

**VIRGINIA  
STANDARDS OF LEARNING ASSESSMENTS**

**Spring 2003 Released Test**

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**END OF COURSE  
CHEMISTRY**

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## Chemistry

### DIRECTIONS

Read each question carefully and choose the best answer.

### SAMPLE

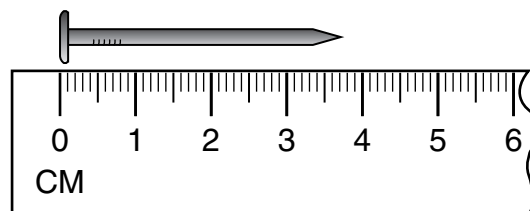
Which of the following is a balanced equation?

- A  $\text{H}_2 + \text{Br}_2 \rightarrow 2\text{HBr}$
- B  $\text{H}_2 + \text{Br}_2 \rightarrow \text{HBr}$
- C  $\text{H}_2 + 2\text{Br}_2 \rightarrow 2\text{HBr}$
- D  $2\text{H}_2 + \text{Br}_2 \rightarrow \text{HBr}$

1 For an experiment, 9.7 mL of HCl are needed. What is the best instrument to use for measuring this volume?

- A Beaker
- B Erlenmeyer flask
- C Graduated cylinder
- D Test tube

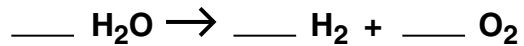
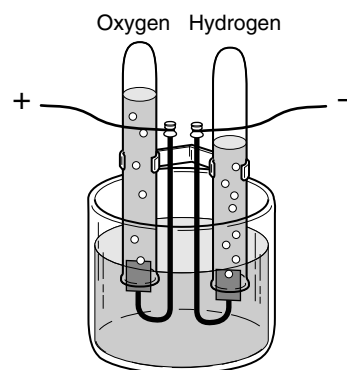
2



A student used the above ruler to measure the length of a nail. The length of this nail, according to the precision of the ruler, is —

- F 3.5 cm
- G 3.55 cm
- H 3.7 cm
- J 3.75 cm

3

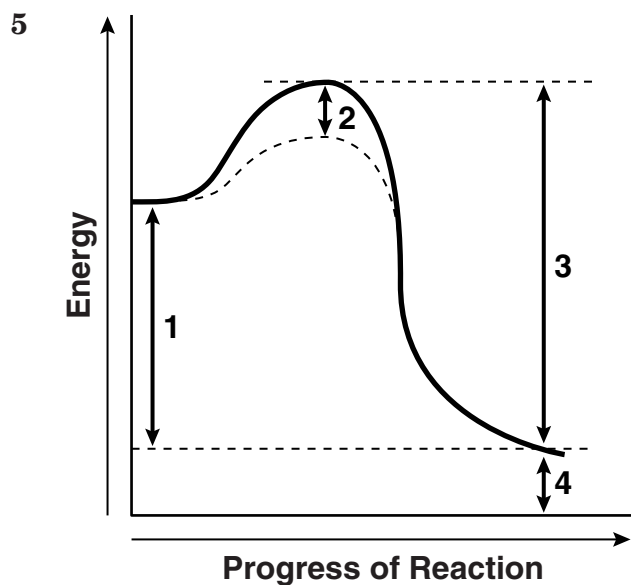


The coefficients of the correctly balanced equation for the reaction illustrated above are —

- A 1, 1, 1
- B 1, 1, 2
- C 2, 1, 2
- D 2, 2, 1

4 Elements from which two groups in the periodic table would *most* likely combine with each other to form an ionic compound?

- F 1 and 2
- G 16 and 17
- H 1 and 17
- J 17 and 18



The diagram above is a potential energy curve for a reaction. Which number represents the effect of a catalyst on the reaction?

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

6 An ice-skating rink has tubes under its floor to freeze the water. Salt water is cooled well below the freezing point of water and pumped through the tubes to freeze the water in the rink. Why can the salt water be cooled so low without freezing?

- F Salt has a very low freezing point.
- G Adding salt to water lowers its freezing point.
- H Movement of the salt water through the tubes keeps it in the liquid state.
- J The salt water is constantly absorbing energy from its surroundings.

