Honors
Review for MC for Final

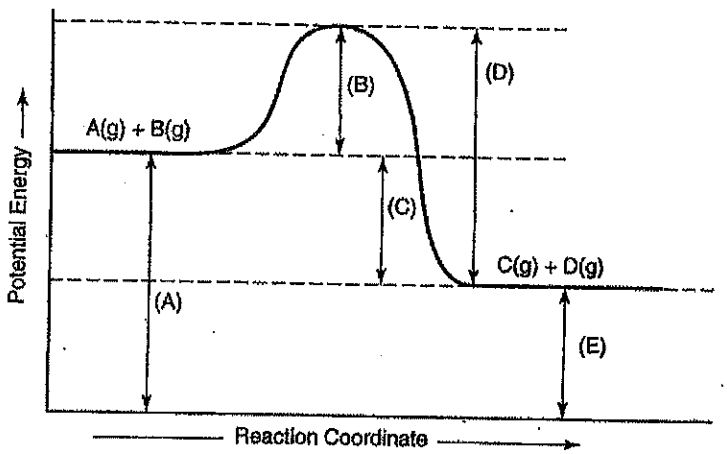
Practice Test 3

Note: For all questions involving solutions and/or chemical equations, assume that the system is in water unless otherwise stated.

Part A

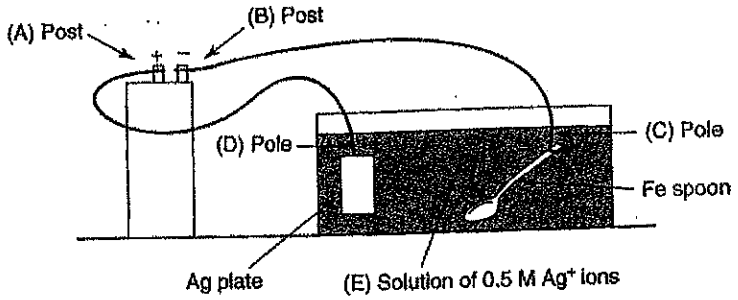
Directions: Each set of lettered choices below refers to the numbered statements or formulas immediately following it. Select the one lettered choice that best fits each statement or formula and then fill in the corresponding oval on the answer sheet. A choice may be used once, more than once, or not at all in each set.

Questions 1–4 refer to the following diagram:



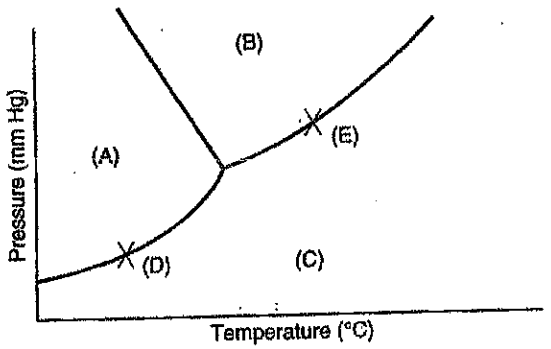
1. The activation energy of the forward reaction
2. The activation energy of the reverse reaction
3. The heat of the reaction for the forward reaction
4. The potential energy of the reactants

Questions 5–7 refer to the following diagram:



5. To plate silver on the spoon, the position to which the wire from the spoon must be connected
6. The position of the anode
7. The position from which silver that is plated out emerges

Questions 8–11 refer to the following graph:



8. The solid area
9. The liquid area
10. The gaseous area
11. The area that can have both liquid and gas

Questions 12–14

(A) 1
(B) 2
(C) 3
(D) 4
(E) 5

12. When the following equation: $Cu + HNO_3 \rightarrow Cu(NO_3)_2 + H_2O + NO$ is balanced, the coefficient, in the lowest whole number, of Cu
13. If 6 moles of Cu reacted according to the above *balanced* equation, the number of moles of NO that would be formed
14. If $Cu(NO_3)_2$ goes into solution as ions, the number of ions into which it will dissociate

Questions 15–18

(A) Ionic substance
(B) Polar covalent substance
(C) Nonpolar covalent substance
(D) Amorphous substance
(E) Metallic network

15. KCl
16. HCl(g)
17. CH_4
18. Li

Questions 19–23

(A) Brownian movement
(B) Litmus paper reaction
(C) Phenolphthalein reaction
(D) Dehydration
(E) Deliquescent

19. The reason why a blue crystal of $CuSO_4 \cdot 5H_2O$ turns white when heated
20. The zigzag path of colloidal particles in light
21. The pink color in a basic solution
22. The pink color in an acid solution
23. The adsorbtion of water to the surface of a crystal

Part B

ON THE ACTUAL CHEMISTRY TEST, THE FOLLOWING TYPE OF QUESTION MUST BE ANSWERED ON A SPECIAL SECTION (LABELED "CHEMISTRY") AT THE LOWER LEFT-HAND CORNER OF PAGE 2 OF YOUR ANSWER SHEET. THESE QUESTIONS WILL BE NUMBERED BEGINNING WITH 101 AND MUST BE ANSWERED ACCORDING TO THE FOLLOWING DIRECTIONS.

