

33) Which properties are most common in nonmetals?

- (a) low ionization energy and low electronegativity
- (b) low ionization energy and high electronegativity
- (c) high ionization energy and low electronegativity
- (d) high ionization energy and high electronegativity

34) Which ion has the largest radius?

- (a)  $\text{Na}^+$
- (b)  $\text{Mg}^{2+}$
- (c)  $\text{K}^+$
- (d)  $\text{Ca}^{2+}$

35) The forces between atoms that create chemical bonds are the result of interactions between

- (a) nuclei
- (b) electrons
- (c) protons and electrons
- (d) protons and nuclei

36) What happens when  $\text{NaCl}(s)$  is dissolved in water?

- (a)  $\text{Cl}^-$  ions are attracted to the oxygen atoms of water molecules.
- (b)  $\text{Na}^+$  ions are attracted to the oxygen atoms of water molecules.
- (c)  $\text{Cl}^-$  ions are repelled by the hydrogen atoms of water molecules.
- (d)  $\text{Na}^+$  ions are repelled by the oxygen atoms of water molecules.

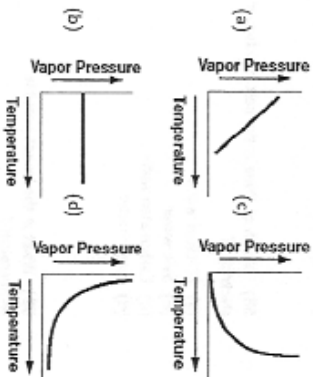
37) Which pair of atoms is held together by a covalent bond?

- (a)  $\text{HCl}$
- (b)  $\text{LiCl}$
- (c)  $\text{NaCl}$
- (d)  $\text{KCl}$

38) Which type of radiation continues in a straight line when passed through an electric field?

- (a) alpha
- (b) beta
- (c) gamma
- (d) proton

39) Which graph best represents the variation in the vapor pressure of water as temperature changes?



40) Which sample of matter is a mixture?

- (a)  $\text{H}_2\text{O}(s)$
- (b)  $\text{H}_2\text{O}(g)$
- (c)  $\text{NaCl}(s)$
- (d)  $\text{NaCl}(aq)$

41) Which substance is a binary compound?

- (a) ammonia
- (b) argon
- (c) glucose
- (d) glycerol

42) The heat absorbed when ice melts can be measured in a unit called a

- (a) torr
- (b) degree
- (c) mole
- (d) calorie

43)  $\text{C}_2\text{H}_6 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$

Which of these could be removed from the above reaction to increase the rate of reaction over time?

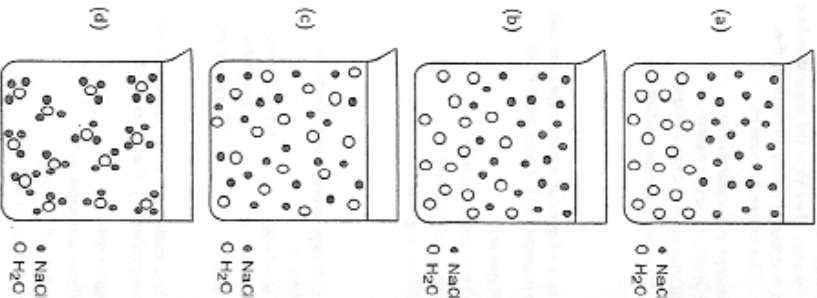
- (a)  $\text{C}_2\text{H}_6$  and  $\text{O}_2$
- (b)  $\text{C}_2\text{H}_6$  and  $\text{CO}_2$
- (c)  $\text{O}_2$  and  $\text{CO}_2$
- (d)  $\text{CO}_2$  and  $\text{H}_2\text{O}$

44)  $\text{C}_2\text{H}_6 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$

Which of these could be added to the above reaction to increase the rate of reaction over time?

- (a)  $\text{C}_2\text{H}_6$  and  $\text{O}_2$
- (b)  $\text{C}_2\text{H}_6$  and  $\text{CO}_2$
- (c)  $\text{O}_2$  and  $\text{CO}_2$
- (d)  $\text{O}_2$  and  $\text{H}_2\text{O}$

45) Which of these shows an accurate diagram of salt water?



46) Which process does random molecular motion explain?

- (a) How solids dissolve in liquids
- (b) How liquids evaporate
- (c) How solids melt
- (d) How precipitation forms

19) A carbon-14 atom spontaneously decayed to form a nitrogen-14 atom. This change took place because

- (a) a transmutation occurred without particle emission
- (b) a transmutation occurred with particle emission
- (c) nitrogen-14 has an unstable nucleus
- (d) carbon-14 has a stable nucleus

20) The heat energy required to change a unit mass of a solid into a liquid at constant temperature is called

- (a) heat of vaporization
- (b) heat of formation
- (c) heat of solution
- (d) heat of fusion

21) The average kinetic energy of water molecules increases when

- (a)  $H_2O(l)$  changes to  $H_2O(g)$  at  $0^\circ C$
- (b)  $H_2O(l)$  changes to  $H_2O(s)$  at  $0^\circ C$
- (c)  $H_2O(l)$  at  $10^\circ C$  changes to  $H_2O(l)$  at  $20^\circ C$
- (d)  $H_2O(l)$  at  $20^\circ C$  changes to  $H_2O(l)$  at  $10^\circ C$

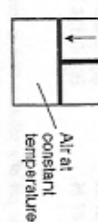
22) Which phase change is exothermic?

- (a) solid to liquid
- (b) solid to gas
- (c) liquid to solid
- (d) liquid to gas

23) Within Period 2 of the Periodic Table, as the atomic number increases, the atomic radius generally

- (a) decreases
- (b) increases
- (c) remains the same
- (d) increases

24) A cylinder with a tightly fitted piston is shown in the diagram below.



As the piston moves downward, the number of molecules of air in the cylinder

- (a) decreases
- (b) increases
- (c) remains the same
- (d) increases

25) As an acid solution is added to neutralize a base solution, the  $OH^-$  concentration of the base solution

- (a) decreases
- (b) increases
- (c) remains the same
- (d) increases

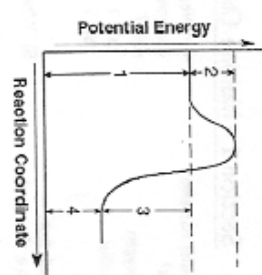
26) If equal volumes of 0.1 M NaOH and 0.1 M HCl are mixed, the resulting solution will contain a salt and

- (a) HCl
- (b) NaOH
- (c)  $H_2O$
- (d) NaCl

27) Carbon dioxide gas is most soluble in water under conditions of

- (a) high pressure and low temperature
- (b) high pressure and high temperature
- (c) low pressure and low temperature
- (d) low pressure and high temperature

The potential energy diagram below represents the reaction  $A + B \rightarrow C + \text{energy}$ .



For questions 28-29

28) Which numbered interval will change with the addition of a catalyst to the system?

- (a) 1
- (b) 2
- (c) 3
- (d) 4

29) Which statement correctly describes this reaction?

- (a) It is endothermic and energy is absorbed.
- (b) It is endothermic and energy is released.
- (c) It is exothermic and energy is absorbed.
- (d) It is exothermic and energy is released.

31) A 1.0-gram sample of powdered Zn reacts faster with HCl than a single 1.0-gram piece of Zn because the surface atoms in powdered Zn have

- (a) higher average kinetic energy
- (b) lower average kinetic energy
- (c) more contact with the  $H^+$  ions in the acid
- (d) less contact with the  $H^+$  ions in the acid

32) Which bond exists between the atoms in a water molecule?

- (a) ionic
- (b) Covalent
- (c) ionic and covalent
- (d) Hydrogen

30) In a reversible reaction, chemical equilibrium is attained when the

- (a) rate of the forward reaction is greater than the rate of the reverse reaction
- (b) rate of the reverse reaction is greater than the rate of the forward reaction
- (c) concentration of the reactants reaches zero
- (d) concentration of the products remains constant

67) A perfume bottle is opened at one end of the room, and after a few minutes the smell of the perfume can be detected at the other end of the room. Which statement correctly explains how the smell traveled across the room?

- (a) The perfume molecules diffused throughout the room.
- (b) The perfume molecules combined with the air molecules in the room.
- (c) The perfume molecules collided with the walls of the room.
- (d) The perfume molecules reacted with other smells in the room.

68) What is the most probable location of an electron?

- (a) an orbital
- (b) a nucleus
- (c) a sublevel
- (d) a principal energy level

69) At constant temperature, the relationship between the volume (V) of a given mass of gas and its pressure (P) is

- (a)  $V = KP$
- (b)  $P = KV$
- (c)  $PV = k$
- (d)  $\frac{V}{P} = k$

70) As  $^{14}\text{C}$  decays to  $^{14}\text{N}$ , the number of protons in the nucleus

- (a) decreases
- (b) increases
- (c) remains the same

71) 24 grams of carbon equals how many moles?

- (a) 1
- (b) 2
- (c) 3
- (d) 4

72) How many grams of carbon are in 3 moles of  $\text{CO}_2$ ?

- (a) 12
- (b) 24
- (c) 36
- (d) 48

73) Which shows the correct Lewis structure for  $\text{H}_2\text{O}$ ?

- (a)  $\text{H}-\text{O}-\text{H}$
- (b)  $\begin{array}{c} \text{H} \\ | \\ \text{O}-\text{H} \\ | \\ \text{H} \end{array}$
- (c)  $\text{H} \cdot \ddot{\text{O}} \cdot \text{H}$
- (d)  $\text{H}-\ddot{\text{O}}-\text{H}$

74) Hotter temperatures generally make \_\_\_\_\_ less soluble in water.

- (a) gases
- (b) solids
- (c) liquids
- (d) salts

Shammi

This is the 1st test than I felt illu I passed since chem Honors.

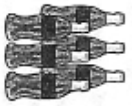
75) Why does a spoonful of loose salt crystals dissolve faster in water than does a block of the same amount of salt?

- (a) The loose salt crystals require less energy to dissolve than the block of salt.
- (b) The loose salt crystals have more surface area exposed to the water than the block of salt.
- (c) The loose salt crystals are less soluble than the block of salt.
- (d) The loose salt crystals have fewer chemical bonds to break than the block of salt.

76) Which substance has atoms and molecules moving in a random pattern relative to one another?

- (a) Salt
- (b) Milk
- (c) Wood
- (d) Cotton

77)



Carbonated beverages are bottled and canned under pressure, because pressure greatly-

- (a) decreases the solubility of solids in liquids.
- (b) increases the solubility of solids in liquids.
- (c) decreases the solubility of gases in liquids.
- (d) increases the solubility of gases in liquids.

78) Which list of substances is in order of increasing intermolecular forces?

- (a) Ice, soda, honey, helium
- (b) Soda, ice, honey, helium
- (c) Helium, soda, honey, ice
- (d) Helium, soda, ice, honey

79) How does the temperature of water influence the solubility of different substances?

- (a) Hotter water generally makes solids more soluble.
- (b) Colder water generally makes liquids more soluble.
- (c) Hotter water generally makes gases more soluble.
- (d) Water temperature does not affect the solubility of substances.

80) Which factor influences the solubility of a substance?

- (a) Temperature
- (b) Pressure
- (c) pH
- (d) All of the above

81) Which molecule exhibits covalent bonding?

