Name:_____

MATTER AND ENERGY

1) What process is used to separate the components of a mixture based on differences in solubility?

A) filtration B) titration C) distillation D) chromatography

2) A true solution is *best* described as a

A) heterogeneous compound
B) homogeneous mixture
C) homogeneous compound
D) heterogeneous mixture

3) Which substance can be decomposed by a chemical change?

A) sulfur B) argon C) ammonia D) sodium

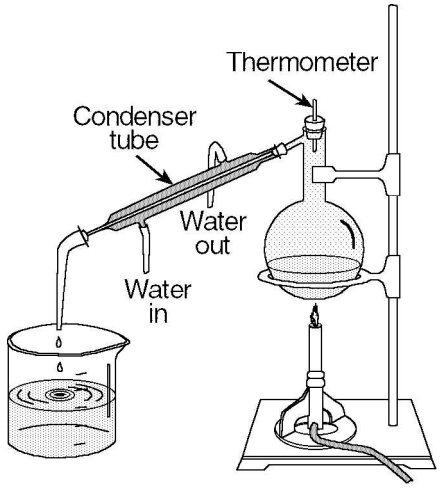
4) Which one of the following can *not* be decomposed into simpler substances?

A) mixtures B) elements C) solutions D) compounds

5) Which one of the following is an example of a physical change?

A) Acid rain causes the decomposition of a marble statue.
B) Zinc metal is added to hydrochloric acid and a gas is released.
C) Concentrated hydrochloric acid is diluted with water.
D) Hydrochloric acid is neutralized by a base to produce a salt and water.

Question 6 refers to the following:



6) What separation procedure uses the laboratory apparatus shown?

A) distillation B) filtration C) chromatography D) titration

7) Which sample represents a homogeneous mixture?

A) $C_2H_5OH(s)$ B) $C_2H_5OH(g)$ C) $C_2H_5OH(\ell)$ D) $C_2H_5OH(aq)$

Name:_____

8) Which one of the following is an example of a physical change in matter?

A) fizzing produced when magesium metal is added to acid
B) sodium metal exploding in water
C) magnesium metal burning with a bright white flame
D) melting of sodium metal

9) Which one of the following is a chemical property of water?

A) it freezes
B) it decomposes into H_2 and O_2
C) it evaporates
D) it boils

10) Which one of the following is *not* a diatomic gas?

A) chlorine B) neon C) hydrogen D) nitrogen

11) A compound differs from a mixture in that a compound *always* has a

A) maximum of two components
B) minimum of three components
C) homogeneous composition
D) heterogeneous composition

12) An example of a heterogeneous mixture is

A) carbon monoxide B) carbon dioxide C) sugar D) soil

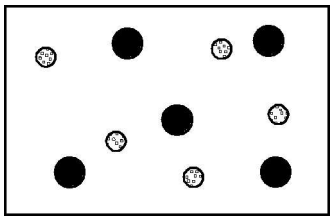
13) Which one of the following statements describes a characteristic of *all* compounds?

A) Compounds contain two elements, only.
B) Compounds contain one element, only.
C) Compounds can be decomposed by physical means.
D) Compounds can be decomposed by chemical means.

14) In an equation, what symbol would indicate a mixture?

A) (ℓ) B) (g) C) (aq) D) (s)

15) The particle diagram below represents a sample of matter.



Which *best* describes the composition of the sample?

A) a mixture of elements
B) a single compound
C) a mixture of compounds
D) a single element

Name:_____

16) Ductility and malleability are examples of

A) physical properties
B) chemical properties
C) properties of nonmetals
D) properties of all matter

17) Burning is an example of a change that is

A) intensive B) chemical C) physical D) endothermic

18) Which substance can *not* be decomposed by chemical change?

A) argon B) ammonia C) water D) sulfuric acid

19) An example of a mixture is

A) gold B) salt water C) silver D) pure water

20) Which substance can *not* be decomposed into simpler substances?

A) methane B) methanol C) aluminum D) ammonia

21) Energy of position or stored energy is also called

A) kinetic energy B) chemical energy C) activation enery D) potential energy

22) Given the reaction:

$Fe + S \rightarrow FeS + energy$

Which one of the following statements about this reaction is true?

A) The potential energy of the reactants is lower than the potential energy of the product.
B) The potential energy of the reactants is the same as the potential energy of the product.
C) It is endothermic.
D) It is exothermic.

23) A 5-gram sample of water is heated and the temperature rises from 10°C to 15°C. The total amount of heat energy absorbed by the water is

A) 25 cal B) 15 cal C) 5 cal D) 20 cal

24) The temperature of 15.0 grams of water increased 3.0 Celsius degrees. How much heat was absorbed by the water?

A) 45.0 joules B) 62.7 joules C) 188 joules D) 10.8 joules

25) If 4.0 grams of water at 1.0°C absorbs 33 joules of heat, what will be the change in temperature of the water?

A) 1.0°C B) 2.0°C C) 3.0°C D) 4.0°C

Name:_____

26) When 84 joules of heat are added to 2.0 grams of water at 15°C, what will be the final temperature of the water?

A) 25°C B) 5.0°C C) 15°C D) 50.°C

27) Which energy change occurs during the burning of magnesium ribbon?

A) chemical energy → electrical energy
B) electrical energy → light energy
C) electrical energy → chemical energy
D) chemical energy → light energy

28) What is the total number of joules of heat energy absorbed by 15.0 grams of water when it is heated from 30.0°C to 40.0°C?

A) 627 J B) 63.0 J C) 5.00 J D) 150. J

29) Consider the reaction:

$$H_2O(\ell) + \text{energy} \rightarrow H_2(g) + \frac{1}{2}O_2(g)$$

Which one of the following phrases *best* describes this reaction?

A) exothermic, releasing energy
B) endothermic, releasing energy
C) exothermic, absorbing energy
D) endothermic, absorbing energy

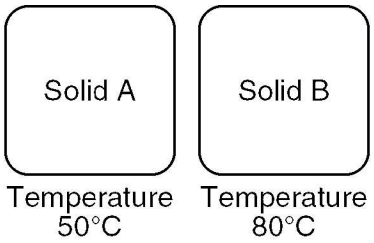
30) A solid is dissolved in a beaker of water. Which observation suggests that the process is endothermic?

A) The solution gives off a gas.
B) The temperature of the solution increases.
C) The temperature of the solution decreases.
D) The solution changes color.

31) The temperature of 50 grams of water was raised to 50°C by the addition of 1,000 calories of heat energy. What was the initial temperature of the water?

A) 20°C B) 10°C C) 30°C D) 60°C

32) 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 *B* to solid *A*. Solid *B* increases in temperature.
B) Heat energy flows from solid *B* to solid *A*. Solid *B* decreases in temperature.
C) Heat energy flows from solid *A* to solid *B*. Solid *A* increases in temperature.
D) Heat energy flows from solid *A* to solid *B*. Solid *A* decreases in temperature.

Name:_____

MATTER AND ENERGY

33) The temperature of 15 grams of water increased 3.0 Celsius degrees. How much heat was absorbed by the water?

A) 45 calories B) 18 calories C) 5.0 calories D) 12 calories

34) How many joules are equivalent to 35 kilojoules?

A) 3,500 joules B) 0.35 joule C) 0.035 joule D) 35,000 joules

35) A 5.00-gram sample of water is heated and the temperature rises from 10.0°C to 15.0°C. What is the total amount of heat energy absorbed by the water?

A) 105 J B) 21.0 J C) 84 J D) 42.0 J

36) Which change of phase is exothermic?

A) $CO_2(s) \rightarrow CO_2(\ell)$ B) $H_2S(g) \rightarrow H_2S(\ell)$ C) $H_2O(s) \rightarrow H_2O(g)$ D) $NH_3(\ell) \rightarrow NH_3(g)$

37) What is the specific heat capacity of $H_2O(\ell)$?

A) 1.00 J/g•°C B) 334 J/g C) 4.18 J/g•°C D) 2,260 J/g

38) Which one of the following statements *best* describes the production of a chlorine molecule according to the reaction $Cl + Cl \rightarrow Cl_2 + 242$ kJ?

A) A bond is broken, and the reaction is endothermic.

B) A bond is formed, and the reaction is exothermic.

C) A bond is formed, and the reaction is endothermic.

D) A bond is broken, and the reaction is exothermic.

39) Solid *X* is placed in contact with solid *Y*. Heat will flow spontaneously from *X* to *Y* when

A) *X* is 20°C and *Y* is 20°C C) *X* is 10°C and *Y* is 5°C

B) *X* is 25°C and *Y* is 30°C D) *X* is −25°C and *Y* is −10°C

40) What is the total number of joules of heat energy needed to raise the temperature of 10.0 grams of water from 20.0°C to 30.0°C?

A) 300. J B) 41.8 J C) 100. J D) 418 J

41) The temperature of a substance is a measure of its particles'

A) average potential energy C) average kinetic energy

B) enthalpy D) entropy

Name:_____

42) As ice at 0°C changes to water at 0°C, the average kinetic energy of the ice molecules

A) decreases
B) remains the same
C) increases

43) At what temperature does a water sample have the *highest* average kinetic energy?

A) 100°C B) 0 K C) 100 K D) 0°C

44) Compared to the average kinetic energy of 1 mole of water at 0°C, the average kinetic energy of 1 mole of water at 298 K is

A) the same, but the number of molecules is greater
B) greater, and the number of molecules is greater
C) the same, and the number of molecules is the same
D) greater, but the number of molecules is the same

45) The temperature of a sample of a substance changes from 10.°C to 20.°C. How many Kelvin degrees does the temperature change?

A) 10. B) 293 C) 283 D) 20.

46) At 1 atmosphere of pressure, the fixed temperature points on a Celsius thermometer are located on the basis of

A) the water/steam equilibrium temperature, only
B) both the ice/water and the water/steam equilibrium temperatures
C) neither the ice/water nor the water/steam equilibrium temperatures
D) the ice/water equilibrium temperature, only

47) Which temperature represents absolute zero?

A) 273 K B) 0°C C) 0 K D) 273°C

48) The temperature of a sample of water is changed from 10°C to 30°C. The same change in Kelvin degrees would be

A) 273 B) 100 C) 303 D) 20

49) What Kelvin temperature is equal to −73°C?

A) 200 K B) 100 K C) 173 K D) 346 K

50) A 250.-gram sample of water loses 9,450 joules of heat energy.

(a) What is the change in temperature of the water? [*Write the correct formula. Show all work. Indicate the correct answer with an appropriate unit.*]

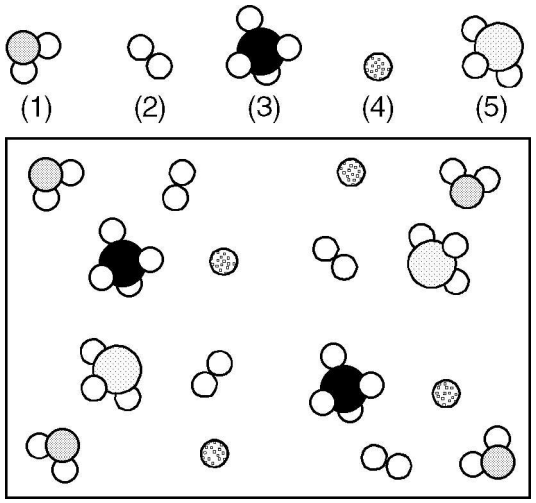
(b) If the water began at 100°C, what is the final temperature of the water?

51) What is the total amount of heat energy needed to change 200. grams of ice to water at 0°C? [*Write the correct formula. Show all work. Express your answer in joules and kilojoules*.]

52) The temperature of 15.00 grams of water was increased by 3.00°C. How much heat energy was absorbed by the water? [*Write the correct formula. Show all work. Indicate the correct answer with an appropriate unit.*]

53) State *two* physical and *two* chemical properties that could be used to distinguish between a cube of copper and a cube of sugar.

54) The diagram below represents a gaseous mixture of the substances labeled 1 through 5.



(a) Which of the five substances are compounds? [*Explain why*.]

(b) Which of the five substances are elements? [*Explain why*.]

(c) Does the diagram represent a homogeneous or a heterogeneous mixture? [*Give one reason to justify your answer*.]

55) A 75.00-gram sample of zinc metal at 96.0°C is added to 100.00 grams of water originally at 25.0°C in a calorimeter. The final temperature of the metal and water in the calorimeter is measured to be 28.0°C.

(a) Describe the transfer of heat energy that occurs in the calorimeter.

(b) Assuming *no* heat is lost to the outside, how many joules of heat energy are transferred?

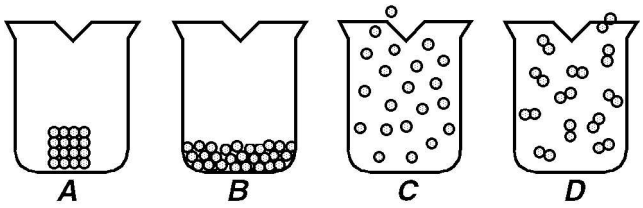
56) What Celsius temperature is equal to 200 Kelvin? [*Write the correct formula. Show all work.*]

Name:_____

PHASES OF MATTER

Questions 57 through 61 refer to the following:

The particle diagrams below represent elements at STP.



57) Which particle diagram *best* represents copper?

A) *A* B) *B* C) *C* D) *D*

58) Which particle diagram *best* represents mercury?

A) *A* B) *B* C) *C* D) *D*

59) Which particle diagram *best* represents a monoatomic gas?

A) *A* B) *B* C) *C* D) *D*

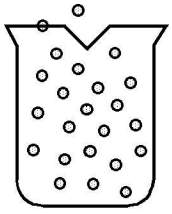
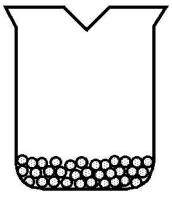
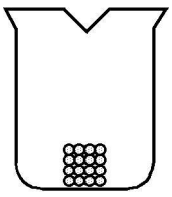
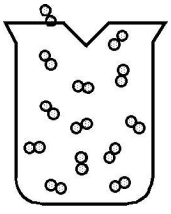
60) Which particle diagram *best* represents a diatomic gas?

A) *A* B) *B* C) *C* D) *D*

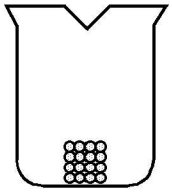
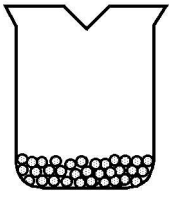
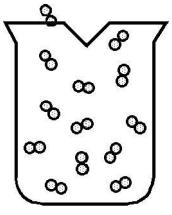
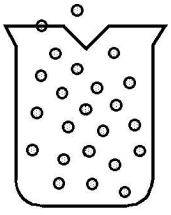
61) Which particle diagram *best* represents hydrogen?

A) *A* B) *B* C) *C* D) *D*

62) Which particle diagram *best* represents a substance in the solid state?

A)  B)  C)  D) 

63) Which particle diagram *best* represents a monoatomic gas?

A)  B)  C)  D) 

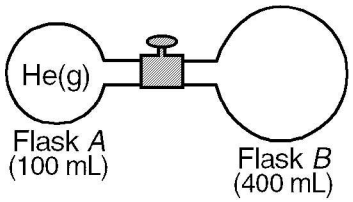
64) In an equation, what symbol would indicate a gas?

A) (g) B) (aq) C) (ℓ) D) (s)

Name:_____

PHASES OF MATTER

65) The diagram below shows two flasks connected by a stopcock. Flask *A* contains helium gas. Flask *B* contains a vacuum.



What final volume will the gas occupy after the stopcock is opened?

A) 400 mL B) 300 mL C) 100 mL D) 500 mL

66) In which sample are the particles arranged in a regular geometric pattern?

A) $HCl(\ell)$ B) $I_2(s)$ C) $N_2(g)$ D) NaCl(aq)

67) Which material has a crystalline structure at room temperature (20°C)?

A) nitrogen B) sucrose C) glass D) water

68) The characteristic which distinguishes a true solid from other phases of matter at STP is that in a true solid, the particles are

A) motionless but changing their relative positions
B) vibrating and changing their relative positions
C) vibrating without changing their relative positions
D) motionless without changing their relative positions

69) Which one of the following statements *best* describes the molecules of H_2O in the solid phase?

A) They move slowly in straight lines.
B) They are arranged in a regular geometric pattern.
C) They are arranged in a random pattern.
D) They move rapidly in straight lines.

70) A substance that has a definite shape, a crystalline structure, and a definite volume at STP is

A) Cl_2 B) Br_2 C) F_2 D) I_2

71) At standard pressure, which element at 25°C could undergo a change of phase when the temperature is decreased?

A) silicon B) chlorine C) sulfur D) aluminum

72) At what point do a liquid and a solid exist at equilibrium?

A) sublimation point B) boiling point C) melting point D) vaporization point

Name:_____

PHASES OF MATTER

73) The amount of energy needed to change a given mass of ice to water at constant temperature is called the heat of

A) formation B) crystallization C) condensation D) fusion

74) The number of joules per gram required to melt ice at its melting point is called

A) heat of fusion B) vapor pressure C) sublimation D) heat of vaporization

75) How many joules of heat energy are needed to completely melt 25.0 grams of ice to water at 0°C?

A) 8,350 J B) 105 J C) 334 J D) 56,500 J

76) What is the total amount of heat energy (in kilojoules) needed to change 200.0 grams of ice to water at 0°C?

A) 4,520 kJ B) 452.0 kJ C) 66.8 kJ D) 334 kJ

77) A 25.0-gram sample of a substance absorbs 3,750 joules of heat energy to melt completely at its melting temperature. What is the heat of fusion of the substance?

A) 2,260 J/g B) 8,350 J/g C) 150. J/g D) 334 J/g

78) At 1 atmosphere, which substance will sublime when heated?

A) HCl(aq) B) $CO_2(s)$ C) $H_2O(\ell)$ D) $CH_4(g)$

79) The phase change represented by the equation $I_2(s) \rightarrow I_2(g)$ is called

A) sublimation B) condensation C) melting D) boiling

80) What process occurs when dry ice, $CO_2(g)$, is changed into $CO_2(s)$?

A) deposition B) fusion C) condensation D) vaporization

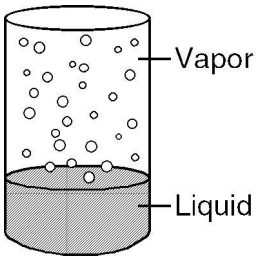
81) At standard pressure, the steam-water equilibrium temperature occurs at

A) 273 K B) 373 K C) 0 K D) 100 K

Name:_____

PHASES OF MATTER

82) A closed system is shown in the diagram below.



The rate of vapor formation at equilibrium is

A) greater than the rate of liquid formation
B) less than the rate of liquid formation
C) equal to the rate of liquid formation

83) The heat of vaporization for water at its normal boiling point is

A) 334 J/g
B) 273 J/g
C) 2,260 J/g
D) 4.18 J/g

84) How many kilojoules of heat are absorbed when 70.00 grams of water is completely vaporized at its boiling point?

A) 2.260
B) 2,260
C) 158,200
D) 158.2

85) As the temperature of a liquid increases, its vapor pressure

A) remains the same
B) decreases
C) increases

86) At 298 K, the vapor pressure of CS_2 is greater than the vapor pressure of H_2O. The *best* explanation for this is that H_2O has

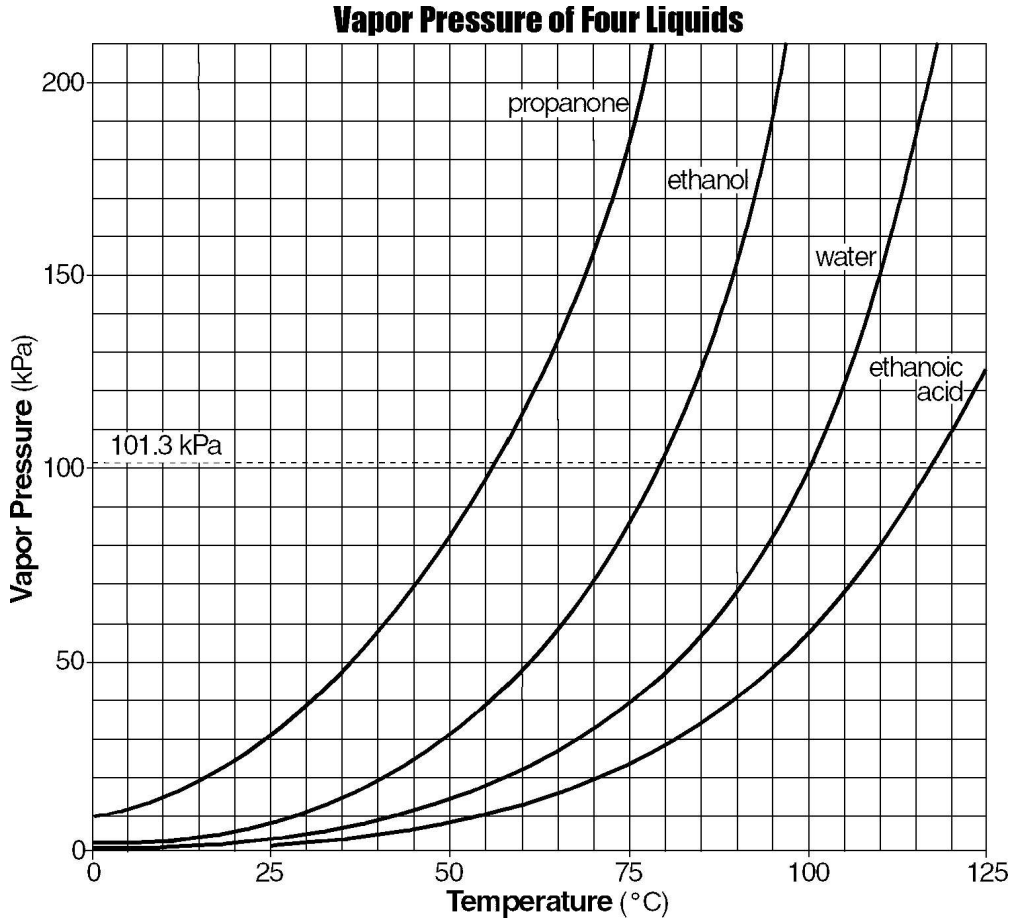
A) larger molecules
B) stronger intermolecular forces
C) a larger molecular mass
D) stronger ionic bonds

Name:_____

PHASES OF MATTER

Questions 87 through 97 refer to the following:

Given the chemistry reference table below:



87) According to the given table, which substance is *most* volatile?