Directions: Each question below consists of two statements, I in the left-hand column and II in the right-hand column. For each question, determine whether statement I is true or false and if statement II is true or false and fill in the corresponding T or F ovals on your answer sheet. Fill in oval CE only if statement II is a correct explanation of statement I.

Sample Answer Grid:

CHEMISTRY * Fill in oval CE only if II is a correct explanation of I.

	I		II		CE*
101.	(T)	(F)	(T)	(F)	◯

101. Elements in the upper right corner of the periodic table are active nonmetals
BECAUSE nonmetals have larger ionic radii than their atomic radii.

102. A synthesis reaction that is nonspontaneous and has a negative value for the heat of formation will not occur until some heat is added
BECAUSE nonspontaneous exothermic reactions need enough activation energy to get them started.

103. Transition elements in a particular period often have the same oxidation number

BECAUSE they have a complete outer energy level.

104. When a crystal is added to a supersaturated solution of itself, the crystal does not change

BECAUSE the supersaturated solution is holding more solute than its normal solubility.

105. Equilibrium is a static condition

BECAUSE at equilibrium, the forward reaction rate equals the reverse reaction rate.

106. The ionic bond is the strongest bond

BECAUSE ionic bonds have electrostatic attraction due to the loss and gain of electron(s).

107. Pressure applied to a gaseous system in equilibrium favors the forward reaction

BECAUSE the product side of an equilibrium would show an increase in gas pressure.

108. If the forward reaction of an equilibrium is exothermic, adding heat to the system favors the reverse reaction

BECAUSE additional heat causes a stress on the system, and the system moves in the direction that releases the stress.

109. An element that has an electron configuration of $1s^2$, $2s^2$, $3s^2$, $3p^6$, $3d^8$, $4s^2$ is a transition element

BECAUSE the transition elements from scandium to zinc are filling the $3d$ orbitals.

110. The most electronegative elements in the periodic chart are found among nonmetals

BECAUSE electronegativity is a measure of the ability of an atom to draw valence electrons to itself.

111. Basic anhydrides react in water to form bases

BECAUSE metallic oxides react with water to form solutions that have an excess of hydroxide ions.

112. There are 3 moles of atoms in 18 grams of water

BECAUSE there are 6×10^{23} atoms in 1 mole.

113. Benzene is a good electrolyte

BECAUSE a good electrolyte has charged ions that carry the electric current.

114. Normal butyl alcohol and 2-butanol are isomers

BECAUSE isomers vary in the number of neutrons in the nucleus of the atom.

115. The reaction of $CaCO_3$ and HCl goes to completion

BECAUSE reactions that form a precipitate go to completion.

116. A large number of alpha particles were deflected in the Rutherford experiment

BECAUSE alpha particles that came close to the nucleus of the gold atom were deflected.

Part C

Directions: Each of the questions or incomplete statements below is followed by five suggested answers or completions. Select the one that is best in each case and then fill in the corresponding oval on the answer sheet.

40. What are the simplest whole-number coefficients that balance this equation?

____ $\ldots C_4H_{10} + \ldots O_2 \rightarrow \ldots CO_2 + \ldots H_2O$

(A) 1, 6, 4, 2
(B) 2, 13, 8, 10
(C) 1, 6, 1, 5
(D) 3, 10, 16, 20
(E) 4, 26, 16, 20

41. How many atoms are present in the formula $KAl(SO_4)_2$?

____ (A) 7
(B) 9
(C) 11
(D) 12
(E) 13

42. All of the following are compounds EXCEPT

____ (A) copper sulfate
(B) carbon dioxide
(C) washing soda
(D) air
(E) lime

43. What volume of gas, in liters, would 1.5 moles of hydrogen occupy at STP?

____ (A) 11.2
(B) 22.4
(C) 33.6
(D) 44.8
(E) 67.2

44. What is the maximum number of electrons held in the *d* orbitals?

____ (A) 2
(B) 6
(C) 8
(D) 10
(E) 14

45. If an element has an atomic number of 11, it will combine most readily with an element that has an atomic configuration of

____ (A) $1s^2, 2s^2, 2p^6, 3s^2, 3p^1$
(B) $1s^2, 2s^2, 2p^6, 3s^2, 3p^2$
(C) $1s^2, 2s^2, 2p^6, 3s^2, 3p^3$
(D) $1s^2, 2s^2, 2p^6, 3s^2, 3p^4$
(E) $1s^2, 2s^2, 2p^6, 3s^2, 3p^5$

46. An example of a physical property is
(A) rusting
(B) decay
(C) souring
(D) low melting point
(E) high heat of formation

47. A gas at STP that contains 6.02×10^{23} atoms and forms diatomic molecules will occupy
(A) 11.2 L
(B) 22.4 L
(C) 33.6 L
(D) 67.2 L
(E) 1.06 qt

48. When excited electrons cascade to lower energy levels in an atom,
(A) visible light is always emitted
(B) the potential energy of the atom increases
(C) the electrons always fall back to the first energy level
(D) the electrons fall indiscriminately to all levels
(E) the electrons fall back to the lowest unfilled energy level

49. The spectroscope uses the concept that
(A) charged particles are evenly deflected in a magnetic field
(B) charged particles are deflected in a magnetic field inversely to the mass of the particles
(C) particles of heavier mass are deflected in a magnetic field to a greater degree than lighter particles
(D) particles are evenly deflected in a magnetic field

50. The bond that includes an upper and a lower sharing of electron orbitals is called
(A) a pi bond
(B) a sigma bond
(C) a hydrogen bond
(D) a covalent bond
(E) an ionic bond

51. What is the boiling point of water at the top of Pike's Peak?
(A) It is 100°C.
(B) It is > 100°C since the pressure is less than at ground level.
(C) It is < 100°C since the pressure is less than at ground level.
(D) It is > 100°C since the pressure is greater than at ground level.
(E) It is < 100°C since the pressure is greater than at ground level.

