Dougherty Valley HS Chemistry

Practice Final Exam Spring 2015

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) $C_6H_8O_6$

2. 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?

3. 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) $C_6H_{12}O_6$

4. 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) 5.0×10^{-11}
   B) 5.0×10^{-10}
   C) 2.0×10^{-4}
   D) 8.0×10^{1}
   E) none of these

5. 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)

6. 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) 2.36×10^{24}
   B) 1.18×10^{24}
   C) 35.3
   D) 1.77×10^{24}
   E) none of these

7. 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

8. 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) 6.29×10^3 g
   B) 36.5 g
   C) 7.69 g
   D) 73.0 g
   E) 0.240 g

9. What is the volume of a helium balloon that contains 2.91 mol helium at 27^oC and 1.10 atm?
   A) 5.86 L
   B) 59.3 L
   C) 71.6 L
   D) 65.1 L
   E) 6.45 L

10. A sample of helium gas occupies 15.0 L at 23^oC and 0.956 atm. What volume will it occupy at $40.^oC$ and 0.956 atm?
    A) 26.1 L
    B) 0.0630 L
    C) 14.2 L
    D) 15.9 L
    E) none of these

11. The specific heat capacity of iron is 0.45 J/g ^oC. How many joules of energy are needed to warm 1.97 g of iron from 20.00^oC to 29.00^oC?
    A) 26 J
    B) 18 J
    C) 39 J
    D) 16 J
    E) 8.0 J

12. How many joules of energy would be required to heat 12.7 g of carbon from 23.6^oC to 54.2^oC? (Specific heat capacity of carbon = 0.71 J/g^oC.)
    A) 2.8×10^2 J
    B) 7.1×10^2 J
    C) 4.9×10^2 J
    D) 5.5×10^2 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. The oxidation state of Rb in any compound is
  A) +2
  B) +1
  C) 0
  D) -1
  E) -2

16. What is the the oxidation state of Cu in $CuNO_2$?
  A) -1
  B) -2
  C) 0
  D) +1
  E) +2

17. What is the oxidation state of oxygen in Li_2CO_3?
  A) -2
  B) -1
  C) 0
  D) +1
  E) +2

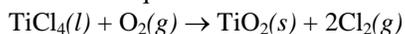Use the following to answer question 18:

Consider the reaction system $CH_4(g) + 2O_2(g) \rightleftharpoons CO_2(g) + 2H_2O(g)$ + 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. $O_2(g)$ is removed from the reaction vessel.

Use the following to answer question 19:

Answer the questions that refer to the following reaction:
$TiCl_4(l) + O_2(g) \rightarrow TiO_2(s) + 2Cl_2(g)$

19. Which species is oxidized?
  A) Ti
  B) Cl
  C) O
  D) TiO_2
  E) O_2

20. In the reaction $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$, 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 $CH_4(g) + 2O_2(g) \rightleftharpoons CO_2(g) + 2H_2O(g)$ + 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. $CO_2(g)$ 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 teh 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 $2H_2(g) + O_2(g) \rightleftharpoons 2H_2O(g)$ 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 $H_2O(g)$ is injected into the reaction vessel.

24. Some $H_2(g)$ is removed from the reaction vessel.

25. The size of the reaction vessel is decreased.

26. The [OH$^-$] in a 0.83 M pyridine (C$_5$H$_5$N; K_b = 1.7 × 10^{-9}) solution is
    A)   1.4 × 10^{-9} M
    B)   3.8 × 10^{-5} M
    C)   0.83 M
    D)   4.5 × 10^{-5} 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 (C$_2$H$_4$) burns in oxygen to give carbon dioxide and water, how many grams of 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. How many electrons are transferred in the following reaction when it is balanced in acidic solution?
    SO$_3^{2-}$(aq) + MnO$_4^-$(aq) → SO$_4^{2-}$(aq) + Mn^{2+}(aq)
    A)   6
    B)   2
    C)   10
    D)   5
    E)   3

