

1987

CHEMISTRY TEST

2nd SAT II

KEY

Part A

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

Questions 1-4

- (A) Thermometer
- (B) Separatory funnel
- (C) Flame spectrophotometer
- (D) Burette
- (E) Volumetric flask

- C 1. Used to study the characteristic emission lines produced by excited atoms of elements
- e 2. Used for the preparation of solutions of specific concentrations when a solid is used as the solute
- B 3. Commonly used for removing the water layer from a system containing oil and water
- D 4. Used for volume measurements during titration

Questions 5-9

- (A) Linear
- (B) Bent (V-shaped)
- (C) Trigonal, planar
- (D) Pyramidal
- (E) Regular tetrahedral

From the list above, select the shape that describes each of the following.

- B 5. H₂O
- C 6. BI₃
- D 7. NH₃
- A 8. Br₂
- E 9. NH₄⁺

Questions 10-12

- (A) NaHCO₃
- (B) H₂SO₄
- (C) CH₄
- (D) Ca(OH)₂
- (E) C₃H₁₈

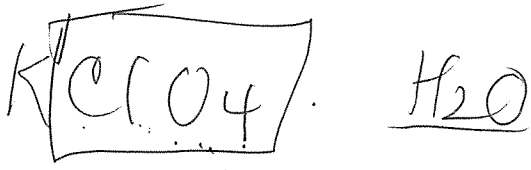
- A 10. A significant constituent of baking powders
- E 11. A constituent of gasoline
- C 12. A major constituent of natural gas

Questions 13-15

- (A) $3 O_2(g) = 2 O_3(g)$
- (B) $OH^- + H_3O^+ = 2 H_2O$
- (C) $BaCl_2 \cdot 2 H_2O(s) \xrightarrow{\Delta} BaCl_2(s) + 2 H_2O(g)$
- (D) $Ca^{2+} + CO_3^{2-} = CaCO_3(s)$
- (E) $Fe + Cu^{2+} = Fe^{2+} + Cu$

- E 13. Represents an oxidation-reduction reaction
- D 14. Involves the formation of an ionic precipitate from a solution
- B 15. Represents a Brønsted acid-base reaction

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Questions 16-19

- (A) 3d Transition metals.
- (B) Alkali metals
- (C) Halogens
- (D) Noble gases
- (E) Actinides

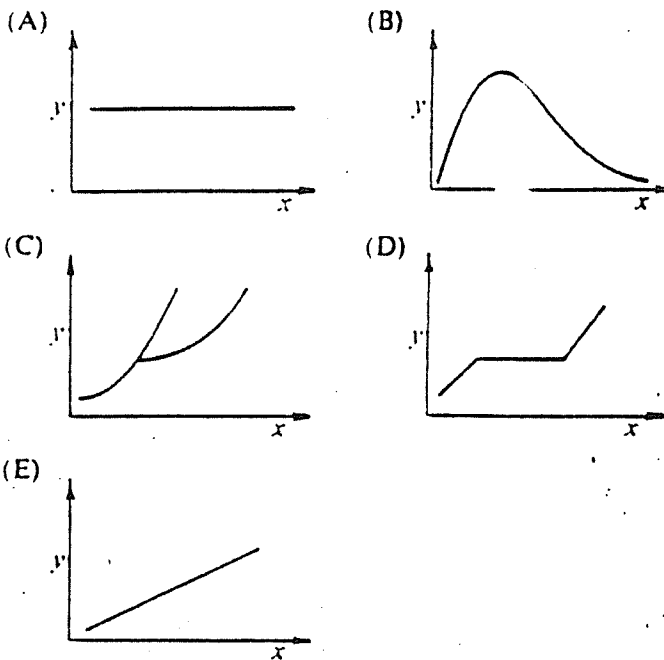
- B 16. Are the most readily oxidized elements within a given period
- D 17. Have the highest first ionization energies (potentials) of the elements in their respective rows of the periodic table
- E 18. Are all radioactive elements
- C 19. Are the most electronegative of the elements above

Questions 20-22 refer to the following dilute solutions.

