

**VIRGINIA**  
**STANDARDS OF LEARNING ASSESSMENTS**

**Spring 2001 Released Test**

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**END OF COURSE**  
**CHEMISTRY**

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**DIRECTIONS**

Read each question carefully and choose the best answer. Then mark the space on the answer sheet for the answer you have chosen.

**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  $2\text{H}_2 + \text{Br}_2 \rightarrow \text{HBr}$

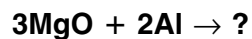
**1 To remove the sand first and then the salt from a mixture of sand and salt water, one combination of techniques you could use would be to *first* —**

- A evaporate and then distill
- B evaporate and then condense
- C filter and then evaporate
- D filter and then condense

**2 Which is an example of a synthesis reaction?**

- F  $\text{HCl} + \text{KOH} \rightarrow \text{KCl} + \text{H}_2\text{O}$
- G  $\text{Pb}(\text{NO}_3)_2 + 2\text{HBr} \rightarrow \text{PbBr}_2 + 2\text{HNO}_3$
- H  $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
- J  $\text{Mg} + \text{H}_2\text{SO}_4 \rightarrow \text{MgSO}_4 + \text{H}_2$

**3**



**What would be the product(s) of this reaction?**

- A  $2\text{Mg}_3\text{Al}_2\text{O}_3$
- B  $\text{Mg}_3\text{Al}_2 + 3\text{O}_2$
- C  $6\text{Mg} + \text{Al}_3\text{O}_2$
- D  $3\text{Mg} + \text{Al}_2\text{O}_3$

**4 One of the main assumptions of the kinetic molecular theory of gases is that the particles of an ideal gas —**

- F** must be single atoms instead of molecules
- G** are in constant motion
- H** must be maintained at very high pressures
- J** must be highly chemically reactive

**5 Which is the correct formula for iron (III) sulfate?**

- A**  $\text{Fe}_3(\text{SO}_4)_2$
- B**  $\text{FeSO}_4$
- C**  $\text{Fe}_2(\text{SO}_4)_3$
- D**  $\text{Fe}_2(\text{SO}_3)_3$

**6 Which of these represents the empirical formula and the molecular formula, respectively, for a given organic compound?**

- F** CH and  $\text{C}_2\text{H}_2$
- G** CH and  $\text{CH}_4$
- H**  $\text{CH}_2$  and  $\text{C}_2\text{H}_2$
- J**  $\text{CH}_3$  and  $\text{C}_3\text{H}_{12}$

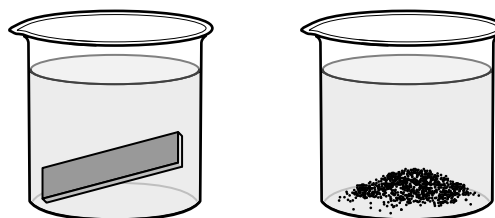
**7 Specific Heat Capacities of Some Common Substances**

Substance	Specific Heat Capacity (cal/g • °C)
Aluminum	0.21
Alcohol	0.58
Water	1.00
Wood	0.42

**What probably causes water to have the highest specific heat of the substances listed above?**

- A Molecule size
- B Molecular mass
- C Strong hydrogen bonds
- D High density of ice

**8**



**Beaker A**

**Beaker B**

**Each beaker shown above contains 2.2 grams of iron and 1 liter of 3M H<sub>2</sub>SO<sub>4</sub> at STP. Which reaction will go to completion first and why?**

- F Beaker A because of increased surface area
- G Beaker B because of increased surface area
- H Beaker A because of a higher concentration level
- J Beaker B because of a higher concentration level

**9 The element chlorine exists as two naturally occurring isotopes. Cl-35 occurs 75% of the time and Cl-37 occurs 25% of the time. Which of the following calculations should be used to calculate the correct average atomic mass of chlorine?**

- A  $(35 \text{ amu} \times .75) + (37 \text{ amu} \times .25)$
- B  $\frac{(35 \text{ amu} \times 3) + 37 \text{ amu}}{2}$
- C  $\frac{(35 \text{ amu} \times 3) + 37 \text{ amu}}{3}$
- D  $\frac{35 \text{ amu} + 37 \text{ amu}}{2}$

- 10 The average kinetic energy of a sample of water molecules is —

F increased as the temperature is decreased  
 G increased as the temperature is increased  
 H unaffected by temperature changes  
 J always equal to zero

11

### Electronegativity Values of Some Atoms

2.1 H							
1.0 Li	1.5 Be	2.0 B	2.5 C	3.0 N	3.5 O	4.0 F	
0.9 Na	1.2 Mg	1.5 Al	1.8 Si	2.1 P	2.5 S	3.0 Cl	
0.8 K	1.0 Ca				2.4 Se	2.8 Br	

Electronegativity differences are often helpful in determining the bond character between two atoms. A general rule states that if the electronegativity difference between two atoms is greater than 1.67, an ionic bond would most likely be formed. Using the chart above, which pair of atoms would probably form the strongest ionic bond?