Answer Key

1. D
2. C$_6$H$_{12}$O$_2$
3. D
4. C
5. A
6. D
7. C
8. D
9. D
10. D
11. E
12. A
13. A
14. C
15. B
16. D
17. A
18. a
19. B
20. B
21. b
22. C
23. a
24. a
25. b
26. B
27. D
28. A
29. C

Chemistry Honors problems

→ **Introduction to Chemistry**

1. How many significant digits are in: 0.000523500 ?
   A. 4   B. 6   C. 7   D. 9

2. 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

3. What is defined as stored energy?
   A. kinetic energy   B. specific heat   C. potential energy   D. solubility

4. Which of the following is defined as atom(s) with a charge?
   A. compound   B. element   C. ion   D. molecule

5. Which of the following allows for the most precise measurement of volume?
   A. graduated cylinder   B. Erlenmeyer flask   C. beaker   D. all equally precise

6. 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

7. What is defined as a substance mass divided by its unit volume?
   A. molality   B. density   C. molarity   D. entropy

8. Calculate the percent by mass of sodium in sodium sulfate.
   A. 10.7%   B. 19.3%   C. 26.9%   D. 32.4%

9. Which has the greatest mass percent composition of calcium?
   A. calcium sulfate   B. calcium sulfite   C. calcium sulfide   D. calcium chloride

10. Calculate the molar mass of CH_3Br.
    A. 94.9 g   B. 97.9 g   C. 94.9 g/mol   D. 97.9 g/mol

11. Which two substances cannot be broken down by chemical change?
    A. C and CuO   B. C and Cu   C. CO_2 and CuO   D. CO_2 and Cu

12. Calculate the number of moles in 15.1 kg of iron.
    A. 843   B. 270   C. 0.000270   D. 0.270

13. How many atoms are present in 0.00250 g Mg?
    A. 5.86 x 10^{27} B. 1.51 x 10^{20} C. 6.19 x 10^{19} D. 1.03 x 10^{-4}

14. Which of the following pairs of compounds have the same empirical formula?
    A. C_2H_2 and C_2H_6 B. C_2H_6 and C_4H_{10} C. $C_{12}H_{10}O$ and C_6H_5OH D. NO_2 and N_2O_4

→ **Concentration**

15. 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

16. A 0.3M solution of which of the following acids will be the best conductor of electricity?
    A. CH_3COOH B. H_2S C. HF   D. HNO_3

17. 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 x 10^{24} B. 2.77 x 10^{24} C. 4.16 x 10^{24} D. 1.39 x 10^{26}

19. If 46 g of $MgBr_2$ 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 $0.1M$ NaOH solution must be added to 100 mL of a $0.2M$ H_2SO_4 solution in order to neutralize all the hydrogen ions in H_2SO_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. $C_6H_{12}O_6$ A. strong electrolyte
22. HNO_3 B. weak electrolyte
23. CH_3NH_2 C. nonelectrolyte
       D. a monkey
       E. none of the above

→ **The Atom and the Periodic Table**

24. Given the Lewis electron-dot diagram:
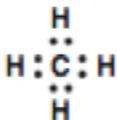
Which electrons are represented by all of the dots?
       A. the carbon valence electrons, only
       B. the hydrogen valence electrons, only
       C. the carbon and hydrogen valence electrons
       D. all of the carbon and hydrogen electrons

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 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_2O C. Ni_2O_3 D. NiO_2

38. A compound composed of cuprous and sulfate ions would have what chemical formula?
   A. Cu_2SO_4 B. $CuSO_4$ C. $Cu(SO_4)_2$ D. $Cu_2(SO_4)_3$

39. What is the chemical name of the compound CBr_4?
   A. carbon tetrabromine   B. carbon tetrabromide   C. monocarbon tetrabromide   D. carbon bromide