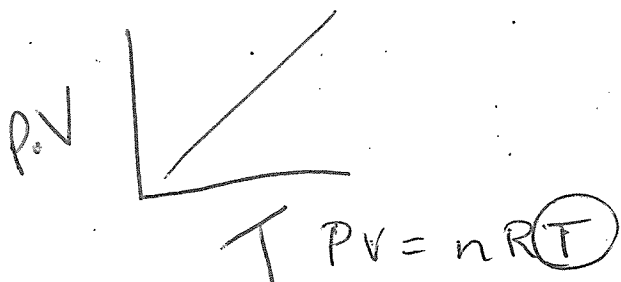
- (A) 0.010-molar HCl
- (B) 0.010-molar NaOH
- (C) 0.010-molar Ba(OH)₂
- (D) 0.010-molar H₂SO₄
- (E) 0.010-molar C₁₂H₂₂O₁₁ (cane sugar)

- D 20. Which of the above has the lowest pH?
- C 21. Which of the above has the highest concentration of OH⁻ ions?
- E 22. Which of the above has a freezing point closest to 0°C?

Questions 23-25



- E 23. Shows how a plot of the pressure-volume product y varies with absolute temperature x for 1 mole of an ideal gas
- D 24. Shows a plot of temperature y versus time x for the complete conversion, by uniform heating, of a pure liquid from below its boiling point to its vapor form above its boiling point
- B 25. Shows a plot of the fraction of molecules in a gas sample y versus kinetic energy x at a given temperature



Handwritten notes: $P.V = nRT$, $P.V = k$, $T = k/P.V$, $P.V = k/T$

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CHEMISTRY TEST—Continued

Part B

Directions: For each of the questions below, ONE or MORE of the responses given are correct. Decide which of the responses is (are) correct and on the answer sheet blacken space

- A if 1, 2, and 3 are correct;
- B if only 1 and 2 are correct;
- C if only 2 and 3 are correct;
- D if only 1 is correct;
- E if only 3 is correct.

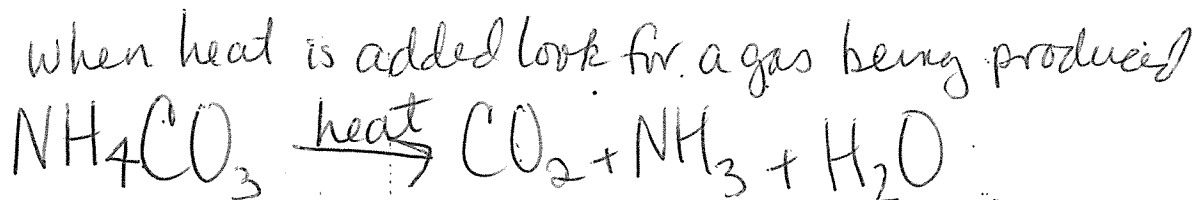
MARK ONE SPACE ONLY ON YOUR ANSWER SHEET FOR EACH QUESTION

<u>Directions Summarized</u>				
<u>(A)</u>	<u>(B)</u>	<u>(C)</u>	<u>(D)</u>	<u>(E)</u>
1, 2, 3	1, 2 only	2, 3 only	1 only	3 only

- B 26. $\text{CaCO}_3(s) \xrightarrow{\text{heat}}$
 Products resulting from the thermal decomposition of CaCO_3 indicated above include
 (1) CaO
 (2) CO₂
 (3) C
- E 27. A neutral atom, atomic number 33 and atomic mass 75, contains
 (1) 75 neutrons
 (2) 42 electrons
 (3) 33 protons
- E 28. When the temperature is increased, the speed of a chemical reaction usually increases because the
 (1) pressure has decreased
 (2) molecules collide less frequently
 (3) fraction of the molecules possessing the activation energy for the reaction increases
- C 29. When H_2S burns completely in oxygen, the products include
 (1) S
 (2) SO₂
 (3) H₂O
- E 30. A piece of zinc may be distinguished from a piece of magnesium by
 (1) determining which conducts electricity
 (2) determining which releases H_2 gas from a 1-molar hydrochloric acid solution
 (3) measuring the density of each
- D 31. Two 1-liter flasks contain hydrogen and oxygen, respectively, at the same temperature and pressure. It is true that the hydrogen and oxygen molecules have the same average
 (1) kinetic energy
 (2) mass
 (3) speed
- A 32. Molecules that involve both *s* and *p* orbital electrons in their bonding include which of the following? (Atomic numbers: H = 1, C = 6, N = 7, Cl = 17)
 (1) NH₃
 (2) CCl₄
 (3) HCl