52. The atomic structure of the alkane series contains the hybrid orbitals designated as
(A) sp
(B) sp^2
(C) sp^3
(D) sp^3d^2
(E) sp^4d^3

53. Which of the following is (are) true for this reaction?

$Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2 \uparrow$

I. It is an oxidation-reduction reaction.
II. Copper is oxidized.
III. The oxidation number of nitrogen goes from +5 to +4.

(A) I only
(B) III only
(C) I and II only
(D) II and III only
(E) I, II, and III

54. Which of the following properties can be attributed to water?

I. It has a permanent dipole moment attributed to its molecular structure.
II. It is a very good conductor of electricity.
III. It has its polar covalent bonds with hydrogen on opposite sides of the oxygen atom, so that the molecule is linear.

(A) I only
(B) III only
(C) I and II only
(D) II and III only
(E) I, II, and III

55. Which of the following define(s) an acid according to conventional acid theories?

I. It is a good proton donor.
II. It is a good electron pair acceptor.
III. It has an excess of H_3O^+ in solution.

(A) I only
(B) III only
(C) I and II only
(D) II and III only
(E) I, II, and III

56. A nuclear reactor must include which of the following parts?

I. Electric generator
II. Fissionable fuel elements
III. Moderator

(A) I only
(B) III only
(C) I and II only
(D) II and III only
(E) I, II, and III

57. Which of the following salts will hydrolyze in water to form basic solutions?

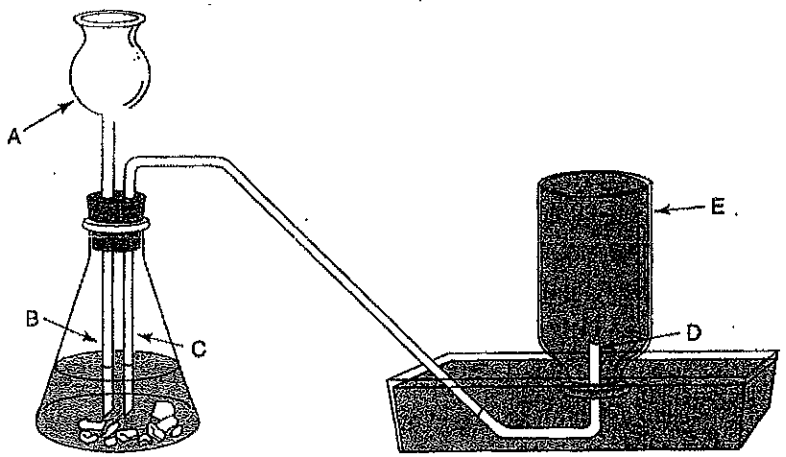
I. NaCl
II. $CuSO_4$
III. K_3PO_4

(A) I only
(B) III only
(C) I and II only
(D) II and III only
(E) I, II, and III

58. When 1 mole of NaCl is dissolved in 1,000 grams of water, the boiling point of the water is changed to
(A) 100.51°C
(B) 101.02°C
(C) 101.53°C
(D) 101.86°C
(E) 103.62°C

59. What is the structure associated with the BF_3 molecule?
(A) linear
(B) trigonal planar
(C) tetrahedron
(D) trigonal pyramidal
(E) bent or V-shaped

Questions 60 and 61 refer to the following setup:



60. What letter designates an error in this laboratory setup?
(A) A
(B) B
(C) C
(D) D
(E) E

61. If the reaction in question 60 created a gas, where would the contents of the flask be expelled under these conditions?
(A) A
(B) B
(C) C
(D) D
(E) E

62. The most active nonmetal has
(A) a high electronegativity
(B) a low electronegativity
(C) a medium electronegativity
(D) large atomic radii
(E) a deliquescent property

63. In the reaction $Fe + 2S \rightarrow FeS_2$, which is true?

(A) $Fe^0 + 2e^- \rightarrow Fe^{2+}$
(B) $Fe^0 \rightarrow Fe^{2+} + 2e^-$
(C) $Fe^{2+} \rightarrow Fe^0 + 2e^-$
(D) $S^0 \rightarrow S^{2-} + 2e^-$
(E) $S^{-2} + 2e^- \rightarrow S^0$

64. What is the pH of a solution with a hydroxide ion concentration of 0.00001 mole/liter?

(A) −5
(B) −1
(C) 5
(D) 9
(E) 14

65. Electrolysis of a dilute solution of sodium chloride results in the cathode product

(A) sodium
(B) hydrogen
(C) chlorine
(D) oxygen
(E) peroxide

66. $.....C_2H_4(g) + ...O_2(g) \rightarrow .....CO_2(g) + ...H_2O(\ell)$

If the equation for the above reaction is balanced with whole-number coefficients, what is the coefficient for oxygen gas?

