

Name

RELEASED FORM

Chemistry

Form A



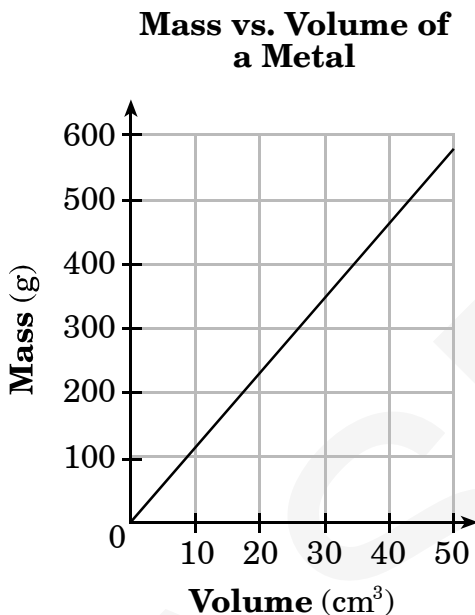
North Carolina Test of Chemistry

Public Schools of North Carolina
www.ncpublicschools.org
State Board of Education
Department of Public Instruction
Division of Accountability Services/North Carolina Testing Program
Raleigh, North Carolina 27699-6314



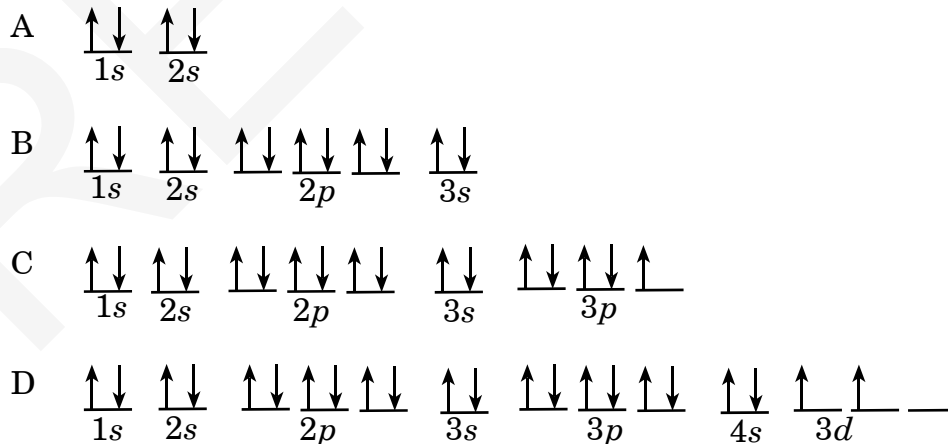
1. How many protons and electrons are in a ${}_{29}^{64}\text{Cu}^{2+}$ ion?
- A 27 protons, 29 electrons
B 27 protons, 31 electrons
C 29 protons, 27 electrons
D 29 protons, 31 electrons
2. What is the name of the compound with the chemical formula CrCl_3 ?
- A chromium tetrachloride
B chromium trichloride
C chromium(II) chloride
D chromium(III) chloride
3. If two oxygen atoms combine to make a molecule, what type of bond will they form?
- A an ionic bond
B a hydrogen bond
C a double covalent bond
D a metallic bond
4. Why did most of the alpha particles go straight through the gold foil in Rutherford's experiment?
- A Most of an atom is empty space.
B Alpha particles are positively charged.
C Alpha particles move with high velocity.
D The center of an atom is positively charged.
5. How does an S^{2-} ion differ from an electrically neutral sulfur atom?
- A mass number
B atomic number
C nuclear charge
D number of electrons
6. A gas under a pressure of 74 mmHg and at a temperature of 75°C occupies a 500.0-L container. How many moles of gas are in the container?
- A 1.7 moles
B 7.9 moles
C 13 moles
D 59 moles

7. A chemistry student is given 5 samples of a metal. The student measures and records the mass and the volume of each sample and then graphs the data, as shown below.



What is the identity of the metal?

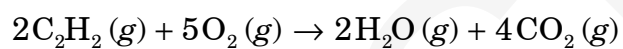
- A aluminum
 - B iron
 - C nickel
 - D lead
-
8. Which orbital notation represents an s-block element in the third period?