40. What is the name of this compound: Ag_2S?
   A. silver sulfate   B. silver sulfide   C. disilver monosulfide   D. disilver sulfide

41. What is the name of this compound: P_4O_{10}?
   A. phosphate oxide   B. tetraphosphorus decoxide   C. tetraphosphate decoxide   D. phosphorus oxide

→ **Stoichiometry**
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^{25} g

43. Given the balanced equation: $X + Cl_2 \rightarrow C_2H_5Cl + HCl$ Which molecule is represented by X?
   A. C_2H_4 B. C_2H_6 C. C_3H_6 D. C_3H_8

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_5H_{12}) 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

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Consider the following chemical equation with the given data:
   __ H_2 (g) + __ CO (g) → __ CH_3OH (l)
   8.60 kg   68.5 kg
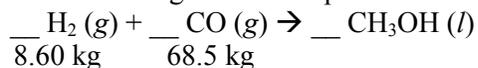
47. Which of the following sets of coefficients best represents those of the balanced equation?
   A. 1, 2, 2   B. 2, 1, 1   C. 2, 1, 2   D. 2, 2, 1

48. Which of the following is the limiting reagent?
   A. H_2 (g)   B. CO (g)   C. CH_3OH (l)   D. there is none

49. How many moles of the product are produced?
   A. 2.13 x 10^3 B. 2.45 x 10^3 C. 4.27 x 10^3 D. 8.54 x 10^3

50. How many grams of the product are produced?

    A. 3.56×10^4 B. 6.82×10^4 C. 1.20×10^5 D. 2.74×10^5

51. What is the percent yield if the actual yield is 3.57×10^4 g?

    A. 52%   B. 76%   C. 88%   D. 92%

→ Gases

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°C expressed in the Kelvin temperature scale is

    A. 284.2°K   B. 284.2 K   C. -261.8°K   D. -261.8 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°C in a 5.6 L container.

    A. 65.62 atm   B. 0.65 atm   C. 14.25 atm   D. 1443.67 atm

→ Chemical Reactions and Solubility

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 $Al_2O_3 \rightarrow Al + O_2$ (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. 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_2O B. barium chloride   C. acetic acid, CH_3COOH D. all are equal

69. Which of the following compounds can be aqueous?
   A. calcium sulfate   B. silver chloride   C. silver nitrate   D. both B and C

70. When aqueous HNO_3 and $BaCl_2$ are mixed, what precipitate forms?
   A. HCl   B. $Ba(NO_3)_2$ C. BaH   D. no precipitate

71. When aqueous Na_3PO_4 and $CrCl_3$ are mixed, what precipitate forms?
   A. $CrPO_4$ B. NaCl   C. $Cr_3(PO_4)_2$ D. no precipitate

72. 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

→ **Thermodynamics**
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

→ **Oxidation-Reduction and Electrochemistry**

81. $Cr_2O_7^{2-} + 6I^- + 14H^+ \rightarrow 2Cr^{3+} + 3I_2 + 7H_2O$
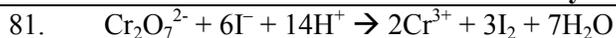
   Which of the following statements about the reaction above is NOT true?
       A. The oxidation number of oxygen remains the same.
       B. The oxidation number of hydrogen changes from +1 to 0.
       C. The oxidation number of chromium changes from +6 to +3.
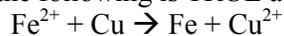   D. The reaction takes place in acidic solution

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

82.	$Fe^{3+} + Mg \rightarrow Fe^{2+} + Mg^{2+}$	A. $n = 4$
83.	$MnO_4^- + Cr \rightarrow MnO_2 + Cr^{3+}$	B. $n = 3$
84.	$NH_3 + H_2O \rightarrow NH_4^+ + OH^-$	C. $n = 2$
85.	$F_2 + Br^- \rightarrow F^- + Br_2$	D. $n = 1$
		E. $n = 0$

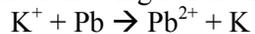86. What happens during reduction?
   A. loss of electrons   B. gain of electrons   C. oxidation # increases   D. both B and C

87. Which of the following is TRUE about the following reaction?
   $$Fe^{2+} + Cu \rightarrow Fe + Cu^{2+}$$
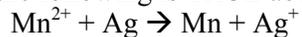   A. Fe is oxidized.   D. Both A and C are true.
   B. Cu is oxidized.   E. Both B and C are true.
   C. Fe is reduced.