(A) 1
(B) 2
(C) 3
(D) 4
(E) 5

67. Five liters of gas at STP have a mass of 12.5 grams. What is the molar mass of the gas?

(A) 12.5 g/mol
(B) 25.0 g/mol
(C) 47.5 g/mol
(D) 56.0 g/mol
(E) 125 g/mol

68. A compound whose molecular mass is 90 grams contains 40.0% carbon, 6.67% hydrogen, and 53.33% oxygen. What is the true formula of the compound?

(A) $C_2H_2O_4$
(B) CH_2O_4
(C) C_3H_6O
(D) C_3HO_3
(E) $C_3H_6O_3$

69. How many moles of CaO are needed to react with an excess of water to form 370 grams of calcium hydroxide?

(A) 1
(B) 2
(C) 3
(D) 4
(E) 5

70. To what volume, in milliliters, must 50.0 milliliters of 3.50 M H_2SO_4 be diluted in order to make 2 M H_2SO_4?

(A) 25
(B) 60.1
(C) 87.5
(D) 93.2
(E) 101

71. A small value of K_{eq} indicates that equilibrium occurs

(A) at a low product concentration
(B) at a high product concentration
(C) after considerable time
(D) with the help of a catalyst
(E) with no forward reaction

72. A student measured 10.0 milliliters of an HCl solution into a beaker and titrated it with a standard NaOH solution that was 0.09 M. The initial NaOH burette reading was 34.7 milliliters while the final reading showed 49.2 milliliters.

What is the molarity of the HCl solution?

(A) 0.13
(B) 0.47
(C) 4.7
(D) 14.5
(E) 36.5

73. A student made the following observations in the laboratory:

(a) Sodium metal reacted vigorously with water while a strip of magnesium did not seem to react at all.
(b) The magnesium strip reacted with dilute hydrochloric acid faster than an iron strip.
(c) A copper rivet suspended in silver nitrate solution was covered with silver-colored stalactites in several days, and the resulting solution had a blue color.
(d) Iron filings dropped into the blue solution were coated with an orange color.

The order of *decreasing* strength as reducing agents is:

(A) Na, Mg, Fe, Ag, Cu
(B) Mg, Na, Fe, Cu, Ag
(C) Ag, Cu, Fe, Mg, Na
(D) Na, Fe, Mg, Cu, Ag
(E) Na, Mg, Fe, Cu, Ag

74. A student placed water, sodium chloride, potassium dichromate, sand, chalk, and hydrogen sulfide into a distilling flask and proceeded to distill. What ingredient besides water would be found in the distillate?

(A) sodium chloride
(B) chalk
(C) sand
(D) hydrogen sulfide
(E) chrome sulfate

75. Which of these statements is NOT correct?
(A) In an exothermic reaction, ΔH is negative and the enthalpy decreases.
(B) In an endothermic reaction, ΔH is positive and the enthalpy increases.
(C) In a reaction where ΔG is negative, the forward reaction is spontaneous.
(D) In a reaction where ΔG is positive, ΔS may also be positive.
(E) In a reaction where ΔH is positive and ΔS is negative, the forward reaction is spontaneous.

76. A student filled a steam-jacketed eudiometer with 32 milliliters of oxygen and 4 milliliters of hydrogen over mercury. How much of which gas would be left uncombined after the mixture was sparked?
(A) none of either
(B) 3 mL H_2
(C) 24 mL O_2
(D) 28 mL O_2
(E) 30 mL O_2

77. What would be the *total* volume, in milliliters, of gases in question 76 after sparking?
(A) 16
(B) 24
(C) 34
(D) 36
(E) 40

78. How can the addition of a catalyst affect an exothermic reaction?
I. Speed up the reaction.
II. Slow down the reaction.
III. Increase the amount of product formed.
(A) I only
(B) II only
(C) I and II only
(D) II and III only
(E) I, II, and III

79. In which period is the most electronegative element found?
(A) 1
(B) 2
(C) 3
(D) 4
(E) 5

80. What could be the equilibrium constant for this reaction: $aA + bB \rightleftharpoons cC + dD$, if A and D are solids?
(A) $\frac{[C]^c[D]^d}{[A]^a[B]^b}$
(B) $\frac{[A]^a[B]^b}{[C]^c[D]^d}$
(C) $\frac{[C]^c}{[B]^b}$
(D) $\frac{[C]^c[D]^d}{[A]^a}$
(E) $[A]^a[B]^b[C]^c[D]^d$

81. Which of the following does NOT react with a dilute solution of sulfuric acid?
(A) $NaNo_3$
(B) Na_2S
(C) Na_3PO_4
(D) Na_2CO_3
(E) NaOH

82. Which of these statements is the best explanation for the sp^3 hybridization of carbon electrons?
(A) The new orbitals are one *s* orbital and three *p* orbitals.
(B) The *s* electron is promoted to the *p* orbitals.
(C) The *s* orbital is deformed into a *p* orbital.
(D) Four new and equivalent orbitals are formed.
(E) The *s* orbital electron loses energy to fall back into a partially filled *p* orbital.