9. What is the volume of 2.00 moles of nitrogen gas (N_2) at STP?

- A 11.2 L
 - B 28.0 L
 - C 44.8 L
 - D 56.0 L
-

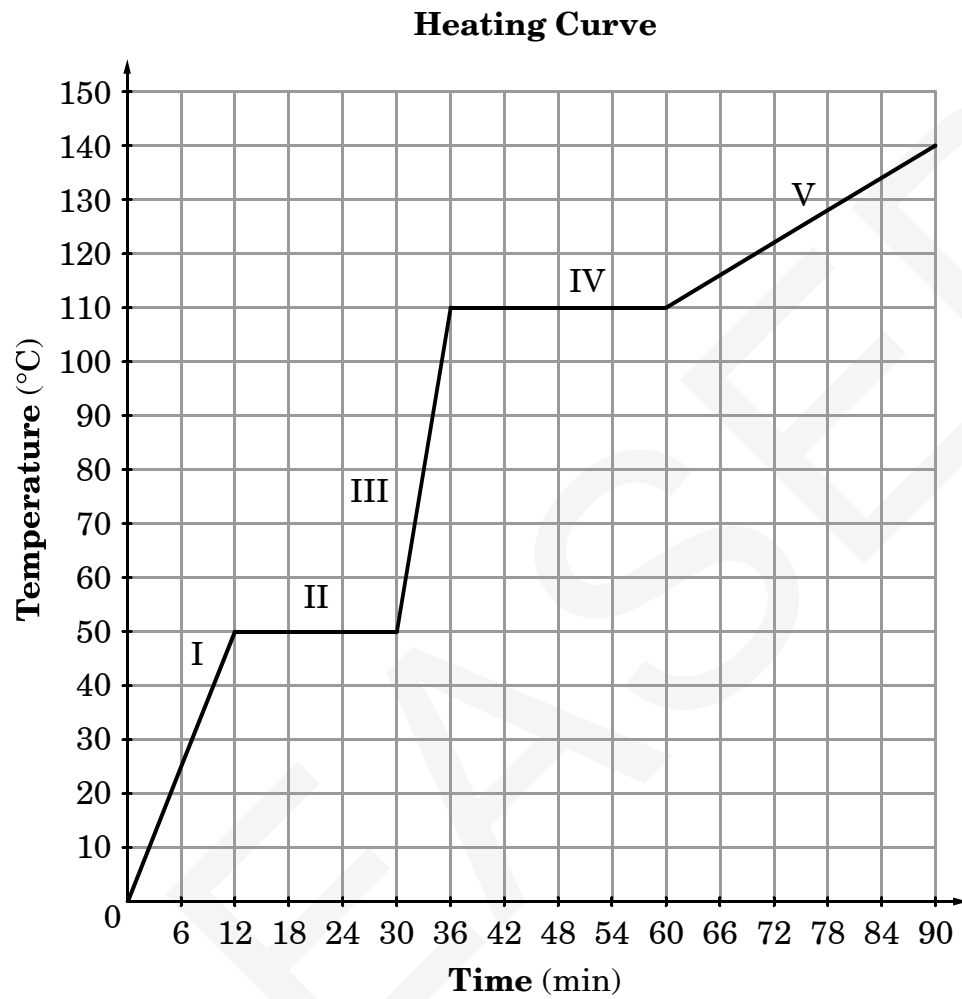
10. According to this balanced chemical equation, what volume of C_2H_2 is required to form 40.0 L of CO_2 ?



- A 20.0 L
- B 44.8 L
- C 80.0 L
- D 100 L

11. In an experiment, 2.62 g of iron react completely with 1.50 g of sulfur. What is the empirical formula for the compound produced?
- A FeS
 - B FeS₂
 - C Fe₂S
 - D Fe₂S₃
12. What do the ions K⁺, Ca²⁺, and Cl⁻ have in common?
- A They have the same number of protons.
 - B They will form covalent bonds with oxygen.
 - C They have the same electron configuration as argon.
 - D They are larger than their corresponding atoms.

13. This graph represents a heating curve of a substance.



Which region on the graph represents the solid phase?