A) propanone B) ethanol C) ethanoic acid D) water

88) A unknown liquid has a vapor pressure of 150 kPa at 90°C. According to the given table, this liquid is *most* likely

A) water B) ethanol C) propanone D) ethanoic acid

89) According to the given table, if the pressure on the surface of water in the liquid state is 47.0 kPa, the water will boil at

A) 35°C B) 60°C C) 95°C D) 80°C

90) According to the given table, at what temperature will water boil when the external pressure is 145 kPa?

A) 110°C B) 120°C C) 90°C D) 105°C

91) According to the given table, what is the vapor pressure of ethanoic acid at the normal boiling temperature of water?

A) 103 kPa B) 101.3 kPa C) 57 kPa D) 117 kPa

Name:_____

PHASES OF MATTER

92) Based on the data shown, what is the boiling point of propanone at standard atmospheric pressure?

A) 30°C B) 78°C C) 100°C D) 56°C

93) According to the given table, which liquid has the *highest* vapor pressure at standard temperature?

A) propanone B) water C) ethanoic acid D) ethanol

94) According to the given table, what liquid has the *lowest* vapor pressure at 60°C?

A) propanone B) ethanol C) water D) ethanoic acid

95) According to the given table, which liquid has a normal boiling point of 79°C?

A) water B) ethanol C) ethanoic acid D) propanone

96) According to the given table, what is the approximate vapor pressure of ethanol at 90°C?

A) 101.3 kPa B) 150 kPa C) 55 kPa D) 40 kPa

97) According to the given table, what is the vapor pressure of ethanoic acid at 110°C?

A) 145 kPa B) 68 kPa C) 79 kPa D) 64 kPa

98) In a closed system, as the temperature of a liquid increases, the vapor pressure of the liquid

A) decreases C) increases
B) remains the same

Name:_____

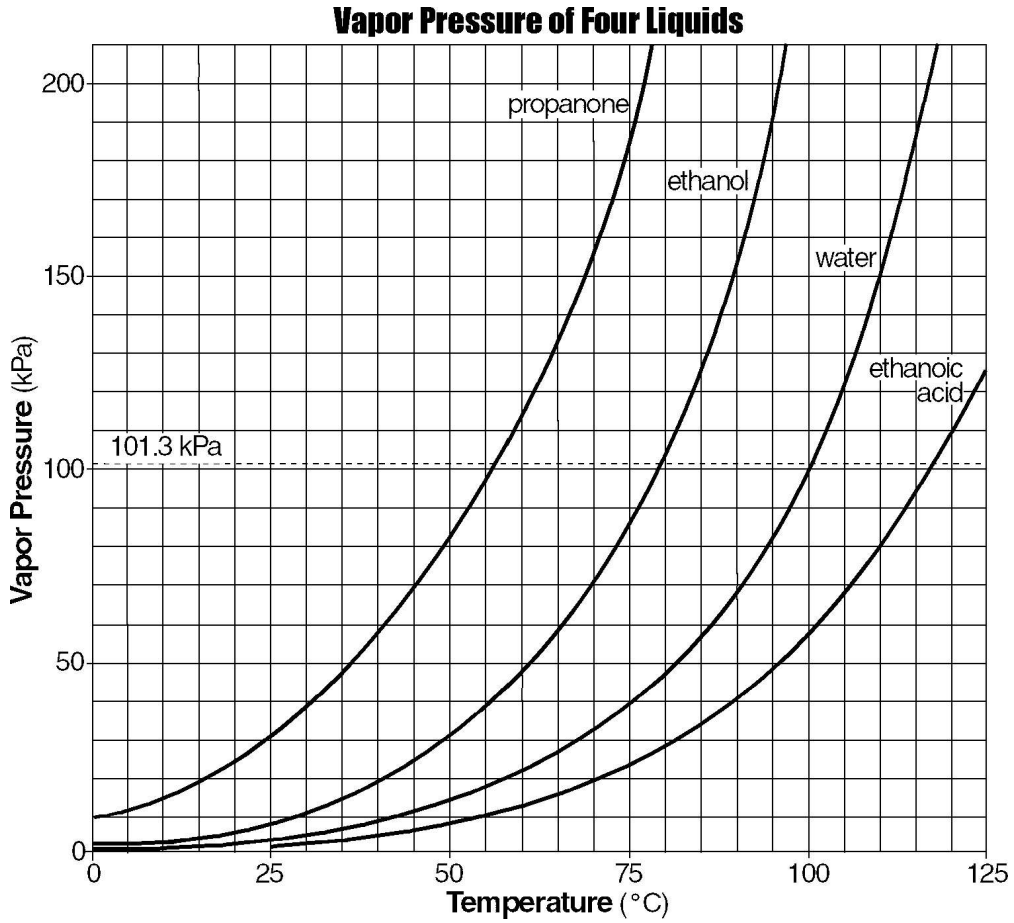
PHASES OF MATTER

Question 99 refers to the following:

In a laboratory experiment, students measured the vapor pressure of two unknown liquids. Their data is recorded in the table below:

Substance	Vapor Pressure (kPa)	Temperature (°C)
X	115	60
Y	145	110

Given the chemistry reference table below:



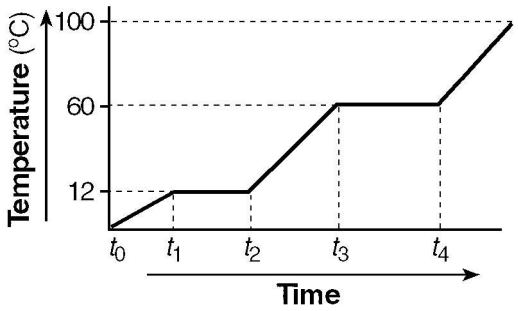
99) Based on the data shown, substance *X* could be

A) propanone B) water C) ethanoic acid D) ethanol

Name:_____

PHASES OF MATTER

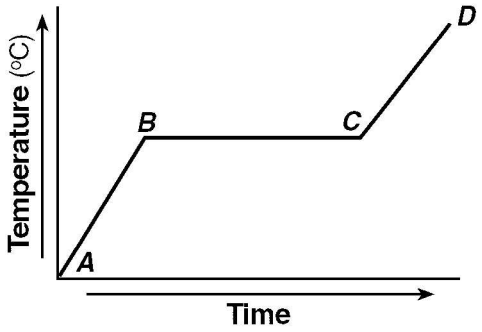
100) The diagram below represents the uniform heating of a substance that is a solid at t_0.



What is the freezing point of the substance?

A) 100°C B) 60°C C) 12°C D) 1°C

101) The graph below represents the relationship between temperature and time as heat was added uniformly to a substance, starting as a solid below its melting point.



During the *BC* portion of the curve, the average kinetic energy of the molecules of the substance

A) remains the same and the potential energy decreases

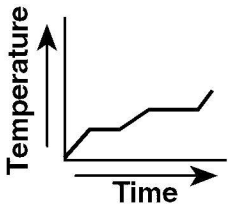
B) remains the same and the potential energy increases

C) increases and the potential energy increases

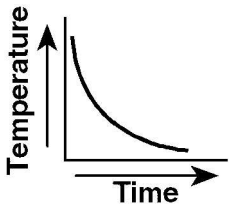
D) decreases and the potential energy increases

102) Which graph *best* represents a change of phase from a gas to a solid?

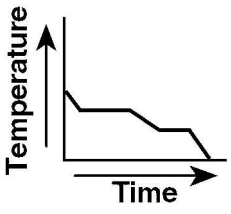
A)



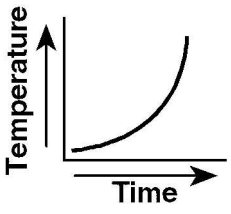
B)



C)



D)

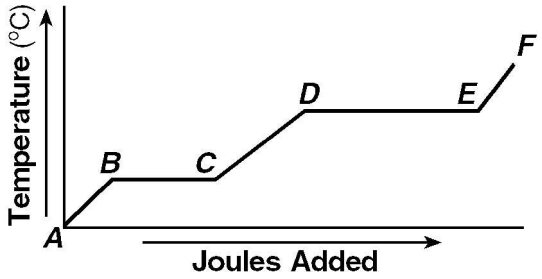


Name:_____

PHASES OF MATTER

Question 103 refers to the following:

The diagram below represents the uniform heating of a water sample at standard pressure, starting at a temperature below 0°C.

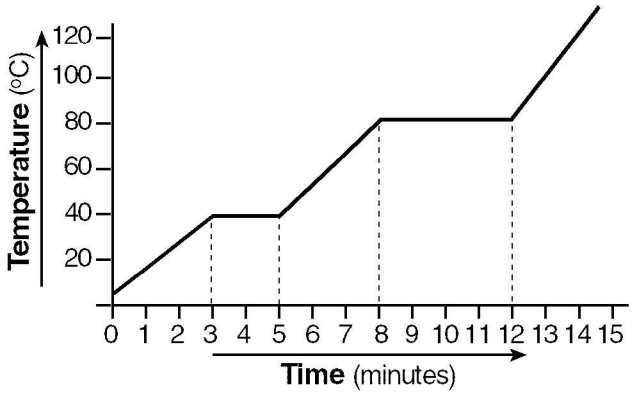


103) The number of joules required to vaporize the entire sample of water at its boiling point is represented by the interval between

A) *C* and *D* B) *E* and *F* C) *D* and *E* D) *A* and *B*

Questions 104 and 105 refer to the following:

The graph below shows the relationship between temperature and time as heat is added to one mole of a substance at a rate of 100 joules per minute. The substance is in the solid phase at 0 minutes.



104) From the time that the solid begins to melt, the minimum number of joules required to completely melt the one mole sample is

A) 100 B) 200 C) 400 D) 600

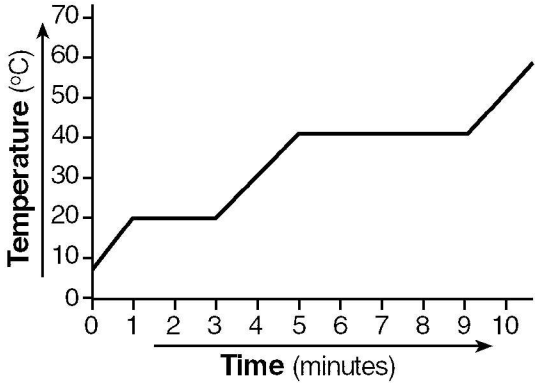
105) At what temperature does the substance begin to boil?

A) 80°C B) 110°C C) 40°C D) 10°C

Name:_____

PHASES OF MATTER

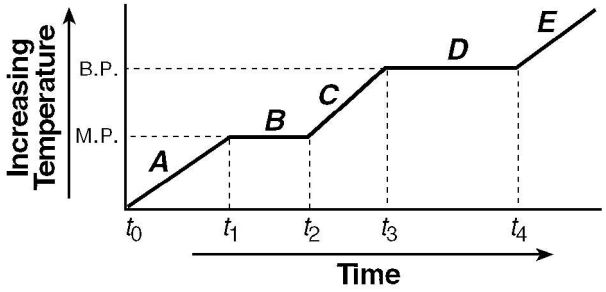
106) The graph below represents changes of state for an unknown substance.



What is the boiling temperature of the substance?

A) 20°C B) 0°C C) 70°C D) 40°C

107) The graph below represents the relationship between temperature and time as heat is added uniformly to a substance, starting when the substance is a solid below its melting point.



What portions of the graph represent times when heat is absorbed and potential energy increases while kinetic energy remains constant?

A) *B* and *D* B) *A* and *C* C) *A* and *B* D) *C* and *D*

108) As a 1-gram sample of $H_2O(\ell)$ changes to $H_2O(g)$ at 100°C, the potential energy of the molecules

A) remains the same C) increases

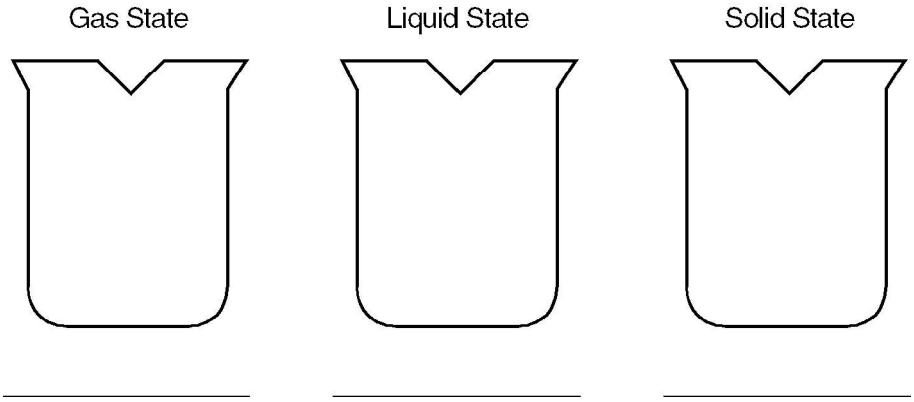
B) decreases

Name:_____

PHASES OF MATTER

Questions 109 through 111 refer to the following:

The Halogen Family (Group 17) contains elements that exist in the gas, liquid, and solid states at room temperature and standard pressure.



109) (a) In the given containers, draw a particle diagram to represent a halogen sample in the gas, liquid, and solid states. [*Use* ○○ *to represent a halogen molecule. Each diagram should contain at least 6 halogen molecules*.]

(b) On the line below each container, identify (by element name or chemical symbol) a halogen which exists in that state of matter at room temperature and standard pressure.

110) Describe the differences in particle arrangement for samples of matter in the solid, liquid, and gas states.

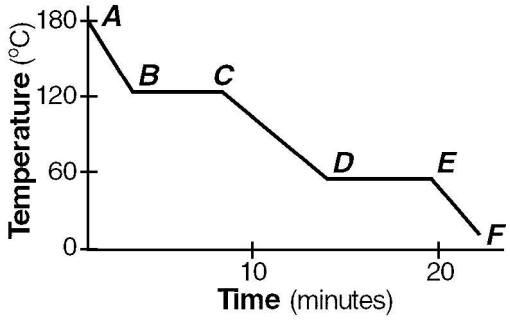
111) Explain, in terms of intermolecular forces of attraction, why different halogens at the same temperature and pressure can exist in three different phases.

112) Which change of phase is exothermic?

A) gas to a liquid B) liquid to a gas C) solid to a gas D) solid to a liquid

Question 113 refers to the following:

The graph below represents uniform cooling of a sample of a pure substance, starting as a gas.



113) Solid and liquid phases can exist in equilibrium between points

A) *D* and *E* B) *C* and *D* C) *E* and *F* D) *B* and *C*

Name:_____

PHASES OF MATTER

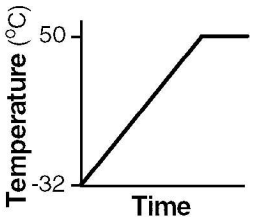
114) As a 1-gram sample of $H_2O(g)$ changes to $H_2O(\ell)$ at 100°C, the potential energy of the molecules

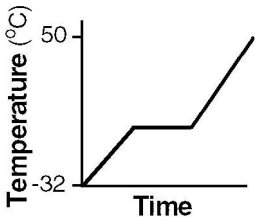
A) increases

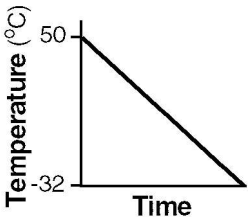
B) remains the same

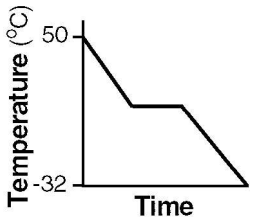
C) decreases

115) A student collected data in an experiment in which the uniform cooling of a water sample was observed from 50°C to −32°C. Which graph *most* likely represents the results obtained by the student?

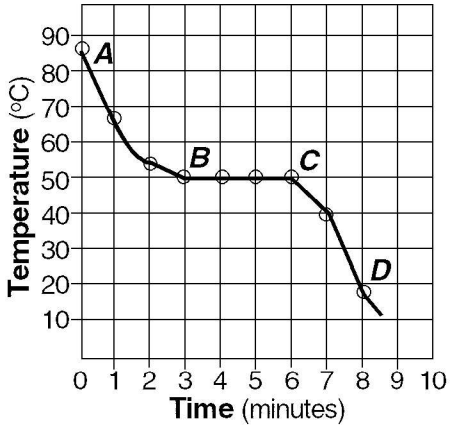
A) 

B) 

C) 

D) 

116) The graph below represents the cooling curve of a substance starting at a temperature below the boiling point of the substance.



During what interval was the substance completely in the solid phase?

A) *A* to *B*

B) *C* to *D*

C) *A* to *C*

D) *B* to *C*

117) Which change results in a release of energy?

A) the melting of $H_2O(s)$

B) the condensation of $H_2O(g)$

C) the boiling of $H_2O(\ell)$

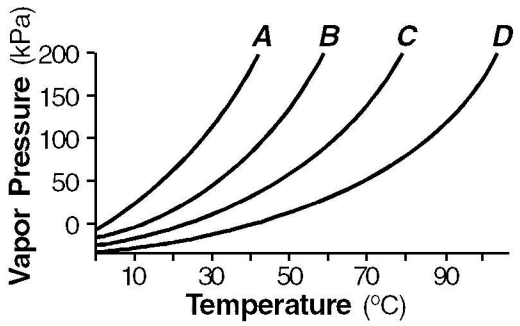
D) the evaporation of $H_2O(\ell)$

Name:_____

PHASES OF MATTER

Question 118 refers to the following:

The chart below shows the change in vapor pressure of four liquids with increasing temperature.



118) What liquid has the *lowest* normal boiling point?

A) *A* B) *B* C) *C* D) *D*

---

119) An ideal gas is made up of gas particles that

A) can be liquefied B) attract each other C) are in random motion D) have volume

120) The average kinetic energy of the molecules of an ideal gas is directly proportional to the

A) volume occupied by individual gas molecules
B) pressure at standard temperature
C) temperature measured on the Kelvin scale
D) number of moles present

121) A flask containing molecules of gas *A* and a separate flask containing the molecules of gas *B* are both at the same temperature. Gases *A* and *B* must have equal

A) volumes
B) pressures
C) masses
D) average kinetic energies

122) When a sample of a gas is heated at constant pressure, the average kinetic energy of its molecules

A) increases, and the volume of the gas increases
B) decreases, and the volume of the gas decreases
C) increases, and the volume of the gas decreases
D) decreases, and the volume of the gas increases

123) One reason that a real gas deviates from an ideal gas is that the molecules of the real gas have

A) forces of attraction for each other
B) a negligible volume
C) no net loss of energy on collision
D) a straight-line motion

124) Which gas under high pressure and low temperature has a behavior *closest* to that of an ideal gas?

A) $CO_2(g)$ B) $O_2(g)$ C) $NH_3(g)$ D) $H_2(g)$

125) Which gas is *least* likely to obey the ideal gas laws at very high pressures and very low temperatures?

A) Kr B) He C) Xe D) Ne

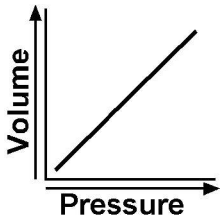
126) If the pressure on a given mass of gas in a closed system is decreased and the temperature remains constant, the volume of the gas will

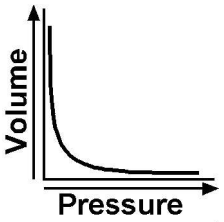
A) remain the same
B) increase
C) decrease

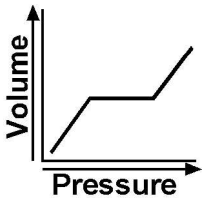
127) As the pressure of a gas at 101.3 kPa is changed to 50.65 kPa at constant temperature, the volume of the gas

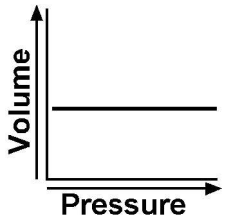
A) increases
B) remains the same
C) decreases

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

A) 

B) 

C) 

D) 

129) 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) 2.0 L B) 0.50 L C) 4.0 L D) 0.25 L

130) A sample of gas has a volume of 2.0 liters at a pressure of 1.0 atmosphere. When the volume increases to 4.0 liters, at constant temperature, the pressure will be

A) 0.50 atm B) 0.25 atm C) 1.0 atm D) 2.0 atm

131) The volume of 50.0 milliliters of an ideal gas at STP increases to 100. milliliters. If the pressure remains constant, the new temperature must be

A) 273 K B) 546 K C) 0 K D) 100. K

132) The volume of a sample of hydrogen gas at STP is 1.00 liter. As the temperature decreases, pressure remaining constant, the volume of the sample

A) remains the same C) decreases

B) increases

133) The volume of a sample of a gas at 273°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) 273 K B) 0 K C) 100. K D) 546 K

134) A gas sample is at 10.0°C. If pressure remains constant, the volume will increase when the temperature is changed to

A) 283 K B) 273 K C) 293 K D) 263 K

135) The volume of a given mass of an ideal gas at constant pressure is

A) inversely proportional to the Kelvin temperature C) directly proportional to the Celsius temperature

B) inversely proportional to the Celsius temperature D) directly proportional to the Kelvin temperature

136) A sample of gas is at STP. As the pressure decreases and the temperature increases, the volume of the gas

A) decreases C) increases

B) remains the same

137) At a temperature of 273 K, a 400-milliliter gas sample has a pressure of 101.3 kPa. If the pressure is changed to 50.65 kPa, at what temperature will this gas sample have a volume of 600 milliliters?