- (a)  $\text{LiF}$
- (b)  $\text{CO}_2$
- (c)  $\text{KBr}$
- (d)  $\text{CaCl}_2$

- 47) Nikia adds a teaspoon of sugar to a cup of water. Over time the sugar dissolves and is distributed evenly throughout the water. This occurs because of-
- random molecular motion.
  - uniform molecular motion.
  - decreasing molecular motion.
  - increasing molecular motion.
- 48) In a mixture of water, sugar, and salt, which ingredient(s), if any, are solutes?
- Water only
  - Water and sugar only
  - Sugar and salt only
  - Water, sugar and salt
- 49) Cellulose, protein, and starch are classified as
- aldehydes
  - esters
  - synthetic polymers
  - natural polymers
- 50) In a mixture of water, sugar, and salt, which ingredient(s), if any, are solvents?
- Water only
  - Water and sugar only
  - Sugar and salt only
  - Water, sugar, and salt
- 51) Which liquid consists of a solute and a solvent?
- Vinegar
  - Water
  - Alcohol
  - Orange juice
- 52) Which of these is a property of most bases?
- They dissolve metals.
  - They react to proteins.
  - They break down oil and grease.
  - They dissolve carbonate compounds.
- 53) How many hydroxide ions are needed to completely neutralize 1.0 liter of 0.50 M HCl?
- $1.5 \times 10^{23}$  ions
  - $3.0 \times 10^{23}$  ions
  - $6.0 \times 10^{23}$  ions
  - $12 \times 10^{23}$  ions
- 54) Which property do most acids share?
- Bitter taste
  - Sour taste
  - Slippery feel
  - Faint color
- 55) A solution has a hydroxide ion concentration of  $1 \times 10^{-5}$  M. What is the hydrogen ion concentration of the solution?
- $1 \times 10^{-1}$  M
  - $1 \times 10^{-5}$  M
  - $1 \times 10^{-9}$  M
  - $1 \times 10^{-14}$  M
- 56) A solute is added to water and a portion of the solute remains undissolved. When equilibrium between the dissolved and undissolved solute is reached, the solution must be
- dilute
  - saturated
  - unsaturated
  - supersaturated
- 57) Which statement best describes a chemical reaction in which energy is released?
- It is exothermic and has a negative  $\Delta H$ .
  - It is exothermic and has a positive  $\Delta H$ .
  - It is endothermic and has a negative  $\Delta H$ .
  - It is endothermic and has a positive  $\Delta H$ .
- 58) Which of these is the best conductor of electricity?
- Distilled water
  - Salt water
  - Carbonated water
  - Sugar water
- 59) What is the lowest possible temperature?
- 273K
  - 0K
  - 273K
  - 373K
- 60) What happens to molecules at 0K?
- They move rapidly and collide often.
  - They move rapidly but rarely collide.
  - They move slowly and rarely collide.
  - They stop moving.
- 61) At what temperature does the motion of molecules stop?
- 373K
  - 273K
  - 0K
  - 273K
- 62) Which element attains the structure of a noble gas when it becomes a  $1+ \text{ion}$ ?
- K
  - Ca
  - F
  - Ne
- 63) What is 373K in Celsius?
- 0°C
  - 100°C
  - 200°C
  - 300°C
- 64) What is 10°C in Kelvin?
- 73K
  - 273K
  - 283K
  - 383K
- 65) Which of these is the correct standard temperature and pressure?
- 100°C and 1 atm
  - 100°C and 2 atm
  - 0°C and 1 atm
  - 0°C and 2 atm
- 66) What is the total number of atoms contained in a 1.00-mole sample of helium?
- 1.00 atom
  - 2.00 atoms
  - $1.20 \times 10^{24}$  atoms
  - $6.02 \times 10^{23}$  atoms

- 99) Given the reaction:  
 $228 \text{ Ra} \rightarrow 222 \text{ Rn} + X$   
 88                      86

Which type of emanation is represented by X?

- (a) alpha particle      (c) proton  
 (b) beta particle      (d) positron

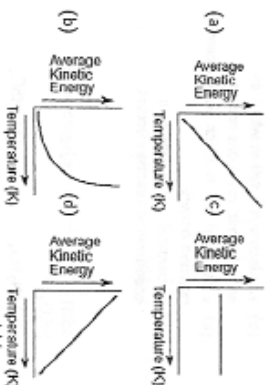
- 100) An atom of fluorine has a mass of 19 atomic mass units. The total number of protons and neutrons in its nucleus is

- (a) 9                      (c) 19  
 (b) 10                    (d) 28

- 101) Standard temperature and a pressure of 0.5 atmosphere are equal to

- (a) 0°C and 380 torr      (c) 0°C and 760 torr  
 (b) 32°C and 380 torr      (d) 32°C and 760 torr

- 102) Which graph best shows the relationship between Kelvin temperature and average kinetic energy?



- 103) A student noted that the temperature of water increased as a result of dissolving a salt in it. From this observation, the student should conclude that dissolving the salt

- (a) produced an acid solution  
 (b) produced a basic solution  
 (c) was endothermic  
 (d) was exothermic

- 104) The reaction  $n\text{C}_2\text{H}_4 \rightarrow (-\text{C}_2\text{H}_4)_n$  is an example of

- (a) saponification      (c) polymerization  
 (b) esterification      (d) fermentation

- 105) When the salt  $\text{NH}_4\text{NO}_3$  is dissolved in water, it produces a solution that is

- (a) acidic, with a pH less than 7  
 (b) acidic, with a pH greater than 7  
 (c) basic, with a pH less than 7  
 (d) basic, with a pH greater than 7

- 106) Given the reaction:



What is the total number of liters of  $\text{O}_2(\text{g})$  at STP needed to produce  $8.0 \times 10^{23}$  molecules of  $\text{H}_2\text{O}(\text{l})$ ?

- (a) 11.2 L                      (c) 33.6 L  
 (b) 22.4 L                      (d) 44.8 L

- 107) The temperature of a sample of water changes from 10°C to 20°C when the water absorbs 100 calories of heat. What is the mass of the sample?

- (a) 1 g                      (c) 100 g  
 (b) 10 g                      (d) 1000 g

- 108) Which property is characteristic of nonmetals?

- (a) They have a high electronegativity.  
 (b) They lose electrons easily.  
 (c) They have a low first ionization energy.  
 (d) They are good conductors of electricity.

- 109) Which sample contains a total of  $9.0 \times 10^{23}$  atoms?

- (a) 0.50 mole of HCl      (c) 1.5 moles of Cu  
 (b) 0.75 mole of  $\text{H}_2\text{O}$       (d) 1.5 moles of  $\text{H}_2$

- 110) As the atomic number of elements within Group 2 increases, the metallic character of each successive element

- (a) decreases                      (c) remains the same  
 (b) increases

- 111) As the temperature of a given sample of a gas decreases at constant pressure, the volume of the gas

- (a) decreases                      (c) remains the same  
 (b) increases

- 112) Which formula represents a saturated hydrocarbon?

- (a)  $\text{C}_2\text{H}_2$                       (c)  $\text{C}_3\text{H}_4$   
 (b)  $\text{C}_2\text{H}_4$                       (d)  $\text{C}_4\text{H}_6$

- 113) Given the reaction at equilibrium:



Which change will not affect the equilibrium concentrations of A(g), B(g), and  $\text{A}_2\text{B}_3(\text{g})$ ?

- (a) adding more A(g)  
 (b) adding a catalyst  
 (c) increasing the temperature  
 (d) increasing the pressure

- 114) Given the reaction:



When equilibrium is reached in this system, the rate of the forward reaction is

- (a) less than the rate of the reverse reaction  
 (b) greater than the rate of the reverse reaction  
 (c) equal to the rate of the reverse reaction  
 (d) unrelated to the rate of the reverse reaction

- 115) Given the reaction:



What volume of  $\text{C}_6\text{H}_6(\text{g})$  will completely react to produce exactly 56 liters of  $\text{H}_2\text{O}(\text{g})$ ?

- (a) 27 L                      (c) 36 L  
 (b) 20 L                      (d) 40 L

82) Given the ionization constant equation:

$$K_w = [\text{H}^+][\text{OH}^-] = 1.0 \times 10^{-14}$$

For water at 25°C, which statement is true?

- (a)  $[\text{H}^+] = [\text{OH}^-]$  (c)  $[\text{H}^+] = 1.0 \times 10^{-14} \text{ M}$   
(b)  $[\text{H}^+] > [\text{OH}^-]$  (d)  $[\text{OH}^-] = 1.0 \times 10^{-14} \text{ M}$

83) Given the reaction:



The  $\text{H}_2\text{O}$  molecule serves as a

- (a) weak base (c) proton donor  
(b) strong base (d) proton acceptor

84) What is the pH of a solution that results from the complete neutralization of an HCl solution with a KOH solution?

- (a) 1 (c) 10  
(b) 7 (d) 4

85) Which list is in order of increasing penetrating strength?

- (a) Alpha, gamma, beta  
(b) Alpha, beta, gamma  
(c) Gamma, alpha, beta  
(d) Gamma, beta, alpha

86) What is the total number of moles of solute in 2.0 liters of 3.0 M NaOH?

- (a) 1.0 mole (c) 3.0 moles  
(b) 2.0 moles (d) 6.0 moles

87) Given the reaction:



In this reaction, 5 grams of powdered iron will react faster than a 1-gram piece of solid iron because the powdered iron

- (a) has less surface area  
(b) has more surface area  
(c) is less dense  
(d) is more dense

88) How are protons held together in the nucleus of an atom?

- (a) Nuclear forces  
(b) Electromagnetic attraction  
(c) Electromagnetic repulsion  
(d) Rotational inertia

89) Given the reaction at equilibrium:



The addition of a catalyst will

- (a) shift the equilibrium to the right  
(b) shift the equilibrium to the left  
(c) increase the rate of forward and reverse reactions equally  
(d) have no effect on the forward or reverse reactions

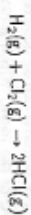
90) Given the reaction:



The value of the equilibrium constant ( $K_{eq}$ ) will be changed by increasing the

- (a) pressure  
(b) temperature  
(c) concentration of  $\text{SO}_2(g)$   
(d) concentration of  $\text{SO}_3(g)$

94) Given the equation:



What is the total number of moles of  $\text{HCl}(g)$  produced when 3 moles of  $\text{H}_2(g)$  is completely consumed?

- (a) 5 moles (c) 3 moles  
(b) 2 moles (d) 6 moles

95) The empirical formula of a compound is  $\text{CH}_2$ . The molecular formula of this compound could be

- (a)  $\text{CH}_4$  (c)  $\text{C}_2\text{H}_6$   
(b)  $\text{C}_2\text{H}_4$  (d)  $\text{C}_3\text{H}_6$

96) In which system do molecule-ion attractions exist?

- (a)  $\text{KC}(s)$  (c)  $\text{KCl}(l)$   
(b)  $\text{KCl}(aq)$  (d)  $\text{KCl}(g)$

97) Which statement about the mass of an electron is correct?

- (a) The mass of an electron is equal to the mass of a proton.  
(b) The mass of an electron is less than the mass of a proton.  
(c) The mass of an electron is equal to the mass of a neutron.  
(d) The mass of an electron is greater than the mass of a neutron.

93) Which of these combine together to form proteins?

- (a) Amino acids  
(b) Lipids  
(c) Sugars  
(d) Nucleic acids

92) At STP,  $3 \times 10^{23}$  molecules of  $\text{SO}_2(g)$  occupy the same volume as

- (a) 1 mole of  $\text{H}_2(g)$  (c) 0.5 mole of  $\text{H}_2(g)$   
(b)  $6 \times 10^{23}$  molecules of  $\text{H}_2(g)$  (d) 4 grams of  $\text{H}_2(g)$   
 $\text{H}_2(g)$

98) What is the atomic number of an element that has six protons and eight neutrons?

- (a) 6 (c) 8  
(b) 2 (d) 14

135) Given the reaction:



What is the total number of liters of  $H_2O(g)$  produced when 1.0 liter of  $C_3H_8(g)$  reacts completely with 5.0 liters of  $O_2(g)$ ?