88. Which of the following is TRUE about the following reaction?
   $$K^+ + Pb \rightarrow Pb^{2+} + K$$
   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. Which of the following is TRUE about the following reaction?
   $$Mn^{2+} + Ag \rightarrow Mn + Ag^+$$
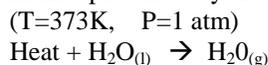   A. Ag is oxidized.   D. Both A and C are true.
   B. Mn is oxidized.   E. Both B and C are true.
   C. Ag is reduced.

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

1. $CaCO_3$ is an organic molecule (T/F)?

2. At equilibrium, the concentration of products always equals the concentration of reactants (T/F).

3. By building cities, organizing communities, and clearing land, humans decrease the universe's trend toward greater entropy (T/F).

4. Adding salt to snow raises the freezing point slightly so that the snow melts more easily (T/F).

5. When dissolved, one mole of $FeCl_3$ (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. Oxidation occurs at the anode in a typical electrochemical cell (T/F).

8. In an electrochemical cell, the salt bridge allows the charge in the solutions to be neutralized by ion exchange (T/F).

9. 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.
    (T=373K, P=1 atm)
    $Heat + H_2O_{(l)} \rightarrow H_2O_{(g)}$
    The reverse reaction is favored when
    A. the total volume of the system is increased
    B. boiling water is added to the system
    C. water vapor is removed from the system
    D. the system is cooled

12. 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?
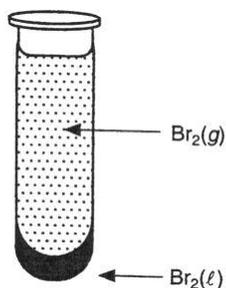
A. More of the liquid will evaporate because the temperature has decreased.
B. All of the gas will condense because the temperature has decreased.
C. The amount of liquid will increase because some of the gas condenses due to a decrease in kinetic energy.
D. Little change will occur because the test 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 equilbrium reaction shown below:

$$\text{energy} + \underset{\text{pink}}{Co(H_2O)_6^{2+}}_{(aq)} + 4\ Cl^{1-}\ (aq) \rightarrow \underset{\text{blue}}{CoCl_4^{2-}}_{(aq)} + 6\ H_2O\ _{(l)}$$

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 (Cl^{1-})
D. decreasing the size of the container

15. Equal volume of nitrogen gas (N_2) and hydrogen sulfide gas (H_2S), 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.
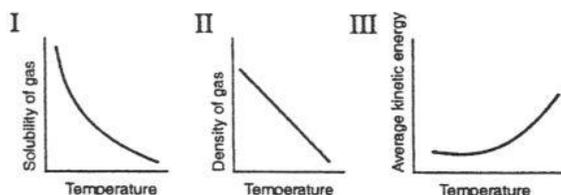
The following phenomena regularly occur in nature.
   X: Hot air rises while cold air sinks.
   Y: Substances evaporate faster in warm weather.
   Z: A glass of warm soda goes flat more quickly than a cold soda.