A) 100 K B) 205 K C) 273 K D) 546 K

138) A 100.-milliliter sample of helium gas is placed in a sealed container of fixed volume. As the temperature of the confined gas increases from 10.°C to 30.°C, the internal pressure

A) decreases C) increases

B) remains the same

139) A sample of gas *A* was stored in a container at a temperature of 50°C and a pressure of 0.50 atmosphere. Compared to a sample of gas *B* at STP, gas *A* had a

A) higher temperature and a higher pressure C) lower temperature and a lower pressure

B) lower temperature and a higher pressure D) higher temperature and a lower pressure

140) A 300.-milliliter container that is filled with 100. milliliters of oxygen and 200. milliliters of hydrogen has a total pressure of 90.0 kPa. What is the partial pressure of the oxygen?

A) 200. kPa B) 30.0 kPa C) 100. kPa D) 60.0 kPa

141) What is the difference in pressure between a gas at 61.3 kPa and a gas at standard pressure?

A) 101.3 kPa B) 273 kPa C) 40.0 kPa D) 0 kPa

142) When 7.00 moles of gas *A* and 3.00 moles of gas *B* are combined, the total pressure exerted by the gas mixture is 1.0 atm. What is the partial pressure exerted by gas *A* in this mixture?

A) 0.70 atm B) 1.0 atm C) 0.30 atm D) 0.10 atm

143) At STP, equal volumes of $N_2(g)$ and $CO_2(g)$ contain equal numbers of

A) electrons B) protons C) atoms D) molecules

144) At STP, 1 liter of $H_2(g)$ and 1 liter of He(g) have the same

A) number of molecules B) number of atoms C) density D) mass

145) Equal volumes of $SO_2(g)$ and NO(g) at the same temperature and pressure would have the same

A) number of molecules B) number of atoms C) mass D) density

146) Which gas would have the *slowest* rate of diffusion when all of the gases are held at the same temperature and pressure?

A) NO B) O_2 C) CO_2 D) N_2

147) Which gas would diffuse *most* rapidly under the same conditions of temperature and pressure?

A) gas *B*, molecular mass = 16

B) gas *C*, molecular mass = 36

C) gas *D*, molecular mass = 49

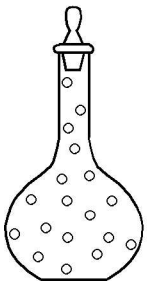
D) gas *A*, molecular mass = 4

148) A gas sample has a volume of 25.0 milliliters at a temperature of 75.0°C and 1.00 atmosphere of pressure. What will be the final temperature of the gas (in degrees Kelvin) if the volume increases to 50.0 milliliters and the pressure remains constant? [*Write the correct formula. Show all work. Indicate the correct answer with an appropriate unit.*]

149) A sample of gas occupies 15.0 liters at 4.00 atmospheres and 300. K. What is the new volume of the gas if pressure is decreased to 2.00 atmosphere and temperature is increased to 400. K? [*Write the correct formula. Show all work. Indicate the correct answer with an appropriate unit.*]

150) Will the volume of a 2.5 liter sample of a gas at STP change if the Kelvin temperature and the pressure are *both* doubled? [*Explain why or why not*.] [*Show a calculation to support your answer*.]

151) The particle diagram below represents a sample of a gas sealed in a 1.0 liter flask. The sample was heated gently and the gas pressure was measured over a range of temperatures as reported in the data table.



Temperature (K)	**Pressure** (kPa)
300	101.3
310	104.7
320	108.1
330	111.4

(a) State the relationship between the temperature and pressure of the gas when the volume remains constant.

(b) Explain the increase in pressure of the sample at higher temperatures in terms of kinetic energy and collisions of the gas particles.

(c) Predict the gas pressure at 340 K. [*Write the correct formula. Show all work. Indicate the correct answer with an appropriate unit.*]

Name:_____

NAMING/FORMULA WRITING

152) An example of a binary compound is

A) ammonium chlorate B) potassium chlorate C) ammonium chloride D) potassium chloride

153) Which one of the following is an example of a binary compound?

A) nitric acid B) potassium hydroxide C) potassium oxide D) acetic acid

154) Which formula represents a binary compound?

A) Ne B) C_3H_8 C) Br_2 D) H_2SO_4

155) What is the chemical formula for mercury(I) chloride?

A) $HgCl_2$ B) Hg_2Cl_2 C) Hg_2Cl_4 D) Hg_2Cl

156) What is the correct chemical formula for iron(III) oxide?

A) FeO_3 B) Fe_3O_2 C) Fe_2O_3 D) Fe_3O

157) What is the formula for chromium(III) oxide?

A) CrO_3 B) Cr_3O_2 C) Cr_2O_3 D) Cr_3O

158) What is the correct formula for iron(II) sulfide?

A) Fe_2S_3 B) $Fe_2(SO_4)_3$ C) $FeSO_3$ D) FeS

159) What is the formula for titanium(III) oxide?

A) Ti_2O_4 B) Ti_3O_2 C) TiO D) Ti_2O_3

160) Which formula is correctly paired with its name?

A) $CuCl_2$ — copper(II) chloride
B) FeO — iron (III) oxide
C) $MgCl_2$ — magnesium chlorine
D) K_2O — phosphorus dioxide

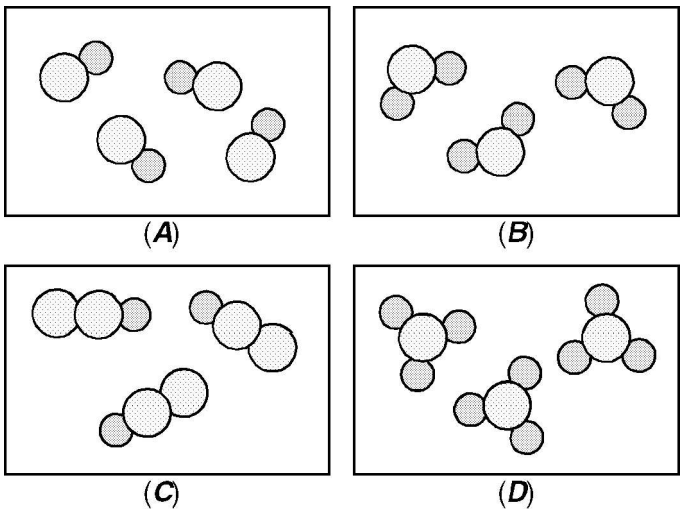
161) An atom represented by *X* forms a compound with the formula X_3N_2. The atom could be

A) Cs B) Na C) Mg D) Al

Name:_____ NAMING/FORMULA WRITING

Question 162 refers to the following:

In the particle diagrams below, ◯ represents an atom of nitrogen and ◯ represents an atom of oxygen.

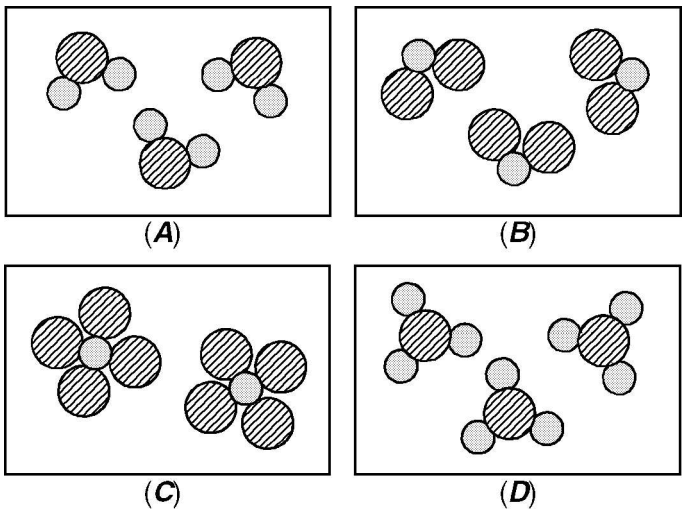


162) Which diagram *best* represents the compound nitrogen(IV) oxide?

A) *A* B) *B* C) *C* D) *D*

Question 163 refers to the following:

In the particle diagrams below, ◯ represents an atom of sulfur and ◯ represents an atom of oxygen.



163) Which diagram *best* represents the compound sulfur(IV) oxide?

A) *A* B) *B* C) *C* D) *D*

164) What is the correct name for the compound with the formula $CrPO_4$?

A) chromium(III) phosphide
B) chromium(III) phosphate
C) chromium(II) phosphate
D) chromium(II) phosphide

Name:_____ NAMING/FORMULA WRITING

165) What is the correct chemical formula for sodium sulfate?

A) Na_2SO_3 B) Na_2SO_4 C) $NaSO_3$ D) $NaSO_4$

166) What is the formula for sodium oxalate?

A) $Na_2C_2O_4$ B) $NaClO$ C) $NaC_2H_3O_2$ D) Na_2O

167) What is the formula for sodium thiosulfate?

A) $Na_2S_2O_4$ B) Na_2SO_3 C) $Na_2S_2O_3$ D) Na_2SO_4

168) What is the formula for ammonium carbonate?

A) $(NH_4)_2(CO_3)_2$ B) $NH_4(CO_3)_2$ C) $(NH_4)_2CO_3$ D) NH_4CO_3

169) What is the formula for sodium perchlorate?

A) $NaClO_2$ B) $NaClO_4$ C) $NaClO_3$ D) $NaClO$

170) What is the formula for calcium cyanide?

A) $CaSCN_2$ B) $Ca(CN)_2$ C) $CaCN_2$ D) $Ca(SCN)_2$

171) In a sample of solid $Ba(NO_3)_2$, the ratio of barium ions to nitrate ions is

A) 1:1 B) 1:3 C) 1:6 D) 1:2

172) An example of an empirical formula is

A) H_2O_2 B) C_2H_2 C) C_2Cl_2 D) $CaCl_2$

173) Which one of the following is an empirical formula?

A) CH B) C_4H_8 C) C_2H_4 D) C_2H_2

174) What is the empirical formula of a compound with the molecular formula $C_6H_{12}O_6$?

A) CH_2O B) $C_2H_4O_2$ C) $C_3H_6O_2$ D) $C_4H_8O_4$

175) In the compound Al_2O_3, the ratio of aluminum to oxygen is

A) 2 moles of aluminum to 3 moles of oxygen
B) 2 grams of aluminum to 3 grams of oxygen
C) 3 moles of aluminum to 2 moles of oxygen
D) 3 grams of aluminum to 2 grams of oxygen

176) The formula H_2 represents one

A) gram B) liter C) molecule D) atom

Name:_____ NAMING/FORMULA WRITING

177) Which one of the following represents a molecule at STP?

A) H B) Kr C) N D) Br

178) Which substance has the same molecular and empirical formulas?

A) $C_6H_{12}O_6$ B) C_2H_4 C) CH_4 D) C_6H_6

179) What is the total number of atoms of oxygen in the formula $Al(ClO_3)_3 \cdot 6H_2O$?

A) 6 B) 15 C) 10 D) 9

180) How many atoms of oxygen are represented by the formula $Al_2(SO_4)_3$?

A) 12 B) 7 C) 3 D) 4

181) What is the name for the sodium salt of the acid $HClO_2$?

A) sodium perchlorate B) sodium chlorite C) sodium chloride D) sodium chlorate

182) Which balanced chemical equation represents a synthesis reaction?

A) $MgBr_2(\ell) \rightarrow Mg(\ell) + Br_2(g)$
B) $Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$
C) $C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(g)$
D) $2Al(s) + 3Cl_2(g) \rightarrow 2AlCl_3(s)$

183) Which balanced chemical equation represents a single replacement reaction?

A) $KCl(aq) + AgNO_3(aq) \rightarrow KNO_3(aq) + AgCl(s)$
B) $C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(g)$
C) $Cl_2(g) + 2KI(aq) \rightarrow 2KCl(aq) + I_2(aq)$
D) $2H_2O(\ell) \rightarrow 2H_2(g) + O_2(g)$

Name:_____ NAMING/FORMULA WRITING

Question 184 refers to the following:

Given the chemistry reference table below:

Activity Series*

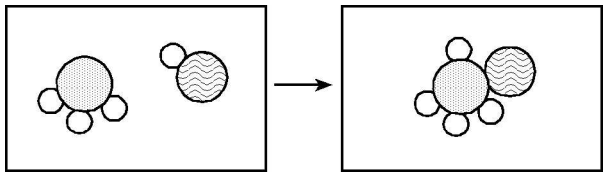
MOST	Metals	Nonmetals	MOST
	Li	F_2	
	Rb	Cl_2	
	K	Br_2	
	Cs	I_2	
	Ba		
	Sr		
	Ca		
	Na		
	Mg		
	Al		
	Ti		
	Mn		
	Zn		
	Cr		
	Fe		
	Co		
	Ni		
	Sn		
	Pb		
	$*H_2$		
	Cu		
	Ag		
LEAST	Au		LEAST

**Activity Series* based on hydrogen standard*

184) According to the given table, which pair of substances would undergo a single replacement reaction?

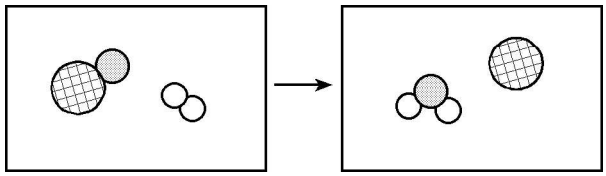
A) Cl_2 and CaF_2 B) I_2 and CaF_2 C) I_2 and $CaCl_2$ D) F_2 and $CaCl_2$

185) What general type of chemical reaction is illustrated in the particle diagram below?



A) double replacement B) decomposition C) synthesis D) single replacement

186) What general type of chemical reaction is illustrated in the particle diagram below?



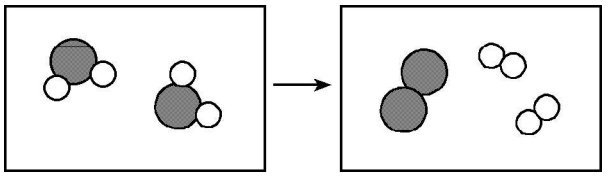
A) single replacement B) double replacement C) synthesis D) decomposition

Name:_____

NAMING/FORMULA WRITING

Questions 187 and 188 refer to the following:

In the particle diagram below, ○ represents an atom of element *A* and ● represents an atom of element *B*.



187) Which equation *best* describes the reaction shown in the diagram?

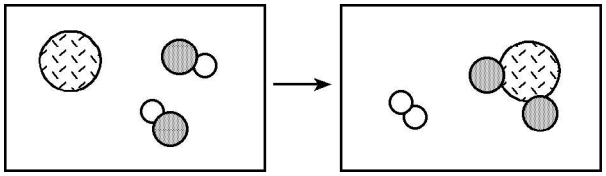
A) $2A_2B \rightarrow 2A_2 + B_2$ B) $2AB \rightarrow 2A + B$ C) $2AB \rightarrow A + 2B$ D) $2AB_2 \rightarrow A_2 + 2B_2$

188) What general type of reaction is illustrated in the diagram?

A) single replacement B) decomposition C) synthesis D) double replacement

Question 189 refers to the following:

In the particle diagram below, ◍ represents an atom of element *A,* ● represents an atom of element *B*, and ○ represents an atom of element *C*.

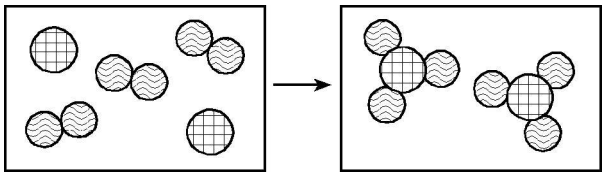


189) What general type of reaction is illustrated in the diagram?

A) decomposition B) single replacement C) synthesis D) double replacement

Questions 190 and 191 refer to the following:

The diagram below represents a reaction between Fe (◍) and Cl_2 (●●).



190) What general type of reaction is illustrated in the diagram?

A) decomposition B) double replacement C) synthesis D) single replacement

191) What is the correct name for the product produced in the reaction?

A) iron(II) chloride B) iron(III) chloride C) iron(III) chlorite D) iron(II) chlorite

Name:_____ NAMING/FORMULA WRITING

192) When the equation $NH_3 + O_2 \rightarrow HNO_3 + H_2O$ is completely balanced using *smallest* whole numbers, the coefficient of O_2 would be

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

193) When the equation $\_\_Na(s) + \_\_H_2O(\ell) \rightarrow \_\_NaOH(aq) + H_2(g)$ is correctly balanced using *smallest* whole numbers, the coefficient of the water is

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

194) When the equation $\_\_Al_2(SO_4)_3 + \_\_ZnCl_2 \rightarrow \_\_AlCl_3 + \_\_ZnSO_4$ is correctly balanced using the *smallest* whole number coefficients, the sum of the coefficients is

A) 9 B) 5 C) 8 D) 4

195) Given the unbalanced equation:

$\_\_Al_2(SO_4)_3 + \_\_Ca(OH)_2 \rightarrow \_\_AlOH_3 + \_\_CaSO_4$

When the equation is completely balanced using the *smallest* whole-number coefficients, the sum of the coefficients is

A) 9 B) 5 C) 3 D) 4

196) Given the unbalanced equation:

$\_\_Ag(s) + \_\_H_2S(g) \rightarrow \_\_Ag_2S(s) + \_\_H_2(g)$

What is the sum of the coefficients when the equation is completely balanced using the *smallest* whole-number coefficients?

A) 5 B) 8 C) 10 D) 4

197) Which one of the following is a correctly balanced equation for a reaction between hydrogen gas and oxygen gas?

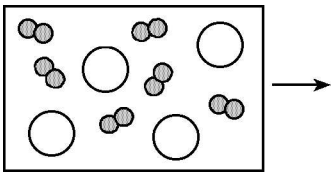
A) $2H_2(g) + O_2(g) \rightarrow 2H_2O(\ell)$ + heat
B) $2H_2(g) + 2O_2(g) \rightarrow H_2O(\ell)$ + heat
C) $H_2(g) + O_2(g) \rightarrow H_2O(\ell)$ + heat
D) $H_2(g) + O_2(g) \rightarrow 2H_2O(\ell)$ + heat

198) Which equation illustrates conservation of mass?

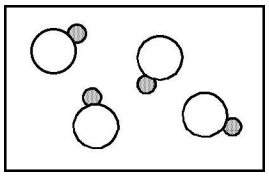
A) $H_2 + O_2 \rightarrow 2H_2O$ B) $H_2 + Cl_2 \rightarrow HCl$ C) $H_2 + Cl_2 \rightarrow 2HCl$ D) $H_2 + O_2 \rightarrow H_2O$

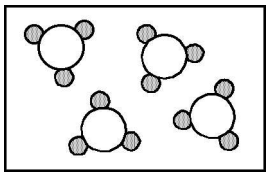
Name:_____ NAMING/FORMULA WRITING

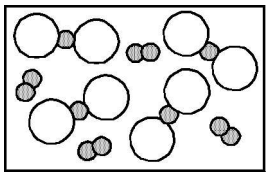
199) The particle diagram below represents a mixture of reactants.

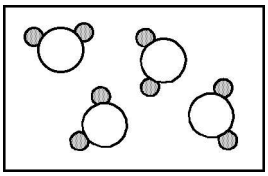


Which diagram for the products of the reaction shows the Law of Conservation of Mass?

A) 

B) 

C) 

D) 

200) The reaction $Ba(NO_3)_2(aq) + Na_2SO_4(aq) \rightarrow 2NaNO_3(aq) + BaSO_4(s)$ goes to completion because a

A) soluble salt is formed
B) nonionized product is formed
C) precipitate is formed
D) gas is formed

201) Given the balanced equation:

$$KCl(aq) + AgNO_3(aq) \rightarrow KNO_3(aq) + X$$

What is the correct formula for the product represented by the letter *X*?

A) $KCl_2(aq)$ B) $K_2Cl(aq)$ C) $AgCl_2(s)$ D) $AgCl(s)$

Questions 202 through 204 refer to the following:

The night operator at *ACME Chemical Company* left a 1,000 gallon reactor half-full of aqueous NaOH solution. The next morning, the day shift operator thought the reactor was empty and added an aqueous solution of $AlCl_3$. Now the employees cannot empty the reactor because a white solid is plugging the bottom outlet of the reactor.

NaOH and $AlCl_3$ react according to the following equation:

$$\_\_NaOH(aq) + \_\_AlCl_3(g) \rightarrow \_\_NaCl + \_\_Al(OH)_3$$

202) Write the correct name for the compound with the formula $Al(OH)_3$.

203) Write the correct name for the compound with the chemical formula $AlCl_3$.

204) Write the correct name for the compound with the chemical formula NaOH.

Name:_____

NAMING/FORMULA WRITING

Question 205 refers to the following:

Carbon(IV) fluoride (common name carbon tetrafluoride) is a colorless, odorless gas used as a refrigerant at low temperatures.

205) Using ● to represent an atom of carbon and ◌ to represent an atom of fluorine, draw a particle diagram in the box below showing one molecule of carbon(IV) fluoride.

206) What is the correct formula for lead(II) phosphate?

Question 207 refers to the following:

Li and KNO_3 react according to the following equation:

$$Li + KNO_3 \rightarrow LiNO_3 + X$$

207) Write the correct name for the compound with the chemical formula $LiNO_3$.