- (a) 1.0  
(b) 5.0  
(c) 3.0  
(d) 4.0

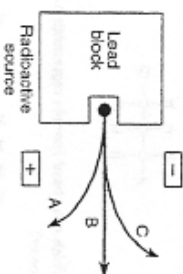
136) Which pair of atoms will share electrons when a bond is formed between them?

- (a) Ba and I  
(b) Br and Cl  
(c) K and Cl  
(d) Li and I

137) What is the total number of moles of atoms represented by the formula  $Al_2(C_2H_3O_2)_3$ ?

- (a) 22  
(b) 11  
(c) 8  
(d) 4

138) The diagram below represents radiation passing through an electric field.



The arrow labeled A most likely represents

- (a) a positron  
(b) an electron  
(c) alpha radiation  
(d) gamma radiation

139) The mass of one carbon atom is approximately equal to the total mass of

- (a) 6 neutrons  
(b) 6 alpha particles  
(c) 12 nucleons  
(d) 12 beta particles

140) A 2.5-liter sample of gas is at STP. When the temperature is raised to 273°C and the pressure remains constant, the new volume of the gas will be

- (a) 1.25 L  
(b) 2.5 L  
(c) 5.0 L  
(d) 10. L

141) Which phase change is exothermic?

- (a)  $H_2O(l) \rightarrow H_2O(g)$   
(b)  $H_2O(l) \rightarrow H_2O(s)$

- (c)  $H_2O(g) \rightarrow H_2O(l)$   
(d)  $H_2O(l) \rightarrow H_2O(s)$

142) At which temperature does an aqueous solution of LiCl have the highest average kinetic energy?

- (a) 100°C  
(b) 200°C  
(c) 273 K  
(d) 373 K

143) As the temperature of a sample of  $H_2O(l)$  decreases, the average kinetic energy of its molecules will

- (a) decrease  
(b) increase  
(c) remain the same

144) What is the maximum number of covalent bonds that carbon atom can form?

- (a) 1  
(b) 2  
(c) 3  
(d) 4

145) Organic compounds always contain the element

- (a) hydrogen  
(b) carbon  
(c) oxygen  
(d) sulfur

146) If 50 milliliters of a 1.0 M NaOH solution is needed to exactly neutralize 10 milliliters of an HCl solution, the molarity of the HCl solution is

- (a) 1.0 M  
(b) 0.20 M  
(c) 5.0 M  
(d) 10. M

147) A catalyst will affect the rate of the forward reaction by changing the

- (a) activation energy  
(b) heat of reaction  
(c) heat of formation  
(d) potential energy of the products

148) The volume occupied by  $9.03 \times 10^{23}$  molecules of  $N_2$  gas at STP is closest to

- (a) 0.500 liter  
(b) 1.50 liters  
(c) 22.4 liters  
(d) 33.6 liters

149) Given the reaction:



What is the total number of moles of  $NH_3(g)$  produced when 10. moles of  $H_2(g)$  reacts completely with  $N_2(g)$ ?

- (a) 6.7  
(b) 2.0  
(c) 3.0  
(d) 15

150) What is the gram formula mass of  $Ca(OH)_2$ ?

- (a) 29 g  
(b) 34 g  
(c) 57 g  
(d) 74 g

151) Properties of nonmetal atoms include

- (a) low ionization energy and low electronegativity  
(b) low ionization energy and high electronegativity  
(c) high ionization energy and low electronegativity  
(d) high ionization energy and high electronegativity

152) If M represents an alkali metal, what is the formula for the compound formed by M and oxygen?

- (a)  $MO_2$   
(b)  $M_2O$   
(c)  $M_2O_3$   
(d)  $M_3O_2$

153) Which list of elements contains two metalloids (semimetals)?

- (a) Ga, Ge, Sn  
(b) Si, P, S  
(c) C, Si, Ge  
(d) B, C, N

154) Which two elements have chemical properties that are most similar?

- (a) Cl and Ar  
(b) Li and Na  
(c) K and Ca  
(d) C and N

155) Which elements in Group 18 is naturally radioactive and has no stable isotopes?

- (a) Ar  
(b) Kr  
(c) Xe  
(d) Rn

156) What is the approximate total number of atoms in 1.0 mole of lithium?

- (a)  $1.0 \times 10^{23}$   
(b)  $6.0 \times 10^{23}$   
(c) 3.0  
(d) 6.9

- 116) Given the reaction:  
 $4\text{NH}_3 + 5\text{O}_2 \rightarrow 4\text{NO} + 6\text{H}_2\text{O}$   
 What is the total number of moles of NO produced when 1.0 mole of  $\text{O}_2$  is completely consumed?  
 (a) 1.0 mole (c) 0.80 mole  
 (b) 1.2 moles (d) 4.0 moles
- 117) The percent by mass of carbon in  $\text{HC}_2\text{H}_3\text{O}_2$  is equal to  
 (a)  $\frac{16}{89} \times 100$  (c)  $\frac{60}{89} \times 100$   
 (b)  $\frac{24}{89} \times 100$  (d)  $\frac{60}{13} \times 100$
- 118) What is the total number of moles of solute in 250 milliliters of a 1.0 M solution of  $\text{NaCl}$ ?  
 (a) 1.0 mole (c) 0.50 mole  
 (b) 0.25 mole (d) 42 moles
- 119) Which group contains a metalloid?  
 (a) 1 (c) 15  
 (b) 11 (d) 18
- 120) Which Group 16 element has only unstable isotopes?  
 (a) Po (c) Se  
 (b) Te (d) S
- 121) Which type of bond exists between an atom of carbon and an atom of fluorine?  
 (a) ionic (c) polar covalent  
 (b) metallic (d) nonpolar covalent
- 122) Which equation is correctly balanced?  
 (a)  $\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}$  (c)  $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$   
 (b)  $\text{Ca} + \text{Cl}_2 \rightarrow \text{CaCl}$  (d)  $\text{Ca} + \text{Cl}_2 \rightarrow \text{Ca}_2\text{Cl}$
- 123) When  $^{226}\text{Ra}$  undergoes a natural transmutation reaction, it emits  
 (a) an alpha particle (c) a proton  
 (b) a beta particle (d) a neutron
- 124) What is the structure of a krypton-85 atom?  
 (a) 49 electrons, 49 protons, and 85 neutrons  
 (b) 49 electrons, 49 protons, and 49 neutrons  
 (c) 35 electrons, 36 protons, and 85 neutrons  
 (d) 35 electrons, 36 protons, and 49 neutrons
- 125) What are the characteristics of a neutron?  
 (a) It has no charge and no mass.  
 (b) It has no charge and a mass of 1 amu.  
 (c) It has a charge of +1 and no mass.  
 (d) It has a charge of +1 and a mass of 1 amu.
- 126) Standard temperature and pressure are  
 (a)  $0^\circ\text{C}$  and 1 mmHg (c)  $273^\circ\text{C}$  and 1 mmHg  
 (b)  $0^\circ$  and 760 mmHg (d)  $273^\circ\text{C}$  and 760 mmHg
- 127) The following data were collected by a student performing an acid-base titration:  
 Volume of the acid,  $\text{HCl} = 20.0$  ml  
 Molarity of the acid =  $0.50$  M  
 Volume of the base,  $\text{NaOH} = 40.0$  ml  
 From the collected data, the concentration of the base should be calculated as  
 (a)  $1.0$  M (c)  $0.25$  M  
 (b)  $2.0$  M (d)  $0.50$  M
- 128) When ammonium chloride crystals are dissolved in water, the temperature of the water decreases. What does this temperature change indicate about the dissolving of ammonium chloride in water?  
 (a) It is endothermic reaction because it absorbs heat.  
 (b) It is endothermic reaction because it releases heat.  
 (c) It is an exothermic reaction because it absorbs heat.  
 (d) It is an exothermic reaction because it releases heat.
- 129) Given the reaction:  
 $^1_1\text{H} + ^1_1\text{H} \rightarrow ^2_2\text{He} + \text{energy}$   
 The process represented by the reaction is called  
 (a) fission  
 (b) fusion  
 (c) artificial transmutation  
 (d) alpha decay
- 130) A condensation polymerization reaction is best described as the  
 (a) joining of monomers by the removal of oxygen  
 (b) joining of monomers by the removal of water  
 (c) oxidation of a hydrocarbon by oxygen  
 (d) oxidation of a hydrocarbon by water
- 131) Given the reaction:  
 $\text{C}_2\text{H}_2 + 2\text{H}_2 \rightarrow \text{C}_2\text{H}_6$   
 This reaction represents  
 (a) substitution (c) esterification  
 (b) addition (d) saponification
- 132) Given the cell reaction:  
 $2\text{H}_2\text{O}(l) + \text{electricity} \rightarrow 2\text{H}_2(g) + \text{O}_2(g)$   
 This cell is best described as  
 (a) an electrolytic cell in which an exothermic reaction occurs  
 (b) an electrolytic cell in which an endothermic reaction occurs  
 (c) a chemical cell in which an exothermic reaction occurs  
 (d) a chemical cell in which an endothermic reaction occurs
- 133) Which is the conjugate acid of  $\text{HSO}_4^-$ ?  
 (a)  $\text{H}_2\text{SO}_4$  (c)  $\text{HSO}_3^-$   
 (b)  $\text{H}_3\text{O}^+$  (d)  $\text{SO}_4^{2-}$
- 134) What is the total number of kilocalories of heat needed to change 150 grams of ice to water at  $0^\circ\text{C}$ ? [Heat of fusion =  $80$  calories per gram]  
 (a) 12 (c) 70  
 (b) 2.0 (d) 230

170) At 1 atmosphere of pressure, 25.0 grams of a compound at its normal boiling point is converted to a gas by the addition of 8,180 calories. What is the heat of vaporization for this compound, in calories per gram?

- (a) 25.0 cal/g (c) 540 cal/g  
(b) 327 cal/g (d) 8,180 cal/g

171) If  $M$  represents an element in Group 2, the formula of its chloride would be

- (a)  $MCl$  (c)  $M_2Cl$   
(b)  $MCl_2$  (d)  $M_2Cl_2$

172) In which area of the Periodic Table are the elements with the strongest nonmetallic properties located?

- (a) lower left (c) lower right  
(b) upper left (d) upper right

173) Which element has a crystalline lattice composed of positive ions through which electrons flow freely?

- (a) bromine (c) carbon  
(b) calcium (d) sulfur

174) What is the chemical formula for copper (I) chlorate?

- (a)  $Cu_2Cl$  (c)  $Cu_2ClO_3$   
(b)  $CuCl_2$  (d)  $Cu(ClO_3)_2$

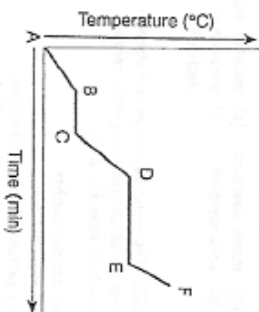
175) When an alpha particle is emitted by an atom, the atomic number of the atom will

- (a) decrease by 2 (c) decrease by 4  
(b) increase by 2 (d) increase by 4

176) A gas at STP has a volume of 1.0 liter. If the pressure is doubled and the temperature remains constant, the new volume of the gas will be

- (a) 0.25 L (c) 0.50 L  
(b) 2.0 L (d) 4.0 L

177) The graph below represents the uniform heating of a substance, starting with the substance as a solid below its melting point.



Which segment of the graph represents a time when both the solid and liquid phases are present?

- (a) AB (c) DE  
(b) BC (d) EF

178) As a chemical bond forms between two hydrogen atoms in a system, energy is released and the stability of the system

- (a) decreases (c) remains the same  
(b) increases

179) Given the reaction:



As the concentration of the  $HCl(aq)$  decreases at constant temperature, the rate of the reaction

- (a) decreases (c) remains the same  
(b) increases

180) Which element is present in all organic compounds?