A Al-P  
 B Na-Cl  
 C K-F  
 D Ca-O

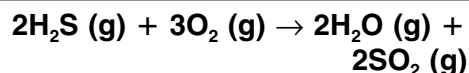
- 12 The mass of an object was recorded as 9.93 g, 9.90 g, and 10.02 g, using an electronic analytical balance. What is the average of these three masses expressed to the correct number of significant figures?

F 9.9 g  
 G 9.95 g  
 H 10.0 g  
 J 10.00 g

- 13 Radioactive iodine-131 has a half-life of eight days. The amount of a 200.0 gram sample left after 32 days would be —

A 6.25 g  
 B 12.5 g  
 C 25.0 g  
 D 50.0 g

14

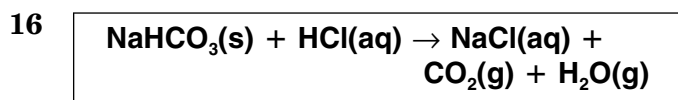


If 3.50 g of  $\text{H}_2\text{S}$  are used in the above reaction, what will be the theoretical yield of water in grams?

F 0.102 g  
 G 0.185 g  
 H 1.85 g  
 J 185 g

15 Which of these describes a tendency for atomic radii as displayed on the periodic chart?

- A Atomic radii decrease left to right across a period.
- B Atomic radii increase left to right across a period.
- C Atomic radii decrease top to bottom down a group.
- D Atomic radii increase, then decrease from top to bottom down a group.



**Data Table**

evaporating dish + watch glass	42.70 g
evaporating dish + watch glass + NaHCO <sub>3</sub>	45.20 g
evaporating dish + watch glass + NaCl	44.45 g

A student conducted an experiment and was interested in the mass of the product of the chemical reaction. Some results of the experiment are shown above. What is the mass of the NaCl?

- F 0.75 g
- G 1.75 g
- H 2.25 g
- J 2.50 g

17 A solution contains 225 g of glucose, C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>, dissolved in enough water to make 0.825 L of solution. What is the molarity of the solution?

- A 0.66 M
- B 0.97 M
- C 1.03 M
- D 1.52 M

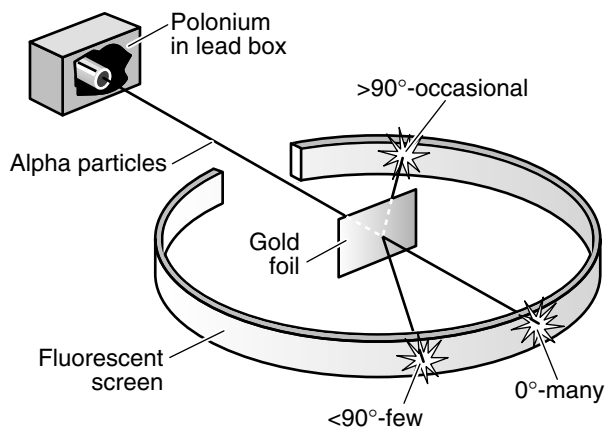
18 A student wanted to calculate the formula for hydrated copper sulfate. After careful massing, she heated the compound to remove the water. She calculated the formula to be CuSO<sub>4</sub> · 4H<sub>2</sub>O. The actual formula was CuSO<sub>4</sub> · 5H<sub>2</sub>O. What is the most likely source of analytical error in the student's experiment?

- F The water was not completely evaporated from the compound.
- G The actual mass of the anhydrous CuSO<sub>4</sub> was less than the measurement.
- H The CuSO<sub>4</sub> reacted with elemental copper.
- J The atmospheric pressure prevented complete reaction.

19 What is the percentage of aluminum in aluminum oxide (Al<sub>2</sub>O<sub>3</sub>)?

- A 47%
- B 48%
- C 53%
- D 54%

20



Which of these conclusions can be drawn from Rutherford's experiment?

- F Each atom contains electrons.
- G The nucleus of an atom can be split.
- H Each atom contains protons.
- J Atoms are mostly empty space.

