

# Spring Final Exam Practice Test #5

## PART 1

- Vitamin C contains the elements C, H, and O. It is known to contain 40.9% C and 4.58% H by mass. The molar mass of vitamin C has been found to be about 180. The molecular formula for vitamin C is:  
A)  $C_2H_3O_2$   
B)  $C_3H_4O_3$   
C)  $C_4H_6O_4$   
D)  $C_6H_8O_6$
- The characteristic odor of pineapple is due to ethyl butyrate, a compound containing carbon, hydrogen, and oxygen. Combustion of 2.78 g of ethyl butyrate leads to formation of 6.32 g of  $CO_2$  and 2.58 g of  $H_2O$ . The properties of the compound suggest that the molar mass should be between 100 and 150. What is the molecular formula?
- What is the empirical formula for  $C_6H_{12}O_6$ .  
A)  $CH_4O$   
B)  $C_3H_6O_3$   
C)  $CHO$   
D)  $CH_2O$   
E)  $C_6H_{12}O_6$
- A 0.126 M solution of the salt NaA has a pH of 8.40. Calculate the  $K_a$  value of the acid HA.  
A)  $5.0 \times 10^{-11}$   
B)  $5.0 \times 10^{-10}$   
C)  $2.0 \times 10^{-4}$   
D)  $8.0 \times 10^1$   
E) none of these
- The pH of a 1.0 M aqueous solution of NaCl is:  
A) 7.0  
B) greater than 7.0  
C) less than 7.0  
D) not enough information is given  
E) none of these (a-d)
- Refer to the following equation:  
 $4NH_3(g) + 7O_2(g) \rightarrow 4NO_2(g) + 6H_2O(g)$   
  
How many molecules of water are produced if 1.96 mol of  $NO_2$  is given off?  
A)  $2.36 \times 10^{24}$   
B)  $1.18 \times 10^{24}$   
C) 35.3  
D)  $1.77 \times 10^{24}$   
E) none of these
- In the reaction  
 $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ , how many moles of ammonia would be produced from 1.28 mol of hydrogen and excess nitrogen?  
A) 1.66 mol  
B) 3.84 mol  
C) 0.853 mol  
D) 2.56 mol  
E) 0.427 mol
- Refer to the following **unbalanced** equation:  
 $C_6H_{14} + O_2 \rightarrow CO_2 + H_2O$   
  
What mass of oxygen ( $O_2$ ) is required to react completely with 20.7 g of  $C_6H_{14}$ ?  
A)  $6.29 \times 10^3$  g  
B) 36.5 g  
C) 7.69 g  
D) 73.0 g  
E) 0.240 g
- What is the volume of a helium balloon that contains 2.91 mol helium at  $27^\circ C$  and 1.10 atm?  
A) 5.86 L  
B) 59.3 L  
C) 71.6 L  
D) 65.1 L  
E) 6.45 L
- A sample of helium gas occupies 15.0 L at  $23^\circ C$  and 0.956 atm. What volume will it occupy at  $40.^\circ C$  and 0.956 atm?  
A) 26.1 L  
B) 0.0630 L  
C) 14.2 L  
D) 15.9 L  
E) none of these
- The specific heat capacity of iron is  $0.45 \text{ J/g } ^\circ C$ . How many joules of energy are needed to warm 1.97 g of iron from  $20.00^\circ C$  to  $29.00^\circ C$ ?  
A) 26 J  
B) 18 J  
C) 39 J  
D) 16 J  
E) 8.0 J
- How many joules of energy would be required to heat 12.7 g of carbon from  $23.6^\circ C$  to  $54.2^\circ C$ ? (Specific heat capacity of carbon =  $0.71 \text{ J/g } ^\circ C$ .)  
A)  $2.8 \times 10^2$  J  
B)  $7.1 \times 10^2$  J  
C)  $4.9 \times 10^2$  J  
D)  $5.5 \times 10^2$  J  
E) none of these

13. In chocolate milk, power is a \_\_\_\_\_, and water is the \_\_\_\_\_.  
 A) solute; solvent  
 B) solvent; solute  
 C) solution; solute  
 D) solute; solution  
 E) solvent; solution

14. You have two solutions of sodium chloride. One is a 2.00 *M* solution, the other is a 4.00 *M* solution. You have much more of the 4.00 *M* solution, and you add the solutions together. Which of the following could be the concentration of the final solution?  
 A) 2.60 *M*  
 B) 3.00 *M*  
 C) 3.80 *M*  
 D) 6.00 *M*  
 E) 7.20 *M*

15. **(SKIP)** The oxidation state of Rb in any compound is  
 A) +2  
 B) +1  
 C) 0  
 D) -1  
 E) -2

16. **(SKIP)** What is the the oxidation state of Cu in CuNO<sub>2</sub>?  
 A) -1  
 B) -2  
 C) 0  
 D) +1  
 E) +2

17. **(SKIP)** What is the oxidation state of oxygen in Li<sub>2</sub>CO<sub>3</sub>?  
 A) -2  
 B) -1  
 C) 0  
 D) +1  
 E) +2

Use the following to answer question 18:

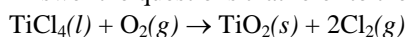
Consider the reaction system  $\text{CH}_4(g) + 2\text{O}_2(g) \rightleftharpoons \text{CO}_2(g) + 2\text{H}_2\text{O}(g) + \text{energy}$ , and use the following choices to describe what happens when the changes below are made to the system at equilibrium.

- a. shifts to the left  
 b. shifts to the right  
 c. no change

18. O<sub>2</sub>(*g*) is removed from the reaction vessel.

Use the following to answer question 19:

Answer the questions that refer to the following reaction:



19. **(SKIP)** Which species is oxidized?  
 A) Ti  
 B) Cl  
 C) O  
 D) TiO<sub>2</sub>  
 E) O<sub>2</sub>

20. **(SKIP)** In the reaction  $\text{N}_2(g) + 3\text{H}_2(g) \rightarrow 2\text{NH}_3(g)$ , nitrogen is \_\_\_\_\_.  
 A) oxidized  
 B) reduced  
 C) synthesized  
 D) electrolyzed  
 E) none of these

Use the following to answer question 21:

Consider the reaction system  $\text{CH}_4(g) + 2\text{O}_2(g) \rightleftharpoons \text{CO}_2(g) + 2\text{H}_2\text{O}(g) + \text{energy}$ , and use the following choices to describe what happens when the changes below are made to the system at equilibrium.