208) Balance the following equation using the *smallest* whole number coefficients.

$$\_\_Fe_2O_3(s) + \_\_CO(g) \rightarrow \_\_Fe(\ell) + \_\_CO_2(g)$$

Name:_____

ATOMIC STRUCTURE

209) Electrons have the properties of

A) particles only
B) particles and waves
C) waves only
D) neither particles nor waves

210) In ancient Greece, it was proposed that matter is composed of earth, air, water, and fire, and that these elements

A) have similar physical properties
B) are stationary
C) have similar chemical properties
D) are in continual motion

211) In an experiment, alpha particles were used to bombard gold foil. As a result of this experiment, the conclusion was made that the nucleus of an atom is

A) smaller than the atom and negatively charged
B) smaller than the atom and positively charged
C) larger than the atom and negatively charged
D) larger than the atom and positively charged

212) When alpha particles are used to bombard gold foil, most of the alpha particles pass through undeflected. This result indicates that most of the volume of a gold atom consists of

A) deuterons B) neutrons C) protons D) unoccupied space

213) Which one of the following statements is a part of Dalton's atomic theory?

A) All atoms of a given element are not identical.
B) During a chemical reaction, atoms cannot be separated, combined, or rearranged.
C) Different atoms combine in simple whole-number ratios to form compounds.
D) Atoms can be created or destroyed.

214) The development of the cathode ray tube led to the discovery of what subatomic particle?

A) positron B) proton C) electron D) neutron

215) What Greek philosopher was the first person to propose the idea that matter is made of tiny individual particles called atoms?

A) Democritus B) Bohr C) Rutherford D) Dalton

216) Which symbol represents a proton?

A) ${}_{1}^{1}\mathrm{H}$ B) ${}_{0}^{0}\mathrm{H}$ C) ${}_{0}^{1}\mathrm{H}$ D) ${}_{1}^{0}\mathrm{H}$

217) Which particle has the *least* mass?

A) a neutron B) an electron C) a proton D) a deuteron

Name:_____

ATOMIC STRUCTURE

218) The mass of an electron is approximately $\frac{1}{1{,}836}$ times the mass of

A) ${}^{2}_{1}\mathrm{H}$ B) ${}^{1}_{1}\mathrm{H}$ C) ${}^{4}_{2}\mathrm{He}$ D) ${}^{3}_{1}\mathrm{H}$

219) What is the approximate mass of an electron?

A) $\frac{1}{12}$ of a C-12 atom B) $\frac{1}{1{,}836}$ of a proton C) $\frac{1{,}835}{1{,}836}$ of a proton D) 1 atomic mass unit

220) What particle has a mass of approximately one atomic mass unit and a unit positive charge?

A) a proton B) an alpha particle C) a beta particle D) a neutron

221) What kind of radiation will travel through an electric field on a pathway that remains unaffected by the field?

A) an electron B) a proton C) an alpha particle D) a gamma ray

222) What particle will be attracted to the positive electrode in an electric field?

A) a beta particle B) a neutron C) an alpha particle D) a positron

223) The atomic number of an atom is *always* equal to the total number of

A) neutrons in the nucleus
B) neutrons plus protons in the atom
C) protons plus electrons in the atom
D) protons in the nucleus

224) Two atoms will *always* have the same atomic number if they have the same

A) number of nucleons B) number of neutrons C) number of protons D) mass number

225) In a sample of pure copper, *all* atoms have

A) the same atomic number, but a different number of protons
B) a different atomic number, but the same number of protons
C) the same atomic number and the same number of protons
D) a different atomic number and a different number of protons

226) A substance that is composed only of atoms having the same atomic number is classified as

A) a heterogeneous mixture
B) an element
C) a homogeneous mixture
D) a compound

227) As the number of neutrons in the nucleus of an atom increases, the nuclear charge of the atom

A) remains the same
B) decreases
C) increases

Name:_____

ATOMIC STRUCTURE

228) Which atom has the *greatest* nuclear charge?

A) Al B) Na C) Ar D) Si

229) The total number of protons found in an OH^- ion is

A) 1 B) 8 C) 9 D) 17

230) What is the number of protons present in the nucleus of an atom of $^{59}_{27}Co$?

A) 86 B) 59 C) 32 D) 27

231) A particle of matter contains 6 protons, 7 neutrons, and 6 electrons. This particle must be a

A) neutral nitrogen atom
B) positively charged carbon ion
C) positively charged nitrogen ion
D) neutral carbon atom

232) The nucleus of which atom is represented by $^{24}_{11}X$?

A) Na B) Mg C) Br D) Al

233) Element *X* has two isotopes. If 72.0% of the element has an isotopic mass of 84.9 atomic mass units, and 28.0% of the element has an isotopic mass of 87.0 atomic mass units, the average atomic mass of element *X* is numerically equal to

A) (72.0 + 84.9) × (28.0 + 87.0)
B) $\frac{(72.0\times84.9)}{100} + \frac{(28.0\times87.0)}{100}$
C) (72.0 × 84.9) + (28.0 × 87.0)
D) (72.0 − 84.9) × (28.0 + 87.0)

234) If 50.0% of the isotopes of an element have a mass of 196 amu and 50.0% of the isotopes have a mass of 198 amu, what is the average atomic mass of the element?

A) 196 amu B) 197 amu C) 98.5 amu D) 198 amu

235) The average atomic mass of iron is 55.847 amu. In a natural sample of iron, which is most likely the *most* abundant isotope?

A) ^{52}Fe B) ^{57}Fe C) ^{54}Fe D) ^{56}Fe

236) An atom of carbon-14 contains

A) 6 protons, 6 neutrons, and 8 electrons
B) 6 protons, 8 neutrons, and 8 electrons
C) 8 protons, 6 neutrons, and 6 electrons
D) 6 protons, 8 neutrons, and 6 electrons

237) What is the mass number of a deuterium atom?

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

Name:_____

ATOMIC STRUCTURE

238) What is the mass number of the atom $^{3}_{1}H$?

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

239) If 75.0% of the isotopes of an element have a mass of 35.0 amu and 25.0% of the isotopes have a mass of 37.0 amu, what is the atomic mass of the element?

A) 35.0 amu B) 36.0 amu C) 35.5 amu D) 37.0 amu

240) Atomic mass is measured in atomic mass units (amu) that are based on an atom of

A) ^{32}S equal to 32.000 amu
B) ^{14}N equal to 14.000 amu
C) ^{12}C equal to 12.000 amu
D) ^{16}O equal to 16.000 amu

241) What is the mass number of an atom which contains 28 protons, 28 electrons, and 34 neutrons?

A) 90 B) 62 C) 56 D) 28

242) What is the total number of protons and neutrons in a nuclide of $^{37}_{17}Cl$?

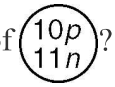
A) 37 B) 17 C) 54 D) 20

243) The major portion of an atom's mass consists of

A) neutrons and protons B) electrons and protons C) neutrons and positrons D) electrons and neutrons

244) An element occurs as a mixture of isotopes. The atomic mass of the element is based upon

A) neither the masses nor the relative abundances of the individual isotopes
B) both the masses and the relative abundances of the individual isotopes
C) the relative abundances of the isotopes, only
D) the masses of the individual isotopes, only

245) Which nuclei is an isotope of 

?

A) 

B) 

C) 

D) 

246) Which one of the following is the symbol for the deuterium isotope of hydrogen?

A) $^{1}_{1}H$ B) $^{4}_{2}H$ C) $^{3}_{1}H$ D) $^{2}_{1}H$

Name:_____

ATOMIC STRUCTURE

247) Which symbol represents an isotope of carbon?

A) ${}^{12}_{5}X$ B) ${}^{14}_{7}X$ C) ${}^{13}_{6}X$ D) ${}^{6}_{4}X$

248) If *X* is the symbol of an element, which pair correctly represents isotopes of *X*?

A) ${}^{64}_{158}X$ and ${}^{158}_{64}X$ B) ${}^{158}_{64}X$ and ${}^{159}_{64}X$ C) ${}^{158}_{64}X$ and ${}^{158}_{64}X$ D) ${}^{158}_{64}X$ and ${}^{158}_{65}X$

249) Which pair of atoms represent different isotopes of the same element?

A) ${}^{39}_{18}\text{Ar}$ and ${}^{39}_{19}\text{K}$ B) ${}^{58}_{27}\text{Co}$ and ${}^{59}_{28}\text{Ni}$ C) ${}^{35}_{17}\text{Cl}$ and ${}^{35}_{17}\text{Cl}$ D) ${}^{12}_{6}\text{C}$ and ${}^{13}_{6}\text{C}$

250) Neutral atoms of the same element can differ in their number of

A) positrons B) electrons C) neutrons D) protons

251) Neutral atoms of ^{35}Cl and ^{37}Cl differ with respect to their number of

A) neutrons B) protons C) electrons D) positrons

252) What is the atomic number of an atom that forms an ion with 18 electrons and a charge of 2+?

A) 18 B) 20 C) 48 D) 30

253) An atom of the element in Period 2 Group 14 is in the ground state. What total number of valence electrons does the atom have?

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

254) A strontium atom differs from a strontium ion in that the atom has a *greater*

A) atomic number B) number of protons C) number of electrons D) mass number

255) When a sodium atom becomes an ion, the size of the atom

A) increases by gaining an electron
B) increases by losing an electron
C) decreases by gaining an electron
D) decreases by losing an electron

256) Compared to a Be^{2+} ion, a Be^{0} atom has

A) fewer protons B) more protons C) fewer electrons D) more electrons

257) If *X* is the symbol of a noble gas atom in the ground state, its electron-dot symbol could be

A)  B) C) D) 

Name:_____

ATOMIC STRUCTURE

258) An atom has the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^5$. The electron-dot symbol for this element is

A)  B) C)  D)

259) What is the correct electron-dot symbol for an aluminum atom in the ground state?

A)  B) C)  D)

260) What is the electron-dot symbol of an atom of boron in the ground state?

A)  B) C)  D)

261) The electron-dot symbol  represents an ion of atom *X*. Atom *X* could be an atom of

A) K B) I C) H D) S

262) Which atom has the *most* stable outermost principal energy level?

A)  B) C)  D)

263) When the electrons of an excited atom fall back to lower levels, there is an emission of energy that produces

A) gamma radiation B) alpha particles C) beta particles D) spectral lines

264) What causes the emission of radiant energy that produces characteristic spectral lines?

A) gamma ray emission from the nucleus
B) movement of electrons to higher energy levels
C) return of electrons to lower energy levels
D) neutron absorption by the nucleus

265) The characteristic bright-line spectrum of an atom is produced by its

A) electrons absorbing quanta
B) protons absorbing quanta
C) electrons emitting quanta
D) protons emitting quanta

266) Which electron transition represents the release of energy?

A) 3*p* to 1*s* B) 1*s* to 3*p* C) 2*p* to 3*s* D) 2*s* to 2*p*

267) As an electron in an atom moves from the ground state to an excited state, the potential energy of the electron

A) remains the same
B) increases
C) decreases

Name:_____

ATOMIC STRUCTURE

268) As an electron moves from its ground state to an excited state, the potential energy of the atom

A) increases
C) decreases
B) remains the same

269) As an electron in a hydrogen atom moves from the second principal energy level to the first principal energy level, the energy of the atom

A) decreases
C) remains the same
B) increases

270) Which electron transition between principal energy levels results in the emission of energy?

A) 1st to 3rd
B) 1st to 4th
C) 4th to 3rd
D) 2nd to 3rd

271) Which principal energy level change by the electron of a hydrogen atom will cause the *greatest* amount of energy to be absorbed?

A) $n = 4$ to $n = 2$
B) $n = 2$ to $n = 5$
C) $n = 5$ to $n = 2$
D) $n = 2$ to $n = 4$

272) Which element has a completely filled third principal energy level?

A) Ar
B) Zn
C) Fe
D) N

273) Which electron configuration represents a potassium atom in the excited state?

A) 2-8-8
B) 2-8-8-1
C) 2-8-7-2
D) 2-8-5

274) In an atom that has an electron configuration of 2-5, what is the total number of electrons in its *highest* energy level?

A) 5
B) 2
C) 8
D) 7

275) Which principal energy level can hold a maximum of 18 electrons?

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

276) Which represents the electron configuraton of a fluorine atom in the excited state?

A) 3-6
B) 2-7
C) 2-8
D) 2-6-1

277) What principal energy level of an atom contains an electron with the *lowest* energy?

A) $n = 4$
B) $n = 2$
C) $n = 3$
D) $n = 1$

278) Which ion has the same electron configuration as an H^- ion?

A) Li^+
B) Cl^-
C) K^+
D) F^-

Name:_____

ATOMIC STRUCTURE

279) An atom of which element in the ground state has a complete outermost shell?

A) Hg B) H C) He D) Be

280) If n represents the principal energy level, the maximum number of electrons possible in that principal energy level is equal to

A) n^2 B) n C) $2n$ D) $2n^2$

281) Which one of the following is the electron configuraton of a calcium atom in the excited state?

A) 2-3-1 B) 2-8-7-3 C) 2-4 D) 2-8-8-2

282) What is the electron configuration of an oxygen ion (O^{2-}) in the ground state?

A) 2-6 B) 2-4 C) 1-7 D) 2-8

283) When a calcium atom loses its valence electrons, the ion formed has an electron configuration which is the same as an atom of

A) Cl B) Ar C) K D) Se

284) What is the electron configuration of an iodine ion (I^-) in the ground state?

A) 2-8-18-18-8 B) 2-8-18-17-9 C) 2-8-18-18-6 D) 2-8-18-18-7

285) Which represents the electron configuration of a silver atom in the ground state?

A) 2-8-4 B) 2-8-18-17-2 C) 2-8-18-18-1 D) 2-8-6

286) Which represents the electron configuration of a silver ion (Ag^+) in the ground state?

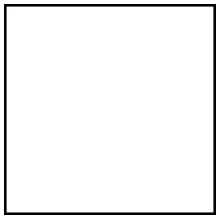
A) 2-8-18-18 B) 2-8-18-18-1 C) 2-8-8 D) 2-8-18-18-2

287) The questions below refer to an atom of silicon.

(a) How many protons are in the nucleus of a silicon atom?

(b) Write the electron configuration for an atom of silicon in the ground state.

(c) Draw a Lewis electron-dot diagram for an atom of silicon.



(d) How does an atom of silicon become a Si^{4-} ion?

(e) What noble gas has the same electron configuration as Si^{4-}?

Name:_____

ATOMIC STRUCTURE

288) The questions below refer to a neutral atom in the ground state having the electron configuration 2-8-1.

(a) Name the element with this electron configuration.

(b) How many protons are contained in the nucleus of this atom?

(c) How many valence electrons does this element contain?

(d) What principal energy level do the valence electrons occupy?

(e) Write a possible electron configuration for this atom in the excited state.

289) The questions below refer to an atom that has 17 protons, 19 neutrons, and 17 electrons.

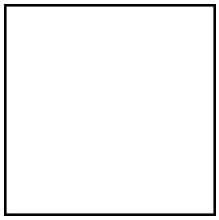
(a) What is the atomic number of this atom?

(b) What is the mass number of this atom?

(c) Write the electron configuration for this atom.

(d) Identify the atom.

(e) Draw a correct Lewis electron-dot diagram for the atom.



290) Given the following Lewis electron-dot diagram: 

Name *three* elements that could be element *X*.

291) By the early 1800's, scientific evidence had led scientists to conclude that atoms were hard, indivisible spheres of different sizes. The first evidence that the atom was not the smallest particle of matter came in the 1860's with the development of the cathode ray tube by William Crookes. Cathode ray tubes became popular scientific toys for years before their potential was realized.

(a) In the 1890's, J.J. Thomson proved that cathode rays had a negative charge. What subatomic particle makes up the cathode rays?

(b) What did the discovery of cathode rays reveal about the structure of the atom?

292) In 1909, a team of British scientists led by Ernest Rutherford, carried out the Gold Foil experiments to determine the arrangement of particles in the atom. In these experiments, alpha particles were used to bombard gold foil.

(a) Most of the alpha particles passed through the gold foil undeflected. What conclusion was made about the structure of the atom based on this observation?

(b) A few of the alpha particles were deflected back at the source. What did this observation reveal about the structure of the atom?

Name:_____

ATOMIC STRUCTURE

293) In the early 1900's, the Bohr model proposed that atoms were composed of a small, dense nucleus with electrons orbiting the empty space outside the nucleus. Based on the presently accepted Wave-Mechanical model of the atom, state *one* weakness with the Bohr model.

294) Relate the colored lines seen on an emission spectrum to electron transitions within an atom.

_____

Name:_____

PERIODIC TABLE

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

A) N, O, and F B) Li, Na, and K C) Al, Si, and P D) Hg, Br, and Rn

296) What is the electron configuration of an atom of a Period 3 element?

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

297) Elements in a given period of the Periodic Table contain the same number of

A) neutrons in the nucleus
B) protons in the nucleus
C) occupied principal energy levels
D) electrons in the outermost level

298) Which represents the correct electron configuration of a Group 14 element in the ground state?

A) 2-8-8-1 B) 2-4 C) 2-7-5 D) 2-3

299) Which group contains elements with the *greatest* variation in chemical properties?

A) Li, Na, K B) B, Al, Ga C) Li, Be, B D) Be, Mg, Ca

300) In the modern Periodic Table, the elements are arranged according to

A) atomic number B) oxidation number C) atomic mass D) mass number

301) Alkali metals, alkaline earth metals, and halogens are found respectively in Groups

A) 1, 2, and 14 B) 1, 2, and 18 C) 2, 13, and 17 D) 1, 2, and 17

302) Which two elements have the *most* similar chemical properties?

A) nickel and phosphorus B) chlorine and sulfur C) aluminum and barium D) sodium and potassium

303) Which sequence of atomic numbers represents elements which have similar chemical properties?

A) 19, 23, 30, 36 B) 3, 12, 21, 40 C) 9, 16, 33, 50 D) 4, 20, 38, 88

304) How many halogens are in Period 3 of the Periodic Table?

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

305) As the atoms of the metals of Group 1 in the ground state are considered in order from top to bottom, the number of occupied principal energy levels

A) decreases
B) increases
C) remains the same

Name:_____

PERIODIC TABLE

306) The elements in Period 3 *all* have the same number of

A) principal energy levels containing electrons
B) orbitals containing electrons
C) valence electrons
D) sublevels containing electrons

307) As the atoms of the elements from atomic number 3 to atomic number 9 are considered in sequence from left to right on the Periodic Table, the atomic radius of each successive atom is

A) larger, and the nuclear charge is less
B) smaller, and the nuclear charge is less
C) smaller, and the nuclear charge is greater
D) larger, and the nuclear charge is greater

308) Which ion has the *largest* radius?

A) I^-
B) Cl^-
C) F^-
D) Br^-

309) In the ground state, atoms of which element have the *highest* first ionization energy?

A) oxygen
B) nitrogen
C) boron
D) carbon

310) Which Group 15 elements can lose an electron *most* readily?

A) Sb
B) P
C) Bi
D) N

311) The S^{2-} ion differs from the S^0 atom in that the S^{2-} ion has a

A) smaller radius and fewer electrons
B) larger radius and fewer electrons
C) smaller radius and more electrons
D) larger radius and more electrons

312) Compared to a neon atom, a helium atom has a

A) smaller first ionization energy
B) larger atomic number
C) greater number of electrons
D) smaller radius

313) Which atom will lose an electron *most* readily?

A) strontium
B) cesium
C) calcium
D) potassium

314) In which group of elements do the atoms gain electrons *most* readily?

A) 1
B) 2
C) 16
D) 18

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

A) Sn
B) Pb
C) Sb
D) P

Name:_____

PERIODIC TABLE

316) As the elements Li to F in Period 2 of the Periodic Table are considered in succession, how do the relative electronegativity and the atomic radius of each successive element compare?

A) The relative electronegativity increases and the atomic radius decreases.
B) The relative electronegativity decreases and the atomic radius decreases.
C) The relative electronegativity increases and the atomic radius increases.
D) The relative electronegativity decreases and the atomic radius increases.

317) Which atom has the *greatest* tendency to gain electrons?

A) I B) F C) Rb D) Al

318) Which element in Group 17 is *least* likely to lose an electron?

A) fluorine B) iodine C) chlorine D) bromine

319) Which number *most* likely represents the first ionization energy (in kilojoules per mole of atoms) for a nonmetallic element?

A) 579 B) 403 C) 1,314 D) 736

320) Which element is so active chemically that it occurs naturally only in compounds?

A) potassium B) copper C) silver D) sulfur

321) As the atoms of the elements in Group 1 are considered in order from top to bottom, the ionization energy of each successive atom

A) increases
B) remains the same
C) decreases

322) As the elements in Period 3 are considered from left to right, they tend to

A) lose electrons more readily and increase in metallic character
B) gain electrons more readily and increase in nonmetallic character
C) gain electrons more readily and increase in metallic character
D) lose electrons more readily and increase in nonmetallic character

323) As the elements of Group 17 are considered in order of increasing atomic number, the nonmetallic character of each successive element

A) decreases
B) increases
C) remains the same

324) Which particle has the *largest* radius?

A) Se B) Cu C) Cu^{2+} D) Se^{2-}

Name:_____

PERIODIC TABLE

325) Which element in Group 15 has the *greatest* metallic character?

A) Sb B) P C) N D) Bi

326) Which element in Period 2 has the *greatest* tendency to form a negative ion?

A) neon B) fluorine C) carbon D) lithium

327) Which group of elements in the Periodic Table contain a semimetal (metalloid)?

A) 1 B) 13 C) 18 D) 7

328) Which element in Group 17 is the *most* active nonmetal?

A) F B) Br C) Cl D) I

329) The reactivity of the metals in Groups 1 and 2 generally increases with

A) increased atomic radius
B) decreased mass
C) increased ionization energy
D) decreased nuclear charge

330) As sodium reacts with fluorine to form the compound NaF, each sodium atom will

A) lose 2 electrons B) gain 1 electron C) gain 2 electrons D) lose 1 electron

331) As the elements of Period 2 are considered in succession from left to right, there is a general decrease in

A) electronegativity B) nonmetallic character C) metallic character D) ionization energy

332) The table below shows some properties of elements *A*, *B*, *C*, and *D*.

Element	Ionization Energy	Electronegativity	Conductivity of Heat and Electricity
A	low	low	low
B	low	low	high
C	high	high	low
D	high	high	high

Which element is *most* likely a nonmetal?