7 Which of the following describes what takes place when iron ( $\text{Fe}^0$ ) is oxidized to  $\text{Fe}^{2+}$  ions?

- A A gain of two electrons
- B A loss of two electrons
- C A gain of two protons
- D A loss of two protons

8 In chemical compounds, covalent bonds form when —

- F the electronegativity difference between two atoms is very large
- G electrons are completely transferred between two metals
- H pairs of electrons are shared between two nonmetal atoms
- J two nonmetal ions are attracted to each other by opposite charges

9 Which scientist was the first to conclude through experimentation that atoms have positive charges in their nuclei?

- A Bohr
- B Dalton
- C Mosley
- D Rutherford

10 Soda water is a solution of carbon dioxide in water. This solution is composed of a —

- F gaseous solute in a gaseous solvent
- G liquid solute in a liquid solvent
- H gaseous solute in a liquid solvent
- J liquid solute in a gaseous solvent

11 If the heat of fusion of water is 80 cal/g, the amount of heat energy required to change 15.0 grams of ice at 0°C to 15.0 grams of water at 0°C is —

- A 80 cal
- B 560 cal
- C 1200 cal
- D 2400 cal

12 Three elements, X, Y, and Z, have consecutive increasing atomic numbers. If element X is a noble gas, what will be the symbol for the ion of element Z in its compounds?

- F  $Z^{2-}$
- G  $Z^{-}$
- H  $Z^{+}$
- J  $Z^{2+}$

13

$$R = 8.31 \frac{\text{kPa} \cdot \text{dm}^3}{\text{moles} \cdot \text{K}}$$

A gas cylinder is filled with 4.00 moles of oxygen gas at 300.0 K. The piston is compressed to yield a pressure of 400.0 kPa. What is the volume inside the cylinder?

- A 3.19 dm<sup>3</sup>
- B 6.25 dm<sup>3</sup>
- C 24.9 dm<sup>3</sup>
- D 31.5 dm<sup>3</sup>

14  $? \text{AgNO}_3 + ? \text{AlCl}_3 \rightarrow ? \text{AgCl} + ? \text{Al}(\text{NO}_3)_3$

Which of these sets of coefficients will balance this equation?

- F 3, 3, 2, 1
- G 3, 1, 3, 1
- H 1, 6, 1, 9
- J 9, 3, 3, 3

15 The formula for lithium nitride is —

- A LiN
- B Li<sub>3</sub>N
- C Li<sub>3</sub>N<sub>3</sub>
- D NLi<sub>3</sub>

16

pH	1-6	7	8-14
Solution added	Acid	Neutral	Base
Litmus paper changes from	Blue to red	Does not change	Red to blue

Which of the following aqueous solutions will cause litmus paper to turn red?

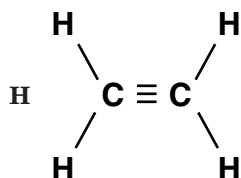
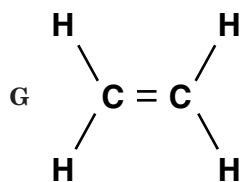
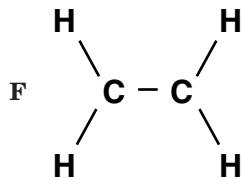
- F NaOH
- G NaCl
- H HCl
- J H<sub>2</sub>O

17 Measurement 1: 5.2 g  
Measurement 2: 5.4 g  
Measurement 3: 3 g  
Measurement 4: 2.45 g

These data show repeated measurements of the same object which has a known mass of 5.38 grams. Which measurement is most accurate?

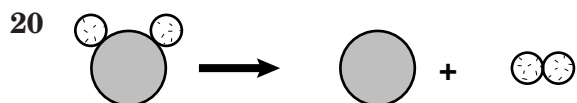
- A 1
- B 2
- C 3
- D 4

18 The correct structural formula for C<sub>2</sub>H<sub>4</sub> is —



19 If a student's hand is accidentally exposed to an acidic solution, what should be done?

- A Rinse the hand in a concentrated base.
- B Rinse the hand in running water.
- C Wrap the hand in paper towels.
- D Cover the hand with oil.