- a. shifts to the left  
 b. shifts to the right  
 c. no change

21. CO<sub>2</sub>(*g*) is removed from the reaction vessel.

22. Catalysts generally affect chemical reactions by  
 A) increasing the temperature of the system  
 B) increasing the surface area of the reactants  
 C) providing an alternate pathway with a lower activation energy  
 D) providing an alternate pathway with a higher activation energy  
 E) lowering the reaction rate

Use the following to answer questions 23-25:

Consider the reaction  $2\text{H}_2(g) + \text{O}_2(g) \rightleftharpoons 2\text{H}_2\text{O}(g)$  at some equilibrium position. Using the following choices, indicate what will happen if the changes below are made.

- a. shifts to the left  
 b. shifts to the right  
 c. no change

23. Additional H<sub>2</sub>O(*g*) is injected into the reaction vessel.

24. Some H<sub>2</sub>(*g*) is removed from the reaction vessel.

25. The size of the reaction vessel is decreased.

26. The  $[\text{OH}^-]$  in a 0.83 M pyridine ( $\text{C}_5\text{H}_5\text{N}$ ;  $K_b = 1.7 \times 10^{-9}$ ) solution is
- A)  $1.4 \times 10^{-9} \text{ M}$
  - B)  $3.8 \times 10^{-5} \text{ M}$
  - C) 0.83 M
  - D)  $4.5 \times 10^{-5} \text{ M}$
  - E) none of these
27. Calculate the pH of a 0.03 M solution of KOH.
- A) 1.5
  - B) 15.5
  - C) 14.0
  - D) 12.5
  - E) cannot calculate answer unless a volume is given
28. When 144.5 g of ethylene ( $\text{C}_2\text{H}_4$ ) burns in oxygen to give carbon dioxide and water, how many grams of  $\text{CO}_2$  are formed?
- A) 453.4 g
  - B) 226.7 g
  - C) 113.4 g
  - D) 5.15 g
  - E) 185.6 g
29. **(SKIP)** How many electrons are transferred in the following reaction when it is balanced in acidic solution?
- $$\text{SO}_3^{2-}(\text{aq}) + \text{MnO}_4^{-}(\text{aq}) \rightarrow \text{SO}_4^{2-}(\text{aq}) + \text{Mn}^{2+}(\text{aq})$$
- A) 6
  - B) 2
  - C) 10
  - D) 5
  - E) 3

## **PART 2**

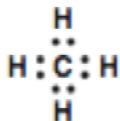
- How many significant digits are in: 0.000523500 ?  
A. 4                                      B. 6                                      C. 7                                      D. 9
- A student calculates the density of an unknown solid. The mass is 10.04 grams, and the volume is 8.21 cubic centimeters. How many significant figures should appear in the final answer?  
A. 1                                      B. 2                                      C. 3                                      D. 4
- What is defined as stored energy?  
A. kinetic energy                      B. specific heat                      C. potential energy                      D. solubility
- Which of the following is defined as atom(s) with a charge?  
A. compound                              B. element                              C. ion                                      D. molecule
- Which of the following allows for the most precise measurement of volume?  
A. graduated cylinder                      B. Erlenmeyer flask                      C. beaker                                      D. all equally precise
- What is defined as an atom with the same number of protons but different numbers of neutrons?  
A. ion                                      B. molecule                              C. isotope                                      D. isomer
- What is defined as a substance mass divided by its unit volume?  
A. molality                              B. density                                      C. molarity                                      D. entropy
- Calculate the percent by mass of sodium in sodium sulfate.  
A. 10.7%                                      B. 19.3%                                      C. 26.9%                                      D. 32.4%
- Which has the greatest mass percent composition of calcium?  
A. calcium sulfate                      B. calcium sulfite                      C. calcium sulfide                      D. calcium chloride
- Calculate the molar mass of  $\text{CH}_3\text{Br}$ .  
A. 94.9 g                                      B. 97.9 g                                      C. 94.9 g/mol                                      D. 97.9 g/mol
- Which two substances cannot be broken down by chemical change?  
A. C and CuO                              B. C and Cu                                      C.  $\text{CO}_2$  and CuO                                      D.  $\text{CO}_2$  and Cu
- Calculate the number of moles in 15.1 kg of iron.  
A. 843                                      B. 270                                      C. 0.000270                                      D. 0.270
- How many atoms are present in 0.00250 g Mg?  
A.  $5.86 \times 10^{27}$                                       B.  $1.51 \times 10^{20}$                                       C.  $6.19 \times 10^{19}$                                       D.  $1.03 \times 10^{-4}$
- Which of the following pairs of compounds have the same empirical formula?  
A.  $\text{C}_2\text{H}_2$  and  $\text{C}_2\text{H}_6$                       B.  $\text{C}_2\text{H}_6$  and  $\text{C}_4\text{H}_{10}$                       C.  $\text{C}_{12}\text{H}_{10}\text{O}$  and  $\text{C}_6\text{H}_5\text{OH}$                       D.  $\text{NO}_2$  and  $\text{N}_2\text{O}_4$
- If 0.500 L of 0.0250M aqueous potassium hydroxide is made, what mass of potassium hydroxide is needed?  
A. 0.0500 g                                      B. 0.0125 g                                      C. 0.701 g                                      D. 2.81 g
- (SKIP)** A 0.3M solution of which of the following acids will be the best conductor of electricity?  
A.  $\text{CH}_3\text{COOH}$                                       B.  $\text{H}_2\text{S}$                                       C. HF                                      D.  $\text{HNO}_3$
- Calculate the molarity of a solution with 1.8 g of potassium nitrate dissolved in 250 mL of water.  
A. 0.071M                                      B. 7.2M                                      C. 225M                                      D. 450M