- (a) hydrogen (c) oxygen  
(b) nitrogen (d) carbon

181) Given the unbalanced equation:



When the equation is correctly balanced using the smallest whole-number coefficients, the coefficient of  $Br^-$  is

- (a) 1 (c) 3  
(b) 2 (d) 4

185) Which reaction results in an increase in entropy?

- (a)  $CO_2(g) \rightarrow CO_2(s)$   
(b)  $H_2O(l) \rightarrow H_2O(s)$   
(c)  $Ca(s) + 2H_2O(l) \rightarrow Ca(OH)_2(aq) + H_2(g)$   
(d)  $NaCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + NaNO_3(aq)$

186) When a catalyst is added to a system at equilibrium, a decrease occurs in

- (a) the heat of the reaction  
(b) activation energy  
(c) potential energy of the reactants  
(d) potential energy of the products

182) If 20 milliliters of a 1.0 M solution of  $HCl$  is exactly neutralized by 40 milliliters of  $NaOH$ , the molarity of the  $NaOH$  solution is

- (a) 1.0 M (c) 0.50 M  
(b) 2.0 M (d) 4.0 M

183) At 1 atm and 298 K, which of the  $K_a$  values listed below represents the strongest acid?

- (a)  $1.1 \times 10^{-7}$  (c)  $5.6 \times 10^{-11}$   
(b)  $1.8 \times 10^{-9}$  (d)  $4.5 \times 10^{-4}$

184) What is the correct formula for magnesium fluoride?

- (a)  $MgF$   
(b)  $Mg_2F$   
(c)  $MgF_2$   
(d)  $MgF_3$

157) Which reaction is matched correctly with the particle represented by letter X?

- (a)  $^{226}_{88}\text{Ra} \rightarrow ^{222}_{86}\text{Rn} + X$ ; X is an alpha particle.  
 (b)  $^{234}_{90}\text{Th} \rightarrow ^{234}_{91}\text{Pa} + X$ ; X is an alpha particle.  
 (c)  $^{230}_{90}\text{Th} \rightarrow ^{226}_{88}\text{Ra} + X$ ; X is a beta particle.  
 (d)  $^{234}_{92}\text{U} \rightarrow ^{230}_{92}\text{Th} + X$ ; X is a beta particle.

158) In which pair of elements do the nuclei of the atoms contain the same number of neutrons?

- (a)  $^7_3\text{Li}$  and  $^9_4\text{Be}$  (c)  $^{23}_{11}\text{Na}$  and  $^{24}_{12}\text{Mg}$   
 (b)  $^{14}_7\text{N}$  and  $^{16}_8\text{O}$  (d)  $^{32}_{16}\text{S}$  and  $^{35}_{17}\text{Cl}$

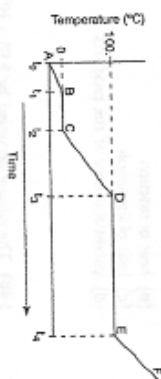
159) Which type of radiation is most similar to high-energy x rays?

- (a) alpha (c) neutron  
 (b) beta (d) gamma

160) Which changes in pressure and temperature occur as a given mass of gas at 380 torr and 546 K is changed to STP?

- (a) The pressure is doubled and the temperature is halved.  
 (b) The pressure is halved and the temperature is doubled.  
 (c) Both the pressure and the temperature are doubled.  
 (d) Both the pressure and the temperature are halved.

161) The graph below shows the change in temperature of water in an open container as heat is added at a constant rate.



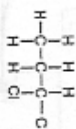
What is the pressure of the system at the temperature represented by segment DE?

- (a) 0 torr  
 (b) between 0 and 760 torr  
 (c) 760 torr  
 (d) more than 760 torr

162) During a fission reaction, which type of particle is captured by a nucleus?

- (a) deuteron (c) neutron  
 (b) electron (d) proton

163) Given the compound:



Which structural formula represents an isomer?

- (a)  $\begin{array}{c} \text{H} & \text{H} & \text{H} & \text{H} \\ | & | & | & | \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{H} \\ | & | & & | \\ \text{H} & \text{H} & & \text{Cl} \end{array}$  (b)  $\begin{array}{c} \text{H} & \text{H} & \text{H} & \text{H} \\ | & | & | & | \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{H} \\ | & | & & | \\ \text{H} & \text{H} & & \text{Cl} \end{array}$   
 (c)  $\begin{array}{c} \text{H} & \text{H} & \text{H} & \text{H} \\ | & | & | & | \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{H} \\ | & | & & | \\ \text{H} & \text{H} & & \text{Cl} \end{array}$  (d)  $\begin{array}{c} \text{H} & \text{H} & \text{H} & \text{H} \\ | & | & | & | \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{H} \\ | & | & & | \\ \text{H} & \text{H} & & \text{Cl} \end{array}$

164) The pH of a 0.1 M solution is 11. What is the concentration of  $\text{H}_3\text{O}^+$  ions, in moles per liter?

- (a)  $1 \times 10^{-1}$  (c)  $1 \times 10^{-11}$   
 (b)  $1 \times 10^{-3}$  (d)  $1 \times 10^{-13}$

165) Which relationship is present in a solution that has a pH of 7?

- (a)  $[\text{H}^+] = [\text{OH}^-]$  (c)  $[\text{H}^+] < [\text{OH}^-]$   
 (b)  $[\text{H}^+] > [\text{OH}^-]$  (d)  $[\text{H}^+] + [\text{OH}^-] = K_w$

166) Given the reaction at equilibrium:



What happens as  $\text{KI}(s)$  is added to the solution?

- (a) The concentration of  $\text{Ag}^+(aq)$  decreases and the concentration of  $\text{I}^-(aq)$  increases.  
 (b) The concentration of  $\text{Ag}^+(aq)$  decreases and the concentration of  $\text{I}^-(aq)$  remains the same.  
 (c) The concentration of  $\text{Ag}^+(aq)$  increases and the concentration of  $\text{I}^-(aq)$  increases.  
 (d) The concentration of  $\text{Ag}^+(aq)$  increases and the concentration of  $\text{I}^-(aq)$  remains the same.

167) Given the reaction:



What is the total number of moles of aluminum oxide that can be formed when 54 grams of aluminum reacts completely with oxygen?

- (a) 1.0 mole (c) 3.0 moles  
 (b) 2.0 moles (d) 4.0 moles

168) An 80-gram sample of water at  $10^\circ\text{C}$  absorbs 400. calories of heat energy. What is the final temperature of the water?

- (a)  $50^\circ\text{C}$  (c)  $5.0^\circ\text{C}$   
 (b)  $15^\circ\text{C}$  (d)  $4.0^\circ\text{C}$

169) If 11 grams of a gas occupies 5.6 liters at STP, what is its gram molecular mass?

- (a) 11 g/mol (c) 44 g/mol  
 (b) 22 g/mol (d) 88 g/mol

187) Given the reaction:



Which change would increase the rate of this reaction?

- (a) a decrease in pressure
- (b) an increase in pressure
- (c) a decrease in temperature
- (d) an increase in temperature

189) What is the volume occupied by 2.00 moles of  $Ar(g)$  at STP?

- (a) 22.4 L
- (b) 44.8 L
- (c) 89.6 L
- (d) 179 L

190) A compound has an empirical formula of  $HCO_2$  and a molecular mass of 90. grams per mole. What is the molecular formula of this compound?

- (a)  $HCO$
- (b)  $H_2C_2O_4$
- (c)  $H_4C_4O_8$
- (d)  $H_6C_6O_{12}$

188) What is the percent by mass of water present in 1.0 mole of  $CaSO_4 \cdot 2H_2O$ ?

- (a) 10%
- (b) 12%
- (c) 21%
- (d) 79%

For questions 191-192

pH Levels

$[H_3O^+]$	pH	Example
$1 \times 10^0$	0	HCl (4%)
$1 \times 10^{-1}$	1	Stomach acid
$1 \times 10^{-2}$	2	Lemon juice
$1 \times 10^{-3}$	3	Vinegar
$1 \times 10^{-4}$	4	Soda
$1 \times 10^{-5}$	5	Rainwater
$1 \times 10^{-6}$	6	Milk
$1 \times 10^{-7}$	7	Pure water
$1 \times 10^{-8}$	8	Egg whites
$1 \times 10^{-9}$	9	Baking soda
$1 \times 10^{-10}$	10	Ammonia
$1 \times 10^{-11}$	11	
$1 \times 10^{-12}$	12	Drain cleaner
$1 \times 10^{-13}$	13	$NaOH$ (4%)
$1 \times 10^{-14}$	14	

191) Which substance is the most basic?

- (a) Egg whites
- (b) Water
- (c) Lemon juice
- (d) Vinegar

192) Which substance is the most acidic?

- (a) Baking soda
- (b) Drain cleaner
- (c) Milk
- (d) Rainwater

193) Given the reaction:



What is the maximum number of moles of  $H_2O$  that can be produced when 2.0 moles of  $NH_3$  are completely reacted?

- (a) 1.0
- (b) 2.0
- (c) 3.0
- (d) 5.0

194) The observed regularities in the properties of elements are periodic functions of their

- (a) atomic numbers
- (b) mass numbers
- (c) oxidation states
- (d) nonvalence electrons

195) The elements calcium and strontium have similar chemical properties because they both have the same

- (a) atomic number
- (b) mass number
- (c) number of valence electrons
- (d) number of completely filled sublevels

196) The element arsenic (As) has the properties of

- (a) metals, only
- (b) nonmetals, only
- (c) both metals and nonmetals
- (d) neither metals nor nonmetals

197) What is the total number of moles of hydrogen atoms contained in 1 mole of  $(NH_4)_2CO_3$ ?

- (a) 6
- (b) 2
- (c) 8
- (d) 4

198) How many grams of sodium are represented by the symbol Na?

- (a) 1.0 g of Na
- (b) 10. g of Na
- (c) 11. g of Na
- (d) 23 g of Na

199) Which electron dot symbol represents the atom in Period 4 with the highest first ionization energy?

- (a)  $\ddot{X}$
- (b)  $\ddot{X} \cdot$
- (c)  $\cdot \ddot{X} \cdot$
- (d)  $\cdot \ddot{X} \cdot \cdot$

200) Which atom in the ground state has only one unpaired electron in its valence shell?

- (a) aluminum
- (b) silicon
- (c) phosphorus
- (d) sulfur

201) When an acid is dissolved in water, it will

- (a) release  $H^+$  ions into the water.
- (b) release  $H^-$  ions into the water.
- (c) release  $OH^-$  ions into the water.
- (d) not release ions into the water.

202) Which nuclear equation represents beta decay?

- (a)  ${}_{27}^{27}Al + {}_2^4He \rightarrow {}_{30}^{30}P + {}_0^1n$
- (b)  ${}_{92}^{238}U \rightarrow {}_{90}^{234}Th + {}_2^4He$
- (c)  ${}_{14}^{14}C \rightarrow {}_{14}^{14}N + {}_{-1}^0e$
- (d)  ${}_{37}^{87}Ar + {}_0^{-1}e \rightarrow {}_{37}^{86}Cl$

- 232) When  $\text{NH}_4\text{NO}_3$  is added to water, an acidic solution forms. This process is referred to as
- (a) dehydration (c) hydrolysis  
(b) electrolysis (d) neutralization

233) Under the same conditions of temperature and pressure, which sample contains particles having the lowest entropy?

- (a)  $\text{CO}_2(\text{g})$  (c)  $\text{CO}_2(\text{s})$   
(b)  $\text{CO}_2(\ell)$  (d)  $\text{CO}_2(\text{aq})$

234) When an equilibrium exists between the dissolved and the undissolved solute in a solution, the solution must be

- (a) diluted (c) supersaturated  
(b) saturated (d) unsaturated

235) Given the reaction:



An increase in the concentration of  $\text{A}_2(\text{g})$  will

- (a) decrease the production of  $\text{AB}(\text{g})$   
(b) decrease the frequency of collisions between  $\text{A}_2(\text{g})$  and  $\text{B}_2(\text{g})$   
(c) increase the production of  $\text{B}_2(\text{g})$   
(d) increase the frequency of collisions between  $\text{A}_2(\text{g})$  and  $\text{B}_2(\text{g})$

236) Given the reaction:



At which temperature will the reaction occur at the greatest rate?