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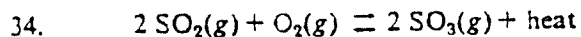
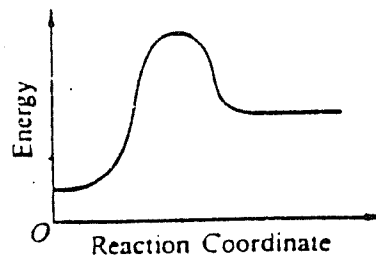


CHEMISTRY TEST—Continued

DIRECTIONS SUMMARIZED ON THE OPPOSITE PAGE.

33. Species that, in water, can function as both a Brønsted acid and a Brønsted base include which of the following?

- (1) HClO_4
- (2) HCO_3^-
- (3) HPO_4^{2-}

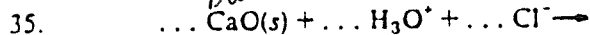


For the system above at equilibrium, increasing the temperature increases the number of moles of which of the following when equilibrium is reestablished?

- (1) $\text{SO}_3(g)$
- (2) $\text{O}_2(g)$
- (3) $\text{SO}_2(g)$

The diagram above shows how the potential energy changes as reactants are converted to products for a given reaction. From the diagram, it can be concluded that the

- (1) overall reaction is endothermic
- (2) activation energy of the forward reaction is greater than that for the reverse reaction
- (3) forward reaction is a more rapid reaction than the reverse reaction



Addition of solid calcium oxide to a solution of hydrochloric acid results in the formation of

- (1) Ca^{2+}
- (2) H_2O
- (3) H_2

The number of moles of CO_2 that can be dissolved in a liter of water increases when the

- (1) pressure of the CO_2 is increased
- (2) temperature of the water is increased
- (3) liquid is stirred

The SiCl_4 molecule is nonpolar and chlorine is more electronegative than silicon. From this information alone it can be deduced that the

- (1) silicon-chlorine bond is nonpolar
- (2) SiCl_4 molecule is planar
- (3) SiCl_4 molecule is symmetrical

$\text{H}^+ \text{ClO}_4^-$	HClO_4	ClO_4^-
H_2CO_3	HCO_3^-	CO_3^{2-}
$(\text{H}_2\text{PO}_4)^{1-}$	HPO_4^{2-}	PO_4^{3-}

Handwritten notes:
 - "incorrect" circled around H_2CO_3
 - "Given" written above the middle column
 - "period" written to the right of the table
 - "OK ✓" written next to H_2CO_3 and $(\text{H}_2\text{PO}_4)^{1-}$
 - PO_4^{3-} and H_2PO_4 written vertically to the right of the table

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CHEMISTRY TEST—Continued

Part C

Directions: Each question below consists of an assertion (statement) in the left-hand column and a reason in the right-hand column. On the appropriate line of the answer sheet blacken space

- A if both assertion and reason are true statements and the reason is a correct explanation of the assertion;
- B if both assertion and reason are true statements, but the reason is NOT a correct explanation of the assertion;
- C if the assertion is true, but the reason is a false statement;
- D if the assertion is false, but the reason is a true statement;
- E if both assertion and reason are false statements.