A) *A* B) *B* C) *C* D) *D*

333) Which one of the following is the electron configuration of a metalloid in the ground state?

A) $1s^2$ B) $1s^2 2s^1$ C) $1s^2 2s^2 2p^1$ D) $1s^2 2s^1 2p^2$

Name:_____

PERIODIC TABLE

334) Which element in Period 4 of the Periodic Table exhibits the *most* nonmetallic properties?

A) Cr B) Ca C) Ga D) Br

335) Which element's atoms have a *larger* atomic radius than atoms of silicon?

A) chlorine B) sodium C) carbon D) sulfur

336) A STP, which substance is the *best* conductor of electricity?

A) oxygen B) helium C) hydrogen D) mercury

337) Which element in Period 3 of the Periodic Table has the *highest* first ionization energy?

A) Mg B) Cl C) Na D) Ar

338) As the elements are considered from top to the bottom of Group 15, which sequence in properties occurs?

A) nonmetal → metalloid → metal
B) metalloid → metal → nonmetal
C) metal → metalloid → nonmetal
D) metal → nonmetal → metalloid

339) Which element is brittle and does *not* conduct heat or electricity?

A) Al(s) B) K(s) C) S(s) D) Mg(s)

340) Which is the *most* active nonmetal in the Periodic Table of Elements?

A) Na B) Cl C) F D) I

341) Based on the Periodic Table of the Elements, which Group 2 element is *most* active?

A) Mg B) Ba C) Ca D) Sr

342) An ion of which element is *smaller* than its atom?

A) Na B) F C) Cl D) O

343) Which three groups of the Periodic Table contain the *most* elements classified as metalloids (semimetals)?

A) 2, 13, and 14 B) 14, 15, and 16 C) 16, 17, and 18 D) 1, 2, and 13

344) At STP, potassium is classified as

A) a network solid B) a metallic solid C) an ionic solid D) a molecular solid

345) The element in Period 3 with the *least* metallic character is

A) silicon B) phosphorus C) sodium D) aluminum

Name:_____

PERIODIC TABLE

346) The *highest* ionization energies in any period are found in Group

A) 1 B) 2 C) 18 D) 17

347) Chlorine combines with element *M* to form a compound with the formula MCl_2. Which group in the Periodic Table contains element *M*?

A) 16 B) 2 C) 13 D) 17

348) Which aqueous solution is blue?

A) $CuSO_4(aq)$ B) $MgSO_4(aq)$ C) $Na_2SO_4(aq)$ D) $K_2SO_4(aq)$

349) Which atom has multiple oxidation states and forms an ion that is colored when in solution?

A) F B) Cl C) Zn D) Cu

350) The halogen with the *highest* electronegativity is

A) iodine B) bromine C) chlorine D) fluorine

351) Element *X* forms the compounds XCl_3 and X_2O_3. In the Periodic Table, element *X* would *most* likely be found in Group

A) 1 B) 2 C) 13 D) 14

352) Which metal atom can form ionic bonds by losing electrons from *both* the outermost and next to outermost principal energy levels?

A) Fe B) Ca C) Mg D) Pb

353) In which period of the Periodic Table are transition elements found?

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

354) In the ground state, how many electrons are in the outermost *s* sublevel of each element in Group 17?

A) 7 B) 2 C) 8 D) 5

355) Which element can react with fluorine to form more than one binary compound?

A) Mg B) Co C) K D) Na

356) If *M* represents an atom of an alkali metal, the correct formula for a compound of this atom with chlorine is

A) MCl_2 B) M_2Cl C) MCl_3 D) MCl

Name:_____

PERIODIC TABLE

357) Which halogens are gases at STP?

A) chlorine and fluorine B) iodine and bromine C) iodine and fluorine D) chlorine and bromine

358) Which element in Period 3 exists as diatomic molecules at STP?

A) chlorine B) sodium C) aluminum D) argon

359) Given the same conditions, which Group 17 element has the *least* tendency to gain electrons?

A) chlorine B) bromine C) iodine D) fluorine

360) A chloride dissolves in water to form a colored solution. The chloride could be

A) KCl B) HCl C) $CaCl_2$ D) $CuCl_2$

361) An aqueous solution of XCl_2 contains colored ions. Element X is *most* likely

A) a halogen B) a transition metal C) an alkali metal D) an alkaline earth

362) What group of the Periodic Table contains the noble gases?

A) 1 B) 2 C) 18 D) 17

363) What is the total number of electrons found in the valence shell of a halogen in the ground state?

A) 1 B) 2 C) 7 D) 8

364) Which element can form a chloride with a general formula of MCl_2 or MCl_3?

A) Fe B) Mg C) Zn D) Al

365) What group in the Periodic Table contains the elements of the alkaline earth family?

A) 1 B) 2 C) 17 D) 18

366) Which represents the correct electron configuration of the outermost principal energy level of a Group 18 element in the ground state?

A) s^2p^4 B) s^2p^6 C) s^2p^8 D) s^2p^2

367) Which group contains elements composed of diatomic molecules at STP?

A) 11 B) 2 C) 7 D) 17

368) Which category is composed of elements that have *both* positive and negative oxidation states?

A) the alkaline earths B) the transition metals C) the alkali metals D) the halogens

Name:_____

PERIODIC TABLE

369) The elements of which group consist of monatomic gas molecules at STP?

A) 1 B) 2 C) 18 D) 17

370) Which Group 18 element would be *most* likely to form a compound with fluorine?

A) Kr B) Ne C) Ar D) He

371) An element whose atoms have the electron configuration 2-8-18-1 is

A) an alkaline earth B) a noble gas C) an alkali metal D) a transition element

372) Which element occurs as a solid at STP?

A) carbon B) mercury C) nitrogen D) bromine

373) Which metal has the *lowest* melting point?

A) iron B) mercury C) silver D) copper

374) Which group of the Periodic Table contains elements in the solid, liquid, and gas phases at 25°C and 1 atmosphere?

A) 18 B) 2 C) 17 D) 16

375) The element in Group 16 whose isotopes are *all* radioactive is

A) S B) Te C) Po D) O

376) Which group contains an element that is a liquid at STP?

A) 1 B) 2 C) 16 D) 17

377) In which group does each element have a total of four electrons in the outermost principal energy level?

A) 1 B) 14 C) 18 D) 16

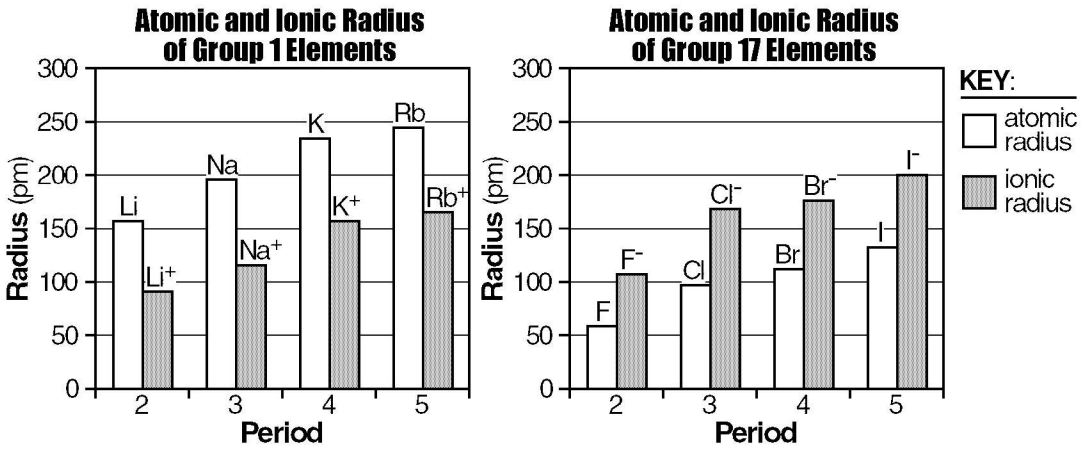
378) An element that is a liquid at STP is in Group

A) 1 B) 2 C) 11 D) 12

Name:_____

PERIODIC TABLE

Questions 379 through 381 refer to the following:



379) State the trend in atomic radius of the Group 1 and Group 17 elements as you go from Period 2 to Period 5 in the Periodic Table.

380) Account for the relationship between atomic and ionic radius in Group 1 elements in the Periodic Table.

381) Compare the atomic radius of Group 17 elements in the Periodic Table to their corresponding ionic radius.

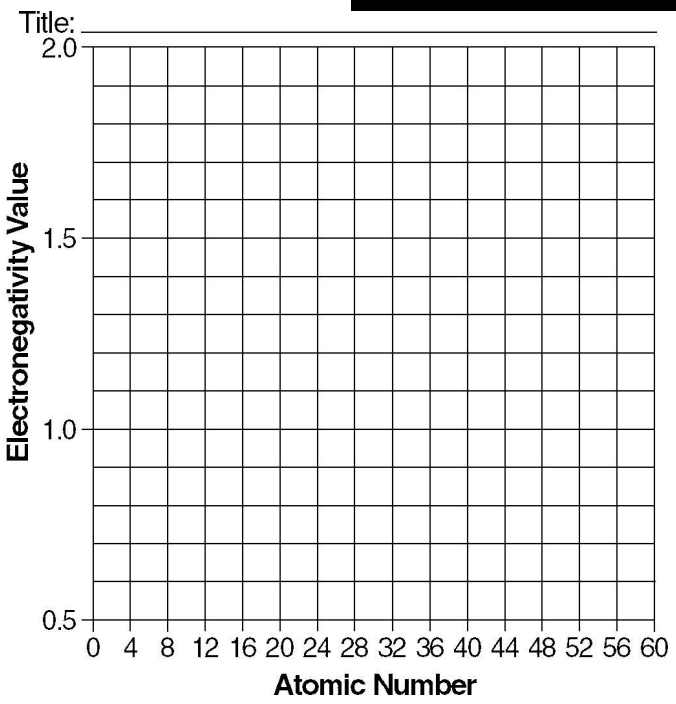
Name:_____

PERIODIC TABLE

382)

DATA TABLE

Atomic Number	Element	Electronegativity Value
4	Be	1.6
12	Mg	1.3
20	Ca	1.0
56	Ba	0.9



(a) Using the information from the given data table, construct a line graph on the grid provided. Circle each point and connect the points with a best-fit curve.

(b) Write an appropriate title on the graph.

(c) Describe the trend in electronegativity values of Group 2 elements as the atomic number increases.

(d) Account for the trend in electronegativty in Group 2 elements in relation to atomic structure.

(e) Using the graph completed in *part (a)*, predict the electronegativity value for the element with atomic number 38.

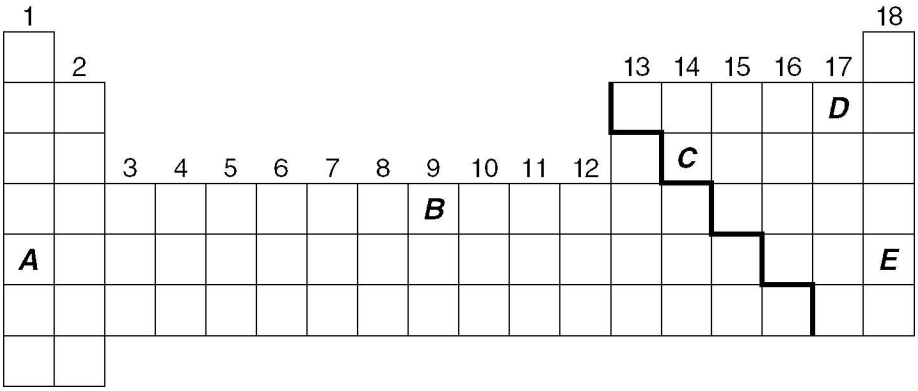
383) Sodium and cesium are both elements in Group 1. They have the same number of valence electrons and similar chemical properties. For example, they both explode in water. However, cesium reacts more violently in water than sodium. Explain why cesium is more reactive than sodium.

Name:_____

PERIODIC TABLE

Questions 384 through 386 refer to the following:

The diagram below represents the *Periodic Table of Elements.* Selected elements are represented by the letters *A* through *E*.



384) Which element is the *most* reactive metal?

385) Which *two* elements would most likely combine to form an ionic compound?

386) Which element exists as a diatomic gas at STP?

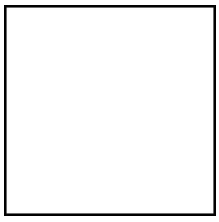
387) A neutral atom has the following electron configuration: 2-8-8-1

(a) State the group and period this element is found on the Periodic Table.

(b) Identify this element.

(c) Classify this element as a metal, nonmetal, or metalloid.

(d) In the box below, draw a Lewis electron-dot structure for this element.



(e) List *two* other elements likely to have properties similar to this element.

Name:_____

PERIODIC TABLE

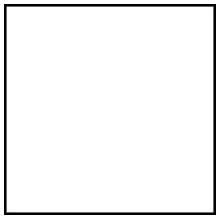
388) A neutral atom has the following electron configuration: 2-8-18-7

(a) State the group and period this element is found on the Periodic Table.

(b) Identify this element.

(c) Classify this element as a metal, nonmetal, or metalloid.

(d) In the box below, draw a Lewis electron-dot structure for this element.



(e) List *two* other elements likely to have properties similar to this element.

389) Which atom has the *strongest* attraction for electrons?

A) F B) Br C) I D) Cl

390) Which pair of atoms would form the *most* stable compound?

A) Li and I B) Li and Cl C) Li and Br D) Li and F

391) As the atoms of the elements in Group 16 are considered in order from top to bottom, their electronegativities

A) remains the same
B) increases
C) decreases

392) Which bond has the *greatest* ionic character?

A) H–O B) H–F C) H–Cl D) H–N

393) Which bond has the *greatest* degree of ionic character?

A) Cl–Cl B) H–Cl C) K–Cl D) I–Cl

394) Which particles may be gained, lost, or shared by an atom when it forms a chemical bond?

A) neutrons B) electrons C) protons D) nucleons

395) An element with an electronegativity of 0.9 bonds with an element with an electronegativity of 3.1. Which one of the following phrases *best* describes the bond between these elements?

A) mostly ionic in character and formed between a metal and a nonmetal
B) mostly ionic in character and formed between two nonmetals
C) mostly covalent in character and formed between a metal and a nonmetal
D) mostly covalent in character and formed between two nonmetals

396) In which compound have electrons been transferred to the oxygen atom?

A) N_2O B) CO_2 C) NO_2 D) Na_2O

397) Which electronegativity is possible for an alkali metal?

A) 1.0 B) 2.0 C) 3.0 D) 4.0

398) Which bond has the *greatest* degree of ionic character?

A) H–Cl B) Li–Br C) F–F D) S–O

399) Which substance is the *best* conductor of electricity?

A) NaCl(s) B) NaCl(ℓ) C) H_2O(s) D) H_2O(g)

400) Which element would *most* likely form an ionic bond with chlorine?

A) N B) S C) O D) K

401) What type of bonding is characteristic of a substance that has a high melting point and electrical conductivity only in the liquid phase?

A) ionic B) coordinate covalent C) metallic D) nonpolar covalent

402) When sodium reacts with chlorine to form sodium chloride, electrons are lost by

A) both sodium and chlorine
B) chlorine, only
C) sodium, only
D) neither sodium nor chlorine

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

A) N B) C C) Li D) O

404) Compounds with the *greatest* ionic character would form when fluorine reacts with

A) alkali metals
B) Group 13 elements
C) metalloids (semimetals)
D) noble gases

405) When a reaction occurs between atoms with the electron configurations 2-8-1 and 2-7, what is the predominant type of bond formed?

A) polar covalent B) metallic C) ionic D) nonpolar covalent

406) A crystalline solid has a high melting point and is a good conductor of electricity in the liquid state. This solid could be

A) KCl B) Hg C) $C_6H_{12}O_6$ D) CO_2

407) Atoms of nonmetals generally react with atoms of metals by

A) sharing electrons to form covalent compounds
B) sharing electrons to form ionic compounds
C) gaining electrons to form ionic compounds
D) gaining electrons to form covalent compounds

408) Which compound contains ionic bonds?

A) HBr(g) B) CO_2(g) C) $C_6H_{12}O_6$(s) D) NaBr(s)

409) When a reaction occurs between atoms with ground state electron configurations $1s^22s^1$ and $1s^22s^22p^5$, the predominant type of bond formed is

A) nonpolar covalent B) polar covalent C) metallic D) ionic

410) The *greatest* degree of ionic character would be found in a bond between sulfur and

A) phosphorus B) chlorine C) bromine D) oxygen

411) Which formula represents an ionic compound?

A) $CCl_4(\ell)$ B) NaCl(s) C) $H_2O(\ell)$ D) $NH_3(g)$

412) An ionic bond forms between atoms of

A) K and Cl B) H and Cl C) I and Cl D) P and Cl

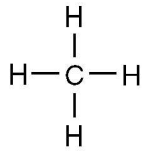
413) Which substance will conduct electricity in *both* the solid phase and the liquid phase?

A) H_2 B) AgCl C) HCl D) Ag

414) What type of bonds are formed when two non-metal atoms combine?

A) ionic bonds B) metallic bonds C) covalent bonds D) network bonds

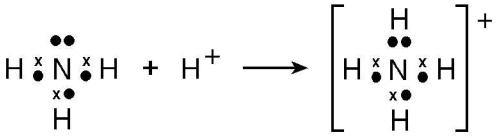
415) Which structural formula represents a polar molecule?

A)  B)  C) H—C≡C—H D) H—H

416) A molecule of ammonia (NH_3) contains

A) covalent bonds, only
B) both covalent and ionic bonds
C) neither covalent nor ionic bonds
D) ionic bonds, only

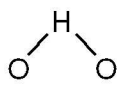
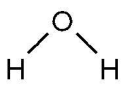
417) Given the reaction:



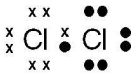
The bond formed between the NH_3 and the H^+ is

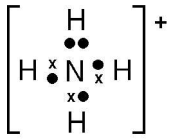
A) coordinate covalent B) metallic C) ionic D) electrovalent

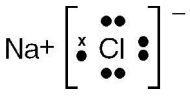
418) Which diagram *best* represents the structure of a water molecule?

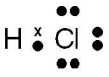
A)  B) H—H—O C)  D) O—H—O

419) Which species contains a coordinate covalent bond?

A) 

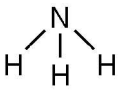
B) 

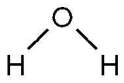
C) 

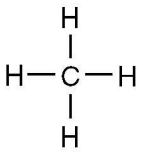
D) 

420) Which structural formula represents a nonpolar symmetrical molecule?

A) 

B) 

C) 

D) 

421) The electrons in a bond between two iodine atoms (I_2) are shared

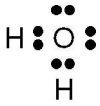
A) equally, and the resulting bond is polar
B) unequally, and the resulting bond is polar
C) unequally, and the resulting bond is nonpolar
D) equally, and the resulting bond is nonpolar

422) The shape and bonding in a diatomic bromine molecule are *best* described as

A) asymmetrical and polar
B) symmetrical and polar
C) symmetrical and nonpolar
D) asymmetrical and nonpolar

423) A diamond consists of covalently bonded carbon atoms. The diamond is an example of

A) an ionic solid
B) a metallic solid
C) a network solid
D) a molecular solid

424) A molecule with the electron-dot formula  is

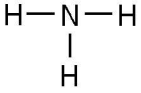
A) linear
B) nonpolar
C) symmetrical
D) polar

425) Which combination of atoms can form a polar covalent bond?

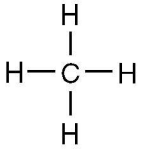
A) H and Br
B) H and H
C) N and N
D) Na and Br

426) Which structural formula represents a polar molecule?

A) 

B) 

C) 

D) 

427) A student investigated samples of four different substances in the solid state. The table is a record of the behaviors observed (marked with an *X*) when each solid was tested.

Behavior Tested	Sample I	Sample II	Sample III	Sample IV
High Melting Point	X		X	
Low Melting Point		X		X
Soluble in Water	X			X
Insoluble in Water		X	X	
Decomposed under High Heat		X		
Stable under High Heat	X		X	X
Electrolyte	X			X
Nonelectrolyte		X	X	

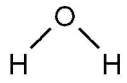
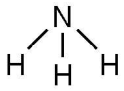
Based on the tabulated results, which of the solids investigated had the characteristics *most* closely associated with those of an organic compound?

A) Sample *I* B) Sample *II* C) Sample *III* D) Sample *IV*

428) What type of bonding is found in the molecule HBr?

A) polar covalent B) ionic C) metallic D) nonpolar covalent

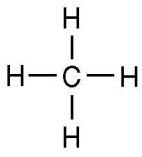
429) Which molecule is nonpolar?

A)  B) O=C=O C)  D) H—Cl

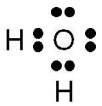
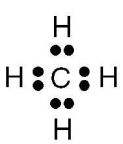
430) The bond between hydrogen and oxygen in a water molecule is classified as

A) ionic and nonpolar B) ionic and polar C) covalent and nonpolar D) covalent and polar

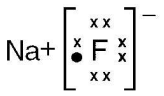
431) Which molecule is a dipole?

A)  B) O=C=O C)  D) N≡N

432) Which molecule could form a coordinate covalent bond with a proton (H^+)?

A)  B) H : H C)  D) H : C ⋮ C : H

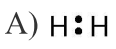
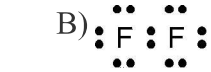
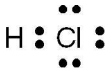
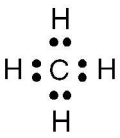
433) Which electron-dot formula represents a molecule that contains a nonpolar covalent bond?

A)  B)  C)  D) 

434) Which formula represents a v-shaped molecule?

A) Br_2 B) H_2O C) $CaCl_2$ D) HBr

435) Which electron-dot formula represents a polar molecule?