- (a) 25°C (c) 75°C  
(b) 50°C (d) 100°C

237) At STP, what is the total volume occupied by a 2.00-gram sample of  $\text{H}_2(\text{g})$ ?

- (a) 1.00 L (c) 11.2 L  
(b) 2.00 L (d) 22.4 L

238) What is the total number of grams of HI in 0.500 liter of 1.00 M HI?

- (a) 1.00 g (c) 54.0 g  
(b) 0.500 g (d) 128 g

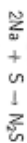
239) Which compound contains the greatest percentage of chlorine by mass?

- (a) HCl (c)  $\text{FeCl}_3$   
(b) NaCl (d)  $\text{ZnCl}_2$

240) What is the gram formula mass of  $\text{Ca}_3(\text{PO}_4)_2$ ?

- (a) 196 g (c) 245 g  
(b) 214 g (d) 310 g

241) Given the balanced equation:



What is the total number of moles of S that reacted when 4.0 moles of Na were completely consumed?

- (a) 1.0 mole (c) 0.5 mole  
(b) 2.0 moles (d) 4.0 moles

242) What occurs when a coordinate covalent bond is formed between nitrogen and hydrogen in the ammonium ion,  $\text{NH}_4^{+7}$ ?

- (a) Hydrogen provides a pair of electrons to be shared with nitrogen.  
(b) Nitrogen provides a pair of electrons to be shared with hydrogen.  
(c) Hydrogen transfers a pair of electrons to nitrogen.  
(d) Nitrogen transfers a pair of electrons to hydrogen.

243) Given the reaction:



Which statement best describes the reaction?

- (a) A bond is formed and energy is absorbed.  
(b) A bond is formed and energy is released.  
(c) A bond is broken and energy is absorbed.  
(d) A bond is broken and energy is released.

244) In which two atoms do both nuclides contain the same number of neutrons?

- |   |   |
|---|---|
| (a) $^{20}_{10}\text{Ne}$ and $^{18}_{10}\text{Ar}$ | (c) $^{24}_{12}\text{Mg}$ and $^{26}_{12}\text{Mg}$ |
| (b) $^{65}_{29}\text{Cu}$ and $^{65}_{30}\text{Zn}$ | (d) $^{14}_6\text{C}$ and $^{16}_8\text{O}$         |

245) An experiment in which alpha particles were used to bombard thin sheets of gold foil led to the conclusion that an atom is composed mostly of

- (a) empty space and has a small, negatively charged nucleus  
(b) empty space and has a small, positively charged nucleus  
(c) a large, dense, positively charged nucleus  
(d) a large, dense, negatively charged nucleus

246) What is the charge and mass of a proton?

- (a) charge of +1 and mass of 1 amu  
(b) charge of +1 and mass of  $\frac{1}{1836}$  amu  
(c) charge of -1 and mass of 1 amu  
(d) charge of -1 and mass of  $\frac{1}{1836}$  amu

247) An example of a binary compound is

- (a) He (c)  $\text{H}_2$   
(b)  $\text{H}_2\text{O}$  (d)  $\text{H}_2\text{SO}_4$

248) Which sample of Fe contains particles having the highest average kinetic energy?

- (a) 5 g at 10°C (c) 5 g at 400 K  
(b) 10 g at 25°C (d) 10 g at 300 K

249) Which phase change at STP represents sublimation?

- (a)  $\text{CO}_2(\text{s}) \rightarrow \text{CO}_2(\text{g})$  (c)  $\text{CO}_2(\ell) \rightarrow \text{CO}_2(\text{g})$   
(b)  $\text{H}_2\text{O}(\text{s}) \rightarrow \text{H}_2\text{O}(\ell)$  (d)  $\text{H}_2\text{O}(\ell) \rightarrow \text{H}_2\text{O}(\text{s})$

215) Which solid's solubility is inversely related to temperature?

- (a) Calcium Chloride
- (b) Ammonium Chloride
- (c) Sodium Chloride
- (d) Cerium Chloride

216) How many milliliters of 0.010 M NaOH are required to exactly neutralize 20.0 milliliters of 0.020 M HCl?

- (a) 10 mL
- (b) 20 mL
- (c) 30 mL
- (d) 40 mL

217) In a reversible chemical reaction, which factors must be equal when the reaction is at equilibrium?

- (a) rate at which reactants are formed and rate at which products are formed
- (b) concentration of reactants and concentration of products
- (c) potential energy of reactants and potential energy of products
- (d) activation energy of reactants and activation energy of products

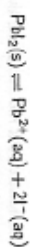
218) Given the reaction:



Which statement describes the reverse reaction?

- (a) It is endothermic and releases 68.3 kilocalories.
- (b) It is endothermic and absorbs 68.3 kilocalories.
- (c) It is exothermic and releases 68.3 kilocalories.
- (d) It is exothermic and absorbs 68.3 kilocalories.

219) Given the solution at equilibrium:



The addition of which nitrate salt will cause a decrease in the concentration of  $\text{I}^{-}(\text{aq})$ ?

- (a)  $\text{Pb}(\text{NO}_3)_2$
- (b)  $\text{Ca}(\text{NO}_3)_2$
- (c)  $\text{LiNO}_3$
- (d)  $\text{KNO}_3$

220) A solution is formed by dissolving 45 grams of  $\text{NH}_4\text{Cl}$  in 100 grams of  $\text{H}_2\text{O}$  at  $70^\circ\text{C}$ . Which statement correctly describes this solution?

- (a)  $\text{NH}_4\text{Cl}$  is the solute, and the solution is saturated.
- (b)  $\text{NH}_4\text{Cl}$  is the solute, and the solution is unsaturated.
- (c)  $\text{NH}_4\text{Cl}$  is the solvent, and the solution is saturated.
- (d)  $\text{NH}_4\text{Cl}$  is the solvent, and the solution is unsaturated.

221) A compound consists of 25.9% nitrogen and 74.1% oxygen by mass. What is the empirical formula of the compound?

- (a) NO
- (b)  $\text{NO}_2$
- (c)  $\text{N}_2\text{O}$
- (d)  $\text{N}_2\text{O}_5$

222) What is the gram molecular mass of a gas that has a density of 5.00 grams per liter at STP?

- (a) 27.4 g
- (b) 56.0 g
- (c) 112 g
- (d) 223 g

223) Approximately how many calories of heat are needed to completely change 10 grams of ice to water at the melting point temperature?

- (a) 1 cal
- (b) 8 cal
- (c) 80 cal
- (d) 800 cal

224) Which element has a total of 5 valence electrons present in the fifth energy level?

- (a) Sn
- (b) Bi
- (c) I
- (d) Br

225) Given the unbalanced equation:

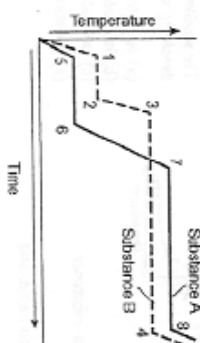


When the equation is correctly balanced using the smallest whole-number coefficients, the coefficient for  $\text{H}_2\text{O}$  is

- (a) 1
- (b) 2
- (c) 3
- (d) 4

For questions 228-229

The graph below shows heat being added at a constant rate to substance A and to substance B, which begin as solids below their melting point temperatures.



228) During which interval is the greatest amount of energy absorbed?

- (a) 1-2
- (b) 2-3
- (c) 3-4
- (d) 7-8

229) Compared to substance B, substance A has a

- (a) lower melting point and a lower boiling point
- (b) lower melting point and a higher boiling point
- (c) higher melting point and a lower boiling point
- (d) higher melting point and a higher boiling point

226) Which sample is composed of particles arranged in a regular geometric pattern?

- (a)  $\text{Cl}_2(\text{g})$
- (b)  $\text{CCl}_4(\ell)$
- (c)  $\text{LiCl}(\text{s})$
- (d)  $\text{LiCl}(\text{aq})$

227) At STP, a 22.4-liter sample of  $\text{NH}_3(\text{g})$  contains the same number of molecules as

- (a) 11.2 L of  $\text{H}_2(\text{g})$
- (b) 22.4 L of  $\text{CO}_2(\text{g})$
- (c) 33.6 L of  $\text{CH}_4(\text{g})$
- (d) 44.8 L of  $\text{O}_2(\text{g})$

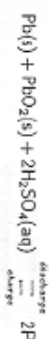
230) As the volume of a fixed mass of a gas increases at constant temperature, the pressure of the gas

- (a) decreases
- (b) increases
- (c) remains the same
- (d) increases

231) As  $\text{HCl}(\text{g})$  is added to water, the pH of the water solution

- (a) decreases
- (b) increases
- (c) remains the same
- (d) increases

257) Given the equation for the overall reaction in a lead-acid storage battery:



Which occurs during the charging of the battery?

- (a) The concentration of  $\text{H}_2\text{SO}_4$  decreases and the number of moles of  $\text{Pb(s)}$  increases.
- (b) The concentration of  $\text{H}_2\text{SO}_4$  decreases and the number of moles of  $\text{H}_2\text{O(l)}$  increases.
- (c) The concentration of  $\text{H}_2\text{SO}_4$  increases and the number of moles of  $\text{Pb(s)}$  decreases.
- (d) The concentration of  $\text{H}_2\text{SO}_4$  increases and the number of moles of  $\text{H}_2\text{O(l)}$  decreases/

259) Given the reaction:



Which is a conjugate acid-base pair?

- (a)  $\text{H}_2\text{O(l)}$  and  $\text{NH}_4^+\text{(aq)}$
- (b)  $\text{H}_2\text{O(l)}$  and  $\text{NH}_3\text{(g)}$

- (c)  $\text{NH}_3\text{(g)}$  and  $\text{OH}^-\text{(aq)}$
- (d)  $\text{NH}_3\text{(g)}$  and  $\text{NH}_4^+\text{(aq)}$

260) Electrostatic attractive forces cause ions of opposite charge to group into a three-dimensional pattern of stacked ions called-

- (a) a crystalline solid.
- (b) a crystal lattice.
- (c) an ionic bond.
- (d) an ionic compound.

262) In a salt crystal,  $\text{NaCl}$ , how does the number of positive sodium ions compare with the number of negative chloride ions?

- (a) The number of positive ions is less than the number of negative ions.
- (b) The number of positive ions is more than the number of negative ions.
- (c) The number of positive ions is equal to the number of negative ions.
- (d) It depends on the particular crystal.

261) If 50.0 milliliters of 3.0 M  $\text{HNO}_3$  completely neutralized 150.0 milliliters of  $\text{KOH}$ , what was the molarity of the  $\text{KOH}$  solution?

- (a) 1.0 M
- (b) 4.5 M
- (c) 3.0 M
- (d) 6.0 M

258) Which materials are naturally occurring polymers?

- (a) nylon and cellulose
- (b) nylon and polyethylene
- (c) starch and cellulose
- (d) starch and polyethylene

263) Which factors must be equal when a reversible chemical process reaches equilibrium?

- (a) mass of the reactants and mass of the products
- (b) rate of the forward reaction and rate of the reverse reaction
- (c) concentration of the reactants and concentration of the products
- (d) activation energy of the forward reaction and activation energy of the reverse reaction

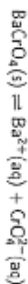
267) Which element has no known stable isotopes?

- (a) Hg
- (b) Po
- (c) Se
- (d) Zn

268) The mass of a calcium atom is due primarily to the mass of its

- (a) protons, only
- (b) neutrons, only
- (c) protons and neutrons
- (d) protons and electrons

264) Given the reaction at equilibrium:



Which substance, when added to the mixture, will cause an increase in the amount of  $\text{BaCrO}_4\text{(s)}$ ?