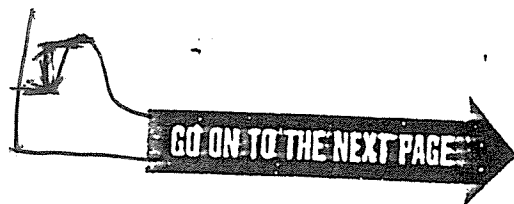
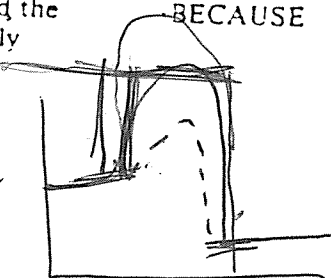
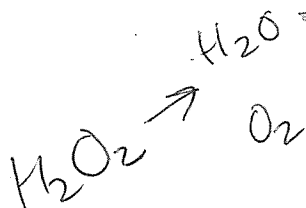
Directions Summarized

A - True	True	Reason is a <u>correct explanation</u>
B - True	True	Reason is <u>NOT</u> a <u>correct explanation</u>
C - True	False	
D - False	True	
E - False	False	

Assertion

Reason

- A 39. Element number 12 and element number 20 undergo similar chemical reactions BECAUSE element number 12 and element number 20 have similar valence electron configurations.
- C 40. The element carbon forms the basic structural framework of more compounds than any other element BECAUSE the carbon-carbon bond is ionic.
- A 41. The molecule CO₂ has a net dipole moment of zero BECAUSE the arrangement of atoms in the CO₂ molecule is linear and symmetrical, and the bond polarities within the molecule are canceled out.
- $O=C=O$
- C 42. A catalyst that increases the rate of a forward reaction also increases the rate of the reverse reaction BECAUSE the activation energy for a forward reaction is necessarily equal to that of the reverse reaction.
- A 43. The boiling temperature of water is lower at high elevations than at sea level BECAUSE the atmospheric pressure is lower at high elevations than at sea level.
- A 44. An element X with the electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^4$ can be expected to form a compound of the type H₂X BECAUSE two additional electrons fill the valence shell of an element with outer electronic configuration $3s^2 3p^4$.
- B 45. The heat of vaporization of water and the heat of fusion of water are numerically different BECAUSE when water freezes or vaporizes, its chemical composition remains unchanged.



GO ON TO THE NEXT PAGE →

CHEMISTRY TEST—Continued

DIRECTIONS SUMMARIZED ON THE OPPOSITE PAGE.

A-46. When a piece of Zn is dropped into 1.0-molar CuSO_4 solution, metallic Cu appears.

BECAUSE Zn is more readily oxidized than Cu is.

A 47. HCO_3^- can act as a Brønsted acid or a Brønsted base

BECAUSE HCO_3^- can donate a proton to form CO_3^{2-} or accept a proton to form H_2CO_3 .

B 48. At 25°C and 1 atmosphere pressure, H_2O is a liquid but H_2S is a gas.

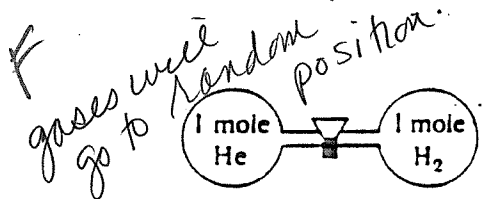
BECAUSE the molecular weight of H_2O is less than that of H_2S .

E 49. The equation $\text{Fe}^{2+} + \text{NO}_3^- + 4\text{H}^+ \rightleftharpoons \text{Fe}^{3+} + \text{NO} + 2\text{H}_2\text{O}$ is balanced

BECAUSE all the atoms and charges in the equation shown for this reaction are conserved.

D 50. ^{50}Ti and ^{50}Cr are isotopes of each other

BECAUSE atoms of ^{50}Ti and ^{50}Cr have the same mass number.

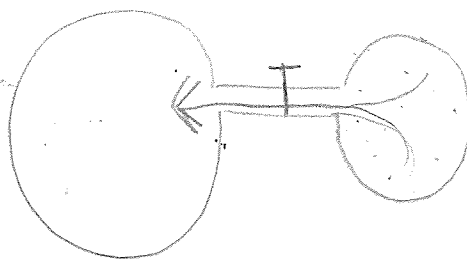
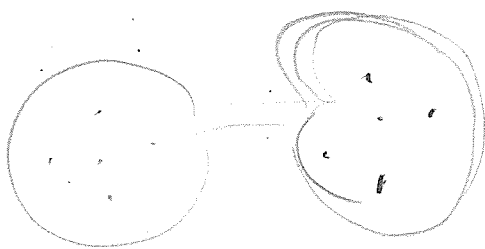


E 51. When the valve in the system shown above is opened and the system is allowed to reach equilibrium, most of the helium remains in the bulb on the left

BECAUSE when two bulbs containing gases are connected, the randomness of the system decreases.