18. How many ions are found in an aqueous solution, in which 2.3 moles of calcium fluoride are dissolved?  
 A.  $1.39 \times 10^{24}$       B.  $2.77 \times 10^{24}$       C.  $4.16 \times 10^{24}$       D.  $1.39 \times 10^{26}$
19. If 46 g of  $\text{MgBr}_2$  is dissolved in water to form 0.50 liters of solution, what is the concentration of bromide ions in the solution?  
 A.  $0.50M$       B.  $1.0M$       C.  $4.0M$       D.  $8.0M$
20. How much  $0.1M$   $\text{NaOH}$  solution must be added to 100 mL of a  $0.2M$   $\text{H}_2\text{SO}_4$  solution in order to neutralize all the hydrogen ions in  $\text{H}_2\text{SO}_4$ ?  
 A. 100 mL      B. 200 mL      C. 300 mL      D. 400 mL

Match the compound on the left column to the choice that best describes it on the right column.

- |   |                       |
|---|-----------------------|
| 21. $\text{C}_6\text{H}_{12}\text{O}_6$ | A. strong electrolyte |
| 22. $\text{HNO}_3$                      | B. weak electrolyte   |
| 23. $\text{CH}_3\text{NH}_2$            | C. nonelectrolyte     |
|   | D. a monkey           |
|   | E. none of the above  |

24. Given the Lewis electron-dot diagram:



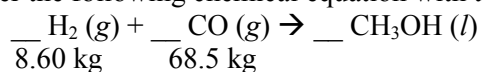
Which electrons are represented by all of the dots?

- A. the carbon valence electrons, only  
 B. the hydrogen valence electrons, only  
 C. the carbon and hydrogen valence electrons  
 D. all of the carbon and hydrogen electrons

25. The atomic mass of an element is equal to that element's number of  
 A. protons.      B. neutrons.      C. protons + neutrons      D. protons + electrons
26. Which of the following subatomic particles found in an atom has the least mass?  
 A. nucleus      B. proton      C. neutron      D. electron
27. Which of the following elements is an example of an alkaline earth metal?  
 A. sodium      B. calcium      C. helium      D. bromine
28. How many neutrons does an atom of gold-198 have?  
 A. 79      B. 118      C. 119      D. 198
29. How many electrons does a phosphorus atom have available for bonding?  
 A. 2      B. 3      C. 4      D. 5
30. What type of bond links the carbon and hydrogen atoms in a molecule of methane gas?  
 A. single covalent      B. double covalent      C. triple covalent      D. single ionic
31. How many electrons does  $\text{As}^{3-}$  have?  
 A. 6      B. 32      C. 34      D. 36
32. How many unpaired valence electrons does silver have?  
 A. 0      B. 1      C. 2      D. 3
33. What type of bond involves transferred electrons?  
 A. covalent      B. ionic      C. strong      D. hydrogen

34. Which of the following elements would be a cation if it had its correct charge attached to it?  
 A. radon                      B. chlorine                      C. neon                      D. vanadium
35. Indium is best described as a:  
 A. metal                      B. nonmetal                      C. metalloid                      D. none of the above
36. What is the charge of all noble gases?  
 A. -1                      B. -2                      C. -3                      D. no charge
37. What is the chemical formula of nickel peroxide?  
 A. NiO                      B. Ni<sub>2</sub>O                      C. Ni<sub>2</sub>O<sub>3</sub>                      D. NiO<sub>2</sub>
38. A compound composed of cuprous and sulfate ions would have what chemical formula?  
 A. Cu<sub>2</sub>SO<sub>4</sub>                      B. CuSO<sub>4</sub>                      C. Cu(SO<sub>4</sub>)<sub>2</sub>                      D. Cu<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>
39. What is the chemical name of the compound CBr<sub>4</sub>?  
 A. carbon tetrabromine                      B. carbon tetrabromide                      C. monocarbon tetrabromide                      D. carbon bromide
40. What is the name of this compound: Ag<sub>2</sub>S?  
 A. silver sulfate                      B. silver sulfide                      C. disilver monosulfide                      D. disilver sulfide
41. What is the name of this compound: P<sub>4</sub>O<sub>10</sub>?  
 A. phosphate oxide                      B. tetraphosphorus decoxide                      C. tetraphosphate decoxide                      D. phosphorus oxide
42. What mass of nickel contains the same number of atoms as 57.0 g of neon?  
 A. 19.6 g                      B. 57.0 g                      C. 166 g                      D. 3.43 x 10<sup>25</sup> g
43. Given the balanced equation:  $X + Cl_2 \rightarrow C_2H_5Cl + HCl$  Which molecule is represented by X?  
 A. C<sub>2</sub>H<sub>4</sub>                      B. C<sub>2</sub>H<sub>6</sub>                      C. C<sub>3</sub>H<sub>6</sub>                      D. C<sub>3</sub>H<sub>8</sub>
44. What is the coefficient of oxygen gas in the balanced equation for  $C_{10}H_{22} + O_2 \rightarrow CO_2 + H_2O$ ?  
 A. 15.5                      B. 21                      C. 31                      D. 32
45. How many moles of oxygen are required to react with 3.6 moles of sulfur dioxide in the following unbalanced reaction:  $SO_2 + O_2 \rightarrow SO_3$ ?  
 A. 0.0                      B. 1.8                      C. 3.6                      D. 7.2
46. If 3.5 moles of pentane (C<sub>5</sub>H<sub>12</sub>) is combined with 35.0 moles of oxygen gas in a combustion reaction, which is the limiting reagent?  
 A. pentane                      B. oxygen gas                      C. neither                      D. not this answer

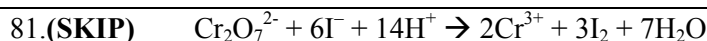
Consider the following chemical equation with the given data:



47. Which of the following sets of coefficients best represents those of the balanced equation?  
 A. 1, 2, 2                      B. 2, 1, 1                      C. 2, 1, 2                      D. 2, 2, 1
48. Which of the following is the limiting reagent?  
 A. H<sub>2</sub>(g)                      B. CO(g)                      C. CH<sub>3</sub>OH(l)                      D. there is none
49. How many moles of the product are produced?  
 A. 2.13 x 10<sup>3</sup>                      B. 2.45 x 10<sup>3</sup>                      C. 4.27 x 10<sup>3</sup>                      D. 8.54 x 10<sup>3</sup>

50. How many grams of the product are produced?  
 A.  $3.56 \times 10^4$       B.  $6.82 \times 10^4$       C.  $1.20 \times 10^5$       D.  $2.74 \times 10^5$
51. What is the percent yield if the actual yield is  $3.57 \times 10^4$  g?  
 A. 52%      B. 76%      C. 88%      D. 92%
52. The concept of an ideal gas is used to explain  
 A. the mass of a gas sample      C. the behavior of a gas sample  
 B. why some gases are monatomic      D. why some gases are diatomic
53. What is the volume of 2.7 moles of argon gas at STP?  
 A. 2.7 L      B. 60 L      C. 0.12 L      D. 8.3 L
54. At what temperature are gases at STP?  
 A. 0 K      B. 273 K      C. 298 K      D. 373 K
55. If the volume of a balloon increases from 4 L to 12 L, what is the new temperature if the initial temperature is 300 K? Assume number of moles and pressure are constant.  
 A. 11 K      B. 100 K      C. 900 K      D. 1600 K
56. If the volume of a balloon increases from 4 L to 12 L, what is the new pressure if the initial pressure is 3 atm? Assume number of moles and temperature are constant.  
 A. 0.11 atm      B. 1 atm      C. 9 atm      D. 16 atm
57.  $11.2^\circ\text{C}$  expressed in the Kelvin temperature scale is  
 A.  $284.2^\circ\text{K}$       B.  $284.2\text{ K}$       C.  $-261.8^\circ\text{K}$       D.  $-261.8\text{ K}$
58. In a balloon filled with 3 gases, gases A and B have equal pressure, while the pressure of gas C is 0.2 atm. If the system of these 3 gases is at STP, what is the pressure of gas A?  
 A. 0.8 atm      B. 22.4 atm      C. 0.4 atm      D. 0.2 atm
59. Which of the gas laws best explains the relationship between the pressure and volume of an ideal gas?  
 A. Boyle's Law      B. Charles's Law      C. Combined Gas Law      D. Dalton's Law
60. If pressure and the temperature are held constant, what happens to the volume if the number of moles of an ideal gas increases?  
 A. increases      B. remains constant      C. decreases      D. becomes a sock
61. As the temperature of a closed system decreases, what happens to the gas pressure inside the system?  
 A. increases      B. remains constant      C. decreases      D. becomes a sock
62. Calculate the pressure 3.4 moles of helium gas exerts at  $13^\circ\text{C}$  in a 5.6 L container.  
 A. 65.62 atm      B. 0.65 atm      C. 14.25 atm      D. 1443.67 atm
63. What is defined as the insoluble product formed when two solutions are mixed?  
 A. spectator ion      B. electrolyte      C. reactant      D. precipitate
64. A catalyst works by  
 A. increasing the potential energy of the reactants      C. increasing the energy released during a reaction  
 B. decreasing the potential energy of the products      D. decreasing the activation energy required for a reaction
65. What type of reaction is  $\text{Al}_2\text{O}_3 \rightarrow \text{Al} + \text{O}_2$  (unbalanced) ?  
 A. combustion      B. single replacement      C. double replacement      D. decomposition

66. At STP, which 4.0-gram zinc sample will react fastest with dilute hydrochloric acid?  
 A. powdered                      B. lump                      C. bar                      D. sheet metal
67. **(SKIP)** The reaction of sulfuric acid with which of the following solutions will form a precipitate?  
 A. silver nitrate                      B. ammonium nitrate                      C. calcium acetate                      D. potassium iodide
68. Which of the following aqueous solutions is a strong electrolyte?  
 A. distilled water, H<sub>2</sub>O                      B. barium chloride                      C. acetic acid, CH<sub>3</sub>COOH                      D. all are equal
69. **(SKIP)** Which of the following compounds can be aqueous?  
 A. calcium sulfate                      B. silver chloride                      C. silver nitrate                      D. both B and C
70. **(SKIP)** When aqueous HNO<sub>3</sub> and BaCl<sub>2</sub> are mixed, what precipitate forms?  
 A. HCl                      B. Ba(NO<sub>3</sub>)<sub>2</sub>                      C. BaH                      D. no precipitate
71. **(SKIP)** When aqueous Na<sub>3</sub>PO<sub>4</sub> and CrCl<sub>3</sub> are mixed, what precipitate forms?  
 A. CrPO<sub>4</sub>                      B. NaCl                      C. Cr<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>                      D. no precipitate
72. **(SKIP)** If barium chloride and potassium sulfate are mixed in water, what is the precipitate?  
 A. barium chloride    B. barium sulfate                      C. potassium chloride                      D. potassium sulfate
73. What is defined as the average kinetic energy of the particles of a substance?  
 A. heat                      B. temperature                      C. entropy                      D. enthalpy
74. Which of the following describes a reaction that can occur on its own without outside help?  
 A. spontaneous                      B. nonspontaneous                      C. endothermic                      D. exothermic
75. Which of the following best indicates that a reaction is exothermic?  
 A. ΔG is negative.                      B. ΔS is negative.                      C. ΔH is negative.                      D. ΔS is positive.
76. Evaporation, in terms of its heat transfer, is best described as  
 A. exothermic.                      B. endothermic.                      C. nonspontaneous.                      D. spontaneous.
77. The freezing point of a substance is the same as the temperature at which the substance  
 A. evaporates                      B. sublimates                      C. condenses                      D. melts
78. Which of the following states of matter has particles with the least kinetic energy of its particles?  
 A. solid                      B. liquid                      C. gas                      D. plasma
79. Which of the following is the temperature at which all particle motion stops?  
 A. -418°C                      B. -273°C                      C. 0°C                      D. 298°C
80. Calculate the thermal energy needed to heat 1000 mL of water from 15°C to 38°C?  
 A. 23000 J                      B. 96140 J                      C. 1237280 J                      D. 1731900 J



Which of the following statements about the reaction above is NOT true?