**What type of reaction does this illustration represent?**

- F Decomposition
  - G Synthesis
  - H Single-replacement
  - J Double-replacement
- 21 **A solution which has a concentration that exceeds its predicted solubility at a certain temperature and pressure would be —**
- A unsaturated
  - B saturated
  - C supersaturated
  - D dilute
- 22 **A student was instructed to carry out an experiment that illustrates the law of conservation of mass. The teacher indicated that the experiment should be carried out three times. The student plans to report the average of the three results. What can the student do to maximize the reliability of the data collected?**
- F Report the result that came closest to the class average.
  - G Conduct each trial using the same balance.
  - H Report the average of the two most similar values only.
  - J Perform each of the trials on different days.

- 23 **Atoms of the same element must —**
- A contain the same number of neutrons
  - B have the same mass number
  - C contain the same number of protons
  - D have equal numbers of protons and neutrons

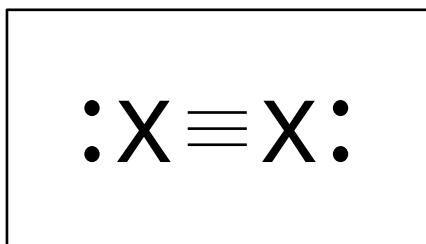
- 24 **A sample of hydrogen gas is collected over water at 25°C. The vapor pressure of water at 25°C is 23.8 mmHg. If the total pressure is 523.8 mmHg, what is the partial pressure of the hydrogen?**
- F 23.8 mmHg
  - G 47.6 mmHg
  - H 500.0 mmHg
  - J 523.8 mmHg

- 25 **Water molecules have the *greatest* kinetic energy in —**
- A ice at 0°C
  - B water at 373 K
  - C water at 98°C
  - D steam at 150°C

26 What is the molarity of a solution prepared by dissolving 27.2 g of sodium chloride in enough water to prepare 500.0 mL of solution?

- F 0.186 M
- G 0.465 M
- H 0.930 M
- J 1.860 M

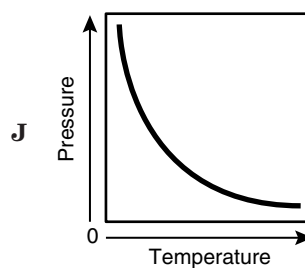
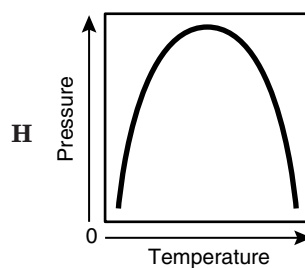
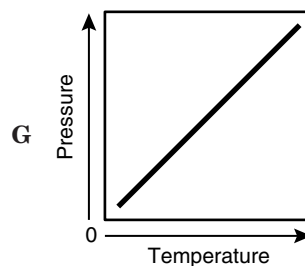
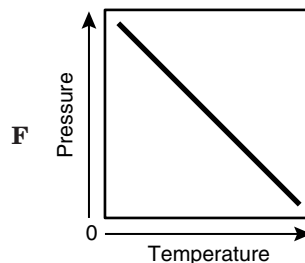
27



If the above diagram were the correct representation for the Lewis structure of a molecule, then the X would be representative of the element —

- A oxygen
- B fluorine
- C nitrogen
- D sulfur

28 At a constant volume, the pressure of a gas will increase as the temperature increases. Which of the following graphs shows that relationship?



29

## Selected Polyatomic Ions

Name	Formula
Hypochlorite	$\text{ClO}^-$
Chlorite	$\text{ClO}_2^-$
Chlorate	$\text{ClO}_3^-$
Perchlorate	$\text{ClO}_4^-$

Chlorine and bromine are in the same family in the periodic table. According to the information in the table above, what would be the correct formula for sodium bromate?

- A  $\text{NaBrO}$
- B  $\text{Na}_2\text{BrO}$
- C  $\text{Na}_3\text{BrO}_3$
- D  $\text{NaBrO}_3$



If 0.600 gram of zinc is used, what is the amount of zinc chloride that is produced in the above reaction?