D 52. The first ionization energy of Li is less than that of Na

BECAUSE Li is a smaller atom than Na.



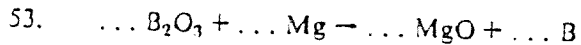
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$$\frac{\text{rate 1}}{\text{rate 2}} = \sqrt{\frac{M_2}{M_1}}$$

CHEMISTRY TEST—Continued

Part D

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 blacken the corresponding space on the answer sheet.



E According to the equation above, how many moles of magnesium would be required to react completely with 1 mole of B_2O_3 ? (Equation is not balanced.)

- (A) 0.2 mole
- (B) 0.3 mole
- (C) 1 mole
- (D) 2 moles
- (E) 3 moles

54. In the ionic solid NH_4NO_3 , the ions present are

- A
- (A) NH_4^+ and NO_3^-
 - (B) N^{5+} , H^+ , and O^{2-}
 - (C) NH_4^+ , N^{5+} , and O^{2-}
 - (D) NH_3 , H^+ , and NO_3^-
 - (E) N^{5+} , N^{3-} , H^+ , and O^{2-}

55. All of the following are good laboratory practices EXCEPT:

- D
- (A) Wait for a hot object to cool before weighing it.
 - (B) Rinse a burette with the solution that will be used to fill the burette.
 - (C) Wear goggles at all times.
 - (D) Return unused chemicals to the reagent bottles.
 - (E) To dilute H_2SO_4 , pour it into water slowly.

56. Which of the following ions does NOT have a noble gas electron configuration? (Atomic numbers: O = 8, Na = 11, Ca = 20, Mn = 25, I = 53)

- D
- (A) O^{2-}
 - (B) Na^+
 - (C) Ca^{2+}
 - (D) Mn^{2+}
 - (E) I^-

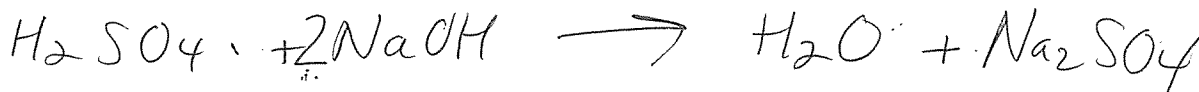
57. What volume of 0.20-molar HCl is required to exactly neutralize 40 milliliters of 0.10-molar NaOH?

- C
- (A) 50 ml
 - (B) 40 ml
 - (C) 20 ml
 - (D) 10 ml
 - (E) 8 ml

58. All of the following are true of aluminum EXCEPT:

- B
- (A) It is a good conductor of electricity.
 - (B) it is a metal of high density.
 - (C) It forms a protective coating in air that resists further corrosion.
 - (D) It is an excellent reducing agent.
 - (E) It forms a hydroxide that is soluble in both strong base and acid.

$$\overset{\text{acid}}{(M_1)(V_1)} = \frac{\overset{\text{base}}{(M_2)(V_2)}}{2}$$



Dilution

6.0 M

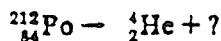
1.5 M

100 ml

X

CHEMISTRY TEST—Continued

59.



The missing product in the equation above is

- (A) ${}^{216}_{86}\text{Pb}$
- (B) ${}^{212}_{85}\text{Pb}$
- (C) ${}^{212}_{82}\text{Pb}$
- (D) ${}^{208}_{84}\text{Pb}$
- (E) ${}^{208}_{82}\text{Pb}$

60. $9 \text{Fe}_2\text{O}_3 + 2 \text{NH}_3 \rightarrow 6 \text{Fe}_3\text{O}_4 + \text{N}_2 + 3 \text{H}_2\text{O}$

According to the balanced equation above, when 1 mole of NH_3 reacts completely, which of the following is true?