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

	X	Y	Z			X	Y	Z
A.	I	III	II		C.	I	II	III
B.	III	I	II		D.	II	III	I

17. Consider the following balanced chemical equation.

$$2H_2(g) + O_2(g) \rightarrow 2H_2O(g) + \text{energy}$$
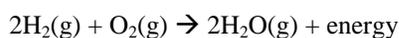
What volume of oxygen gas (O_2) will combine completely with 4.0L of hydrogen gas (H_2) to form water if both gases are measured at the same temperature and pressure?
A. 16.0L   B. 8.0L   C. 4.0L   D. 2.0L

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 $^{90}_{38}Sr$, also called Strontium-90, is a harmful nuclear waste product.

How many protons and neutrons are in a the nucleus of this isotope?
A. 38 protons and 38 neutrons   C. 52 protons and 38 neutrons
B. 38 protons and 90 neutrons   D. 38 protons and 52 neutrons

21. The approximate freezing point of the substance is:

Heating Curve for a Substance
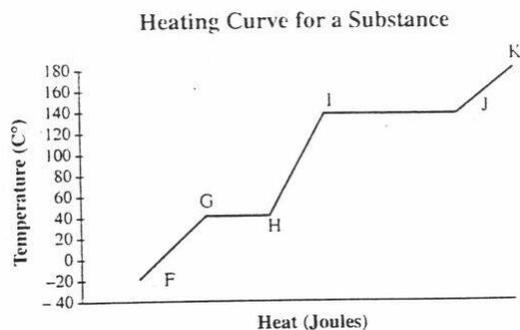
A. -20°C   C. 150°C
B. 40°C   D. 180°C

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 (NH_4NO_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. In the following reaction:
$Cu^{2+}(aq) + Pb\ (s) \rightarrow Pb^{2+}(aq) + Cu(s)$
A. Cu^{2+} and Pb both gain electrons
B. Cu^{2+} and Pb both lose electrons
C. Cu^{2+} gains electrons and Pb loses electrons
D. Cu^{2+} loses electrons and Pb gains electrons

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

A.
KCl KCl
KCl KCl
KCl KCl

B.
Cl⁻ Cl⁻
Cl⁻ Cl⁻
K⁺ K⁺
K⁺ K⁺

C.
K⁺ Cl⁻ K⁻ Cl⁻
Cl⁻ K⁺ Cl⁻ K⁺

D.
K⁺ Cl⁻ K⁺
Cl⁻ K⁺ Cl⁻
Cl⁻ K⁺
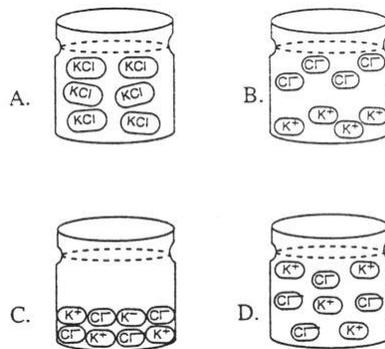
A. A   B. B   C. C   D. D

26. One mole of chlorine gas (Cl_2) and one mole of hydrogen gas (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 cloride gas (HCl) are in another identical container (Flask 2). Both flasks are at the same temperature.

1 mole H_2(g) and 1 mole Cl_2 (g)

2 moles HCl (g)

Flask 1   Flask 2
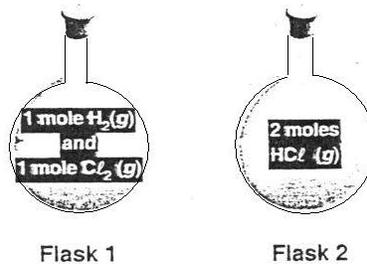
Which of the following will be the SAME for the substances in the two flasks?

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.

X   Y   X   Y
    BEFORE   AFTER
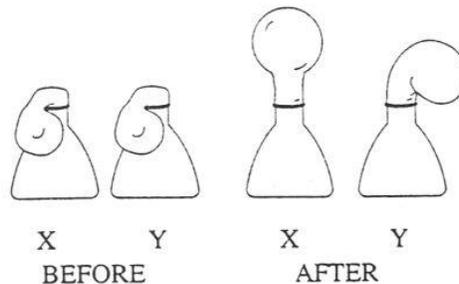
Which of the following sets of conditions was most likel to be present for Flask X?