83. The bonding that is most significant in explaining the variation of the boiling point of water from the boiling points of similarly structured molecules is
(A) hydrogen bonding
(B) van der Waals forces
(C) covalent bonding
(D) ionic bonding
(E) coordinate covalent bonding

84. If *K* for the reaction $H_2 + I_2 \rightleftharpoons 2HI$ is equal to 45.9 at 450°C, and 1 mole of H_2 and 1 mole of I_2 are introduced into a 1-liter box at that temperature, what will be the expression for *K* at equilibrium?
(A) $\frac{[x^2]^2}{[1-x][1-x]}$
(B) $\frac{[2x]^2}{[1-x][1-x]}$
(C) $\frac{[2x]^2}{[x][x]}$
(D) $\frac{[1-x][1-x]}{[2x]^2}$
(E) $\frac{[1-x][1-x]}{[x^2]^2}$

85. What is the molar mass of a nonionizing solid if 10 grams of this solid, dissolved in 200 grams of water, formed a solution that froze at –3.72°C?
(A) 25 g/mol
(B) 50 g/mol
(C) 100 g/mol
(D) 150 g/mol
(E) 1,000 g/mol

STOP

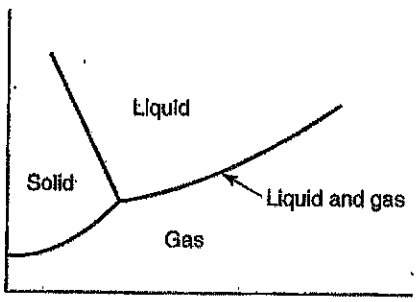
IF YOU FINISH BEFORE ONE HOUR IS UP, YOU MAY GO BACK TO CHECK YOUR WORK OR COMPLETE UNANSWERED QUESTIONS.

Answers and Explanations for Test 3

1. (B) The activation energy of the forward reaction is the energy needed to begin the reaction.
2. (D) For the reverse reaction to occur, activation energy equal to the sum of (B) + (C) is needed. This is shown by (D).
3. (C) The heat of the reaction is the heat liberated between the level of potential energy of the reactants and that of the products. This is quantity (C) on the diagram.
4. (A) The potential energy of the reactants is the total of the original potential energies of the reactants shown by (A).
5. (B) The spoon must be made the cathode to attract the Ag^+ ions.
6. (D) The silver plate is the anode.
7. (E) The solution of Ag^+ provides the silver for plating.

8. (A)
9. (B)
10. (C)

In a phase diagram, the zones are as shown below.



11. (E) The boundry of liquid and gas is shown on the diagram.

12–14. The balanced equations with half-reactions are as follows:

12. (C)

$$3Cu^0 \rightarrow 3Cu^{2+} + 2e^-$$

$$2NO_3^- + 8H^+ + 3e^- \rightarrow 2NO + 4H_2O$$

$$3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 4H_2O + 2NO$$

13. (D) The coefficients show that 3 mol of Cu produces 2 mol of NO, so 6 mol of Cu produces 4 mol of NO.

14. (C) The expression $Cu(NO_3)_2 \rightarrow Cu^{2+} + 2NO_3^-$ shows that the dissociation yields 3 ions.

15. (A) KCl is ionic because it is the product of a very active metal combining with a very active nonmetal.

16. (B) The electronegativity difference between H and Cl is between 0.5 and 1.7. This indicates an unequal sharing of electrons, which results in a polar covalent bond.

17. (C) Because the polar bonds are symmetrically arranged in the methane molecule, the molecule is nonpolar covalent.

18. (E) Lithium (Li) is a metal.

19. (D) When hydrated copper sulfate is heated, the crystal crumples as the water is forced out of the structure, and a white powder is the result.

20. (A) Brownian movement is due to molecular collisions with colloidal particles, which knock the particles about in a zigzag path noted by the reflected light from these particles.

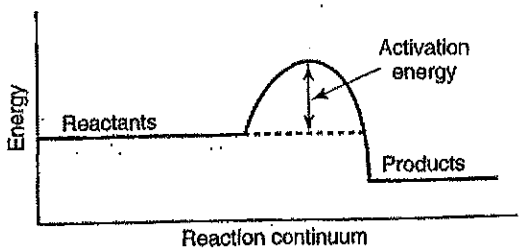
21. (C) The indicator phenolphthalein turns pink in a basic solution.

22. (B) Litmus paper turns pink in an acid solution.

23. (E) A substance that is deliquescent, such as a crystal, draws water to its surface. At times it can draw enough water to form a water solution.

101. (T, T) The assertion is true because the nonmetals have a tendency to gain electrons readily. The reason is a true statement but does not explain the assertion.

102. (T, T, CE) The assertion is explained by the reason. The graphic display of this is:



103. (T, F) The assertion is true but the reasoning is false. Transition elements have incomplete inner energy levels that are being filled with the additional electrons, thus leaving the outer energy level the same in most cases. As a result, these elements have common oxidation numbers.

104. (F, T) The assertion is false and the reason is true. A supersaturated solution is holding more than its normal solubility, and the addition of a crystal causes crystallization to occur.