- (A) 1 mole of N_2 must be formed
- (B) 1 mole of H_2O must be formed
- (C) 3 moles of Fe_3O_4 must be formed
- (D) 2 moles of Fe_2O_3 must react
- (E) 4 moles of Fe_2O_3 must react

61. What is the percent composition of CaBr_2 ?

(Atomic weights: Ca = 40, Br = 80)

- (A) 10% Ca and 90% Br
- (B) 20% Ca and 80% Br
- (C) 25% Ca and 75% Br
- (D) 33% Ca and 67% Br
- (E) 50% Ca and 50% Br

62. Two samples were weighed using different balances and the following data were obtained.

Sample #1 = 3.719 grams

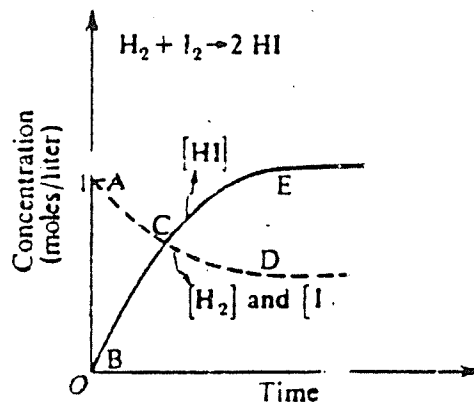
Sample #2 = 0.42 gram

The total mass of the samples should be reported as

- (A) 4 grams
- (B) 4.1 grams
- (C) 4.139 grams
- (D) 4.14 grams
- (E) 4.140 grams

63. A solution of a base that has a pH of 9.0 has a hydrogen ion concentration of

- (A) 1×10^{-9} molar
- (B) 1×10^{-6} molar
- (C) 1×10^{-5} molar
- (D) 1×10^{-7} molar
- (E) 1×10^{-9} molar



64. The graph above shows the variation in concentration of reactants and products as H_2 and I_2 react to form HI at a given temperature. Equilibrium is reached when the concentration of HI is

- (A) A
- (B) B
- (C) C
- (D) D
- (E) E

Element	Electronegativity
P	2.1
H	2.2
Br	2.8
O	3.5

On the basis of the electronegativity values given above, in which of the following are the bonds most polar?

- (A) PH_3
- (B) H_2O
- (C) HBr
- (D) P_4
- (E) PBr_3

66. Potassium hydroxide is a good conductor of an electric current in the

- (A) gaseous state only
- (B) molten (fused) state only
- (C) solid state only
- (D) solid and molten (fused) states
- (E) molten (fused) state and in aqueous solution

GO ON TO THE NEXT PAGE

CHEMISTRY TEST—Continued

67. Liquid Vapor Pressure (mm Hg), 25° C

A	20	low
B	35	
C	56	
D	112	
E	224	high, weak

In which of the liquids listed in the table above are the intermolecular forces of attraction the strongest?

- (A) A
- (B) B
- (C) C
- (D) D
- (E) E

68. The range of oxidation states exhibited by most elements in group V of the periodic table (N, P, As, Sb, Bi) is

- (A) -3 to +1
- (B) -3 to +3
- (C) -3 to +5
- (D) -2 to +3
- (E) +1 to +5

N gain 3e⁻ (-3) lose 5e⁻ (+5)
 1s 2s 2p 3p
 gain lose
 -3 -2 -1 +3 +2 +1

70. To find the concentration of a solution of a base by titration with a solution of an acid, which of the following represents the minimum data needed, assuming that the titration has been carried to the proper end point and that the equation for the reaction is known?

- I. Volume of acid
- II. Volume of base
- III. Concentration of acid

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

71. ... Cr(OH)₃ (s) + ... OH⁻ = ... CrO₂⁻ + ... H₂O

When the equation above is balanced, how many grams of water will be produced when 1.00 mole of CrO₂⁻ is formed?