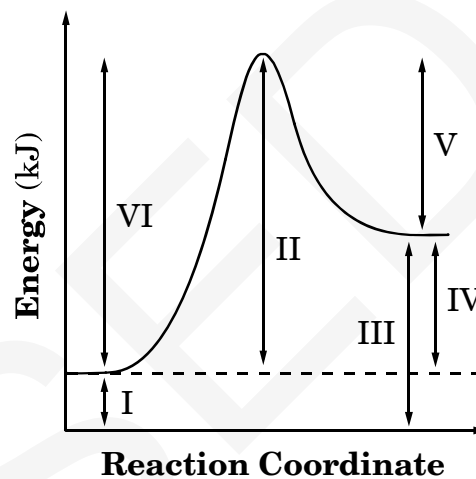
- A I
- B II
- C III
- D IV

14. When $^{42}_{19}\text{K}$ undergoes radioactive decay, the result is two products, one of which is calcium-42. What is the other product?

- A ^4_2He
 B ^2_4He
 C ^1_1e
 D $^0_{-1}\text{e}$

15. This graph is a potential energy diagram for a chemical reaction.

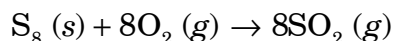
Potential Energy Diagram



Which energy measure will remain unchanged with the addition of a catalyst?

- A II
 B IV
 C V
 D VI

16. What type of chemical reaction is represented by this balanced equation?



- A synthesis
B decomposition
C single replacement
D double replacement
17. Which chemical equation is balanced?

- A $\text{LiOH} + \text{CO}_2 \rightarrow \text{Li}_2\text{CO}_3 + \text{H}_2\text{O}$
B $2\text{LiOH} + \text{CO}_2 \rightarrow \text{Li}_2\text{CO}_3 + \text{H}_2\text{O}$
C $\text{LiOH} + 3\text{CO}_2 \rightarrow 2\text{Li}_2\text{CO}_3 + \text{H}_2\text{O}$
D $4\text{LiOH} + \text{CO}_2 \rightarrow \text{Li}_2\text{CO}_3 + 2\text{H}_2\text{O}$

18. Neutralization occurs when 15.0 mL of KOH react with 25.0 mL of HNO_3 . If the molarity of HNO_3 is 0.750 M, what is the molarity of the KOH?

- A 1.67 M
B 1.25 M
C 0.600 M
D 0.450 M

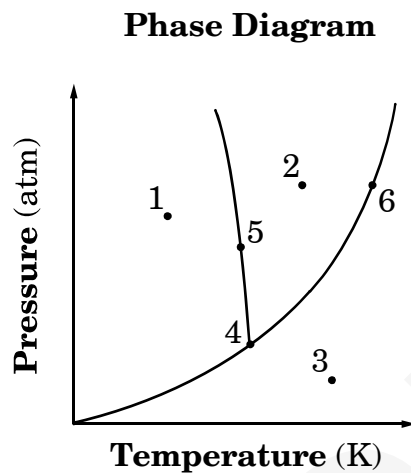
19. Which substance can act as either an acid or a base according to the Brønsted-Lowry definition?

- A H_3O^{1+}
B NH_4^{1+}
C HOH
D HCl

20. What is the oxidation number of sulfur in BaSO_4 ?

- A -2
B 0
C +1
D +6

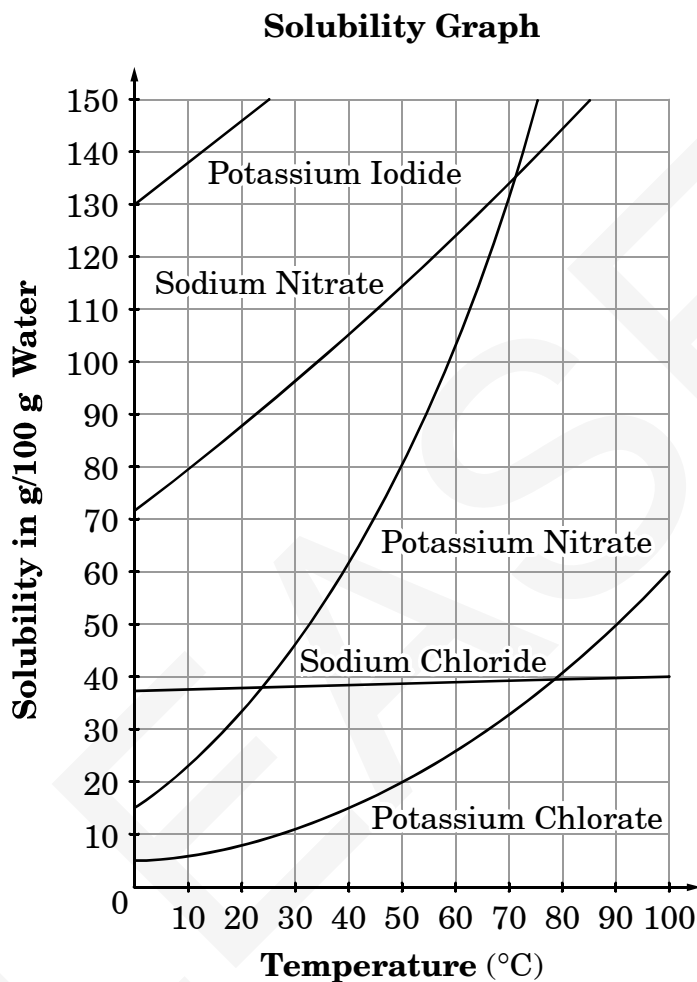
21. This diagram represents a phase diagram for a substance.