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 (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 HCl solution.
   C. Use 20 mL of 2.0 M HCl solution
   B. Cool the reaction and its container
   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
Phenol-phthalein	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 is phenolphalein.
   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. $\dfrac{P}{n} = \dfrac{RT}{v}$

   B. $\dfrac{PV}{T} = nR$
   D. $R = \dfrac{PV}{nT}$

31. According to the kinetic-molecular theory, particles of matter
   A. are in constant motion.
   C. have different colors.
   B. have different shapes.
   D. do not move at temperatures below 0□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
   C. vacuum pump
   B. manometer
   D. torrometer

34. Convert the pressure 0.840 atm to mm Hg.
   A. 365 mm Hg
   C. 638 mm Hg
   B. 437 mm Hg
   D. 780 mm Hg

35. Which of the following is an electrolyte?
   A. aqueous sodium chloride
   C. pure water
   B. aqueous sugar
   D. glass

36. How many moles of ions are produced by the dissociation of 1 mol of $MgCl_2$?
    A. 0
    B. 1 mol
    C. 2 mol
    D. 3 mol

37. What is the quantity of one mole?
    A. 6.02
    B. 6.02×10^{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. HNO_3
    B. CH_3COOH
    C. H_2SO_4
    D. HCl

41. Which of the following is a strong base?
    A. NH_3
    B. aniline
    C. NaOH
    D. acetate ion

42. What is neutralization?
    A. an acid-base reaction that does not include dissocation 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 OH^- in pure water?
    A. 10^{-7} M
    B. 0.7 M
    C. 55.4 M
    D. 10^7 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. Which of the following is a measure of the disorder in a system?
    A. entropy
    B. enthalpy
   C. free energy
    D. temperature

48. Which of the following substances has the highest entropy?
   A. steam
   B. ice water
   C. liquid water
   D. crushed ice

49. 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
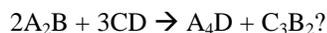
   $2A_2B + 3CD \rightarrow A_4D + C_3B_2$?

   A. $\dfrac{6[A_2B][CD]}{[A_4D][C_3B_2]}$

   C. $\dfrac{[A_2B]^2[CD]^3}{[A_4D][C_3B_2]}$

   B. $\dfrac{[A_4D][C_3B_2]}{6[A_2B][CD]}$

   D. $\dfrac{[A_4D][C_3B_2]}{[A_2B]^2[CD]^3}$

53. 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. 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. Which of the following are large molecules made of many small units joined by organic reactions?
   A. monomers
   B. copolymers
   C. polymers
   D. linear polymers

57. How many protons and neutrons does Neon-20 have
   A. 2 neutrons and 10 protons
   B. 20 neutrons and 20 protons
   C. 20 neutrons and 10 protons
   D. 10 neutrons and 10 protons

58. Which of the following elements has 60 neutrons
    A. *Silver-107*   C. *Sodium-22*
    B. *Silver-108*   D. *Carbon-12*

59. What do all organic compounds contain?
    A. calcium   C. oxygen
    B. water   D. carbon

60. Use these graphs for the following question:

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

61. What is the temperature of STP
    A. 273K   C. 0K
    B. 273°C   D. 25°C

62. If 0.500 L of 0.0250M aqueous potassium hydroxide is made, what mass of potassium hydroxide is needed?
    A. 0.0500g   C. 0.701g
    B. 0.0125g   D. 2.81g

63. What is produced when you react a strong acid with a strong base?
    A. salt   C. Water and salt
    B. water   D. carbon