- (A) 9.0 grams
- (B) 18.0 grams
- (C) 27.0 grams
- (D) 36.0 grams
- (E) 45.0 grams

69. Mass of Empty Flask 38.913 grams
 Mass of Flask + KMnO₄ 39.898 grams
 Mass of Flask + Residue (after ignition) 39.773 grams

The data above were taken for the decomposition of KMnO₄ by ignition, which liberates oxygen and leaves a solid residue. The experimental mass ratio is

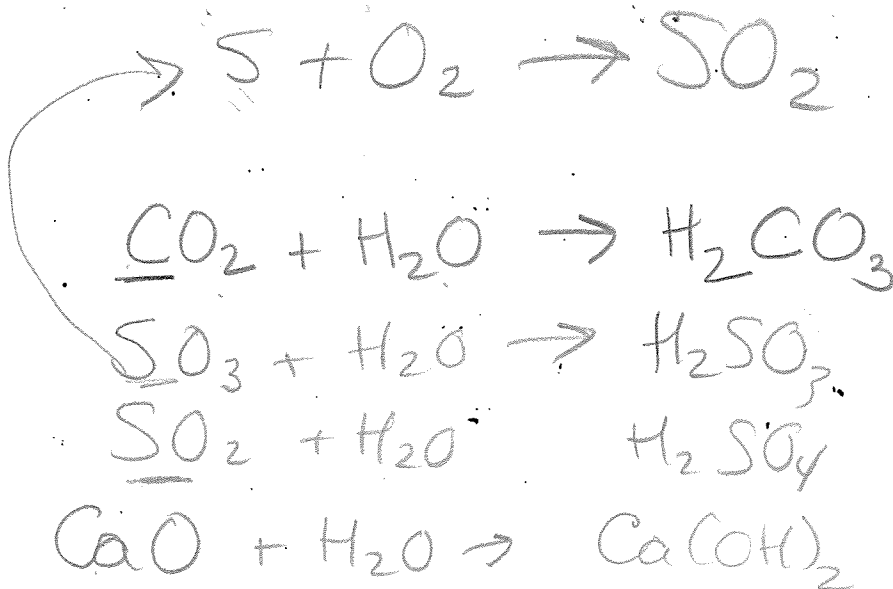
- (A) $\frac{0.125}{0.985}$ gram residue/ gram KMnO₄
- (B) $\frac{0.125}{0.860}$ gram residue/ gram KMnO₄
- (C) $\frac{0.860}{0.985}$ gram residue/ gram KMnO₄
- (D) $\frac{0.985}{0.860}$ grams residue/ gram KMnO₄
- (E) $\frac{0.860}{0.125}$ grams residue/ gram KMnO₄

KMnO₄ Part
 .985 whole
 O₂ → O₂
GO ON TO THE NEXT PAGE

Haber

39.898
 - 38.913

 .985



CHEMISTRY TEST—Continued

72. Which of the following statements concerning fluorine and chlorine is FALSE?

- (A) Fluorine is more electronegative than chlorine.
- D** (B) The atomic radius of the fluorine atom is less than that of the chlorine atom.
- (C) Fluorine is a stronger oxidizing agent than chlorine.
- (D) Both fluorine and chlorine commonly exist in positive and negative oxidation states.
- (E) Both fluorine and chlorine are diatomic gases at room conditions.

73. How many moles of sodium oxalate, $\text{Na}_2\text{C}_2\text{O}_4$, are present in 6.7 grams of this compound?

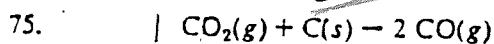
- E** (Atomic weights: C = 12, O = 16, Na = 23)
- (A) 2.0 moles
 - (B) 1.0 mole
 - (C) 0.50 mole
 - (D) 0.10 mole
 - (E) 0.050 mole

$6.7 \text{ g} \times \frac{1 \text{ mole}}{134} = 0.05 \text{ mole}$

74. A sample of 90.0 grams of glucose is dissolved in enough water to yield 200. milliliters of solution. What is the molar concentration of glucose (molecular weight 180.)?