At which point do solid, liquid, and gas phases exist in equilibrium?

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

22. Using the solubility graph provided, a student performs an experiment to find the solubility of a substance. The student finds the amount of substance needed to make a saturated solution in 100 g of water at different temperatures. The student's data are shown in the table below the graph.



Student Data

Trial	Temperature (°C) of Water	Salt in 100 g of water (g)
1	25	40
2	68	126

What is the identity of the substance?

- A Sodium Nitrate
- B Potassium Nitrate
- C Sodium Chloride
- D Potassium Chlorate

23. What is the correct chemical formula for sodium sulfate?
- A NaSO_4
- B Na_2SO_4
- C $\text{Na}(\text{SO}_4)_2$
- D $\text{Na}_2(\text{SO}_4)_2$
24. Which compound contains both covalent and ionic bonds?
- A CaCO_3
- B CO_2
- C H_2O
- D NaCl
25. In a flexible container, 15.9 L of gas is under 589 kPa of pressure at a temperature of 56.5°C . If the pressure and temperature change to STP, what is the new volume?
- A 10.2 L
- B 76.6 L
- C 92.4 L
- D 112 L
26. What are the differences between these isotopes of hydrogen shown below?
- ${}^1_1\text{H}$, ${}^2_1\text{H}$, and ${}^3_1\text{H}$
- A the number of electrons and the atomic number
- B the number of protons and the atomic number
- C the number of neutrons and the mass number
- D the number of electrons and protons
27. What is the correct name for the acid whose chemical formula is H_2SO_4 ?
- A hydrosulfuric acid
- B hydrosulfurous acid
- C sulfurous acid
- D sulfuric acid
28. Which element is located in Group 2 (IIA) and Period 6 of the periodic table?
- A barium (Ba)
- B molybdenum (Mo)
- C radium (Ra)
- D tungsten (W)

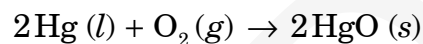
29. How many moles are in 325 g of $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$?
- A 0.732 mole
B 0.776 mole
C 1.29 moles
D 1.37 moles
30. Which compound contains the greatest percent of oxygen by mass?
- A CO_2
B NO_2
C SO_2
D SiO_2
31. This balanced equation represents a chemical reaction:



How many moles of KCl are produced when 4.25 moles of KClO_3 decompose?

- A 1.06 moles
B 2.13 moles
C 4.25 moles
D 8.50 moles

32. Considering this balanced chemical equation, how many grams of HgO will be produced when 44 g of Hg react with excess O_2 ?



- A 28 g
B 44 g
C 48 g
D 96 g

33. Which electron transmission in the hydrogen atom will result in the emission of red light?

- A $n = 2$ to $n = 3$
B $n = 2$ to $n = 4$
C $n = 3$ to $n = 2$
D $n = 4$ to $n = 2$

34. What can be said of a closed system when an exothermic reaction proceeds in an aqueous solution?

- A There is a net energy loss.
B There is a net energy gain.
C Heat is transferred from the water to the reactants.
D Heat is transferred from the reactants to the water.

35. In which group are the particles arranged in order of decreasing mass?

- A alpha, beta, neutron
- B alpha, neutron, beta
- C neutron, beta, alpha
- D neutron, alpha, beta

36. Consider this incomplete chemical equation:



What are the products of this equation?