- A. The oxidation number of oxygen remains the same.
- B. The oxidation number of hydrogen changes from +1 to 0.
- C. The oxidation number of chromium changes from +6 to +3.
- D. The reaction takes place in acidic solution



The choices below refer to  $n$ , the number of moles of electrons transferred in a reaction.

- |            |  |            |
|------------|--|------------|
| 82. (SKIP) | $\text{Fe}^{3+} + \text{Mg} \rightarrow \text{Fe}^{2+} + \text{Mg}^{2+}$   | A. $n = 4$ |
| 83. (SKIP) | $\text{MnO}_4^- + \text{Cr} \rightarrow \text{MnO}_2 + \text{Cr}^{3+}$     | B. $n = 3$ |
| 84. (SKIP) | $\text{NH}_3 + \text{H}_2\text{O} \rightarrow \text{NH}_4^+ + \text{OH}^-$ | C. $n = 2$ |
| 85. (SKIP) | $\text{F}_2 + \text{Br}^- \rightarrow \text{F}^- + \text{Br}_2$            | D. $n = 1$ |
|            |  | E. $n = 0$ |

86. (SKIP) What happens during reduction?  
A. loss of electrons      B. gain of electrons      C. oxidation # increases      D. both B and C
87. (SKIP) Which of the following is TRUE about the following reaction?  
 $\text{Fe}^{2+} + \text{Cu} \rightarrow \text{Fe} + \text{Cu}^{2+}$   
A. Fe is oxidized.      D. Both A and C are true.  
B. Cu is oxidized.      E. Both B and C are true.  
C. Fe is reduced.
88. (SKIP) Which of the following is TRUE about the following reaction?  
 $\text{K}^+ + \text{Pb} \rightarrow \text{Pb}^{2+} + \text{K}$   
A. Pb is oxidized.      D. Both A and C are true.  
B. K is oxidized.      E. Both B and C are true.  
C. K is reduced.
89. (SKIP) Which of the following is TRUE about the following reaction?  
 $\text{Mn}^{2+} + \text{Ag} \rightarrow \text{Mn} + \text{Ag}^+$   
A. Ag is oxidized.      D. Both A and C are true.  
B. Mn is oxidized.      E. Both B and C are true.  
C. Ag is reduced.

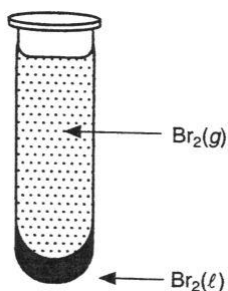
True/False

### **PART 3**

Put "A" for true and "B" for false on your answer key.

1. (SKIP)  $\text{CaCO}_3$  is an organic molecule (T/F)?
2. At equilibrium, the concentration of products always equals the concentration of reactants (T/F).
3. (SKIP) By building cities, organizing communities, and clearing land, humans decrease the universe's trend toward greater entropy (T/F).
4. (SKIP) Adding salt to snow raises the freezing point slightly so that the snow melts more easily (T/F).
5. When dissolved, one mole of  $\text{FeCl}_3$  (which is soluble) will dissociate, producing four moles of ions in solution (T/F).
6. When heated, the pressure of a gas always increases (T/F).
7. (SKIP) Oxidation occurs at the anode in a typical electrochemical cell (T/F).
8. (SKIP) In an electrochemical cell, the salt bridge allows the charge in the solutions to be neutralized by ion exchange (T/F).
9. (SKIP) Oxidation always involves a loss of electrons (T/F).
10. An empirical formula is useful in distinguishing isomers (T/F).
11. Consider the equilibrium represented by the following equation for boiling water in a closed system.  
$$\text{Heat} + \text{H}_2\text{O}_{(l)} \rightarrow \text{H}_2\text{O}_{(g)}$$
  
( $T=373\text{K}$ ,  $P=1\text{ atm}$ )  
The reverse reaction is favored when  
A. the total volume of the system is increased      C. water vapor is removed from the system  
B. boiling water is added to the system      D. the system is cooled

12. (SKIP) A large, stoppered test tube at room temperature contains an equilibrium mixture of bromine liquid and bromine vapor as shown. The test tube is placed into a flask of ice. Which statement most accurately predicts the result?

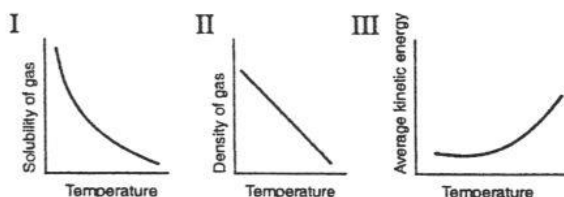


- A. More of the liquid will evaporate because the temperature has decreased.  
 B. All of the gas will condense because the temperature has decreased.  
 C. The amount of liquid will increase because some of the gas condenses due to a decrease in kinetic energy.  
 D. Little change will occur because the test tube is stoppered.
13. Athletes use heat packs to soothe and warm sore muscles. The chemical reaction in the pack is
- A. exothermic and the heat produced flows to the muscles.  
 B. endothermic and the heat produced flows to the muscles  
 C. exothermic and the heat flows from the muscles to the pack.  
 D. endothermic and the heat flows from the muscles to the pack

14. Consider the equilibrium reaction shown below:
- $$\text{energy} + \underset{\text{pink}}{\text{Co}(\text{H}_2\text{O})_6^{2+}}(\text{aq}) + 4 \text{Cl}^{-}(\text{aq}) \rightarrow \underset{\text{blue}}{\text{CoCl}_4^{2-}}(\text{aq}) + 6 \text{H}_2\text{O}(\text{l})$$

Which condition should cause a cobalt chloride mixture to become more blue in color?