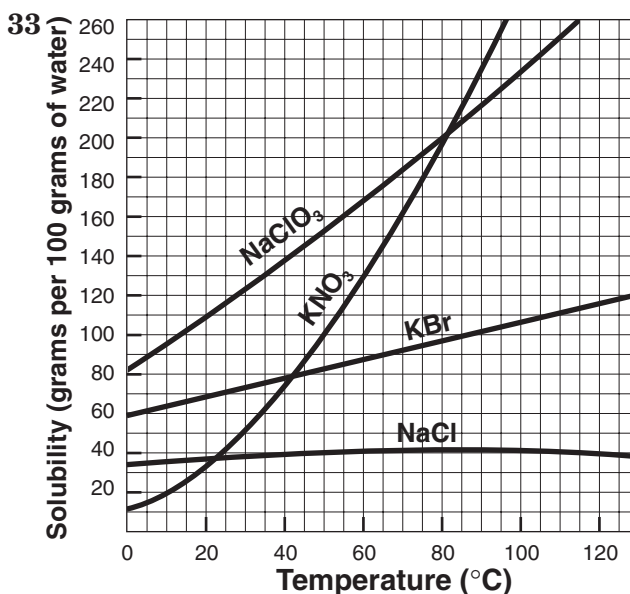
- F 0.125 gram
- G 1.25 grams
- H 12.5 grams
- J .018 gram

31 When naming a transition metal that has more than one oxidation number, the numeric value of the oxidation number is indicated by a —

- A Roman numeral
- B Greek prefix
- C subscript
- D suffix

32 A compound is composed of 85.64% carbon and 14.36% hydrogen. The compound has a formula mass of 42.08 grams. What is the molecular formula?

- F  $\text{CH}_2$
- G  $\text{C}_3\text{H}_6$
- H  $\text{C}_2\text{H}_4$
- J  $\text{C}_2\text{H}_{18}$



Which salt is most soluble in water at  $90^\circ\text{C}$ ?

- A  $\text{NaClO}_3$
- B  $\text{KNO}_3$
- C  $\text{KBr}$
- D  $\text{NaCl}$

34 Which of the following is the correct molecular shape of  $\text{CH}_4$ ?

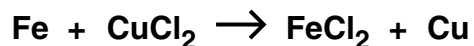
- F Bent
- G Linear
- H Pyramidal
- J Tetrahedral



35 A student uses a mortar and pestle to crush 1.0 g of marble chips and places them into a test tube. A whole 1.0 g marble chip is placed into a second test tube, and 5.0 mL of 6 M HCl is added to each test tube. The bubbling speed of the produced CO<sub>2</sub> gas is noted. This experiment is designed to study the effect of the —

- A introduction of a catalyst on reaction rate
- B type of introduced acid on reaction rate
- C surface area of a reactant on reaction rate
- D temperature of a reactant on reaction rate

36



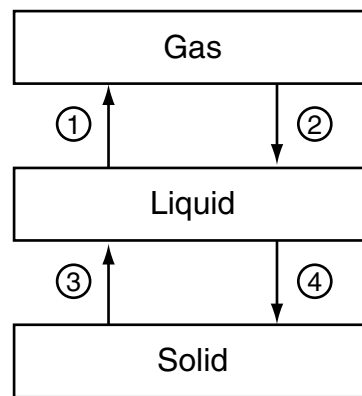
The type of reaction represented by the above equation is —

- F single-replacement
- G double-replacement
- H synthesis
- J decomposition

37 When CuSO<sub>4</sub> · 5H<sub>2</sub>O is heated in a crucible, there is a loss of water. How should a student determine the amount of water lost?

- A Subtract the mass of the CuSO<sub>4</sub> from the mass of CuSO<sub>4</sub> · 5H<sub>2</sub>O
- B Subtract the mass of the CuSO<sub>4</sub> · 5H<sub>2</sub>O from the mass of CuSO<sub>4</sub>
- C Add the masses of CuSO<sub>4</sub> · 5H<sub>2</sub>O and CuSO<sub>4</sub>
- D Multiply the masses of CuSO<sub>4</sub> · 5H<sub>2</sub>O and CuSO<sub>4</sub>

38



Which numbered process represents condensation?