- A BaCl_2 and CuCl_2
- B BaCuCl_2 and Ba
- C BaCl_2 and Cu
- D BaCu and Cl_2

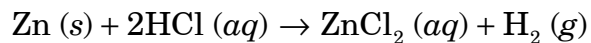
37. What is the **best** reason for using iron filings instead of an iron nail in a chemical reaction?

- A to decrease the amount of catalyst during the reaction
- B to increase the molecular structure during the reaction
- C to decrease the rate of reaction
- D to increase the surface area of the reaction

38. Which is a characteristic of a strong acid?

- A It has a pH greater than 7.
- B It completely ionizes in solution.
- C It contains many hydroxide ions.
- D It reacts only with a strong base.

39. Consider this balanced chemical equation:



Which is the oxidation half-reaction?

- A $\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^-$
 - B $\text{Zn} + 2\text{e}^- \rightarrow \text{Zn}^{2+}$
 - C $2\text{H}^+ \rightarrow \text{H}_2 + 2\text{e}^-$
 - D $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$
-

40. What is the net ionic equation for the reaction between $\text{Pb}(\text{NO}_3)_2$ and HCl ?

- A $\text{Pb}^{2+} \text{ (aq)} + 2\text{Cl}^- \text{ (aq)} \rightarrow \text{PbCl}_2 \text{ (s)}$
- B $2\text{NO}_3^- \text{ (aq)} + 2\text{H}^+ \text{ (aq)} \rightarrow 2\text{HNO}_3 \text{ (aq)}$
- C $\text{Pb}(\text{NO}_3)_2 \text{ (aq)} + 2\text{HCl} \text{ (aq)} \rightarrow \text{PbCl}_2 \text{ (s)} + 2\text{HNO}_3 \text{ (aq)}$
- D $\text{Pb}^{3+} \text{ (aq)} + 2\text{NO}_3^- \text{ (aq)} + 2\text{H}^+ \text{ (aq)} + 2\text{Cl}^- \text{ (aq)} \rightarrow \text{PbCl}_2 \text{ (s)} + 2\text{H}^+ \text{ (aq)} + 2\text{NO}_3^- \text{ (aq)}$

41. When combined, two gases have a pressure of 4.0 atm. If one gas has a pressure of 1.5 atm, what is the pressure of the second gas?
- A 1.5 atm
 - B 2.0 atm
 - C 2.5 atm
 - D 5.5 atm
42. What compound has the chemical formula MgI_2 ?
- A di-iodide magnesium
 - B iodide(II) magnesium
 - C magnesium iodide
 - D magnesium(I) iodine(II)
43. Which elements have the same number of neutrons?
- A $^{10}_5\text{B}$ and $^{12}_6\text{C}$
 - B $^{55}_{25}\text{Mn}$ and $^{56}_{26}\text{Fe}$
 - C $^{108}_{47}\text{Ag}$ and $^{112}_{48}\text{Cd}$
 - D $^{197}_{79}\text{Au}$ and $^{201}_{80}\text{Hg}$

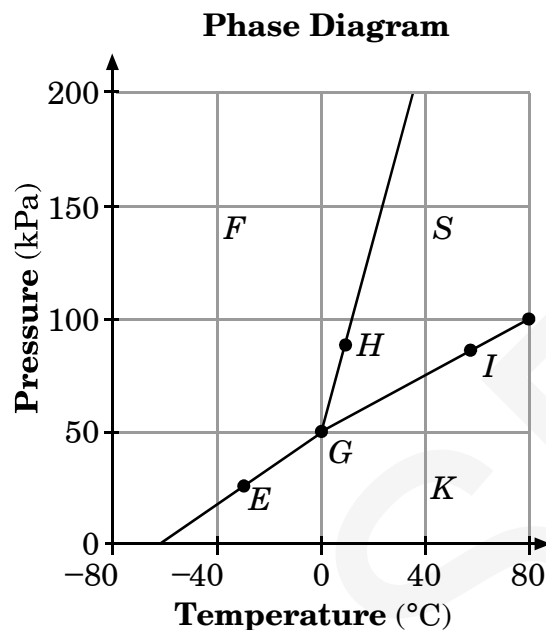
44. This chart represents the melting point of several substances.

Substance	Melting Point (°C)
Cl ₂	-101.5
Na	97.72
NaCl	801

What *best* explains the high melting point of the salt?