A)  B)  C)  D) 

436) A chemical bond results when two nuclei have a simultaneous attraction for

A) neutrons B) protons C) electrons D) nucleons

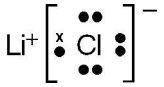
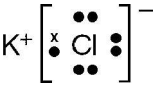
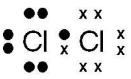
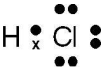
437) Which molecule is polar and contains polar bonds?

A) CO_2 B) N_2 C) CCl_4 D) NH_3

438) Which one of the following is a property of network solids, but *not* of molecular solids?

A) electrical insulators B) water soluble C) high melting points D) high malleability

439) Which electron-dot diagram represents a molecule that has a polar covalent bond?

A)  B)  C)  D) 

440) Which factor distinguishes a metallic bond from an ionic bond or a covalent bond?

A) the mobility of protons
B) the unequal sharing of electrons
C) the equal sharing of electrons
D) the mobility of electrons

441) Which substance contains particles held together by metallic bonds?

A) $I_2(s)$ B) Ne(s) C) Ni(s) D) $N_2(s)$

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

A) calcium B) carbon C) bromine D) sulfur

443) 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) mobile electrons
C) high electronegativities
D) mobile protons

444) Oxygen, nitrogen, and fluorine bond with hydrogen to form molecules. These molecules are attracted to each other by

A) coordinate covalent bonds
B) hydrogen bonds
C) ionic bonds
D) electrovalent bonds

445) The halogen that undergoes sublimation at room temperature is

A) iodine B) chlorine C) bromine D) fluorine

446) As the distance between molecules of a liquid decreases, the intermolecular forces of attraction

A) increase
B) remain the same
C) decrease

447) The *strongest* hydrogen bonds are formed between molecules in which hydrogen is covalently bonded to an element with

A) high electronegativity and large atomic radius
B) high electronegativity and small atomic radius
C) low electronegativity and large atomic radius
D) low electronegativity and small atomic radius

448) Hydrogen bonds are *strongest* between molecules of

A) HBr(g) B) HCl(g) C) HI(g) D) HF(g)

449) What is the predominate type of attraction between molecules of HF in the liquid state?

A) ionic bonding B) hydrogen bonding C) electrovalent bonding D) covalent bonding

450) Which liquid has the *weakest* intermolecular forces of attraction between its molecules?

A) Xe(ℓ) B) Kr(ℓ) C) Ne(ℓ) D) He(ℓ)

451) Which compound in the liquid phase has the *highest* normal boiling point?

A) C_5H_{12} B) C_4H_{10} C) C_3H_8 D) C_2H_6

452) Which compound has the *lowest* normal boiling point?

A) propane B) butane C) methane D) ethane

453) Argon has a *higher* boiling point than neon because argon has

A) fewer electrons in its 2nd principal energy level
B) more electrons in its outermost principal energy level
C) stronger intermolecular forces of attraction
D) weaker intermolecular forces of attraction

454) What kinds of bonds are found in a sample of $H_2O(s)$?

A) both covalent and hydrogen bonds
B) hydrogen bonds, only
C) covalent bonds, only
D) both ionic and hydrogen bonds

455) When NaCl(s) is dissolved in $H_2O(\ell)$, the sodium ion is attracted to the water molecule's

A) positive end, which is oxygen
B) positive end, which is hydrogen
C) negative end, which is oxygen
D) negative end, which is hydrogen

456) The *strongest* hydrogen bonds are formed between molecules in which hydrogen is covalently bonded to

A) N B) O C) F D) Cl

457) The *strongest* hydrogen bonds are formed between molecules of

A) H_2Te B) H_2O C) H_2Se D) H_2S

458) At 298 K, the vapor pressure of H_2O is *less* than the vapor pressure of CH_3OH because H_2O has

A) stronger ionic bonds
B) stronger hydrogen bonds
C) larger molecules
D) a larger molecular mass

459) In an aqueous solution of an ionic salt, the oxygen atom of the water molecule is attracted to the

A) positive ion of the salt, due to oxygen's partial negative charge
B) positive ion of the salt, due to oxygen's partial positive charge
C) negative ion of the salt, due to oxygen's partial negative charge
D) negative ion of the salt, due to oxygen's partial positive charge

460) Which element exhibits the *strongest* attractions between molecules?

A) oxygen B) hydrogen C) nitrogen D) chlorine

461) Given the phase change:

$H_2(g) \rightarrow H_2(\ell)$

What kind of force acts between molecules of H_2 during this phase change?

A) ionic bond B) hydrogen bond C) molecule-ion D) London dispersion

462) Intermolecular forces of attraction between nonpolar molecules *always* decrease with

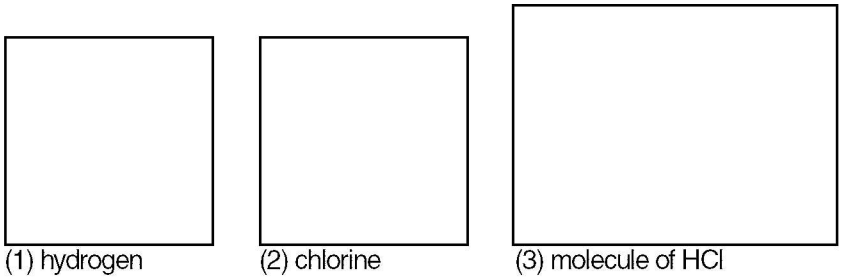
A) decreasing molecular size and decreasing distance between the molecules
B) increasing molecular size and decreasing distance between the molecules
C) decreasing molecular size and increasing distance between the molecules
D) increasing molecular size and increasing distance between the molecules

463) Which element has the *lowest* normal boiling point?

A) Kr B) Ne C) He D) Ar

464) In the boxes below, draw a correct Lewis electron-dot structure for:

(1) an atom of hydrogen
(2) an atom of chlorine
(3) a molecule of hydrogen chloride (HCl)

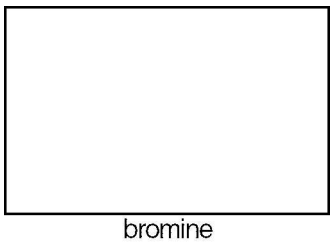


Question 465 refers to the following:

Given the binary compound formed from magnesium and chlorine:

465) Write the correct chemical formula for this compound.

466) In the box below, draw a Lewis electron-dot structure for a molecule of bromine.



Questions 467 and 468 refer to the following:

Given the binary compound formed from calcium and bromine:

467) In the box below, draw the Lewis electron-dot structure for the compound formed from calcium and bromine. [*Include any charges or partial charges*.]

468) Write the correct IUPAC name for this compound.

469) Metals like copper are often used in electrical wiring.

(a) Name *two* properties of metals that makes them useful in electrical wiring.

(b) Explain how metallic bonding between copper atoms can account for each of these properties.

Questions 470 and 471 refer to the following:

Given the binary compound formed from potassium and iodine:

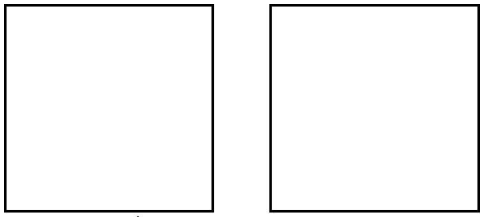
470) What type of bond forms between potassium and iodine? [*Give one reason to support your answer*.]

471) In the box below, draw the Lewis electron-dot structure for the compound formed from potassium and iodine. [*Include any charges or partial charges*.]

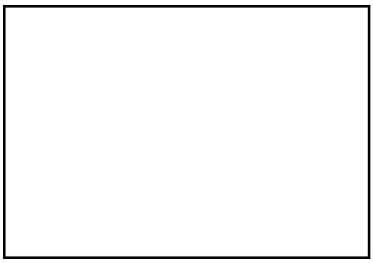
Questions 472 and 473 refer to the following:

Given the binary compound formed from magnesium and oxygen:

472) In the boxes below, draw the Lewis electron-dot diagrams for the elements Mg and O.

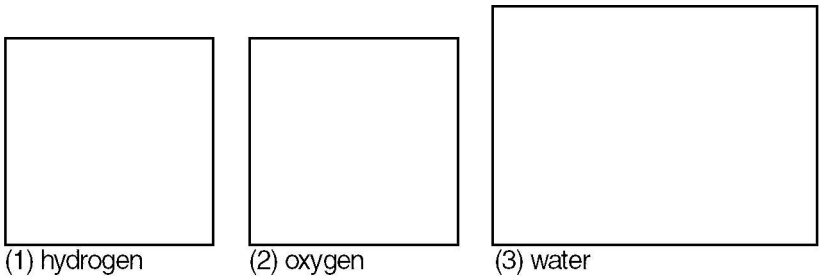


473) In the box below, draw the Lewis electron-dot structure for the compound formed from magnesium and oxygen. [*Include any charges or partial charges*.]

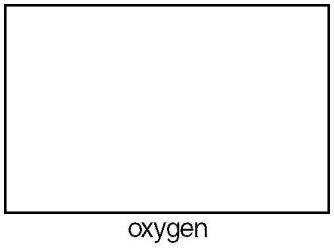


474) In the boxes below, draw a correct Lewis electron-dot structure for:

(1) an atom of hydrogen
(2) an atom of oxygen
(3) a molecule of water (H_2O)



475) In the box below, draw a Lewis electron-dot structure for a molecule of oxygen.



Name:_____

MOLES/STOICH

476) What is the total mass of oxygen, in grams, in 1.00 mole of $Al_2(CrO_4)_3$?

A) 48.0 g B) 192 g C) 112 g D) 64.0 g

477) What is the gram formula mass of $Al_2(SO_4)_3$?

A) 150. g B) 342 g C) 214 g D) 123 g

478) What is the gram formula mass of Li_2SO_4?

A) 110 g B) 54 g C) 55 g D) 206 g

479) The gram molecular mass of CO_2 is the same as the gram molecular mass of

A) CO B) SO_2 C) C_2H_6 D) C_3H_8

480) Which substance has the *greatest* molecular mass?

A) I_2 B) NO C) H_2O_2 D) CF_4

481) Which represents the *greatest* mass of chlorine?

A) 1 gram of chlorine B) 1 molecule of chlorine C) 1 atom of chlorine D) 1 mole of chlorine

482) What is the gram formula mass of $CuSO_4 \cdot 5H_2O$?

A) 160. g B) 250. g C) 178 g D) 186 g

483) What is the ratio by mass of carbon to hydrogen in the compound C_2H_6?

A) 4:1 B) 6:2 C) 2:6 D) 1:4

484) Approximately how many atoms are there in 3.0 moles of Al?

A) $4(6.0 \times 10^{23})$ B) $3(6.0 \times 10^{23})$ C) $2(6.0 \times 10^{23})$ D) 6.0×10^{23}

485) How many moles of carbon atoms are there in one mole of $C_6H_{12}O_6$?

A) $6(6.00 \times 10^{23})$ B) 12 C) $12(6.00 \times 10^{23})$ D) 6

486) How many molecules are in 0.25 mole of O_2?

A) 6.0×10^{23} B) 3.0×10^{23} C) 12×10^{23} D) 1.5×10^{23}

487) At STP, what mass of CH_4 has the same number of molecules as 64 grams of SO_2?

A) 16 g B) 32 g C) 64 g D) 128 g

Name:_____

MOLES/STOICH

488) What is the mass of 3.0×10^{23} atoms of neon?

A) 1.0 g B) 20. g C) 10. g D) 0.50 g

489) A sample of nitrogen containing 3.0×10^{23} molecules has the same number of molecules as a sample containing

A) 0.25 mole of O_2 B) 2.0 moles of He C) 0.50 mole of Ne D) 1.0 mole of H_2

490) How many molecules are in 0.25 mole of CO?

A) 6.0×10^{23} B) 1.5×10^{23} C) 9.0×10^{23} D) 3.0×10^{23}

491) How many moles of hydrogen atoms are there in one mole of $C_6H_{12}O_6$ molecules?

A) $12(6.00 \times 10^{23})$ B) 12 C) 24 D) $24(6.00 \times 10^{23})$

492) What is the total number of moles of hydrogen gas contained in 9.03×10^{23} molecules?

A) 2.00 moles B) 9.03 moles C) 1.50 moles D) 6.02 moles

493) A sealed container of nitrogen gas contains 6×10^{23} molecules at STP. As the temperature increases, the mass of the nitrogen will

A) remain the same C) decrease

B) increase

494) How many moles of hydrogen atoms are present in one mole of $C_2H_4(OH)_2$?

A) 6 B) 2 C) 8 D) 4

495) A sample of nitrogen containing 1.5×10^{23} molecules has the same number of molecules as a sample containing

A) 2.0 moles of He B) 0.50 mole of Ne C) 0.25 mole of O_2 D) 1.0 mole of H_2

496) What is the total mass of 3.01×10^{23} atoms of helium gas?

A) 4.00 g B) 3.50 g C) 8.00 g D) 2.00 g

497) What is the total number of atoms in 1 mole of calcium?

A) 1 B) $20(6 \times 10^{23})$ C) 20 D) 6×10^{23}

498) Which gas sample contains a total of 3.0×10^{23} molecules?

A) 2.0 g of H_2 B) 38 g of F_2 C) 14 g of N_2 D) 71 g of Cl_2

Name:_____

MOLES/STOICH

499) What is the percent by mass of hydrogen in NH_3 (formula mass = 17.0)?

A) 5.9% B) 82.4% C) 21.4% D) 17.6%

500) What is the percent by mass of oxygen in Fe_2O_3 (formula mass = 160)?

A) 70.% B) 30.% C) 56% D) 16%

501) What is the percent by mass of nitrogen in N_2O?

A) 8.0 B) 64 C) 16 D) 32

502) A student determining the percent by mass of water in a hydrated crystal obtained the following data.

Mass of crystal before heating..... 5.0 g
Mass of crystal after 1st heating.... 4.0 g
Mass of crystal after 2nd heating... 4.0 g

What is the percent by mass of water hydrate?

A) 0.80% B) 0.20% C) 20.% D) 80.%

Question 503 refers to the following:

The diagram below shows the data collected during the heating of a 5.0 gram sample of a hydrated salt.

Mass of Salt (grams)	Heating Time (minutes)
5.0	0.0
4.1	5.0
3.1	10.
3.0	15.
3.0	30.
3.0	60.

503) What is the percent water in the original sample?

A) 40.% B) 30.% C) 60.% D) 82.%

504) What is the percent by mass of oxygen in $Mg(OH)_2$ (formula mass = 58)?

A) 19% B) 41% C) 30% D) 55%

505) What is the percent by mass of oxygen in magnesium oxide, MgO?

A) 40% B) 50% C) 20% D) 60%

506) What is the percent by mass of hydrogen in CH_3COOH (formula mass = 60.)?

A) 5.0% B) 7.1% C) 1.7% D) 6.7%

Name:_____

MOLES/STOICH

507) What is the percent by mass of water in the hydrate $Na_2CO_3 \cdot 10H_2O$ (formula mass = 286)?

A) 62.9% B) 6.89% C) 26.1% D) 214.5%

508) What is the percent by mass of oxygen in Na_2SO_4?

A) 64% B) 22% C) 11% D) 45%

509) A compound has an empirical formula of CH_2 and a molecular mass of 56. What is the molecular formula of the compound?

A) C_4H_8 B) C_2H_4 C) C_5H_{10} D) C_3H_6

510) Which compound has the same empirical and molecular formula?

A) ethane B) ethene C) methane D) acetylene

511) A compound with an empirical formula of CH_2 has a molecular mass of 70. What is the molecular formula?

A) C_4H_8 B) C_5H_{10} C) C_2H_4 D) CH_2

512) The molecular mass of a compound of carbon and hydrogen is 42. What is the empirical formula of the compound?

A) CH_3 B) CH_2 C) CH D) CH_4

513) What is the molecular formula of a compound with an empirical formula of CH and a molecular mass of 78?

A) CH B) C_4H_{10} C) C_6H_6 D) C_2H_2

514) What is the molecular formula of a compound with the empirical formula P_2O_5 and a gram-molecular mass of 284 grams?

A) P_2O_5 B) P_4O_{10} C) $P_{10}O_4$ D) P_5O_2

515) Vitamin C has an empirical formula of $C_3H_4O_3$ and a molecular mass of 176. What is the molecular formula of vitamin C?

A) $C_3H_4O_3$ B) $C_9H_{12}O_9$ C) $C_{10}H_8O_3$ D) $C_6H_8O_6$

516) What is the empirical formula of a compound whose composition by mass is 40.% sulfur and 60.% oxygen?

A) S_2O_3 B) S_2O_7 C) SO_2 D) SO_3

Name:_____

MOLES/STOICH

517) A compound contains 0.5 mole of sodium, 0.5 mole of nitrogen, and 1.0 mole of hydrogen. The empirical formula of the compound is

A) $NaNH_2$ B) $Na(NH)_2$ C) Na_2NH D) NaNH

518) A compound consists of 46.7% nitrogen and 53.3% oxygen by mass. What is its empirical formula?

A) N_2O B) NO C) NO_2 D) N_2O_s

519) A sample of a compound contains 24 grams of carbon and 64 grams of oxygen. What is the empirical formula of this compound?

A) CO_2 B) C_2O_4 C) C_2O_2 D) CO

520) Given the reaction:

$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

What is the total number of moles of NaOH needed to react completely with 2 moles of H_2SO_4?

A) 1 B) 2 C) 0.5 D) 4

521) Given the reaction:

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

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) 3.0 B) 15 C) 6.7 D) 2.0

522) Given the reaction:

$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$

What is the total number of CO_2 molecules produced when one mole of C_2H_6 is consumed?

A) 6.02×10^{23} B) $3(6.02 \times 10^{23})$ C) $2(6.02 \times 10^{23})$ D) $4(6.02 \times 10^{23})$

523) Given the reaction:

$4Al + 3O_2 \rightarrow 2Al_2O_3$

How many moles of Al_2O_3 will be formed when 27 grams of Al reacts completely with O_2?

A) 1.0 B) 2.0 C) 0.50 D) 4.0

524) Given the reaction:

$3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$

The total number of grams of Cu needed to produce 1.0 mole of $Cu(NO_3)_2$ is

A) 128 g B) 32 g C) 192 g D) 64 g

Name:_____

MOLES/STOICH

525) In the reaction $N_2 + 3H_2 \rightarrow 2NH_3$, how many grams of H_2 are needed to produce exactly 1 mole of ammonia?

A) 1 g B) 3 g C) 2 g D) 4 g

526) Given the balanced equation:

$NaOH + HCl \rightarrow NaCl + H_2O$

What is the total number of grams of H_2O produced when 116 grams of the product, NaCl, is formed?

A) 36 g B) 18 g C) 9.0 g D) 54 g

527) Given the balanced equation for the combustion of propane (C_3H_8):

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

What is the total number of grams of H_2O produced when 22 grams of propane undergoes complete combustion?

A) 72 g B) 36 g C) 18 g D) 44 g

528) The maximum number of grams of potassium that can be obtained from 100. grams of $KHCO_3$ is

A) 19.0 g B) 58.0 g C) 100. g D) 39.0 g

529) What is the gram molecular mass of 1 mole of $C_3H_5(OH)_3$? [*Round atomic masses from the Periodic Table to the nearest tenth.*] [*Show all work.*]

530) In a laboratory experiment, a student determined the mass of the product, $MgCl_2(s)$, to be 117.22 grams.

(a) Calculate the gram formula mass of $MgCl_2(s)$. [*Round atomic masses from the Periodic Table to the nearest tenth.*] [*Show all work.*] [*Indicate the correct answer with an appropriate unit.*]

(b) Calculate the number of moles of $MgCl_2(s)$ produced. [*Show all work.*] [*Indicate the correct answer with an appropriate unit.*]

531) A laboratory experiment requires 4.00 grams of KI(s).

(a) Calculate the gram formula mass of KI(s). [*Round atomic masses from the Periodic Table to the nearest tenth.*] [*Show all work.*] [*Indicate the correct answer with an appropriate unit.*]

(b) Calculate the number of moles of KI(s) needed for the experiment. [*Show all work.*] [*Indicate the correct answer with an appropriate unit.*]

Name:_____

MOLES/STOICH

Question 532 refers to the following:

Sulfur dioxide, $SO_2(g)$, is released into the atmosphere by coal burning power plants and is a major contributor to air pollution and acid rain. Very small amounts of $SO_2(g)$ are not harmful; however, if the amount of $SO_2(g)$ in the air exceeds 0.145 parts per million for several days, human health may be affected.

532) Calculate the number of molecules of $SO_2(g)$ in 0.145 grams. [*Show all work.*] [*Indicate the correct answer with an appropriate unit.*]

533) The empirical formula of a compound is NO_2 and the molecular mass is 92.0 grams. What is the molecular formula of the compound? [*Round atomic masses from the Periodic Table to the nearest tenth.*] [*Show all work.*]

534) What is the percent by mass of water present in 1.0 mole of $CaSO_4 \cdot 2H_2O$? [*Round atomic masses from the Periodic Table to the nearest tenth.*] [*Show all work.*]

535) A compound has an empirical formula of HCO_2 and a molecular mass of 90.0 grams per mole. What is the molecular formula of this compound? [*Round atomic masses from the Periodic Table to the nearest tenth.*] [*Show all work.*]

Questions 536 and 537 refer to the following:

Acetylene, C_2H_2, is a colorless gas which burns with a brilliant flame. Acetylene torches are used by welders for cutting and soldering metals. Acetylene is produced by the reaction of calcium carbide, $CaC_2(s)$, in water according to the following equation:

$$CaC_2(s) + 2H_2O(\ell) \rightarrow C_2H_2(g) + Ca(OH)_2(aq)$$

536) Determine the mass, in grams, of 2.25 moles of $C_2H_2(g)$. [*Show all work.*] [*Indicate the correct answer with an appropriate unit.*]

537) Calculate the gram formula mass of $C_2H_2(g)$. [*Round atomic masses from the Periodic Table to the nearest tenth.*] [*Show all work.*] [*Indicate the correct answer with an appropriate unit.*]

538) Given the equation:

$$2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(g)$$

How many moles of carbon dioxide gas are produced for each mole of $C_4H_{10}(g)$ consumed?