- (a)  $\text{K}_2\text{CO}_3$
- (b)  $\text{CaCO}_3$
- (c)  $\text{BaCl}_2$
- (d)  $\text{CaCl}_2$

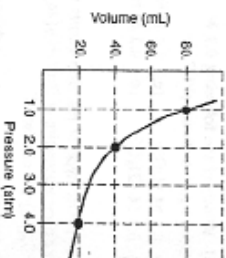
265) The heat of vaporization of a liquid is 320 calories per gram. What is the minimum number of calories needed to change 40.0 grams of the liquid to vapor at the boiling point?

- (a) 8.00
- (b) 320
- (c) 3280
- (d) 12,800

266) The characteristic spectral lines of elements are caused when electrons in an excited atom move from

- (a) lower to higher energy levels, releasing energy
- (b) lower to higher energy levels, absorbing energy
- (c) higher to lower energy levels, releasing energy
- (d) higher to lower energy levels, absorbing energy

269) The graph below represents the relationship between pressure and volume of a given mass of a gas at constant temperature.



The product of pressure and volume is constant. According to the graph, what is the product in  $\text{atm} \cdot \text{mL}$ ?

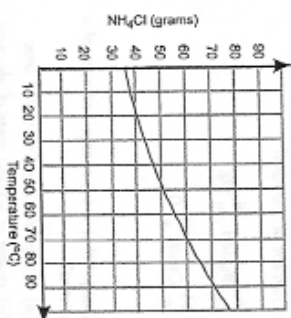
- (a) 20.
- (b) 40.
- (c) 60.
- (d) 80.

270) The volume of a sample of a gas at  $273^\circ\text{C}$  is 200. liters. If the volume is decreased to 100. liters at constant pressure, what will be the new temperature of the gas?

- (a) 0 K
- (b) 100. K
- (c) 273 K
- (d) 546 K

- 250) If 60. liters of hydrogen gas at 546 K is cooled to 273 K at constant pressure, the new volume of the gas will be
- (a) 120 L (c) 30 L  
 (b) 20 L (d) 40 L

251) The graph shows how the amount of ammonium chloride (NH<sub>4</sub>Cl) that can be dissolved in 100 mL of water changes with temperature.



What is the minimum temperature at which 45 grams of ammonium chloride can be dissolved in 100 mL of water?

- (a) 34°C  
 (b) 39°C  
 (c) 44°C  
 (d) 49°C

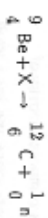
252) The table below shows the data collected by a student as heat was applied at a constant rate to a solid below its freezing point.

Time (min)	Temperature (°C)	Time (min)	Temperature (°C)
0	20	18	44
2	24	20	47
4	28	22	51
6	32	24	54
8	32	26	54
10	32	28	54
12	35	30	54
14	38	32	58
16	41	34	62

What is the boiling point of this substance?

- (a) 32°C (c) 62°C  
 (b) 54°C (d) 100°C

253) Given the nuclear reaction:



What is the identity of particle X?

- (a) alpha particle (c) proton  
 (b) beta particle (d) neutron

254) In which list can all particles be accelerated by an electric field?

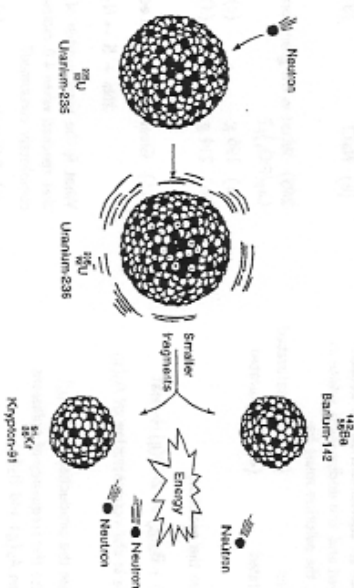
- (a) alpha particles, beta particles, and neutrons  
 (b) alpha particles, beta particles, and protons  
 (c) alpha particles, protons, and neutrons  
 (d) beta particles, protons, and neutrons

255) What are the coefficients that will balance this chemical equation?



- (a) 1, 1, 2, 1  
 (b) 1, 1, 1, 2  
 (c) 1, 2, 1, 2  
 (d) 1, 2, 2, 1

256) The diagram below represents a nuclear reaction in which a neutron bombards a heavy nucleus.



Which type of reaction does the diagram illustrate?

- (a) fission (c) alpha decay  
 (b) fusion (d) beta decay

- 285) What is the total number of moles of sulfur atoms in 1 mole of  $\text{Fe}_2(\text{SO}_4)_3$ ?
- (a) 1 (c) 3  
(b) 15 (d) 17

287) Given the unbalanced equation:



What is the coefficient of  $\text{Al}_2(\text{SO}_4)_3$  when the equation is completely balanced using the smallest whole-number coefficients?

- (a) 1 (c) 3  
(b) 2 (d) 4

288) The molecular formula of a compound is represented by  $\text{X}_3\text{Y}_6$ . What is the empirical formula of this compound?

- (a)  $\text{X}_3\text{Y}$  (c)  $\text{X}_1\text{Y}_2$   
(b)  $\text{X}_2\text{Y}$  (d)  $\text{X}_1\text{Y}_3$

289) Which element has atoms in the ground state with a sublevel that is only half filled?

- (a) helium (c) nitrogen  
(b) beryllium (d) neon

290) What is the total number of electrons in an atom of an element with an atomic number of 18 and a mass number of 40?

- (a) 18 (c) 40  
(b) 22 (d) 58

291) Which electron-dot symbol represents an atom of chlorine in the ground state?

- (a)  $\text{Cl}:$  (c)  $:\ddot{\text{Cl}}:$   
(b)  $:\ddot{\text{Cl}}:$  (d)  $:\ddot{\text{Cl}}:$

292) What volume will a 300.-milliliter sample of a gas at STP occupy when the pressure is doubled at constant temperature?

- (a) 150. mL (c) 300. mL  
(b) 450. mL (d) 600. mL

293) Which phase change is endothermic?

- (a) gas  $\rightarrow$  solid (c) liquid  $\rightarrow$  solid  
(b) gas  $\rightarrow$  liquid (d) liquid  $\rightarrow$  gas

294) Given the phase equilibrium at a pressure of 1 atmosphere:



What is the temperature of the equilibrium mixture?

- (a) 273°C (c) 373°C  
(b) 273 K (d) 373 K

295) Solid A at 80°C is immersed in liquid B at 50°C. Which statement correctly describes the energy changes between A and B?

- (a) A releases heat and B absorbs heat.  
(b) A absorbs heat and B releases heat.  
(c) Both A and B absorb heat.  
(d) Both A and B release heat.

296) In a fusion reaction, reacting nuclei must collide. Collisions between two nuclei are difficult to achieve because the nuclei

- (a) both negatively charged and repel each other  
(b) both positively charged and repel each other  
(c) oppositely charged and attract each other  
(d) oppositely charged and repel each other

297) Given the equation:



Which type of reaction does the equation represent?

- (a) esterification (c) hydrolysis  
(b) decomposition (d) neutralization

298) Given the reaction:



Which statement is true when this closed system reaches equilibrium?

- (a) All of the  $\text{N}_2(g)$  has been consumed.  
(b) All of the  $\text{O}_2(g)$  has been consumed.  
(c) Pressure changes no longer occur.  
(d) The forward reaction no longer occurs.

299) Which statement describes  $\text{KCl}(aq)$ ?

- (a)  $\text{KCl}$  is the solute in a homogeneous mixture.  
(b)  $\text{KCl}$  is the solute in a heterogeneous mixture.  
(c)  $\text{KCl}$  is the solvent in a homogeneous mixture.  
(d)  $\text{KCl}$  is the solvent in a heterogeneous mixture.

300) Given the reaction:



What is the total number of grams of  $\text{O}_2(g)$  needed to react completely with 0.50 mole of  $\text{C}_2\text{H}_2(g)$ ?

- (a) 10. g (c) 80. g  
(b) 40. g (d) 160 g

301) The heat of fusion of a compound is 30.0 calories per gram. What is the total number of calories of heat that must be absorbed by a 15.0-gram sample to change the compound from solid to liquid at its melting point?

- (a) 15.0 cal (c) 150. cal  
(b) 45.0 cal (d) 450. cal

302) Given the incomplete equation:



Which set of products completes and balances the incomplete equation?

- (a)  $2\text{N}_2(g) + \text{O}_2(g)$   
(b)  $2\text{N}_2(g) + \text{O}_2(g)$   
(c)  $4\text{H}_2\text{O}(g) + \text{O}_2(g)$   
(d)  $4\text{H}_2\text{O}(g) + 5\text{O}_2(g)$

303) Which emanation has no mass and no charge?

- (a) alpha (c) gamma  
(b) beta (d) neutron

304) What is the total number of unpaired electrons in an atom of nickel in the ground state?

- (a) 0 (c) 3  
(b) 2 (d) 4

- 2711) A real gas would behave most like an ideal gas under conditions of
- low pressure and low temperature
  - low pressure and high temperature
  - high pressure and low temperature
  - high pressure and high temperature

2713) Which reaction is an organic reaction?

- $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g)$
- $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$
- $3Cu^{2+}(aq) + 2Fe(s) \rightarrow 3Cu(s) + 2Fe^{3+}(aq)$
- $NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$

2714) Which of the following 0.1 M solutions has the lowest pH?

- 0.1 M NaOH
- 0.1 M  $CH_3OH$
- 0.1 M NaCl
- 0.1 M HCl

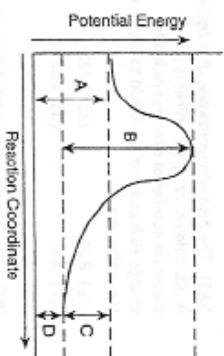
2715) Which type of reaction occurs when 50-milliliter quantities of  $Ba(OH)_2(aq)$  and  $H_2SO_4(aq)$  are combined?

- hydrolysis
- ionization
- hydrogenation
- neutralization

2722) Which formula represents a saturated compound?

- $C_2H_4$
- $C_2H_2$
- $C_5H_8$
- $C_5H_{12}$

2726) The potential energy diagram of a chemical reaction is shown below.



Which arrow represents the part of the reaction most likely to be affected by the addition of a catalyst?

- A
- B
- C
- D

2777) Given the reaction at equilibrium:



Which stress would cause the equilibrium to shift to the left?

- increasing the temperature
- increasing the pressure
- adding  $N_2(g)$  to the system
- adding  $H_2(g)$  to the system

2780) Beaker A contains a 1-gram piece of zinc and beaker B contains 1 gram of powdered zinc. If 100 milliliters of 0.1 M HCl is added to each of the beakers, how does the rate of reaction in beaker A compare to the rate of reaction in beaker B?

- The rate in A is greater due to the smaller surface area of the zinc.
- The rate in A is greater due to the larger surface area of the zinc.
- The rate in B is greater due to the smaller surface area of the zinc.
- The rate in B is greater due to the larger surface area of the zinc.

2799) Given the reaction:



What is the minimum number of grams of oxygen gas required to produce 1.00 mole of aluminum oxide?

- 32.0 g
- 48.0 g
- 96.0 g
- 192 g

2800) A 20-milliliter sample of 0.60 M HCl is diluted with water to a volume of 40. milliliters. What is the new concentration of the solution?

- 0.15 M
- 0.60 M
- 0.30 M
- 1.2 M

2811) The properties of silicon are characteristic of

- a metal, only
- a nonmetal, only
- both a metal and a nonmetal
- neither a metal nor a nonmetal

2823) In which set do the elements exhibit the most similar chemical properties?