- A the strong electrostatic attraction between Na⁰ and Cl⁰
- B the weak electrostatic attraction between Na⁰ and Cl⁰
- C the weak electrostatic attraction between Na⁺ and Cl⁻
- D the strong electrostatic attraction between Na⁺ and Cl⁻
-
45. Based on the VSEPR theory, what is the molecular geometry of CO₂?
- A linear
- B tetrahedral
- C trigonal planar
- D trigonal pyramidal

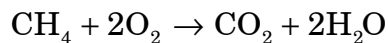
46. This graph represents a phase diagram for a substance.



What is the state of the substance at point *I*?

- A gas
- B liquid
- C liquid and gas
- D solid and liquid
-
47. Which one of these compounds is soluble in water?
- A aluminum sulfide
- B calcium carbonate
- C iron(III) hydroxide
- D potassium sulfate
48. In which block does an element with the electron configuration $[\text{Xe}] 6s^2 4f^{14} 5d^{10} 6p^1$ belong?
- A s block
- B p block
- C d block
- D f block

49. Which statement is true for the reaction represented by this equation?

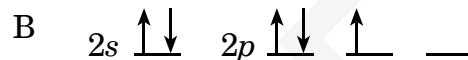


- A 1 gram of CH_4 is required to react with 2 grams of O_2 .
- B 1 gram of CH_4 is required to react with 4 grams of O_2 .
- C 1 mole of CH_4 is required to react with 2 moles of O_2 .
- D 1 mole of CH_4 is required to react with 4 moles of O_2 .

50. What is the percent by mass of N in $\text{Ca}(\text{CN})_2$?

- A 15.21%
- B 21.19%
- C 30.42%
- D 42.39%

51. Which orbital notation shows the lowest energy arrangement of valence electrons for $1s^2 2s^2 2p^3$?

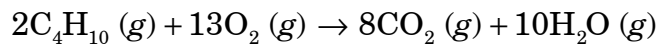


52. What is the molarity of 28.9 g of CaCl_2 dissolved in water to make 0.78 L of solution?

- A 0.33 M
- B 0.69 M
- C 1.5 M
- D 3.0 M

53. The half-life of phosphorus-32 is 14.3 days. How much of a sample of phosphorus-32 will remain after 57.2 days?
- A $\frac{1}{32}$
- B $\frac{1}{16}$
- C $\frac{1}{8}$
- D $\frac{1}{4}$
54. To increase the temperature of 100.0 g of H_2O (s) from -50.0°C to -10.0°C , how much energy is required?
- A $1.67 \times 10^4 \text{ J}$
- B $8.20 \times 10^3 \text{ J}$
- C $8.08 \times 10^3 \text{ J}$
- D $1.95 \times 10^3 \text{ J}$
55. What is the $[\text{H}^+]$ of an HCl solution if the pH is measured to be 6?
- A $1 \times 10^{-7} \text{ M}$
- B $1 \times 10^{-6} \text{ M}$
- C $6 \times 10^{-6} \text{ M}$
- D $8 \times 10^{-1} \text{ M}$

56. This balanced equation represents a chemical reaction.



What type of chemical reaction is represented by the equation?

- A combustion
- B decomposition
- C double replacement
- D single replacement
-
57. This balanced equation represents a chemical reaction using palladium, Pd, as a catalyst.
- $$\text{CO}_2 (g) + \text{H}_2\text{O} (l) \xrightarrow{\text{Pd}} \text{H}_2\text{CO}_3 (l)$$
- Without palladium the reaction is slow and produces low concentrations of product. How does the palladium increase the speed of the reaction?
- A The palladium reacts with the water.
- B The palladium lowers the activation energy.
- C The palladium purifies the carbon dioxide.
- D The palladium increases the reaction temperature.
58. Which pair of substances will likely undergo a single replacement reaction?
- A Na and BaCl_2
- B Zn and BaCl_2
- C Ca and BaCl_2
- D K and BaCl_2

59. What is the net ionic equation for the reaction between aqueous solutions of LiBr and AgNO₃?
- A $\text{Ag}^+ (aq) + \text{Br}^- (aq) \rightarrow \text{AgBr} (s)$
- B $\text{Li}^+ (aq) + \text{NO}_3^- (aq) \rightarrow \text{LiNO}_3 (s)$
- C $\text{Li}^+ (aq) + \text{Br}^- (aq) \rightarrow \text{LiBr} (s)$
- D $\text{Ag}^+ (aq) + \text{NO}_3^- (aq) \rightarrow \text{AgNO}_3 (s)$
60. A scientist hypothesizes that a colorless gas produced during a chemical reaction is carbon dioxide. Which observation would confirm this hypothesis?
- A The gas will react violently with water.
- B A glowing splint placed in the gas will burn brighter.
- C Burning the gas in the presence of oxygen will produce water.
- D Bubbling the gas through lime water will make the lime water cloudy.