105. (F, T) Equilibrium is a dynamic condition because of the reason stated. The assertion is false; the reason, true.

106. (T, T, CE) Both statements are true, and the reason explains why ionic bonding is the strongest.

107. (F, F) An equilibrium system must have a gaseous reactant or product for pressure to affect the equilibrium. Then increased pressure will cause the reaction to go in the direction that reduces the concentration of gaseous substances.

108. (T, T, CE) The assertion is explained by the reason; both are true.

109. (T, T, CE) Both the assertion and the reason are true; they explain that the element's orbital designation places it in the first transition series of filling the 3*d* orbitals.

110. (T, T, CE) The assertion is true; the reason is true and explains why nonmetals have the highest electronegativity.

111. (T, T, CE) The assertion is explained by the reason; both are true.

112. (T, T) There are 3 moles of atoms in 18 g of water because 18 g is 1 mol of water molecules and each molecule has three atoms. The reason does not explain the assertion but is also true.

113. (F, T) Benzene is a nonionizing substance and therefore a nonelectrolyte. The reason is a true statement.

114. (T, F) Isomers have the same empirical formula but vary in their structural formulas.

115. (T, F) The reaction does go to completion, but a gaseous product is formed, not a precipitate. $2HCl + CaCO_3 \rightarrow CaCl_2 + H_2O + CO_2(g)$

116. (F, T) In the Rutherford experiment relatively few alpha particles were deflected, indicating a great deal of empty space in the atom. The reason is a true statement.

40. (B) The correct coefficients are 2, 13, 8, and 10.

41. (D) 1K + 1Al + 2S + 8O = 12 total

42. (D) Air is a mixture; all others are compounds. Washing soda (C) is sodium carbonate, and lime (E) is calcium oxide.

43. (C) One mole of a gas at STP occupies 22.4 L, so 1.5 mol × 22.4 L = 33.6 L.

44. (D) The maximum number of electrons in each kind of orbital is:

$s = 2$ in one orbital
$p = 6$ in three orbitals
$d = 10$ in five orbitals
$f = 14$ in seven orbitals

45. (E) The element with atomic number 11 is sodium with 1 electron in the 3*s* orbital. It would readily combine with the element that has $3p^5$ as the outer orbital since it needs only 1 more electron to fill it.

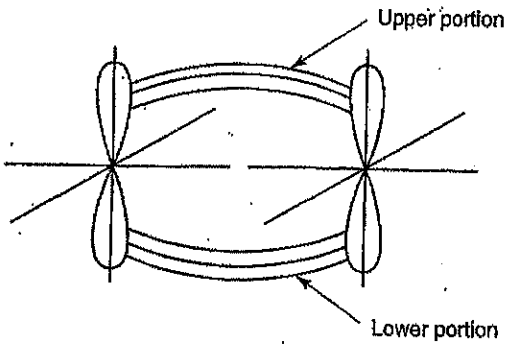
46. (D) The only physical property named in the list is low melting point.

47. (A) If the gas is diatomic, then 6.02×10^{23} atoms will form $6.02 \times 10^{23}/2$ molecules. At STP, 6.02×10^{23} molecules occupy 22.4 L, so half that number will occupy 11.2 L.

48. (E) Cascading excited electrons can fall only to the lowest energy level that is unfilled.

49. (B) The spectroscope uses a magnetic field to separate isotopes by bending their path. The lighter ones are bent farther than the heavier ones.

50. (A) The pi bond is a bond between two p orbitals, like this:



51. (C) At Pike's Peak (alt. approx. 14,000 ft) the pressure is lower than at ground level; therefore the vapor pressure at a lower temperature will equal the outside pressure and boiling will occur.

52. (C) The alkanes contain the sp^3 hybrid orbitals.

53. (E) I, II, and III are correct.

54. (A) Only I is correct.

55. (E) I, II, and III are acid definitions.

56. (D) I is not necessary for the reactor, but often nuclear energy is used to operate an electric generator. The others, II and III, are necessary for fuel and neutron-speed control, respectively.

57. (B) III is a salt from a strong base and a weak acid, which hydrolyzes to form a basic solution with water.

58. (B) Since the boiling point is increased by 0.51°C for each mole of particles, 1 mol of $NaCl \rightarrow Na^+ + Cl^-$ gives 2 mol of particles. Therefore the boiling point will be 1.02° higher or 101.02°C.

59. (B) The VSEPR model shows BF_3 is trigonal planar and so is related to the triangle shape on one plane.

60. (C) The delivery tube is below the fluid level in the flask and will cause liquid to be forced up the thistle tube when gas is evolved in the reaction.

61. (A) At first the fluid will be expelled up the thistle tube by the gas generated and exerting pressure in the reaction flask. When the level of the fluid falls below the end of the thistle tube, the gas will then be released through the thistle tube.

62. (A) The most active nonmetal has a high attraction for another electron—thus high electronegativity.

63. (B) Fe loses electrons to form the Fe^{2+} ion.

64. (D) The K_w of water = $[H^+][OH^-] = 10^{-14}$. If $[OH^-] = 10^{-5}$ mol/L, then $[H^+] = 10^{-14}/10^{-5} = 10^{-9}$

$pH = -\log [H^+]$ (by definition)

$pH = -[-9]$

$pH = 9$

65. (B) When dilute NaCl solution is electrolyzed, hydrogen is given off at the cathode, chlorine is given off at the anode, and sodium hydroxide is left in the container.