- A. adding water  
 B. heating the mixture  
 C. removing chloride ions ( $\text{Cl}^{-}$ )  
 D. decreasing the size of the container
15. Equal volume of nitrogen gas ( $\text{N}_2$ ) and hydrogen sulfide gas ( $\text{H}_2\text{S}$ ), under the same conditions of temperature and pressure, have equal
- A. number of molecules.  
 B. number of atoms.  
 C. number of protons and neutrons.  
 D. mass.
16. The following graphs show trends in behavior of matter as temperature changes.



The following phenomena regularly occur in nature.

X: Hot air rises while cold air sinks.

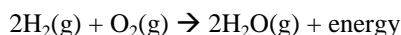
Y: Substances evaporate faster in warm weather.

Z: A glass of warm soda goes flat more quickly than a cold soda.

Select the letter that correctly matches each graph to the phenomenon it explains.

- |    |          |          |          |  |
|----|----------|----------|----------|--|
|    | <u>X</u> | <u>Y</u> | <u>Z</u> |  |
| A. | I        | III      | II       |  |
| B. | III      | I        | II       |  |
|    | <u>X</u> | <u>Y</u> | <u>Z</u> |  |
| C. | I        | II       | III      |  |
| D. | II       | III      | I        |  |

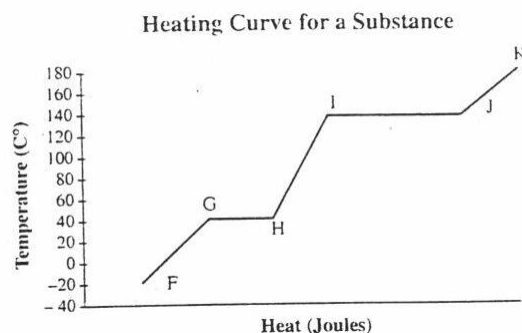
17. Consider the following balanced chemical equation.



What volume of oxygen gas ( $\text{O}_2$ ) will combine completely with 4.0L of hydrogen gas ( $\text{H}_2$ ) to form water if both gases are measured at the same temperature and pressure?

- A. 16.0L  
 B. 8.0L  
 C. 4.0L  
 D. 2.0L

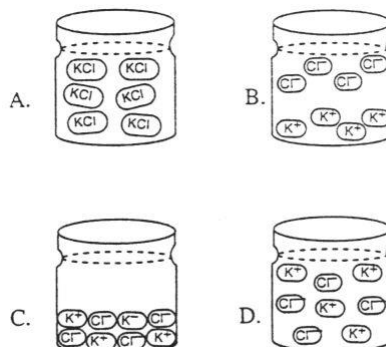
18. A mixture of 50g of water and 50g of common salt (solubility: 35g/100g of water) is well stirred. When stirring produces no more changes, the reaction vessel will contain
- A. a solution phase only  
B. pure water and solid salt phases  
C. solution and solid salt phases  
D. a solid salt phase only
19. Radioactivity is observed when an atomic nucleus
- A. absorbs UV light  
B. is heated to a very high temperature  
C. absorbs light from a laser  
D. changes into a different nucleus
20. The radioactive isotope  $^{90}_{38}\text{Sr}$ , also called Strontium-90, is a harmful nuclear waste product. How many protons and neutrons are in the nucleus of this isotope?
- A. 38 protons and 38 neutrons  
B. 38 protons and 90 neutrons  
C. 52 protons and 38 neutrons  
D. 38 protons and 52 neutrons
21. The approximate freezing point of the substance is:



22. Vitamin C is water-soluble. Vitamin E is fat-soluble. This suggests that
- A. Vitamin C is polar; Vitamin E is nonpolar  
B. Vitamin C is nonpolar; Vitamin E is polar  
C. Vitamin C has a higher molar mass  
D. Vitamin C has a lower molar mass
23. Solid ammonium nitrate ( $\text{NH}_4\text{NO}_3$ ) and water are used in "cold packs" to treat first aid emergencies. When they are mixed, the solid dissolves. The pack feels cold because
- A. the reaction is endothermic and energy flows out of you  
B. the reaction is endothermic and energy flows to you  
C. the reaction is exothermic and energy flows to you  
D. the reaction is exothermic and energy flows out of you
24. **(SKIP)** In the following reaction:
- $$\text{Cu}^{2+}(\text{aq}) + \text{Pb}(\text{s}) \rightarrow \text{Pb}^{2+}(\text{aq}) + \text{Cu}(\text{s})$$
- A.  $\text{Cu}^{2+}$  and Pb both gain electrons  
B.  $\text{Cu}^{2+}$  and Pb both lose electrons  
C.  $\text{Cu}^{2+}$  gains electrons and Pb loses electrons  
D.  $\text{Cu}^{2+}$  loses electrons and Pb gains electrons

25. Which diagram BEST represents an aqueous solution of potassium chloride?

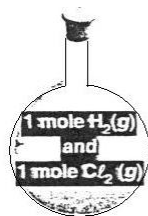
- A. A  
B. B  
C. C  
D. D



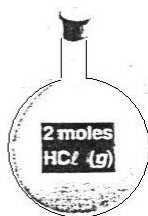
26. One mole of chlorine gas ( $\text{Cl}_2$ ) and one mole of hydrogen gas ( $\text{H}_2$ ) are put into a sealed container (Flask 1), and they do not react until exposed to ultraviolet (UV) light.

Two moles of hydrogen chloride gas ( $\text{HCl}$ ) are in another identical container (Flask 2). Both flasks are at the same temperature.

Which of the following will be the SAME for the substances in the two flasks?



Flask 1

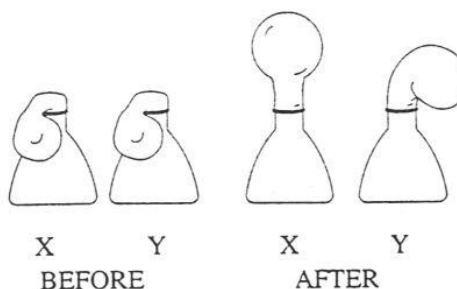


Flask 2

- A. the total pressure
- B. their solubilities in water
- C. the polarity of the molecules
- D. their chemical properties

27. 100 mL of water is placed in two identical flasks. 5.0 grams of a stomach antacid seltzer tablet is added to each and the neck of the flask is sealed with a balloon. The reaction is allowed to proceed for 1 minute. Different results are seen as shown in the diagrams below.