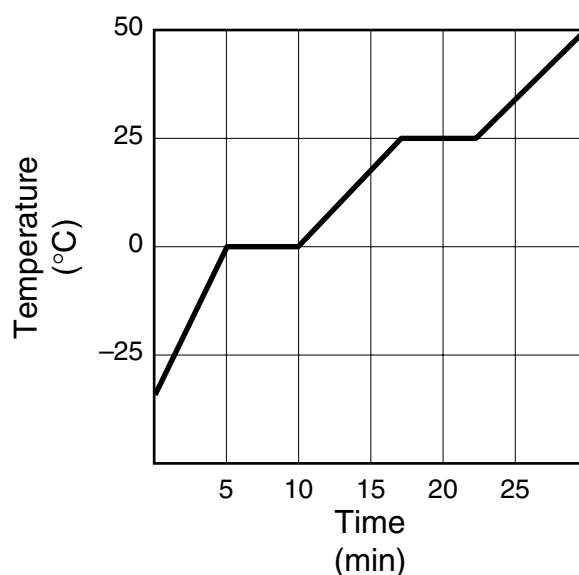
21 How does the radioactive isotope C-14 differ from its stable counterpart C-12?

- A It has a different number of protons and two less neutrons than C-12.
- B It has the same number of protons and two more electrons than C-12.
- C It has the same number of protons but two more neutrons than C-12.
- D It has a different number of protons and two more neutrons than C-12.

22 A compound has 50% sulfur and 50% oxygen. What is its empirical formula?

- F  $\text{SO}_4$
- G  $\text{S}_2\text{O}_4$
- H  $\text{SO}_3$
- J  $\text{SO}_2$

23



An experiment yielded the above temperature and time information. What is the freezing point of the material in this experiment if the material is a solid at time zero?

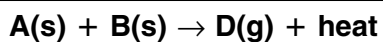
- A  $-25^\circ\text{C}$
- B  $0^\circ\text{C}$
- C  $25^\circ\text{C}$
- D  $50^\circ\text{C}$

24 How many milliliters of 2.00 M  $\text{H}_2\text{SO}_4$  are needed to provide 0.250 mole of  $\text{H}_2\text{SO}_4$ ?

- F 125 mL
- G  $1.25 \times 10^1$  mL
- H  $8.00 \times 10^3$  mL
- J 8.00 mL



25



The reaction shown above is —

- A an endothermic reaction
- B an exothermic reaction
- C a decomposition reaction
- D a double-replacement reaction

26 Chlorine forms a 1- ion. How many electrons does a chloride ion have?

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

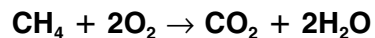
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Group	Mass Data for Sample X (g)	Displacement Data for Sample X (mL)
1	2.7	3.4
2	1.20	1.5
3	6.2	7.40

According to the above data, which of the following represents the average density for sample X using the correct number of significant figures?

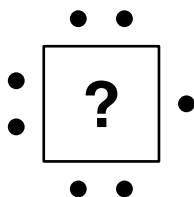
- A 1 g/mL
- B 0.8 g/mL
- C 0.81 g/mL
- D 0.821 g/mL

28



The number of grams of oxygen required for the complete combustion of 4.00 grams of methane ( $\text{CH}_4$ ) is —

- F 4.00 g
- G 8.00 g
- H 16.0 g
- J 32.0 g

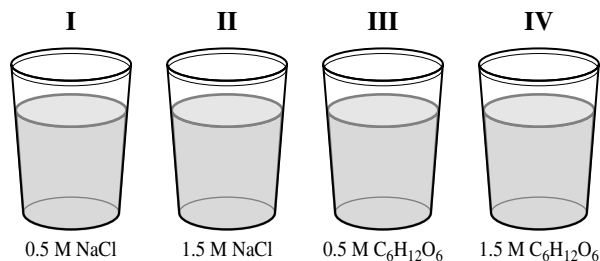


Which of the groups below has the electron dot structure shown above?

- A Noble gases
- B Halogens
- C Alkali metals
- D Transition elements

30 A student must make a 3 M acid solution using a 5 M acid solution. Which of these is the safest way to make the solution?

- F Slowly pour the 5 M acid into water
- G Slowly add water to the 5 M acid solution
- H Mix half the acid with water, then add the remaining water
- J Mix half the water with the acid, then add the remaining acid



Four aqueous solutions and their concentrations are shown in the above illustration. Which of the solutions is most likely to be the strongest conductor of electricity?

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

32 Water can be made to boil *above* its normal boiling point of 100°C by —

- F decreasing the air pressure
- G increasing the air pressure
- H increasing the heat being applied
- J decreasing the volume of the container

33 What is the first step that should be taken when a caustic chemical gets into a person's eye?

- A Identify the chemical
- B Call for an ambulance
- C Flush the affected area with water
- D Apply a neutralizing agent

**34 Melting and Boiling Points of Some Bond Types**

Substance	Type of Bond	Boiling Point	Melting Point	Phase at 24°C
Helium	atom (monatomic)	-269°C	-272°C	gas
Hydrogen	molecule (nonpolar covalent)	-253°C	-259°C	gas
Iron	atom (metallic crystal)	3000°C	1535°C	solid
Sodium chloride	ionic crystal	1413°C	800°C	solid
Water	molecule (polar covalent)	100°C	0°C	liquid

According to the table, which of these probably has the strongest bonds?