- N, O, and F
- Hg, Br, and Rh
- Li, Na, and K
- Al, Si, and P

2833) As the elements in Group 15 are considered in order of increasing atomic number, which sequence in properties occurs?

- nonmetal  $\rightarrow$  metalloid  $\rightarrow$  metal
- metalloid  $\rightarrow$  metal  $\rightarrow$  nonmetal
- metal  $\rightarrow$  metalloid  $\rightarrow$  nonmetal
- metal  $\rightarrow$  nonmetal  $\rightarrow$  metalloid

2844) The symmetrical structure of the  $CH_4$  molecule is due to the fact that the four single bonds between carbon and hydrogen atoms are directed toward the corners of a

- triangle
- tetrahedron
- square
- rectangle

2855) The elements Li and F combine to form an ionic compound. The electron configurations in this compound are the same as the electron configurations of atoms in Group

- 1
- 14
- 17
- 18

321) The bond between hydrogen and oxygen in a water molecule is classified as

- (a) ionic and nonpolar
- (b) ionic and polar
- (c) covalent and nonpolar
- (d) covalent and polar

322) When ionic bonds are formed, metallic atoms tend to

- (a) lose electrons and become negative ions
- (b) lose electrons and become positive ions
- (c) gain electrons and become negative ions
- (d) gain electrons and become positive ions

323) The ability to conduct electricity in the solid state is a characteristic of metallic bonding. This characteristic is best explained by the presence of

- (a) high ionization energies
- (b) high electronegativities
- (c) mobile electrons
- (d) mobile protons

324) Atoms of which element have the weakest attraction for electrons?

- (a) Na
- (b) P
- (c) Si
- (d) S

325) What is the total number of hydrogen atoms required to form 1 molecule of  $C_2H_5(OH)_3$ ?

- (a) 1
- (b) 5
- (c) 3
- (d) 8

326) Which subatomic particle is found in the nucleus of all isotopes of hydrogen?

- (a) proton
- (b) neutron
- (c) electron
- (d) positron

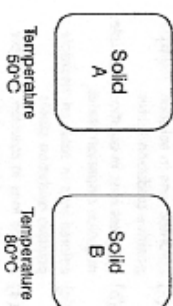
327) In the equation  ${}^{234}\text{Th} \rightarrow {}^{234}\text{Pa} + X$  the symbol X represents

- (a)  $0 \ e^+ \ n$
- (b)  $0 \ e^- \ n$
- (c)  $1 \ 0 \ n \ n$
- (d)  $1 \ 1 \ H^+ \ n$

328) A gas sample has a volume of 25.0 milliliters at a pressure of 1.00 atmosphere. If the volume increases to 50.0 milliliters and the temperature remains constant, the new pressure will be

- (a) 1.00 atm
- (b) 2.00 atm
- (c) 0.250 atm
- (d) 0.500 atm

329) The diagrams below represent two solids and the temperature of each.



What occurs when the two solids are placed in contact with each other?

- (a) Heat energy flows from solid A to solid B. Solid A decreases in temperature.
- (b) Heat energy flows from solid A to solid B. Solid A increases in temperature.
- (c) Heat energy flows from solid B to solid A. Solid B decreases in temperature.
- (d) Heat energy flows from solid B to solid A. Solid B increases in temperature.

330) The reaction during which monomers are combined and water is released is called

- (a) saponification
- (b) neutralization
- (c) addition polymerization
- (d) condensation polymerization

331) Given the unbalanced equation:



What is the coefficient of  $\text{Ag}_2\text{S}$  when the equation is completely balanced using the smallest whole numbers?

- (a) 6
- (b) 2
- (c) 3
- (d) 4

332) Which acid-base pair will always undergo a reaction that produces a neutral solution?

- (a) a weak acid and a weak base
- (b) a weak acid and a strong base
- (c) a strong acid and a weak base
- (d) a strong acid and a strong base

333) Given the reaction:



How many milliliters of 1 M NaOH are needed to exactly neutralize 100 milliliters of 1 M  $\text{H}_2\text{SO}_4$ ?

- (a) 50 mL
- (b) 200 mL
- (c) 300 mL
- (d) 400 mL

334) When HCl is dissolved in water, the only positive ion present in the solution is the

- (a) hydrogen ion
- (b) hydroxide ion
- (c) hydride ion
- (d) chloride ion

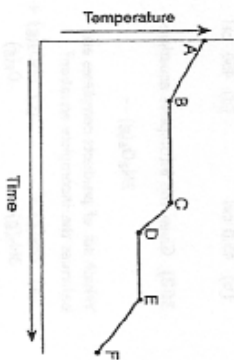
335) Given the solution at equilibrium:



When  $\text{Na}_2\text{SO}_4$  is added to the system, how will the equilibrium shift?

- (a) The amount of  $\text{CaSO}_4(\text{s})$  will decrease, and the concentration of  $\text{Ca}^{2+}(\text{aq})$  will decrease.
- (b) The amount of  $\text{CaSO}_4(\text{s})$  will decrease, and the concentration of  $\text{Ca}^{2+}(\text{aq})$  will increase.
- (c) The amount of  $\text{CaSO}_4(\text{s})$  will increase, and the concentration of  $\text{Ca}^{2+}(\text{aq})$  will decrease.
- (d) The amount of  $\text{CaSO}_4(\text{s})$  will increase, and the concentration of  $\text{Ca}^{2+}(\text{aq})$  will increase.

305) The graph below represents the uniform cooling of a substance, starting with the substance as a gas above its boiling point.



During which interval is the substance completely in the liquid phase?

- (a) AB  
(b) BC  
(c) CD  
(d) DE

306) At 1 atmosphere of pressure, the steam-water equilibrium occurs at a temperature of

- (a) 0 K  
(b) 100 K  
(c) 273 K  
(d) 373 K

307) The energy absorbed when ammonium chloride dissolves in water can be measured in

- (a) degrees  
(b) kilocalories  
(c) moles per liter  
(d) liters per mole

308) Given the closed system at equilibrium:



As the pressure on the system increases, the solubility of the  $\text{CO}_2(\text{g})$

- (a) decreases  
(b) increases  
(c) remains the same

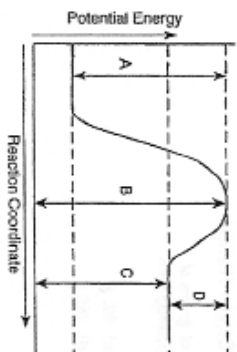
309) As the number of neutrons in the nucleus of a given atom of an element increases, the atomic number of that element

- (a) decreases  
(b) increases  
(c) remains the same

310) How many milliliters of 0.20 M HCl are needed to exactly neutralize 40. milliliters of 0.40 M KOH?

- (a) 20. mL  
(b) 40. mL  
(c) 80. mL  
(d) 160 mL

For question 311



311) The forward reaction is best described as an

- (a) endothermic reaction in which energy is released  
(b) exothermic reaction in which energy is absorbed  
(c) endothermic reaction in which energy is released  
(d) endothermic reaction in which energy is absorbed

312) An increase in the temperature of a system at equilibrium favors the

- (a) endothermic reaction and decreases its rate  
(b) endothermic reaction and increases its rate  
(c) exothermic reaction and decreases its rate  
(d) exothermic reaction and increases its rate

313) Given the reaction at equilibrium:



When the reaction is subjected to stress, a change will occur in the concentration of

- (a) reactants, only  
(b) products, only  
(c) both reactants and products  
(d) neither reactants nor products

314) What is the concentration of a solution of 10. moles of copper (II) nitrate in 5.0 liters of solution?

- (a) 0.50 M  
(b) 2.0 M  
(c) 5.0 M  
(d) 10. M

315) Given the unbalanced equation:



When the equation is balanced using smallest whole-number coefficients, the ratio of moles of hydrogen consumed to moles of ammonia produced is

- (a) 1:3  
(b) 2:3  
(c) 3:1  
(d) 3:2

316) The gram atomic mass of oxygen is 16.0 grams per mole. How many atoms of oxygen does this mass represent?

- (a) 16.0  
(b) 32.0  
(c)  $6.02 \times 10^{23}$   
(d)  $2(6.02 \times 10^{23})$

317) Which element is classified as a metalloid (semimetal)?

- (a) sulfur  
(b) silicon  
(c) barium  
(d) bromine

318) As the elements in Group 2 are considered in order of increasing atomic number, the atomic radius of each successive element increases. This increase is primarily due to an increase in the number of

- (a) occupied principal energy levels  
(b) electrons in the outermost shell  
(c) neutrons in the nucleus  
(d) unpaired electrons

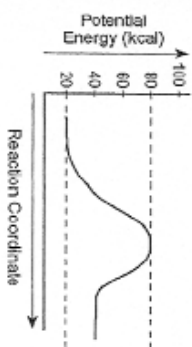
319) Which of these Group 14 elements has the most metallic properties?

- (a) C  
(b) Ge  
(c) Si  
(d) Sn

320) According to the Periodic Table, which element has more than one positive oxidation state?

- (a) cadmium  
(b) iron  
(c) silver  
(d) zinc

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



What is the difference between the potential energy of the reactants and the potential energy of the products?

- (a) 20 kcal  
(b) 40 kcal  
(c) 60 kcal  
(d) 80 kcal

355) An increase in the surface area of reactants in a heterogeneous reaction will result in

- (a) a decrease in the rate of the reaction  
(b) an increase in the rate of the reaction  
(c) a decrease in the heat of reaction  
(d) an increase in the heat of reaction

356) Given the system at equilibrium:



Which change will *not* shift the point of equilibrium?

- (a) changing the pressure  
(b) changing the temperature  
(c) changing the concentration of  $\text{H}_2(\text{g})$   
(d) changing the concentration of  $\text{HF}(\text{g})$

357) What is the molarity of a solution that contains 40. grams of  $\text{NaOH}$  in 0.50 liter of solution?

- (a) 1.0 M  
(b) 2.0 M  
(c) 0.50 M  
(d) 0.25 M

358) Given the balanced equation:



What total mass of iron is necessary to produce 1.00 mole of copper?

- (a) 25.0 g  
(b) 55.8 g  
(c) 112 g  
(d) 192 g

359) What occurs as the atomic number of the elements in Period 2 increases?

- (a) The nuclear charge of each successive atom decreases, and the covalent radius decreases.  
(b) The nuclear charge of each successive atom decreases, and the covalent radius increases.  
(c) The nuclear charge of each successive atom increases, and the covalent radius decreases.  
(d) The nuclear charge of each successive atom increases, and the covalent radius increases.

360) What is the total number of molecules in a 0.5mole sample of He gas?

- (a)  $6 \times 10^{23}$   
(b)  $2 \times 10^{23}$   
(c)  $3 \times 10^{23}$   
(d)  $4 \times 10^{23}$

361) Atoms of metals tend to

- (a) lose electrons and form negative ions  
(b) lose electrons and form positive ions  
(c) gain electrons and form negative ions  
(d) gain electrons and form positive ions

362) Elements in the Periodic Table are arranged according to their

- (a) atomic number  
(b) atomic mass  
(c) relative activity  
(d) relative size

- 336) Which change in a sample of water is accompanied by the greatest increase in entropy?
- (a)  $\text{H}_2\text{O}(l)$  at  $100^\circ\text{C}$  is changed to  $\text{H}_2\text{O}(g)$  at  $200^\circ\text{C}$ .  
 (b)  $\text{H}_2\text{O}(g)$  at  $100^\circ\text{C}$  is changed to  $\text{H}_2\text{O}(g)$  at  $200^\circ\text{C}$ .  
 (c)  $\text{H}_2\text{O}(s)$  at  $-100^\circ\text{C}$  is changed to  $\text{H}_2\text{O}(s)$  at  $0^\circ\text{C}$ .  
 (d)  $\text{H}_2\text{O}(s)$  at  $-100^\circ\text{C}$  is changed to  $\text{H}_2\text{O}(l)$  at  $0^\circ\text{C}$ .