Which of the following sets of conditions was most likely to be present for Flask X?



- I. tablet was crushed
  - II. tablet was whole (uncrushed)
  - III. water was cold
  - IV. water was hot
- A. I and III
  - B. I and IV
  - C. II and III
  - D. II and IV

28. When a piece of magnesium metal is added to 10 mL of a 2.0 M hydrochloric acid ( $\text{HCl}$ ) solution, it takes 52 seconds for the magnesium to completely react. Which of the following would increase the rate at which the magnesium reacts?

- A. Use a 1.0 M  $\text{HCl}$  solution.
- B. Cool the reaction and its container
- C. Use 20 mL of 2.0 M  $\text{HCl}$  solution
- D. Use magnesium powder

29. Use this chart for the following question.

Indicator Color and pH

Indicator	pH interval	Color at lower pH	Color at higher pH
Bromothymol blue	6.0-8.0	yellow	blue
Methyl orange	3.2-4.5	orange	yellow
Phenolphthalein	8.2-10.0	colorless	pink

The result of a test of vinegar (acetic acid) with the indicators listed above would be

- A. blue in bromothymol blue and orange in methyl orange.
- B. pink in phenolphthalein and blue in bromothymol blue.
- C. orange in methyl orange and colorless in phenolphthalein.
- D. colorless in phenolphthalein and blue in bromothymol blue.

30. All of the following equations are statements of the ideal gas law except

A.  $P = nRTV$

C.  $\frac{P}{n} = \frac{RT}{V}$

B.  $\frac{PV}{T} = nR$

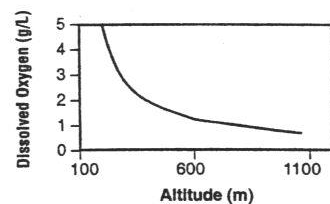
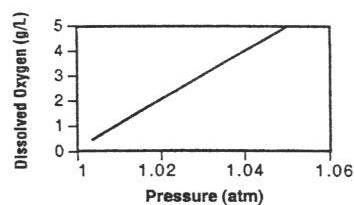
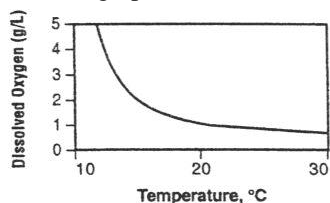
D.  $R = \frac{PV}{nT}$

31. According to the kinetic-molecular theory, particles of matter
- A. are in constant motion.
  - B. have different shapes.
  - C. have different colors.
  - D. do not move at temperatures below  $0^{\circ}\text{C}$
32. Unlike in an ideal gas, in a real gas
- A. all particles move in the same direction.
  - B. all particles have the same kinetic energy.
  - C. the particles cannot diffuse.
  - D. the particles exert attractive forces on each other.
33. What instrument measures atmospheric pressure?
- A. barometer
  - B. manometer
  - C. vacuum pump
  - D. torrrometer
34. Convert the pressure 0.840 atm to mm Hg.
- A. 365 mm Hg
  - B. 437 mm Hg
  - C. 638 mm Hg
  - D. 780 mm Hg
35. Which of the following is an electrolyte?
- A. aqueous sodium chloride
  - B. aqueous sugar
  - C. pure water
  - D. glass
36. How many moles of ions are produced by the dissociation of 1 mol of  $\text{MgCl}_2$ ?
- A. 0
  - B. 1 mol
  - C. 2 mol
  - D. 3 mol
37. What is the quantity of one mole?
- A. 6.02
  - B.  $6.02 \times 10^{23}$
  - C. 60.2
  - D. 602-1023
38. What is the solute in salt water
- A. water.
  - B. salt.
  - C. Salt water.
  - D. both.
39. How many liters in a 5M solution with 10moles of NaCl?
- A. 2.5L
  - B. 2L
  - C. 50L
  - D. 0.2L
40. Which of the following is NOT a strong acid?
- A.  $\text{HNO}_3$
  - B.  $\text{CH}_3\text{COOH}$
  - C.  $\text{H}_2\text{SO}_4$
  - D.  $\text{HCl}$
41. Which of the following is a strong base?
- A.  $\text{NH}_3$
  - B. aniline
  - C.  $\text{NaOH}$
  - D. acetate ion
42. What is neutralization?
- A. an acid-base reaction that does not include dissociation of ions
  - B. a synthesis reaction
  - C. an acid-base reaction which produces water and a type of salt
  - D. a combustion reaction
43. What is the concentration of  $\text{OH}^-$  in pure water?
- A.  $10^{-7} \text{ M}$
  - B. 0.7 M
  - C. 55.4 M
  - D.  $10^7 \text{ M}$