Name:_____

MOLES/STOICH

539) In a bunsen burner, methane, $CH_4(g)$, undergoes combustion according to the following reaction:

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$$

(a) Calculate the gram molecular mass of $CH_4(g)$. [*Round atomic masses from the Periodic Table to the nearest tenth.*] [*Show all work.*] [*Indicate the correct answer with an appropriate unit.*]

(b) How many moles of $H_2O(g)$ are produced from the complete combustion of 2.5 moles of $CH_4(g)$? [*Show all work.*] [*Indicate the correct answer with an appropriate unit.*]

(c) Calculate the mass, in grams, of 2.5 moles of $CH_4(g)$. [*Show all work.*] [*Indicate the correct answer with an appropriate unit.*]

Name:_____

SOLUTIONS

540) A solution in which the crystallizing rate of the solute equals the dissolving rate of the solute must be

A) saturated B) concentrated C) unsaturated D) dilute

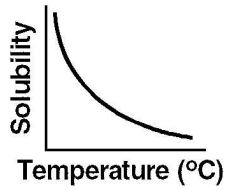
541) Ionic solids will *most* likely dissolve in

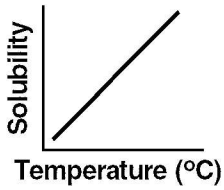
A) $H_2O(\ell)$, which is a nonpolar solvent
B) $CCl_4(\ell)$, which is a polar solvent
C) $H_2O(\ell)$, which is a polar solvent
D) $CCl_4(\ell)$, which is a nonpolar solvent

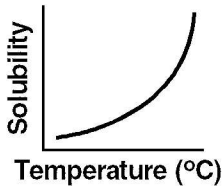
542) Solubility data for salt *X* is shown in the table below.

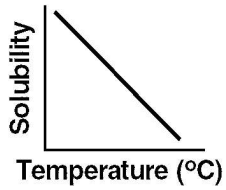
Temperature (°C)	Solubility $\left(\frac{\text{g salt X}}{\text{100g } H_2O}\right)$
10	5
20	10
30	15
40	20
50	30
60	45

Which graph *most* closely represents the data shown in the table?

A) 

B) 

C) 

D) 

543) Which solution contains the *greatest* number of moles of solute?

A) 0.5 L of 2 M B) 2 L of 2 M C) 0.5 L of 0.5 M D) 2 L of 0.5 M

544) How many liters of a 0.5 M sodium hydroxide solution would contain 2 moles of solute?

A) 1 L B) 4 L C) 3 L D) 2 L

545) What is the molarity of a solution that contains 40. grams of NaOH in 0.50 liter of solution?

A) 1.0 M B) 0.50 M C) 0.25 M D) 2.0 M

546) How many moles of H_2SO_4 are needed to prepare 5.0 liters of a 2.0 M solution of H_2SO_4?

A) 5.0 B) 20. C) 10. D) 2.5

547) How many grams of KOH are needed to prepare 250. milliliters of a 2.00 M solution of KOH (formula mass = 56.0)?

A) 1.00 g B) 112 g C) 2.00 g D) 28.0 g

Name:_____

SOLUTIONS

548) Which expression defines the molality (*m*) of a solution?

A) $\frac{\text{grams of solute}}{\text{kg of solution}}$ B) $\frac{\text{grams of solute}}{\text{kg of solvent}}$ C) $\frac{\text{moles of solute}}{\text{kg of solvent}}$ D) $\frac{\text{moles of solute}}{\text{kg of solution}}$

549) How many grams of $AgNO_3$ (formula mass = 169.9) are dissolved in 1,000 grams of water to make a 0.5 molal solution?

A) 85 g B) 34 g C) 0.085 g D) 0.34 g

550) How many grams of KI are needed to prepare 2,000. grams of an aqueous solution containing 25 parts per million (ppm) of solute?

A) .050 g B) 1.25×10^4 g C) 0.0125 g D) 5.0×10^4 g

551) How many grams of $MgCl_2$ are contained in 1,000 grams of 10 ppm solution?

A) 1×10^{-2} g B) 1×10^4 g C) 1×10^2 g D) 1×10^7 g

552) What is the mass of NaCl in 50 grams of a 10% solution?

A) 0.2 g B) 0.5 g C) 5 g D) 10 g

553) Which solution has the *highest* boiling point?

A) 1 mole of $NaNO_3$ in 1,000 g of water
B) 1 mole of $NaNO_3$ in 750 g of water
C) 1 mole of $NaNO_3$ in 250 g of water
D) 1 mole of $NaNO_3$ in 500 g of water

554) A student dissolves 1.0 mole of sucrose ($C_{12}H_{22}O_{11}$) in 1,000. grams of water at 1.0 atmosphere. Compared to the boiling point of pure water, the boiling point of the resulting solution is

A) 1.86°C lower B) 0.52°C lower C) 1.86°C higher D) 0.52°C higher

555) A 1-kilogram sample of water will have the *highest* freezing point when it contains

A) 1×10^{21}dissolved particles
B) 1×10^{19} dissolved particles
C) 1×10^{23} dissolved particles
D) 1×10^{17} dissolved particles

556) Which solution will freeze at the *lowest* temperature?

A) 2 moles of sugar in 1,000 g of water
B) 2 moles of sugar in 500 g of water
C) 1 mole of sugar in 1,000 g of water
D) 1 mole of sugar in 500 g of water

557) How many moles of dissolved particles are required to lower the freezing point of 1,000 grams of water by 5.58 C°?

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

Name:_____

SOLUTIONS

558) What occurs as a salt dissolves in water?

A) The number of ions in the solution decreases, and the freezing point decreases.
B) The number of ions in the solution increases, and the freezing point decreases.
C) The number of ions in the solution decreases, and the freezing point increases.
D) The number of ions in the solution increases, and the freezing point increases.

559) Compared to the normal freezing point and boiling point of water, a 1-molal solution of sugar in water will have a

A) lower freezing point and a higher boiling point
B) lower freezing point and a lower boiling point
C) higher freezing point and a lower boiling point
D) higher freezing point and a higher boiling point

560) At standard pressure, a 1-molal solution of sugar has a boiling point

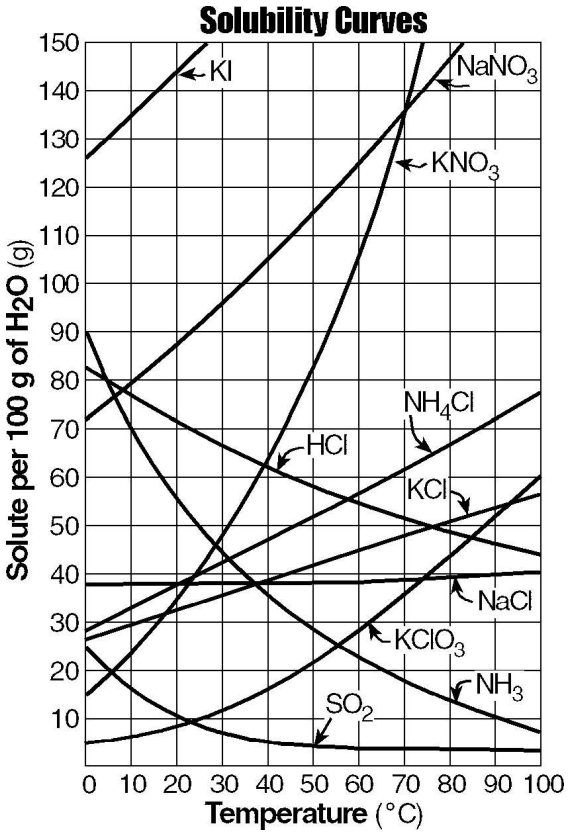
A) greater than 100°C and a freezing point of less than 0°C
B) greater than 100°C and a freezing point of greater than 0°C
C) less than 100°C and a freezing point of less than 0°C
D) less than 100°C and a freezing point of greater than 0°C

Name:_____

SOLUTIONS

Questions 561 through 568 refer to the following:

Given the chemistry reference table below:



561) Based on the given table, which salt solution could contain 42 grams of solute per 100 grams of water at 40°C?

A) a saturated solution of KCl
B) an unsaturated solution of NaCl
C) a saturated solution of $KClO_3$
D) an unsaturated solution of NH_4Cl

562) A solution containing 55 grams of NH_4Cl in 100. grams of water is saturated at a temperature of

A) 77°C B) 67°C C) 57°C D) 47°C

563) Which quantity of salt will form a saturated solution in 100 grams of water at 45°C?

A) 30 g of KCl B) 35 g of NH_4Cl C) 60 g of KNO_3 D) 110 g of $NaNO_3$

564) How many grams of $NaNO_3$ per 100 grams of H_2O would produce a supersaturated solution?

A) 80 g at 20°C B) 110 g at 40°C C) 60 g at 10°C D) 90 g at 30°C

565) A solution contains 90 grams of a salt dissolved in 100 grams of water at 10°C. The solution could be an unsaturated solution of

A) KCl B) KI C) NaCl D) KNO_3

Name:_____

SOLUTIONS

566) According to the given table, a temperature change from 10°C to 30°C would have the *least* effect on the solubility of

A) SO_2 B) $KClO_3$ C) NaCl D) NH_3

567) Based on the given table, which substance is *most* soluble at 60°C?

A) NH_4Cl B) KCl C) NaCl D) NH_3

568) A student tested the solubility of a salt at different temperatures and then used the given chemistry reference table to identify the salt. The students data table appears below.

Temperature (°C)	g of salt per 10 g of water
30	1.2
50	2.2
62	3.0
76	4.0

What is the identity of the salt?

A) potassium chlorate B) sodium chloride C) ammonium chloride D) potassium nitrate

Questions 569 and 570 refer to the following:

Given the chemistry reference table below:

Solubility Guidelines

Ions That Form *Soluble* Compounds	Exceptions
Group 1 ions (Li^+, Na^+, etc.)	
ammonium (NH_4^+)	
nitrate (NO_3^-)	
acetate ($C_2H_3O_2^-$ or CH_3COO^-)	
hydrogen carbonate (HCO_3^-)	
chlorate (ClO_3^-)	
perchlorate (ClO_4^-)	
halides (Cl^-, Br^-, I^-)	when combined with Ag^+, Pb^{2+}, and Hg_2^{2+}
sulfates (SO_4^{2-})	when combined with Ag^+, Ca^{2+}, Sr^{2+}, Ba^{2+}, and Pb^{2+}

Ions That Form *Insoluble* Compounds	Exceptions
carbonate (CO_3^{2-})	when combined with Group 1 ions or ammonium (NH_4^+)
chromate (CrO_4^{2-})	when combined with Group 1 ions, Ca^{2+}, Mg^{2+}, or ammonium (NH_4^+)
phosphate (PO_4^{3-})	when combined with Group 1 ions or ammonium (NH_4^+)
sulfide (S^{2-})	when combined with Group 1 ions or ammonium (NH_4^+)
hydroxide (OH^-)	when combined with Group 1 ions, Ca^{2+}, Ba^{2+}, Sr^{2+}, or ammonium (NH_4^+)

569) Based on the given table, a saturated solution of which salt would be *most* concentrated?

A) AgCl B) $ZnCl_2$ C) $PbCrO_4$ D) $BaSO_4$

Name:_____

SOLUTIONS

570) Solutions of $AgNO_3(aq)$ and KCl(aq) are mixed. Will a visible reaction occur?

A) Yes, because KNO_3 will precipitate out of solution.

B) Yes, because AgCl will precipitate out of solution.

C) No, because KNO_3 is soluble in water.

D) No, because AgCl is soluble in water.

Questions 571 and 572 refer to the following:

Given the chemistry reference table below:

Table of Solubilities in Water

i — nearly insoluble **ss** — slightly soluble **s** — soluble **d** — decomposes **n** — not isolated	acetate	bromide	carbonate	chloride	chromate	hydroxide	iodide	nitrate	phosphate	sulfate	sulfide
Aluminum	ss	s	n	s	n	i	s	s	i	s	d
Ammonium	s	s	s	s	s	s	s	s	s	s	s
Barium	s	s	i	s	i	s	s	s	i	i	d
Calcium	s	s	i	s	s	ss	s	s	i	ss	d
Copper II	s	s	i	s	i	i	n	s	i	s	i
Iron II	s	s	i	s	n	i	s	s	i	s	i
Iron III	s	s	n	s	i	i	n	s	i	ss	d
Lead	s	ss	i	ss	i	i	ss	s	i	i	i
Magnesium	s	s	i	s	s	i	s	s	i	s	d
Mercury I	ss	i	i	i	ss	n	i	s	i	ss	i
Mercury II	s	ss	i	s	ss	i	i	s	i	d	i
Potassium	s	s	s	s	s	s	s	s	s	s	s
Silver	ss	i	i	i	ss	n	i	s	i	ss	i
Sodium	s	s	s	s	s	s	s	s	s	s	s
Zinc	s	s	i	s	s	i	s	s	i	s	i

571) According to the given table, which salt would have the *smallest* K_{sp} value?

A) $AlBr_3$ B) $PbBr_2$ C) NaBr D) AgBr

572) According to the given table, which compound is more soluble than $BaSO_4$ at 1 atmosphere and 298 K?

A) ZnS B) AgBr C) $PbCl_2$ D) AgI

Name:_____

ACIDS AND BASES

573) Which compound is an electrolyte?

A) $C_6H_{12}O_6$ B) CH_3CH_2OH C) $C_{12}H_{22}O_{11}$ D) HCOOH

574) Which one of the following is a characteristic of a solution of HNO_3?

A) It turns litmus blue.
B) It forms OH^- ions.
C) It conducts electricity.
D) It turns phenolphthalein pink

575) Which one of the following is the *best* conductor of electricity?

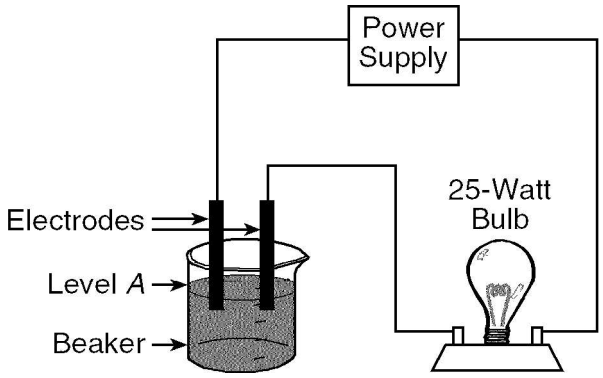
A) NaCl(aq) B) $C_6H_{12}O_6$(aq) C) $C_6H_{12}O_6$(s) D) NaCl(s)

576) Which substance dissolves in pure water and produces a solution that is a good conductor of electricity?

A) O_2 B) N_2 C) $C_6H_{12}O_6$ D) $CaCl_2$

Question 577 refers to the following:

A material will be used to fill an empty beaker to level *A*, as shown in the diagram below.



577) Which one of the following, if placed in the beaker shown in the diagram, would cause the lamp bulb to glow brightly?

A) NaOH(s) B) NaOH(aq) C) $CH_3OH(\ell)$ D) CH_3OH(aq)

578) According to the Arrhenius theory of acids, citric acid in oranges and acetic acid in vinegar are classified as acids because their aqueous solutions contain

A) hydrogen atoms B) hydroxide ions C) hydroxide atoms D) hydrogen ions

579) When substance *X* is dissolved in water, the only positive ions in the solution are hydrogen ions. Substance *X* could be

A) NaOH B) H_2S C) NH_3 D) NaH

580) According to the Arrhenius theory, the only negative ions in an aqueous solution of a base are

A) HS^- ions B) H^- ions C) OH^- ions D) HCO_3^- ions

Name:_____

ACIDS AND BASES

581) An aqueous solution of an ionic compound turns red litmus blue, conducts electricity, and reacts with an acid to form a salt and water. This compound could be

A) HCl B) NaI C) LiOH D) KNO_3

582) Given reactions *A* and *B*:

(**A**) $HCl + H_2O \rightarrow Cl^- + H_3O^+$
(**B**) $HCl + HS^- \rightarrow Cl^- + H_2S$

In which of the reactions can HCl be classified as a Bronsted-Lowry acid?

A) both *A* and *B* B) neither *A* nor *B* C) *A*, only D) *B*, only

583) Which formula represents a conjugate acid-base pair?

A) CH_3COOH and CH_3COO^-
B) H_3O^+ and OH^-
C) H_2SO_4 and SO_4^{2-}
D) H_3PO_4 and PO_4^{3-}

584) In the reaction $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$, a conjugate acid-base pair is

A) NH_3 and H_2O B) NH_3 and OH^- C) H_2O and OH^- D) H_2O and NH_4^+

585) In the reaction $H_2SO_4 + H_2O \rightleftharpoons H_3O^+ + HSO_4^-$, which two are proton donors?

A) H_2O and HSO_4^- B) H_2O and H_3O^+ C) H_2SO_4 and H_3O^+ D) H_2SO_4 and HSO_4^-

586) What are the two Bronsted acids in the reaction below?

$HPO_4^{2-} + H_2O \rightleftharpoons PO_4^{3-} + H_3O^+$

A) HPO_4^{2-} and PO_4^{3-} B) HPO_4^{2-} and H_3O^+ C) H_2O and PO_4^{3-} D) H_2O and H_3O^+

587) Given the equation:

$H_2O + HF \rightleftharpoons H_3O^+ + F^-$

Which pair represents Bronsted-Lowry acids?

A) H_2O and F^- B) HF and F^- C) H_2O and H_3O^+ D) HF and H_3O^+

588) In the reaction $H_2O + CO_3^{2-} \rightleftharpoons OH^- + HCO_3^-$, the two Bronsted-Lowry acids are

A) CO_3^{2-} and HCO_3^- B) H_2O and HCO_3^- C) CO_3^{2-} and OH^- D) H_2O and OH^-

589) Which ion is the conjugate base of H_2SO_4?

A) HSO_4^- B) SO_3^{2-} C) HSO_3^- D) S^{2-}

590) What is the conjugate base of water?

A) H_2O B) H_3O^+ C) H^+ D) OH^-

Name:_____

ACIDS AND BASES

591) The conjugate acid of the NO_2^- ion is

A) HNO_2 B) H_2NO_2 C) NO^- D) H^+

592) What is the conjugate acid of the HSO_4^- ion?

A) H_2SO_4 B) H^+ C) SO_3 D) SO_4^{2-}

593) As HCl(aq) is added to a basic solution, the pH of the solution will

A) decrease
B) remain the same
C) increase

594) Which one of the following is the *most* likely pH for a solution of a weak acid?

A) 1 B) 5 C) 14 D) 11

595) Which pH value represents a solution with the *lowest* OH^- ion concentration?

A) 1 B) 14 C) 10 D) 7

596) What is the pH of the solution formed by completely neutralizing 50 milliliters of 0.1 M HNO_3 with 50 milliliters of 0.1 M NaOH at 298 K?

A) 1 B) 10 C) 7 D) 4

597) As the H_3O^+ ion concentration of a solution increases and the OH^- ion concentration decreases, the pH of the solution

A) increases
B) remains the same
C) decreases

598) An aqueous solution that has a hydrogen ion concentration of 1.0×10^{-8} mole per liter has a pH of

A) 6, which is basic B) 8, which is basic C) 8, which is acidic D) 6, which is acidic

599) If a solution has a hydronium ion concentration of 1×10^{-9} M, the solution is

A) basic and has a pH of 5
B) acidic and has a pH of 9
C) basic and has a pH of 9
D) acidic and has a pH of 5

600) The H_3O^+ ion concentration of a solution is 1×10^{-4} mole per liter. This solution is

A) basic and has a pH of 10
B) basic and has a pH of 4
C) acidic and has a pH of 10
D) acidic and has a pH of 4

601) What is the concentration of H_3O^+ ions, in moles per liter, of a 0.0001 M HCl solution?

A) 1×10^{-3} B) 1×10^{-2} C) 1×10^{-4} D) 1×10^{-1}

Name:_____

ACIDS AND BASES

602) What is the hydroxide ion concentration of a solution with a pH of 4? ($K_w = [H_3O^+][OH^-] = 10^{-14}$)

A) 1×10^{-4} mole/liter B) 1×10^{-7} mole/liter C) 1×10^{-14} mole/liter D) 1×10^{-10} mole/liter

603) What is the pH of a 0.001 M solution of HCl?

A) 1 B) 7 C) 3 D) 11

604) As a solution of NaOH is diluted from 0.1 M to 0.001 M, the pH of the solution

A) increases C) decreases

B) remains the same

605) What is the hydroxide ion concentration of a solution that has a hydronium ion concentration of 1×10^{-9} mole per liter at 298 K?

A) 1×10^{-5} mole per liter C) 1×10^{-7} mole per liter

B) 1×10^{-9} mole per liter D) 1×10^{-14} mole per liter

606) What is the hydroxide ion concentration of a solution with a pH of 4?

A) 1×10^{-4} B) 1×10^{-10} C) 1×10^{-7} D) 1×10^{-14}

607) What is the H^+ ion concentration of a solution that has an OH^- ion concentration of 1×10^{-6} mole per liter at 25°C?

A) 1×10^{-8} M B) 1×10^{-14} M C) 1×10^{-6} M D) 1×10^{-10} M

608) When tested, a solution turns red litmus to blue. This indicates that the solution contains more

A) H_3O^+ ions than OH^- ions C) H^+ ions than OH^- ions

B) OH^- ions than H_3O^+ ions D) H^+ and OH^- ions than H_2O molecules

609) One sample of a solution with a pH of 10 is tested with phenolphthalein and another sample of this solution is tested with litmus. In this solution the color of the litmus is

A) blue and the phenolphthalein is colorless C) red and the phenolphthalein is pink

B) red and the phenolphthalein is colorless D) blue and the phenolphthalein is pink

610) What color is phenolphthalein in a solution that has a pH of 9?