66. (C) The correctly balanced equation is

$$C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(\ell)$$

67. (D) One mole of a gas at STP occupies 22.4 L.

If $\frac{5\text{ L}}{12.5\text{ g}}$, then

$$\frac{22.4\text{ L}}{\text{gram-molecular mass}}$$

$$\frac{5\text{ L}}{12.5\text{ g}} = \frac{22.4\text{ L}}{x\text{ g}}$$

$x = 56.0$ g/mol

68. (E) To find the simple or empirical formula, divide each % by the element's atomic mass.

Carbon

$40 \div 12 = 3.333$

Hydrogen

$6.67 \div 1 = 6.67$

Oxygen

$53.33 \div 16 = 3.33$

Next, divide each quotient by the smallest quotient in an attempt to get small whole numbers.

$3.33 \div 3.33 = 1$ C

$6.67 \div 3.33 = 2$ H

$3.33 \div 3.33 = 1$ O

The simplest formula is CH_2O, which has a molecular mass of 30. The true molecular mass is given as 90, which is three times the simplest. Therefore the true formula is $C_3H_6O_3$.

69. (E) The reaction is

$$CaO + H_2O \xrightarrow{370\text{ g}} Ca(OH)_2$$

$Ca(OH)_2$ molecular mass = 74

370 g ÷ 74 = 5 mol of $Ca(OH)_2$ wanted. The reaction shows 1 mol of CaO produces 1 mol of $Ca(OH)_2$, so the answer is 5 mol.

70. (C) In dilution problems, this formula can be used:
$M_{before} \times V_{before} = M_{after} \times V_{after}$
Substituting gives:
$3.5 \times 50 = 2 \times (?x)$
$x = 87.5$ mL, new volume after dilution

71. (A) For K_{eq} to be small, the numerator, which is made up of the concentration(s) of the product(s) at equilibrium, must be smaller than the denominator. This generally means that equilibrium is reached rather rapidly.

72. (A) The amount of NaOH used is
$49.2 - 34.7 = 14.5$ mL
Using $M_1 \times V_1 = M_2 \times V_2$ gives
$0.09\ M \times 14.5\ mL = M_2 \times 10\ mL$
$M_2 = 0.13\ M$

73. (E) The reactions recorded indicated that the ease of losing electrons is greater in sodium than magnesium, greater in magnesium than iron, greater in iron than copper, and finally greater in copper than silver.

74. (D) Distillation removes only dissolved solids from the distillate. The volatile gases, such as H_2S, will be carried into the distillate.

75. (E) All the first four statements are correct.
The Gibbs free-energy equation is:
$\Delta G = \Delta H - T\Delta S$
In choice (E), if ΔH is positive and ΔS is negative, then ΔG will definitely be positive, which means that the forward reaction will not occur spontaneously.

76. (E) H_2 to O_2 ratio by volume is 2 : 1 in the formation of water. Therefore, 4 mL H_2 will react with 2 mL of O_2 to make 4 mL of steam.
$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$
This leaves 30 mL of O_2 uncombined.

77. (C) There will be 30 mL of O_2 + 4 mL of steam = 34 mL total.

78. (C) By definition, a catalyst can be used to speed up or slow down a reaction, so I and II are correct.

79. (B) The most electronegative element is fluorine (F), found in period 2.

80. (C) Solids are incorporated into the K value and therefore do not appear on the right side of the equation.

81. (A) Only $NaNO_3$ will not react because it requires heat to react.

82. (D) When hybridization forms the sp^3 orbitals, four entirely new orbitals, different from but equivalent to the former s and p orbitals, result.

83. (A) Hydrogen bonding between water molecules causes the boiling point to be higher than would be expected.

84. (B) At the beginning of the reaction
$[H_2] = 1$ mol/L
$[I_2] = 1$ mol/L
$[HI] = 0$
At equilibrium
$(H_2 + I_2 \rightleftharpoons 2HI)$
(Let x = moles/liter of H_2 and I_2 in HI form)
$[H_2] = (1 - x)$ mol/L
$[I_2] = (1 - x)$ mol/L
$[HI] = 2x$ mol/L
Then, substituting the values above into the equation, you get:

$$K = \frac{[HI]^2}{[H_2][I_2]}$$

$$= \frac{[2x]^2}{[1-x][1-x]} = 45.9$$

85. (A) 10 g/200 g of water = 50 g/1,000 g of water (5 times as much)
The freezing point depression, 3.72°, is divided by 1.86°, which is the depression caused by 1 mol in 1,000 g of water, to find how many moles are dissolved.
3.72° ÷ 1.86° = 2 mol
If 50 g caused this depression and is equal to 2 mol, then 1 mol would be ½ of 50 g, or 25 g. So, the molar mass of the solid is 25 g/mol.

CALCULATING YOUR SCORE

Your score on Practice Test III can now be computed manually. The actual test will be scored by machine, but the same method is used to arrive at the raw score. You get one point for each correct answer. For each wrong answer, you lose one-fourth of a point. Questions that you omit or that have more than one answer are not counted. On your answer sheet mark all correct answers with a "C" and all incorrect answers with an "X".