- F 1
- G 2
- H 3
- J 4

39 The alkali metals are located in which group of the periodic table?

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

40 A student wanted to obtain a very accurate value for the volume of a piece of steel. He filled a 100.0 cm<sup>3</sup> graduated cylinder to the 50.0 cm<sup>3</sup> mark with water. After he carefully dropped the steel into the cylinder, the water level rose to the 55.6 cm<sup>3</sup> level. He reported the volume of the steel as 5.6 cm<sup>3</sup>. How could the student improve the reliability of his analysis?

- F Report the volume as 56 mm<sup>3</sup>
- G Fill the graduated cylinder to the 70.0 cm<sup>3</sup> mark before adding the steel
- H Mass the steel and report its density in g/cm<sup>3</sup>
- J Repeat the measurement many times and report an average value

41

	Protons	Neutrons	Electrons
1	11	12	10
2	1	0	2
3	15	16	15
4	20	20	18

Which of these is an ion with a charge of 1+?

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

42 A balanced chemical equation has equal numbers of atoms of each type on both sides of the equation. This illustrates the principle of —

- F conservation of energy
- G conservation of mass
- H action and reaction
- J natural selection

43 What is the density of carbon dioxide at STP?

- A 1.96 g/L
- B 22.0 g/L
- C 46.0 g/L
- D  $5.09 \times 10^{-1}$  g/L

44 When magnesium metal (Mg) is burned, it forms MgO. How many moles of oxygen gas (O<sub>2</sub>) are needed to burn 10 moles of Mg?

- F 2
- G 5
- H 10
- J 20

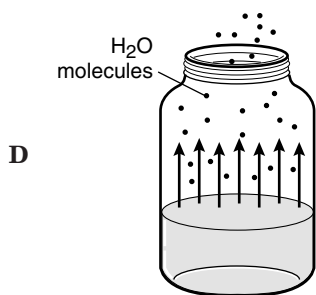
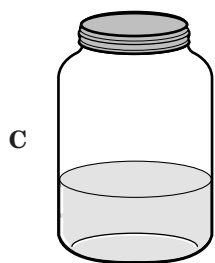
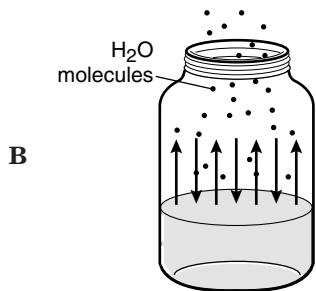
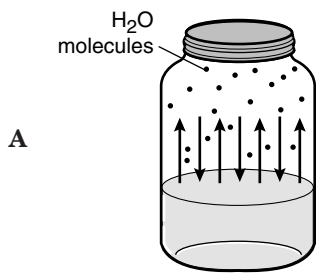
45 Nitrogen gas is a diatomic molecule. What is the mass of one mole of nitrogen gas?

- A 7 g
- B 14 g
- C 28 g
- D  $6 \times 10^{23}$  g

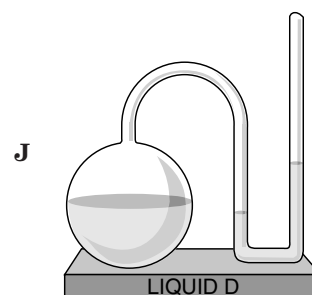
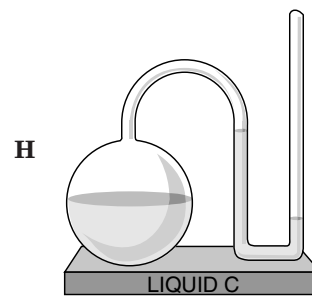
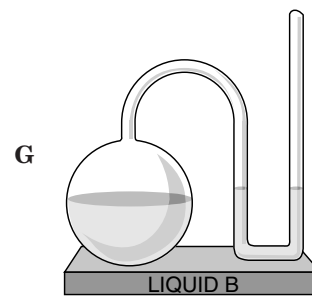
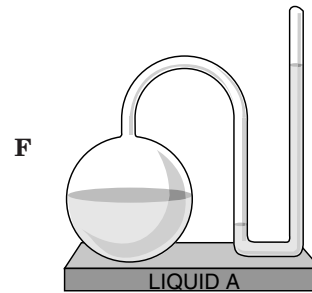
46 An increase in atomic number is related to an increase in atomic mass because —