A) blue B) pink C) white D) colorless

611) Which solution can turn phenolphthalein pink?

A) $CH_3COOH(aq)$ B) $CH_3OH(aq)$ C) $HCl(aq)$ D) $NaOH(aq)$

Name:_____

ACIDS AND BASES

612) Household vinegar has a pH of approximately 3.0. Which would appear yellow when added to a vinegar solution?

A) phenolphthalein B) litmus C) methyl orange D) bromcresol green

613) Which solution will change bromthymol blue indicator from yellow to blue?

A) $CH_3COOH(aq)$ B) $KOH(aq)$ C) $CH_3OH(aq)$ D) $HCl(aq)$

614) Which indicator would turn yellow when added to a solution having a pH = 4.0?

A) bromthymol blue B) litmus C) bromcresol green D) methyl orange

615) Which indicator is blue in a neutral solution?

A) bromcresol green B) thymol blue C) litmus D) bromthymol blue

616) Which equation represents a neutralization reaction?

A) $Ag^+(aq) + I^-(aq) \rightarrow AgI(s)$

B) $Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$

C) $H^+(aq) + OH^-(aq) \rightarrow H_2O(\ell)$

D) $NaCl(aq) + AgNO_3(aq) \rightarrow NaNO_3(aq) + AgCl(s)$

617) The reaction between 1 mole of hydronium ions and 1 mole of hydroxide ions is called

A) oxidation B) hydrolysis C) neutralization D) reduction

618) Which compound is classified as a salt?

A) C_2H_5OH B) $NaC_2H_3O_2$ C) CH_3COOH D) $NaOH$

619) How much water is formed when 1.0 mole of HCl reacts completely with 1.0 mole of NaOH?

A) 2.0 moles B) 1.0 mole C) 0.25 mole D) 0.50 mole

620) If 50 milliliters (ml) of a 0.01 M HCl solution is required to neutralize exactly 25 milliliters (ml) of NaOH, what is the concentration of the base?

A) 0.0005 M B) 0.04 M C) 0.02 M D) 0.01 M

621) If 20. milliliters of 1.0 M HCl was used to completely neutralize 40. milliliters of an NaOH solution, what was the molarity of the NaOH solution?

A) 1.5 M B) 2.0 M C) 0.50 M D) 4.0 M

622) Which salt will hydrolyze in water to produce a basic solution?

A) $NaNO_2$ B) $CaCl_2$ C) BaI_2 D) $MgSO_4$

Name:_____

ACIDS AND BASES

623) The table below shows the results produced when two drops of phenolphthalein are added to 0.1 M solutions of three salts.

Salt	Resulting Color
$NaNO_3$	colorless
KI	colorless
$NaC_2H_3O_2$	pink

Which ion produces a basic solution when dissolved in water?

A) I^- B) K^+ C) NO_3^- D) $C_2H_3O_2^-$

624) When the salt Na_2CO_3 undergoes hydrolysis, the resulting solution will be

A) acidic with a pH less than 7
B) basic with a pH less than 7
C) acidic with a pH greater than 7
D) basic with a pH greater than 7

625) Potassium chloride, KCl, is a salt derived from the neutralization of a

A) strong acid and a strong base
B) weak acid and a strong base
C) strong acid and a weak base
D) weak acid and a weak base

626) In a chemical reaction, the products have a lower potential energy than the reactants. This reaction must have a negative

A) ΔX B) ΔG C) ΔH D) ΔS

627) Which one of the following statements describes characteristics of an endothermic reaction?

A) The sign of ΔH is positive, and the products have more potential energy than the reactants.
B) The sign of ΔH is negative, and the products have less potential energy than the reactants.
C) The sign of ΔH is negative, and the products have more potential energy than the reactants.
D) The sign of ΔH is positive, and the products have less potential energy than the reactants.

628) Consider the reaction:

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(\ell) + \text{energy}$$

Which one of the following phrases *best* describes this reaction?

A) endothermic, absorbing energy
B) endothermic, releasing energy
C) exothermic, absorbing energy
D) exothermic, releasing energy

629) The potential energy possessed by a molecule is dependent upon

A) its composition, only
B) neither its composition nor its structure
C) both its composition and its structure
D) its structure, only

Questions 630 through 635 refer to the following:

Given the chemistry reference table below:

Heats of Reaction at 101.3 kPa and 298 K

Reaction	ΔH (kJ)*
$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(\ell)$	−890.4
$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(\ell)$	−2,219.2
$2C_8H_{18}(\ell) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(\ell)$	−10,943
$2CH_3OH(\ell) + 3O_2(g) \rightarrow 2CO_2(g) + 4H_2O(\ell)$	−1,452
$C_2H_5OH(\ell) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(\ell)$	−1,367
$C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(\ell)$	−2,804
$2CO(g) + O_2(g) \rightarrow 2CO_2(g)$	−566.0
$C(s) + O_2(g) \rightarrow CO_2(g)$	−393.5
$4Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$	−3,351
$N_2(g) + O_2(g) \rightarrow 2NO(g)$	+182.6
$N_2(g) + 2O_2(g) \rightarrow 2NO_2(g)$	+66.4
$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$	−483.6
$2H_2(g) + O_2(g) \rightarrow 2H_2O(\ell)$	−571.6
$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$	−91.8
$2C(s) + 3H_2(g) \rightarrow C_2H_6(g)$	−84.0
$2C(s) + 2H_2(g) \rightarrow C_2H_4(g)$	+52.4
$2C(s) + H_2(g) \rightarrow C_2H_2(g)$	+227.4
$H_2(g) + I_2(g) \rightarrow 2HI(g)$	+53.0
$KNO_3(s) \xrightarrow{H_2O} K^+(aq) + NO_3^-(aq)$	+34.89
$NaOH(s) \xrightarrow{H_2O} Na^+(aq) + OH^-(aq)$	−44.51
$NH_4Cl(s) \xrightarrow{H_2O} NH_4^+(aq) + Cl^-(aq)$	+14.78
$NH_4NO_3(s) \xrightarrow{H_2O} NH_4^+(aq) + NO_3^-(aq)$	+25.69
$NaCl(s) \xrightarrow{H_2O} Na^+(aq) + Cl^-(aq)$	+3.88
$LiBr(s) \xrightarrow{H_2O} Li^+(aq) + Br^-(aq)$	−48.83
$H^+(aq) + OH^-(aq) \rightarrow H_2O(\ell)$	−55.8

* Minus sign indicates an exothermic reaction.

630) Based on the given table, the *most* energy would be released when oxygen reacts completely with 1.0 mole of

A) $C_6H_{12}O_6$ B) CO C) CH_3OH D) CH_4

631) According to the given table, the decomposition of which compound would be an exothermic reaction?

A) $CO_2(g)$ B) $H_2O(g)$ C) $NH_3(g)$ D) $NO_2(g)$

632) Based on the given table, the formation of 1 mole of which substance releases the *greatest* amount of energy?

A) $C_2H_2(g)$ B) $Al_2O_3(s)$ C) $C_2H_4(g)$ D) $H_2O(\ell)$

633) According to the given table, in which reaction do the products have a *higher* energy content than the reactants?

A) $2CH_3OH(\ell) + 3O_2(g) \rightarrow 2CO_2(g) + 4H_2O(\ell)$

B) $NH_4Cl(s) \xrightarrow{H_2O} NH_4^+(aq) + Cl^-(aq)$

C) $NaOH(s) \xrightarrow{H_2O} Na^+(aq) + OH^-(aq)$

D) $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(\ell)$

634) Based on the given table, which equation represents an endothermic reaction?

A) $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$

B) $C(s) + O_2(g) \rightarrow CO_2(g)$

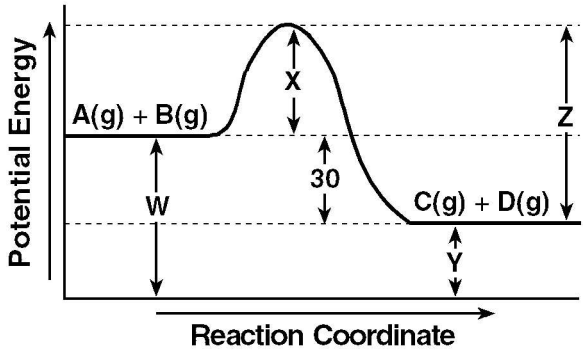
C) $2C(s) + 3H_2(g) \rightarrow C_2H_6(g)$

D) $H_2(g) + I_2(g) \rightarrow 2HI(g)$

635) Based on the given table, how many kilojoules of heat are given off when 0.500 mole of $Al_2O_3(s)$ is formed from its elements?

A) 1,676 kJ B) 3,351 kJ C) 13,404 kJ D) 838 kJ

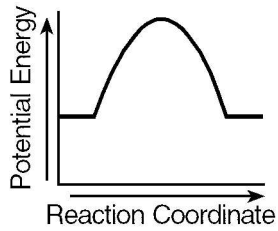
Question 636 refers to the following:

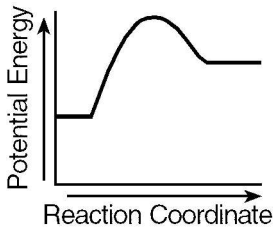


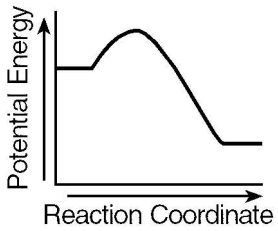
636) The potential energy of the activated complex is equal to the sum of

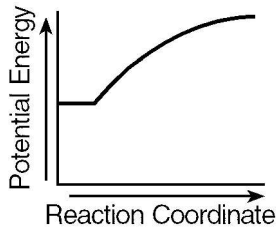
A) $X + Y$ B) $X + W$ C) $X + W + Z$ D) $X + Y + W$

637) Which diagram represents the potential energy of an exothermic reaction?

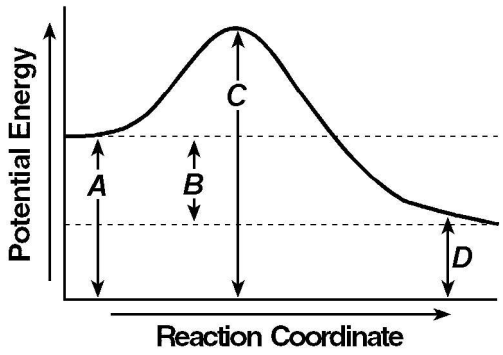
A) 

B) 

C) 

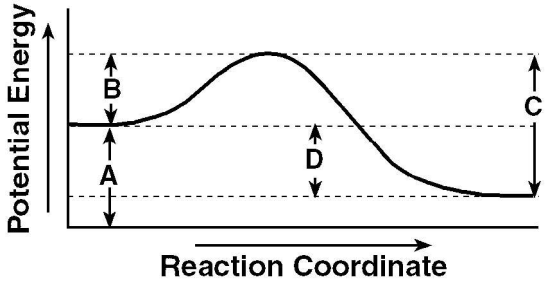
D) 

638) In the potential energy diagram below, what arrow represents the potential energy of the activated complex?



A) *A* B) *B* C) *C* D) *D*

639) The graph below is a potential energy diagram of a compound which is formed from its elements.



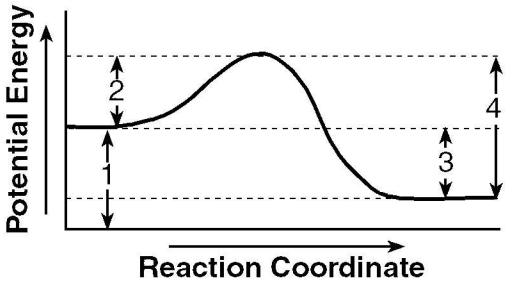
What interval represents the heat of reaction?

A) *A* B) *B* C) *C* D) *D*

640) As a chemical bond forms between two hydrogen atoms, the potential energy of the atoms

A) remains the same
B) increases
C) decreases

Question 641 refers to the following:



641) The activation energy for the reverse reaction is represented by

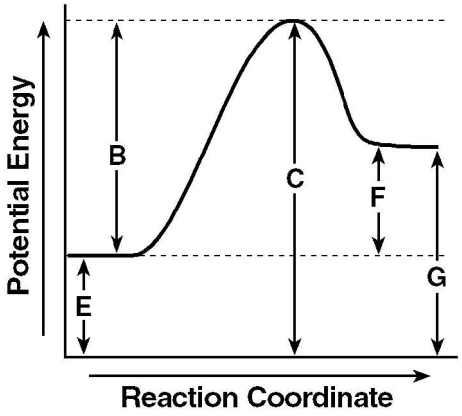
A) 1 B) 2 C) 3 D) 4

642) Activation energy is required to initiate

A) neither exothermic nor endothermic reactions
B) both exothermic and endothermic reactions
C) exothermic reactions, only
D) endothermic reactions, only

Question 643 refers to the following:

The diagram below represents a potential energy diagram of a chemical reaction.



643) What interval represents the heat of reaction (ΔH)?

A) *F*
B) *E*
C) *C*
D) *G*

644) In a gaseous system, temperature remaining constant, a decrease in pressure will

A) decrease the reaction rate
B) decrease the activation energy
C) increase the reaction rate
D) increase the activation energy

645) As the number of effective collisions between the reactant particles in a chemical reaction decreases, the rate of the reaction

A) decreases
B) increases
C) remains the same

646) Under which condition will the rate of a chemical reaction *always* decrease?

A) The concentration of the reactants decreases, and the temperature decreases.
B) The concentration of the reactants increases, and the temperature decreases.
C) The concentration of the reactants decreases, and the temperature increases.
D) The concentration of the reactants increases, and the temperature increases.

647) Given the reaction:

$Zn(s) + 2HCl(aq) \rightarrow Zn^{2+}(aq) + 2Cl^{-}(aq) + H_2(g)$

If the concentration of the HCl(aq) is increased, the frequency of reacting collisions will

A) decrease, producing a decrease in the reaction rate
B) increase, producing a decrease in the reaction rate
C) increase, producing an increase in the reaction rate
D) decrease, producing an increase in the reaction rate

648) Charcoal reacts with oxygen according to the equation $C(s) + O_2(g) \rightarrow CO_2(g)$. Which change would cause the *greatest* increase in the rate of reaction?

A) decreasing the pressure of $O_2(g)$
B) decreasing the concentration of $O_2(g)$
C) using charcoal in powdered form
D) using charcoal in lump form

649) Given the reaction:

$A + B \rightarrow C + D$

The reaction will *most* likely occur at the *greatest* rate if *A* and *B* represent

A) solutions of nonpolar molecular compounds
B) solutions of ionic compounds
C) nonpolar molecular compounds in the solid phase
D) ionic compounds in the solid phase

650) Given the reaction:

$CuSO_4(s) \rightleftharpoons Cu^{2+}(aq) + SO_4^{2-}(aq)$

The $CuSO_4(s)$ dissolves more rapidly when it is powdered because the increased surface area due to powdering permits

A) increased solute solubility
B) increased solvent contact
C) the equilibrium to shift to the left
D) the equilibrium to shift to the right

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

A) an increase in the heat of reaction
B) a decrease in the heat of reaction
C) a decrease in the rate of the reaction
D) an increase in the rate of the reaction

652) Given the system $AgCl(s) \rightleftharpoons Ag^{+}(aq) + Cl^{-}(aq)$ at equilibrium and 25°C. Which change will affect the value of the solubility product (K_{sp}) for AgCl(s)?

A) decreasing the concentration of $Ag^{+}(aq)$
B) decreasing the concentration of $Cl^{-}(aq)$
C) increasing the amount of AgCl(s)
D) increasing the temperature of the AgCl solution

653) Given the reaction:

$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$

The reaction occurs more slowly when a single piece of zinc is used than when the same mass of powdered zinc is used. Why does this occur?

A) The powdered zinc has a greater surface area.

B) The powdered zinc is more concentrated.

C) The powdered zinc generates more heat energy.

D) The powdered zinc requires less activation energy.

654) When a catalyst lowers the activation energy of a reaction, the rate of the reaction

A) remains the same

B) decreases

C) increases

Question 655 refers to the following:

The table below records the production of 50 milliliters of CO_2 in the reaction of HCl with $NaHCO_3$. Five trials were performed under different conditions as shown. (The same mass of $NaHCO_3$ was used in each trial.)

Trial	Particle Size of $NaHCO_3$	Concentration of HCl	Temperature (°C) of HCl
A	small	1 M	20
B	large	1 M	20
C	large	1 M	40
D	small	2 M	40
E	large	2 M	40

655) What two trials could be used to measure the effect of surface area?

A) trials *A* and *C* B) trials *B* and *D* C) trials *A* and *D* D) trials *A* and *B*

656) Given the reaction at equilibrium:

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

The rate of the forward reaction increases by adding more SO_2 because the

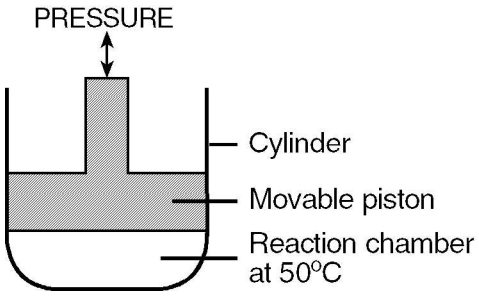
A) temperature will increase

B) reaction will shift to the left

C) forward reaction is endothermic

D) number of molecular collisions will increase

657) The reaction $A(g) + B(g) \rightarrow C(g)$ is occurring in the apparatus shown below.



The rate of reaction can be decreased by increasing the

A) temperature of the reactants
B) pressure on the reactants
C) volume of the reaction chamber
D) concentration of reactant $A(g)$

658) If the concentration of one of the reactants in a chemical reaction is increased, the rate of the reaction usually

A) increases
B) decreases
C) remains the same

659) Which reaction results in an increase in entropy?

A) $NaCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + NaNO_3(aq)$
B) $Ca(s) + 2H_2O(\ell) \rightarrow Ca(OH)_2(aq) + H_2(g)$
C) $H_2O(\ell) \rightarrow H_2O(s)$
D) $CO_2(g) \rightarrow CO_2(s)$

660) A 1-gram sample of a substance has the *greatest* entropy when it is in the

A) crystalline state
B) gaseous state
C) solid state
D) liquid state

661) Which reaction system tends to become less random as reactants form products?

A) $2Mg(s) + O_2(g) \rightarrow 2MgO(s)$
B) $I(g) + Cl_2(g) \rightarrow 2ICl(g)$
C) $S(s) + O_2(g) \rightarrow SO_2(g)$
D) $C(s) + O_2(g) \rightarrow CO_2(g)$

662) As the temperature of a system increases, the entropy of the system

A) remains the same
B) increases
C) decreases

663) Which change results in an increase in entropy?

A) $H_2O(g) \rightarrow H_2O(s)$
B) $H_2O(s) \rightarrow H_2O(\ell)$
C) $H_2O(\ell) \rightarrow H_2O(s)$
D) $H_2O(g) \rightarrow H_2O(\ell)$

664) As products are formed in the following reaction, $NH_4^+(aq) + Cl^-(aq) \xrightarrow{H_2O} NH_4Cl(s) + 14.6\ kJ$, the entropy of the system

A) decreases and heat is absorbed
B) increases and heat is released
C) increases and heat is absorbed
D) decreases and heat is released

665) Which change in a sample of water is accompanied by the *greatest* increase in entropy?

A) $H_2O(s)$ at −100°C is changed to $H_2O(\ell)$ at 0°C.
B) $H_2O(g)$ at 100°C is changed to $H_2O(g)$ at 200°C.
C) $H_2O(\ell)$ at 100°C is changed to $H_2O(g)$ at 200°C.
D) $H_2O(s)$ at −100°C is changed to $H_2O(s)$ at 0°C.

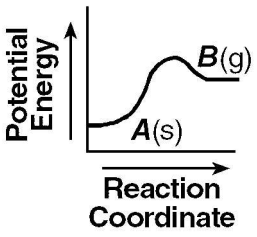
666) Which change represents an increase of entropy?

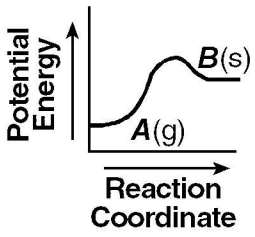
A) $I_2(g) \rightarrow I_2(\ell)$ B) $I_2(g) \rightarrow I_2(s)$ C) $H_2O(\ell) \rightarrow H_2O(g)$ D) $H_2O(g) \rightarrow H_2O(\ell)$

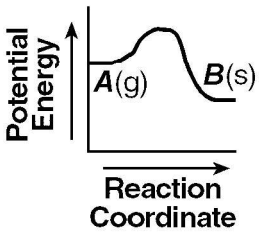
667) The ΔG of a chemical reaction refers to the change in

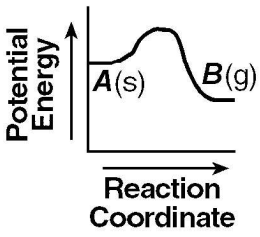
A) free energy B) entropy C) activation energy D) state

668) Which potential energy diagram indicates a reaction that must occur spontaneously?

A)


B)


C)


D)


669) In the free energy equation $\Delta G = \Delta H - T\Delta S$, the symbol T refers to

A) time in seconds B) time in hours C) Kelvin temperature D) Celsius temperature

670) Which one of the following statements is true if the free energy (ΔG) of a reaction is zero?

A) The reaction is approaching equilibrium.
B) The reaction is at equilibrium.
C) The rate of the reverse reaction is zero.
D) The rate of the forward reaction is zero.

671) Which tendency favors a spontaneous reaction?

A) decreasing enthalpy and decreasing entropy
B) decreasing enthalpy and increasing entropy
C) increasing enthalpy, and decreasing entropy
D) increasing enthalpy and increasing entropy