Determining Your Raw Test Score

Total the number of correct answers you have recorded on your answer sheet. It should be the same as the total of all the numbers you place in the block in the lower left corner of each area of the Subject Area summary in the next section.

A. Enter the total number of correct answers here: _____
Now count the number of wrong answers you recorded on your answer sheet.
B. Enter the total number of wrong answers here: _____
Multiply the number of wrong answers in B by 0.25.
C. Enter that product here: _____
Subtract the result in C from the total number of right answers in A.
D. Enter the result of your subtraction here: _____
E. Round the result in D to the nearest whole number: _____. **This is your raw test score.**

Conversion of Raw Scores to Scaled Scores

Your raw score is converted by the College Board into a scaled score. The College Board scores range from 200 to 800. This conversion is done to ensure that a score earned on any edition of a particular SAT II: Chemistry test is comparable to the same scaled score earned on any other edition of the same test. Because some editions of the tests may be slightly easier or more difficult than others, scaled scores are adjusted so that they indicate the same level of performance regardless of the edition of the test taken and the ability of the group that takes it. Consequently, a specific raw score on one edition of a particular test will not necessarily translate to the same scaled score on another edition of the same test.

Since the practice tests in this book have no large population of scores with which they can be scaled, scaled scores cannot be determined.

Results from previous SAT II Chemistry tests appear to indicate that the conversion of raw scores to scaled scores GENERALLY follows this pattern:

Raw Score	*Scaled Score*	*Raw Score*	*Scaled Score*
85–75	800–800	30–25	560–540
75–70	800–780	25–20	540–520
70–65	780–750	20–15	520–490
65–60	750–720	15–10	490–460
60–55	720–700	10–5	460–430
55–50	700–680	5–0	430–410
50–45	680–650	0 to –5	410–380
45–40	650–620	–5 to –10	380–360
40–35	620–590	–10 to –15	360–330
35–30	590–560		

Note that this scale provides only a *general idea* of what a raw score may translate into on a scaled score range of 800–200. Scaling on every test is usually slightly different. Some students who have taken the SAT II: Chemistry after using this book have reported that they have scored slightly higher on the SAT II test than on the practice tests in this book. They *all* reported that preparing well for the test paid off in a better score!

DIAGNOSING YOUR NEEDS

After taking Practice Test 3, check your answers against the correct ones. Then fill in the chart below.

In the space under each question number, place a check if you answered that question correctly.

- **EXAMPLE:**

If your answer to question 5 was correct, place a check in the appropriate box.

Next, total the check marks for each section and insert the number in the designated block. Now do the arithmetic indicated and insert your percent for each area.

SUBJECT AREA	(✓) QUESTIONS ANSWERED CORRECTLY						
I. Atomic Theory and Structure, including periodic relationships	110	112	116	44	48	50	82
☐ No. of checks ÷ 7 × 100 = _____%							
II. Nuclear Reactions	49	56					
☐ No. of checks ÷ 2 × 100 = _____%							
III. Chemical Bonding and Molecular Structure	15	16	17	18	106	41	45	54	59	83
☐ No. of checks ÷ 10 × 100 = _____%										
IV. States of Matter and Kinetic Molecular Theory of Gases	8	9	10	11	43	47	51			
☐ No. of checks ÷ 7 × 100 = _____%										
V. Solutions, including concentration units, solubility, and colligative properties	19	20	104	58	70					
☐ No. of checks ÷ 5 × 100 = _____%										
VI. Acids and Bases	21	22	113	115	55	57	64			
☐ No. of checks ÷ 7 × 100 = _____%										
VII. Oxidation-Reduction and Electrochemistry	5	6	7	53	65	63				
☐ No. of checks ÷ 6 × 100 = _____%										

SUBJECT AREA	(✓) QUESTIONS ANSWERED CORRECTLY										
VIII. Stoichiometry	12	13	14	40	66	67	68	69	76	77	85
☐ No. of checks ÷ 11 × 100 = _____%											
IX. Reaction Rates										1	108
☐ No. of checks ÷ 2 × 100 = _____%											
X. Equilibrium									105	107	71	80	84
☐ No. of checks ÷ 5 × 100 = _____%													
XI. Thermodynamics: energy changes in chemical reactions, randomness, and criteria for spontaneity	2	3	4	102	75	78
☐ No. of checks ÷ 6 × 100 = _____%						
XII. Descriptive Chemistry: physical and chemical properties of elements and their familiar compounds; organic chemistry; periodic properties	23	101	103	109	111	114
	42	46	52	62	79	81
☐ No. of checks ÷ 12 × 100 = _____%						
XIII. Laboratory: equipment, procedures, observations, safety, calculations, and interpretation of results	60	61	72	73	74
☐ No. of checks ÷ 5 × 100 = _____%					

PLANNING YOUR STUDY

The percentages give you an idea of how you have done on the various major areas of the test. Because of the limited number of questions on some parts, these percentages may not be as reliable as the percentages for parts with larger numbers of questions. However, you should now have at least a rough idea of the areas in which you have done well and those in which you need more study.