- F Hydrogen gas
- G Iron crystals
- H Sodium chloride
- J Water

**35 In the reaction  $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$ , which change would cause the greatest increase in the concentration of  $\text{SO}_3$ ?**

- A Decrease the concentration of  $\text{SO}_2$
- B Decrease the concentration of  $\text{O}_2$
- C Increase the concentration of  $\text{SO}_2$
- D Increase the concentration of  $\text{O}_2$

**36 A catalyst accelerates a chemical reaction because the —**

- F catalyst decreases the number of collisions in a reaction
- G activation energy of the reaction is lowered in the presence of a catalyst
- H catalyst decreases the concentration of the reactants
- J temperature of the reaction increases due to the catalyst

**37 A compound is composed of 58.8% C, 9.8% H, and 31.4% O, and the molar mass is 102 g/mol. What is the molecular formula for this compound?**

- A  $\text{C}_2\text{H}_{10}\text{O}_3$
- B  $\text{C}_5\text{H}_5\text{O}_3$
- C  $\text{C}_5\text{H}_{10}\text{O}_2$
- D  $\text{CH}_3\text{O}_3$

**38 Which of these shows a volume of 1.25 liters expressed in milliliters?**

- F 125 mL
- G  $12.5 \times 10^1$  mL
- H  $1.25 \times 10^2$  mL
- J  $1.25 \times 10^3$  mL

- 39 An element has an electron configuration of  $1s^2 2s^2 2p^6 3s^2$ . Which of these will be in the same group as this element?

A  $1s^2 2s^2 2p^6$   
B  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$   
C  $1s^2 2s^2 2p^6 3s^1$   
D  $1s^2 2s^2 2p^6 3s^2 3p^6$

40

Very Active Metal + Water  $\rightarrow$  Metal Hydroxide + ?

Which of these completes this reaction?

F Oxygen  
G Hydrogen  
H Metal oxide  
J Air

- 41 Which of these elements is the most chemically active?

A F  
B Cl  
C Br  
D I

- 42 If the heat of fusion of water is  $3.4 \times 10^2$  J/g, the amount of heat energy required to change 15.0 grams of ice at  $0^\circ\text{C}$  to 15.0 grams of water at  $0^\circ\text{C}$  is —

F  $3.4 \times 10^2$  J  
G  $2.4 \times 10^3$  J  
H  $5.1 \times 10^3$  J  
J  $1.0 \times 10^4$  J

- 43 If the pressure exerted on a confined gas is doubled, then the volume of the gas —

A increases four times  
B decreases by one-fourth  
C is doubled  
D is halved

- 44 If the temperature of a reaction is increased, the reaction proceeds at a much quicker rate because the —

F activation energy increases  
G energy of the products increases  
H frequency of collisions between reactants increases  
J energy of the activated complex increases

- 45 The formula  $\text{H}_2\text{SO}_4$  is representative of which of the following?

A A catalyst  
B A base  
C An acid  
D An organic compound

- 46 Which compound contains both ionic and covalent bonds?

F  $\text{NH}_4\text{Cl}$   
G  $\text{MgBr}_2$   
H  $\text{CH}_4$   
J  $\text{NH}_3$

47 Which volume will be occupied by a gas containing  $6.02 \times 10^{23}$  atoms at STP?

- A 1.0 L
- B 11.2 L
- C 22.4 L
- D 44.8 L

49 A sample of oxygen gas is collected over water at 22°C and 98.67 kPa pressure. If the partial pressure of the water is 2.67 kPa, the partial pressure of the oxygen is —

- A 93.33 kPa
- B 96.00 kPa
- C 98.66 kPa
- D 101.33 kPa

48 **Some Solubilities in Water**

Key i = nearly insoluble ss = slightly soluble s = soluble n = not isolated	acetate	bromide	carbonate	chloride	chromate	hydroxide
Aluminum	ss	s	n	s	n	i
Ammonium	s	s	s	s	s	s
Barium	s	s	i	s	i	s
Calcium	s	s	i	s	s	ss
Copper (II)	s	s	i	s	i	i
Iron (II)	s	s	i	s	n	i

Using the chart above, which of these combinations will probably form a precipitate?

- F Ammonium chloride
- G Barium bromide
- H Calcium chromate
- J Copper (II) carbonate

50 The hydrogen ion concentration is  $1 \times 10^{-7}$ . What is the pH of this solution?

- F 1
- G 7
- H 10
- J 14