337) Adding a catalyst to a chemical reaction changes the rate of reaction by causing

- (a) a decrease in the activation energy  
 (b) an increase in the activation energy  
 (c) a decrease in the heat of reaction  
 (d) an increase in the heat of reaction

338) The properties of carbon are expected to be most similar to those of

(a) boron (c) silicon  
 (b) aluminum (d) phosphorus

339) An atom with the electron configuration  $1s^2 2s^2 2p^6 3s^2$  would most likely

- (a) decrease in size as it forms a positive ion  
 (b) increase in size as it forms a positive ion  
 (c) decrease in size as it forms a negative ion  
 (d) increase in size as it forms a negative ion

340) Which set of properties is most characteristic of transition elements?

- (a) colorless ions in solution, multiple positive oxidation states  
 (b) colorless ions in solution, multiple negative oxidation states  
 (c) colored ions in solution, multiple positive oxidation states  
 (d) colored ions in solution, multiple negative oxidation states

341) At which location in the Periodic Table would the most active metallic element be found?

- (a) in Group 1 at the top  
 (b) in Group 1 at the bottom  
 (c) in Group 17 at the top  
 (d) in Group 17 at the bottom

342) An element has a first ionization energy of 314 kilocalories/mole and an electronegativity of 3.5. It is classified as a

- (a) metal (c) metalloid  
 (b) nonmetal (d) halogen

343) Which atom will form an ionic bond with a Br atom?

- (a) N (c) O  
 (b) Li (d) C

344) Which atoms are isotopes of the same element?

- (a)  $^{24}\text{X}$  and  $^{12}\text{X}$  (c)  $^{31}\text{X}$  and  $^{32}\text{X}$   
 (b)  $^{20}\text{X}$  and  $^{20}\text{X}$  (d)  $^{31}\text{X}$  and  $^{31}\text{X}$

345) Which subatomic particles have a mass of approximately 1 atomic mass unit each?

- (a) proton and electron  
 (b) proton and neutron  
 (c) neutron and positron  
 (d) electron and positron

346) Which change of phase is exothermic?

- (a) solid to liquid (c) solid to gas  
 (b) gas to liquid (d) liquid to gas

347) Which term represents a form of energy?

- (a) heat (c) kilocalorie  
 (b) degree (d) temperature

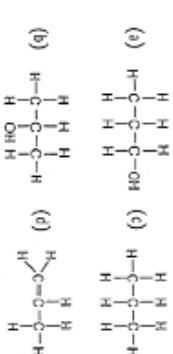
348) As energy is released during the formation of a bond, the stability of the chemical system generally will

- (a) decrease (c) remain the same  
 (b) increase (d) increase

349) As a solid substance absorbs heat at its melting point, the melting point will

- (a) decrease (c) remain the same  
 (b) increase (d) increase

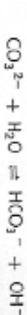
350) Which structural formula represents a saturated hydrocarbon?



351) Proteins are produced through the process of

- (a) addition (c) polymerization  
 (b) substitution (d) combustion

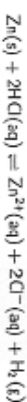
352) Given the reaction:



Which species is the strongest conjugate base?

- (a)  $\text{CO}_3^{2-}$  (c)  $\text{HCO}_3^-$   
 (b)  $\text{H}_2\text{O}$  (d)  $\text{OH}^-$

353) Given the reaction:

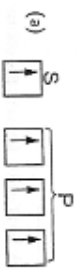
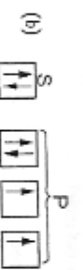
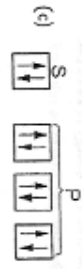
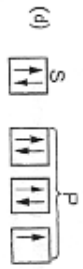


If the concentration of the  $\text{HCl}(aq)$  is increased, the frequency of reacting collisions will

- (a) decrease, producing a decrease in the reaction rate  
 (b) decrease, producing an increase in the reaction rate  
 (c) increase, producing a decrease in the reaction rate  
 (d) increase, producing an increase in the reaction rate

## Chemistry Standards Practice Test2

## Section 1 - Multiple Choice

- 1) Which of the following elements has the strongest attraction for electrons?  
 (a) boron (c) oxygen  
 (b) aluminum (d) sulfur
- 2) Which particles may be gained, lost, or shared by an atom when it forms a chemical bond?  
 (a) protons (c) neutrons  
 (b) electrons (d) nucleons
- 3) Which atom in the ground state has three half-filled orbitals?  
 (a) P (c) Al  
 (b) Si (d) Li
- 4) What is the total number of valence electrons in an atom of boron in the ground state?  
 (a) 1 (c) 3  
 (b) 7 (d) 5
- 5) What is the total number of protons and neutrons in an atom of  $^{85}_{37}\text{Rb}$ ?  
 (a) 37 (c) 86  
 (b) 49 (d) 123
- 6) Which type of radiation has zero mass and zero charge?  
 (a) alpha (c) neutron  
 (b) beta (d) gamma
- 7) Which orbital notation correctly represents a noble gas in the ground state?
- (a) 
- (b) 
- (c) 
- (d) 
- 8) As the temperature of a gas is increased from  $0^\circ$  to  $10^\circ$  C at constant pressure, the volume of the gas will  
 (a) increase by  $\frac{1}{273}$  (c) decrease by  $\frac{1}{273}$   
 (b) increase by  $\frac{10}{273}$  (d) decrease by  $\frac{10}{273}$
- 9) In the reaction  $\text{NH}_3 + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4^+ + \text{OH}^-$ , a conjugate acid-base pair is  
 (a)  $\text{NH}_3$  and  $\text{H}_2\text{O}$  (c)  $\text{H}_2\text{O}$  and  $\text{NH}_4^+$   
 (b)  $\text{NH}_3$  and  $\text{OH}^-$  (d)  $\text{H}_2\text{O}$  and  $\text{OH}^-$

- 10) What is the molarity of a nitric acid solution,  $\text{HNO}_3$ , if 20.0 mL of the solution is needed to 3 exactly neutralize 10.0 mL of a 1.67 M NaOH solution?  
 (a) 3.34 M (c) 0.835 M  
 (b) 1.67 M (d) 0.334 M

- 11) The pH of a solution that is formed by the neutralization of 1.0 M  $\text{H}_2\text{SO}_4$  and 1.0 M KOH is closest to  
 (a) 1 (c) 10  
 (b) 7 (d) 4

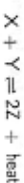
- 12) Given the system at equilibrium:



How will the addition of  $\text{Na}_2\text{CO}_3(\text{aq})$  affect  $[\text{Pb}^{2+}](\text{aq})$  and the mass of  $\text{PbCO}_3(\text{s})$ ?

- (a)  $[\text{Pb}^{2+}](\text{aq})$  will decrease and the mass of  $\text{PbCO}_3(\text{s})$  will decrease.  
 (b)  $[\text{Pb}^{2+}](\text{aq})$  will decrease and the mass of  $\text{PbCO}_3(\text{s})$  will increase.  
 (c)  $[\text{Pb}^{2+}](\text{aq})$  will increase and the mass of  $\text{PbCO}_3(\text{s})$  will increase.  
 (d)  $[\text{Pb}^{2+}](\text{aq})$  will increase and the mass of  $\text{PbCO}_3(\text{s})$  will increase.

- 13) Given the reaction at equilibrium:



The concentration of the product could be increased by

- (a) adding a catalyst  
 (b) adding more heat to the system  
 (c) increasing the concentration of Y  
 (d) decreasing the concentration of X

- 14) Which statement describes the elements in Period 3?

- (a) Each successive element has a greater atomic radius.  
 (b) Each successive element has a lower electronegativity.  
 (c) All elements have similar chemical properties.  
 (d) All elements have valence electrons in the same principal energy level.

- 15) An element with a partially filled  $d$  sublevel in the ground state is classified as

- (a) halogen  
 (b) a transition metal  
 (c) an alkali metal  
 (d) an alkaline earth metal

- 16) When compared to  $\text{H}_2\text{S}$ ,  $\text{H}_2\text{O}$  has a higher boiling point because  $\text{H}_2\text{O}$  contains stronger

- (a) metallic bonds (c) ionic bonds  
 (b) covalent bonds (d) hydrogen bonds

- 17) Which type of bond is formed when an atom of potassium transfers an electron to a bromine atom?

- (a) metallic (c) nonpolar covalent  
 (b) ionic (d) polar covalent

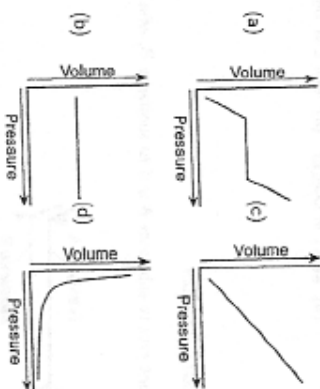
- 18) What is the nuclear charge of an iron atom?

- (a) +26 (c) +56  
 (b) +30 (d) +82

203) What is the total number of electrons needed to completely fill all of the orbitals in an atom's second principal energy level?

- (a) 16  
(b) 2  
(c) 8  
(d) 4

204) Which graph best shows the change in the volume of 1 mole of nitrogen gas as pressure increases and temperature remains constant?



205) Which statement best describes the molecules of H<sub>2</sub>O in the solid phase?

- (a) They move slowly in straight lines.  
(b) They move rapidly in straight lines.  
(c) They are arranged in a regular geometric pattern.  
(d) They are arranged in a random pattern.

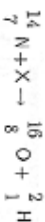
207) A sample of oxygen gas in a closed system has a volume of 200 milliliters at 600 K. If the pressure is held constant and the temperature is lowered to 300 K, the new volume of the gas will be

- (a) 100 mL  
(b) 200 mL  
(c) 300 mL  
(d) 400 mL

208) A student observed that when sodium hydroxide was dissolved in water, the temperature of the water increased. The student should conclude that the dissolving of sodium hydroxide

- (a) is endothermic  
(b) is exothermic  
(c) produces an acid solution  
(d) produces a salt solution

209) Given the nuclear equation:



What is particle X?

- (a) an alpha particle  
(b) a beta particle  
(c) a deuteron  
(d) a triton

210) Given the reaction:



If the temperature is increased and the pressure is kept constant, the new equilibrium concentration will be

- (a) less for NH<sub>3</sub>(g)  
(b) the same for NH<sub>3</sub>(g)  
(c) less for N<sub>2</sub>(g)  
(d) the same for N<sub>2</sub>(g)

211) Given the unbalanced equation:



What is the coefficient of SO<sub>2</sub> when the equation is correctly balanced?

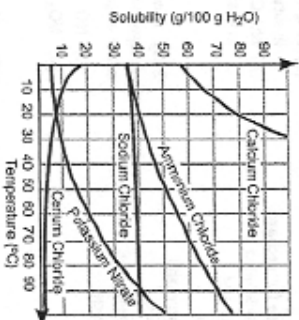
- (a) 1  
(b) 2  
(c) 5  
(d) 8

212) The ability of H<sub>2</sub>SO<sub>4</sub>(aq) to change blue litmus red is mainly due to the presence of

- (a) SO<sub>2</sub> molecules  
(b) H<sub>2</sub>O molecules  
(c) H<sub>3</sub>O<sup>+</sup>(aq) ions  
(d) SO<sub>4</sub><sup>2-</sup>(aq) ions

For questions 213-215

The graph shows the solubility of certain solids in water as a function of temperature.



213) At what temperature is the solubility of sodium chloride the same as the solubility of potassium nitrate?

- (a) 20°C  
(b) 39°C  
(c) 74°C  
(d) 89°C

214) Which solid's solubility in water is least affected by temperature?

- (a) Calcium Chloride  
(b) Ammonium Chloride  
(c) Sodium Chloride  
(d) Cerium Chloride