End of Chemistry Test

North Carolina Test of Chemistry
Form A RELEASED Fall 2009
Answer Key

Item Number	Correct Answer	Goal
1	C	2 — Structures & Properties of Matter
2	D	2 — Structures & Properties of Matter
3	C	2 — Structures & Properties of Matter
4	A	2 — Structures & Properties of Matter
5	D	2 — Structures & Properties of Matter
6	A	2 — Structures & Properties of Matter
7	D	2 — Structures & Properties of Matter
8	B	3 — Regularities in Chemistry
9	C	3 — Regularities in Chemistry
10	A	3 — Regularities in Chemistry
11	A	3 — Regularities in Chemistry
12	C	3 — Regularities in Chemistry
13	A	4 — Energy Changes in Chemistry
14	D	4 — Energy Changes in Chemistry
15	B	4 — Energy Changes in Chemistry
16	A	5 — Chemical Reactions
17	B	5 — Chemical Reactions
18	B	5 — Chemical Reactions
19	C	5 — Chemical Reactions
20	D	5 — Chemical Reactions
21	D	2 — Structures & Properties of Matter
22	B	2 — Structures & Properties of Matter
23	B	2 — Structures & Properties of Matter
24	A	2 — Structures & Properties of Matter
25	B	2 — Structures & Properties of Matter
26	C	2 — Structures & Properties of Matter
27	D	2 — Structures & Properties of Matter
28	A	3 — Regularities in Chemistry
29	C	3 — Regularities in Chemistry
30	A	3 — Regularities in Chemistry
31	C	3 — Regularities in Chemistry
32	C	3 — Regularities in Chemistry
33	C	4 — Energy Changes in Chemistry
34	D	4 — Energy Changes in Chemistry
35	B	4 — Energy Changes in Chemistry
36	C	5 — Chemical Reactions
37	D	5 — Chemical Reactions
38	B	5 — Chemical Reactions
39	A	5 — Chemical Reactions
40	A	5 — Chemical Reactions
41	C	2 — Structures & Properties of Matter
42	C	2 — Structures & Properties of Matter

North Carolina Test of Chemistry
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Answer Key

43	B	2 — Structures & Properties of Matter
44	D	2 — Structures & Properties of Matter
45	A	2 — Structures & Properties of Matter
46	C	2 — Structures & Properties of Matter
47	D	2 — Structures & Properties of Matter
48	B	3 — Regularities in Chemistry
49	C	3 — Regularities in Chemistry
50	C	3 — Regularities in Chemistry
51	D	3 — Regularities in Chemistry
52	A	3 — Regularities in Chemistry
53	B	4 — Energy Changes in Chemistry
54	B	4 — Energy Changes in Chemistry
55	B	5 — Chemical Reactions
56	A	5 — Chemical Reactions
57	B	5 — Chemical Reactions
58	D	5 — Chemical Reactions
59	A	5 — Chemical Reactions
60	D	5 — Chemical Reactions

**North Carolina Test of Chemistry
Form A RELEASED Fall 2009
Raw to Scale Score Conversion**

Raw Score	Scale Score
0	120
1	121
2	121
3	122
4	122
5	123
6	124
7	124
8	125
9	126
10	126
11	127
12	128
13	129
14	130
15	131
16	132
17	133
18	134
19	135
20	136
21	137
22	138
23	139
24	140
25	141
26	142
27	143
28	144
29	145
30	146
31	147
32	148
33	149
34	149
35	150
36	151
37	152
38	153
39	153
40	154
41	155

**North Carolina Test of Chemistry
Form A RELEASED Fall 2009
Raw to Scale Score Conversion**

42	156
43	156
44	157
45	158
46	159
47	160
48	160
49	161
50	162
51	163
52	164
53	165
54	166
55	168
56	169
57	171
58	173
59	175
60	178