18	MC	A	62%	Chm.2.1.1
19	MC	A	72%	Chm.2.1.3
20	MC	C	59%	Chm.2.1.4
21	MC	B	90%	Chm.2.1.5
22	MC	B	70%	Chm.2.1.3
23	MC	D	55%	Chm.2.1.5
24	MC	B	71%	Chm.2.2.1
25	MC	C	38%	Chm.2.2.2
26	MC	B	79%	Chm.2.2.3
27	MC	D	40%	Chm.2.2.4
28	MC	B	76%	Chm.2.2.5
29	MC	B	59%	Chm.2.2.2
30	MC	D	56%	Chm.2.2.4
31	MC	D	58%	Chm.3.1.1
32	MC	A	39%	Chm.3.1.3
33	MC	A	47%	Chm.3.1.2
34	MC	B	58%	Chm.3.1.3

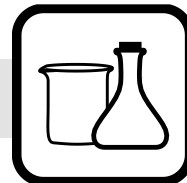
CHEMISTRY — RELEASED ITEMS



Question Number	Question Type	Correct Answer	Percent Correct ²	Objective
35	MC	C	60%	Chm.3.2.1
36	MC	C	71%	Chm.3.2.2
37	MC	B	56%	Chm.3.2.3
38	MC	A	60%	Chm.3.2.4
39	MC	C	50%	Chm.3.2.5
40	MC	B	47%	Chm.3.2.6

¹These released items were administered to students during a previous test administration. This sample set of released items may not reflect the breadth of the standards assessed and/or the range of item difficulty found on the NC Final Exam. Additional information about the NC Final Exam is available in the *Assessment Specification* for each exam located at <http://www.ncpublicschools.org/accountability/common-exams/specifications/>.

²Percent correct is the percentage of students who answered the item correctly during a previous administration.



Clarifying Objectives Descriptions

Only clarifying objective descriptions addressed by the released items in this document are listed below. A complete list of North Carolina *Essential Standards* for Science may be reviewed at <http://www.ncpublicschools.org/curriculum/science/scos/support-tools/#standards>.

Chm.1.1.1 (Matter: Properties and Change)

Analyze the structure of atoms, isotopes, and ions.

Chm.1.1.2 (Matter: Properties and Change)

Analyze an atom in terms of the location of electrons.

Chm.1.1.3 (Matter: Properties and Change)

Explain the emission of electromagnetic radiation in spectral form in terms of the Bohr model.

Chm.1.1.4 (Matter: Properties and Change)

Explain the process of radioactive decay by the use of nuclear equations and half-life.

Chm.1.2.1 (Matter: Properties and Change)

Compare (qualitatively) the relative strengths of ionic, covalent, and metallic bonds.

Chm.1.2.2 (Matter: Properties and Change)

Infer the type of bond and chemical formula formed between atoms.

Chm.1.2.3 (Matter: Properties and Change)

Compare inter- and intra-particle forces.

Chm.1.2.4 (Matter: Properties and Change)

Interpret the name and formula of compounds using IUPAC convention.

Chm.1.2.5 (Matter: Properties and Change)

Compare the properties of ionic, covalent, metallic, and network compounds.

Chm.1.3.1 (Matter: Properties and Change)

Classify the components of a periodic table (period, group, metal, metalloid, nonmetal, transition).

Chm.1.3.2 (Matter: Properties and Change)

Infer the physical properties (atomic radius, metallic and nonmetallic characteristics) of an element based on its position on the Periodic Table.

Chm.1.3.3 (Matter: Properties and Change)

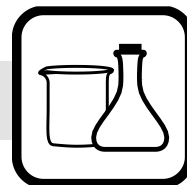
Infer the atomic size, reactivity, electronegativity, and ionization energy of an element from its position in the Periodic Table.

Chm.2.1.1 (Energy: Conservation and Transfer)

Explain the energetic nature of phase changes.

Chm.2.1.3 (Energy: Conservation and Transfer)

Interpret the data presented in phase diagrams.

**Chm.2.1.4 (Energy: Conservation and Transfer)**

Infer simple calorimetric calculations based on the concepts of heat lost equals heat gained and specific heat.

Chm.2.1.5 (Energy: Conservation and Transfer)

Explain the relationships between pressure, temperature, volume, and quantity of gas both qualitative and quantitative.

Chm.2.2.1 (Energy: Conservation and Transfer)

Understand the energy content of a chemical reaction.

Chm.2.2.2 (Energy: Conservation and Transfer)

Analyze the evidence of chemical change.

Chm.2.2.3 (Energy: Conservation and Transfer)

Analyze the law of conservation of matter and how it applies to various types of chemical equations (synthesis, decomposition, single replacement, double replacement, and combustion).

Chm.2.2.4 (Energy: Conservation and Transfer)

Analyze the stoichiometric relationships inherent in a chemical reaction.

Chm.2.2.5 (Energy: Conservation and Transfer)

Analyze quantitatively the composition of a substance (empirical formula, molecular formula, percent composition, and hydrates)

Chm.3.1.1 (Interactions of Energy and Matter)

Explain the factors that affect the rate of a reaction (temperature, concentration, particle size and presence of a catalyst).

Chm.3.1.2 (Interactions of Energy and Matter)

Explain the conditions of a system at equilibrium.

Chm.3.1.3 (Interactions of Energy and Matter)

Infer the shift in equilibrium when a stress is applied to a chemical system (Le Chatelier's Principle).

Chm.3.2.1 (Interactions of Energy and Matter)

Classify substances using the hydronium and hydroxide ion concentrations.

Chm.3.2.2 (Interactions of Energy and Matter)

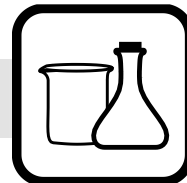
Summarize the properties of acids and bases.

Chm.3.2.3 (Interactions of Energy and Matter)

Infer the quantitative nature of a solution (molarity, dilution, and titration with a 1:1 molar ratio).

Chm.3.2.4 (Interactions of Energy and Matter)

Summarize the properties of solutions.



Chm.3.2.5 (Interactions of Energy and Matter)

Interpret solubility diagrams.

Chm.3.2.6 (Interactions of Energy and Matter)

Explain the solution process.

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