- F more electrons are present in the atomic nucleus
- G more electrons are orbiting the atomic nucleus
- H more protons are present in the atomic nucleus
- J more protons are orbiting the atomic nucleus

47 Which of the following containers of water *best* shows dynamic equilibrium between vapor and liquid?



48 Equal quantities of different liquids are placed in closed manometers at 20°C. Which liquid has the highest vapor pressure?



**49** Ulcers are often caused by an excess of stomach acid. Milk of magnesia is often used to soothe the irritation. Milk of magnesia is probably —

- A an acid
- B a base
- C an indicator
- D a colloid

**50** Which of these elements contains four valence electrons?

- F Helium
- G Beryllium
- H Carbon
- J Oxygen



## Answer Key

Test Sequence	Correct Answer	Reporting Category	Reporting Category Description
1	C	001	Scientific Investigation
2	J	001	Scientific Investigation
3	D	003	Nomenclature, Chemical Formulas, and Reactions
4	H	003	Nomenclature, Chemical Formulas, and Reactions
5	B	003	Nomenclature, Chemical Formulas, and Reactions
6	G	005	Phases of Matter and Kinetic Molecular Theory
7	B	002	Atomic Structure and Periodic Relationships
8	H	003	Nomenclature, Chemical Formulas, and Reactions
9	D	002	Atomic Structure and Periodic Relationships
10	H	005	Phases of Matter and Kinetic Molecular Theory
11	C	005	Phases of Matter and Kinetic Molecular Theory
12	J	002	Atomic Structure and Periodic Relationships
13	C	005	Phases of Matter and Kinetic Molecular Theory
14	G	003	Nomenclature, Chemical Formulas, and Reactions
15	B	003	Nomenclature, Chemical Formulas, and Reactions
16	H	004	Molar Relationships
17	B	001	Scientific Investigation
18	G	003	Nomenclature, Chemical Formulas, and Reactions
19	B	001	Scientific Investigation
20	F	003	Nomenclature, Chemical Formulas, and Reactions
21	C	004	Molar Relationships
22	G	001	Scientific Investigation
23	C	002	Atomic Structure and Periodic Relationships
24	H	005	Phases of Matter and Kinetic Molecular Theory
25	D	005	Phases of Matter and Kinetic Molecular Theory
26	H	004	Molar Relationships
27	C	003	Nomenclature, Chemical Formulas, and Reactions
28	G	001	Scientific Investigation
29	D	003	Nomenclature, Chemical Formulas, and Reactions
30	G	004	Molar Relationships
31	A	003	Nomenclature, Chemical Formulas, and Reactions
32	G	003	Nomenclature, Chemical Formulas, and Reactions
33	B	001	Scientific Investigation
34	J	003	Nomenclature, Chemical Formulas, and Reactions
35	C	001	Scientific Investigation
36	F	003	Nomenclature, Chemical Formulas, and Reactions
37	A	001	Scientific Investigation
38	G	005	Phases of Matter and Kinetic Molecular Theory
39	A	002	Atomic Structure and Periodic Relationships
40	J	001	Scientific Investigation
41	A	002	Atomic Structure and Periodic Relationships
42	G	003	Nomenclature, Chemical Formulas, and Reactions
43	A	004	Molar Relationships
44	G	004	Molar Relationships
45	C	004	Molar Relationships
46	H	002	Atomic Structure and Periodic Relationships
47	A	003	Nomenclature, Chemical Formulas, and Reactions
48	F	005	Phases of Matter and Kinetic Molecular Theory
49	B	004	Molar Relationships
50	H	002	Atomic Structure and Periodic Relationships