44. The pH of an acidic solution is  
 A. less than 0.  
 B. less than 7.  
 C. greater than 7.  
 D. greater than 14.
45. What process measures the amount of a solution of known concentration required to react with a measured amount of a solution of unknown concentration?  
 A. autoprotolysis  
 B. hydrolysis  
 C. neutralization  
 D. titration
46. What units are used to measure heat?  
 A. joules/mole or kilojoules/mole  
 B. kelvins or degrees Celsius  
 C. joules or kilojoules  
 D. None of the above
47. **(SKIP)** Which of the following is a measure of the disorder in a system?  
 A. entropy  
 B. enthalpy  
 C. free energy  
 D. temperature
48. **(SKIP)** Which of the following substances has the highest entropy?  
 A. steam  
 B. ice water  
 C. liquid water  
 D. crushed ice
49. **(SKIP)** A reaction is spontaneous if its voltage is  
 A. zero.  
 B. negative.  
 C. positive.  
 D. You can tell
50. Catalysts generally affect chemical reactions by  
 A. increasing the temperature of the system.  
 B. increasing the surface area of the reactants.  
 C. providing an alternate pathway with a lower activation energy.  
 D. providing an alternate pathway with a higher activation energy.
51. At equilibrium,  
 A. the forward reaction rate is lower than the reverse reaction rate.  
 B. the forward reaction rate is higher than the reverse reaction rate.  
 C. the forward reaction rate is equal to the reverse reaction rate.  
 D. no reactions take place.
52. What is the chemical equilibrium expression for the equation  
 $2A_2B + 3CD \rightarrow A_4D + C_3B_2$ ?  
 A.  $\frac{6[A_2B][CD]}{[A_4D][C_3B_2]}$   
 B.  $\frac{[A_4D][C_3B_2]}{6[A_2B][CD]}$   
 C.  $\frac{[A_2B]^2[CD]^3}{[A_4D][C_3B_2]}$   
 D.  $\frac{[A_4D][C_3B_2]}{[A_2B]^2[CD]^3}$
53. **(SKIP)** What are the oxidation numbers in the ion  $SO_3^{2-}$ ?  
 A. S = +6, O = -2  
 B. S = +1, O = -1  
 C. S = +4, O = -2  
 D. S = 0, O = -1
54. **(SKIP)** In the reaction  $F_2 + Mg \rightarrow 2F^- + Mg^{2+}$ , which species is oxidized?  
 A.  $F_2$  only  
 B. Mg only  
 C. both Mg and  $F_2$   
 D. neither Mg nor  $F_2$
55. How many valence electrons does a carbon atom have?  
 A. 3  
 B. 4  
 C. 5  
 D. 6

56. **(SKIP)** Which of the following are large molecules made of many small units joined by organic reactions?
- monomers
  - copolymers
  - polymers
  - linear polymers
57. How many protons and neutrons does Neon-20 have
- 2 neutrons and 10 protons
  - 20 neutrons and 20 protons
  - 20 neutrons and 10 protons
  - 10 neutrons and 10 protons
58. Which of the following elements has 60 neutrons
- Silver-107*
  - Silver-108*
  - Sodium-22*
  - Carbon-12*
59. **(SKIP)** What do all organic compounds contain?
- calcium
  - water
  - oxygen
  - carbon

60. Use these graphs for the following question:



Which statement applies to all the graphs?

- Fish in a high-altitude lake would have a larger supply of dissolved oxygen than those in a lake of similar temperature close to sea level.
- After a two-week heat spell, the dissolved oxygen supply in a lake should be lower than normal.
- High altitude and temperature are two conditions that lead to an increase in dissolved oxygen in a lake.
- A cold-water lake will have a lower dissolved oxygen concentration than a warm one.

61. What is the temperature of STP
- 273K
  - 273°C
  - 0K
  - 25°C
62. If 0.500 L of 0.0250M aqueous potassium hydroxide is made, what mass of potassium hydroxide is needed?
- 0.0500g
  - 0.0125g
  - 0.701g
  - 2.81g
63. What is produced when you react a strong acid with a strong base?
- salt
  - water
  - Water and salt
  - carbon
64. How much 0.1M NaOH solution must be added to 100 mL of a 0.2M HCl solution in order to neutralize all the hydrogen ions in HCl?
- 100mL
  - 200mL
  - 300mL
  - 400mL

65. How many neutrons are in tin-118  
 A. 68  
 B. 65  
 C. 50  
 D. 58
66. Calculate the molar mass of  $\text{CH}_3\text{Br}$ .  
 A. 94.9g  
 B. 94.9g/mole  
 C. 97.9g  
 D. 97.9g/mole
67. How many electrons does  $\text{As}^{3-}$  have?  
 A. 6  
 B. 32  
 C. 34  
 D. 36
68. What is the volume of 2.7 moles of argon gas at STP?  
 A. 2.7L  
 B. 60L  
 C. 0.12L  
 D. 8.3L
69.  $11.2^\circ\text{C}$  expressed in the Kelvin temperature scale is  
 A. 284.2K  
 B. 274.2K  
 C. -261.8K  
 D. 273K
70. As the temperature of a closed system decreases, what happens to the gas pressure inside the system?  
 A. increase  
 B. Remains constant  
 C. Decrease  
 D. Becomes a sock
71. Calculate the pressure 3.4 moles of helium gas exerts at  $13^\circ\text{C}$  in a 5.6 L container.  
 A. 65.62 atm  
 B. 0.65 atm  
 C. 14.25 atm  
 D. 1443.67 atm
72. A catalyst works by  
 A. Decreasing the activation energy  
 B. Increasing the activation energy  
 C. Changes the reaction  
 D. Decreasing the potential energy
73. Which of the following is the temperature at which all particle motion stops?  
 A. 273K  
 B.  $273^\circ\text{C}$   
 C.  $0^\circ\text{C}$   
 D.  $-273^\circ\text{C}$
74. Calculate the thermal energy needed to heat 1000 g of water from  $15^\circ\text{C}$  to  $38^\circ\text{C}$ ? ( $C = 4.18\text{J/g}\cdot^\circ\text{C}$ )  
 A. 23000 J  
 B. 96140 J  
 C. 1237280 J  
 D. 1731900 J
75. **(SKIP)** Which of the following is TRUE about the following reaction?  

$$\text{Pb}^{2+} + \text{K} \rightarrow \text{Pb} + \text{K}^+$$
  
 A. Pb is the anode  
 B. K is the anode  
 C. Both A and C  
 D. Neither A or C
76. What is the molar mass of  $\text{H}_2\text{O}$   
 A. 18g/mole  
 B. 16g/mole  
 C. 2g  
 D. 18g
78. What element below has a molar mass of 16g/mole?  
 A. calcium  
 B. water  
 C. oxygen  
 D. carbon
77.  $2\text{NaCl} + 3\text{O}_2 \leftrightarrow 2\text{NaClO}_3 + \text{Heat}$   
 What happens to the equilibrium reaction above if you add oxygen gas  
 A. Shifts to the left  
 B. Shifts to the right  
 C. Oxygen is produced  
 D. The reaction stops
79. Suppose that 20.0mL of 0.10 M KOH is required to neutralize 12.0mL of aqueous HCl solution. What is the molarity of the HCl solution?  
 A. 0.167M  
 B. 0.167L  
 C. 0.247M  
 D. 0.002M