64. What 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?
    A. 100mL   C. 300mL
    B. 200mL   D. 400mL

65. How many neutrons are in tin-118
   A. 68   C. 50
   B. 65   D. 58

66. Calculate the molar mass of CH_3Br.
   A. 94.9g   C. 97.9g
   B. 94.9g/mole   D. 97.9g/mole

67. How many electrons does As^{3-} have?
   A. 6   C. 34
   B. 32   D. 36

68. What is the volume of 2.7 moles of argon gas at STP?
   A. 2.7L   C. 0.12L
   B. 60L   D. 8.3L

69. $11.2^{\circ}C$ expressed in the Kelvin temperature scale is
   A. 284.2K   C. -261.8K
   B. 274.2K   D. 273K

70. As the temperature of a closed system decreases, what happens to the gas pressure inside the system?
   A. increase   C. Decrease
   B. Remains constant   D. Becomes a sock

71. Calculate the pressure 3.4 moles of helium gas exerts at $13^{\circ}C$ in a 5.6 L container.
   A. 65.62 atm   C. 14.25 atm
   B. 0.65 atm   D. 1443.67 atm

72. A catalyst works by
   A. Decreasing the activation energy   C. Changes the reaction
   B. Increasing the activation energy   D. Decreasing the potential energy

73. Which of the following is the temperature at which all particle motion stops?
   A. 273K   C. $0^{\circ}C$
   B. $273^{\circ}C$ D. $-273^{\circ}C$

74. Calculate the thermal energy needed to heat 1000 g of water from $15^{\circ}C$ to $38^{\circ}C$? ($C = 4.18J/g*^{\circ}C$)
   A. 23000 J   C. 1237280 J
   B. 96140 J   D. 1731900 J

75. Which of the following is TRUE about the following reaction?
$$Pb^{2+} + K \rightarrow Pb + K^{+}$$
   A. Pb is the anode   C. Both A and C
   B. K is the anode   D. Neither A or C

76. What is the molar mass of H_2O
   A. 18g/mole   C. 2g
   B. 16g/mole   D. 18g

77. $2NaCl + 3O_2 \leftrightarrow 2NaClO_3 + Heat$
What happens to the equilibrium reaction above if you add oxygen gas
   A. Shifts to the left   C. Oxygen is produced
   B. Shifts to the right   D. The reaction stops

78. What element below has a molar mass of 16g/mole?
   A. calcium
   B. water
   C. oxygen
   D. carbon

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

80. What is your favorite class this year?
   A. Chemistry
   B. Study of compounds
   C. The class where we studied the periodic table
   D. Mr. Schnell's class

Answer Section

TRUE/FALSE

	A	B
1.	F	6
2.	F	7
3.	F	8
4.	F	9
5.	T	10
6.	F	1
7.	T	2
8.	T	3
9.	T	4
10.	F	5

MULTIPLE CHOICE

11.	D	41
12.	C	42
13.	A	43
14.	B	44
15.	A	45
16.	D	46
17.	D	47
18.	C	48
19.	D	49
20.	D	50
21.	B	51
22.	A	52
23.	A	53
24.	C	54
25.	D	55
26.	A	56
27.	B	57
28.	D	58
29.	C	59
30.	A	60
31.	A	61
32.	D	62
33.	A	63
34.	C	64
35.	A	65
36.	D	66
37.	B	67

38.	B	68
39.	B	69
40.	B	70
41.	C	71
42.	C	72
43.	A	73
44.	B	74
45.	D	75
46.	C	76
47.	A	77
48.	A	78
49.	C	79
50.	C	11
51.	C	12
52.	D	13
53.	C	14
54.	B	15
55.	B	16
56.	C	17
57.	D	18
58.	A	19
59.	D	20
60.	B	21
61.	A	22
62.	C	23
63.	C	24
64.	B	25
65.	A	26
66.	B	27
67.	D	28
68.	B	29
69.	A	30
70.	C	31
71.	C	32
72.	A	33
73.	D	34
74.	B	35
75.	B	36
76.	A	37
77.	B	38
78.	C	39
79.	A	40
80.	ABCD	