- D**
- (A) 0.500 M
 - (B) 1.00 M
 - (C) 2.00 M
 - (D) 2.50 M
 - (E) 10.0 M

100 L excess



E A sample of 100 liters of carbon dioxide at 25°C and 1 atmosphere pressure is reduced by being passed over hot coke according to the equation above. When measured at 25°C and 1 atmosphere pressure, the volume of carbon monoxide formed is

- (A) 22.4 liters
- (B) 44.8 liters
- (C) 50 liters
- (D) 100 liters
- (E) 200 liters

$\frac{1 \text{ mole}}{100 \text{ L}} = \frac{2 \text{ mol}}{X \text{ L}}$

$X = 200 \text{ L}$

1 : 2

$\frac{22.4 \text{ L}}{100 \text{ L}} = \frac{44.8 \text{ L}}{X}$

76. Which of the following acids, listed with their ionization constants at 25°C , is the strongest?

- (A) Nitrous acid (HNO_2) $K_i = 4.5 \times 10^{-4}$
- A** (B) Formic acid (HCHO_2) $K_i = 1.8 \times 10^{-4}$
- (C) Benzoic acid ($\text{HC}_7\text{H}_5\text{O}_2$) $K_i = 6.3 \times 10^{-5}$
- (D) Acetic acid ($\text{HC}_2\text{H}_3\text{O}_2$) $K_i = 1.8 \times 10^{-5}$
- (E) Hydrocyanic acid (HCN) $K_i = 4.0 \times 10^{-10}$



A What is the maximum yield of iodine that can be obtained when 1 mole of $\text{Na}_2\text{S}_2\text{O}_8$ reacts completely with excess iodide ion according to the equation above? (Equation above is not balanced.)

- (A) 1 mole
- (B) 2 moles
- (C) 4 moles
- (D) 6 moles
- (E) 8 moles

78. The heat of formation for CO_2 is given as $\Delta H = -94.2 \text{ kcal/mole}$. The negative value of ΔH indicates that

- C**
- (A) CO_2 is formed from its elements by an endothermic reaction
 - (B) the reaction of carbon with oxygen occurs rapidly at 25°C
 - (C) the enthalpy of the product CO_2 is less than that of the reactants, O_2 and C
 - (D) no heat is liberated when carbon is oxidized
 - (E) 94.2 kcal must be added to oxidize one mole of carbon

79. The oxidation number of the nitrogen atom in the ammonium ion is

- E**
- (A) +3
 - (B) +2
 - (C) +1
 - (D) -2
 - (E) -3

HT



CHEMISTRY TEST—Continued.

80. Which of the following is a saturated hydrocarbon?

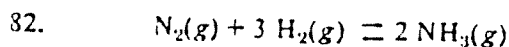
- (A) C₂H₂
- (B) C₂H₄
- (C) C₂H₆
- (D) C₃H₄
- (E) C₆H₁₀

C

81. The volume occupied by 0.50 mole of propane gas, C₃H₈, at a temperature of 27° C and a pressure of 2.0 atmospheres is best expressed by which of the following? (R = 0.082 liter-atm/mole° K)

- (A) $\frac{0.50 \times 0.082 \times 27}{2}$ liters
- (B) $\frac{0.50 \times 0.082 \times 300}{2}$ liters
- (C) $\frac{0.50 \times 0.082 \times 273}{300}$ liters
- (D) $\frac{0.50 \times 0.082 \times 300}{2 \times 760}$ liters
- (E) $\frac{0.50 \times 0.082 \times 27}{2 \times 760}$ liters

B



The correct equilibrium expression, K_c, for the formation of ammonia according to the equation above is

- (A) $K_c = \frac{[N_2][H_2]}{[NH_3]}$
- (B) $K_c = \frac{[NH_3]}{[N_2][H_2]}$
- (C) $K_c = \frac{[N]^2[H]^6}{[NH_3]^2}$
- (D) $K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$
- (E) $K_c = \frac{[N_2][H_2]^3}{[NH_3]^2}$

D

83. In qualitative analysis the separation of Ag⁺ ions from Cu²⁺ ions by the addition of HCl depends on the fact that

solubility

- B (A) Cu²⁺ forms an insoluble chloride and Ag⁺ does not
- (B) Ag⁺ forms an insoluble chloride and Cu²⁺ does not
- (C) Cu²⁺ forms a complex with HCl and Ag⁺ does not
- (D) Cu reacts with HCl and Ag does not
- (E) Ag⁺ is oxidized by HCl whereas Cu²⁺ is in its highest oxidation state

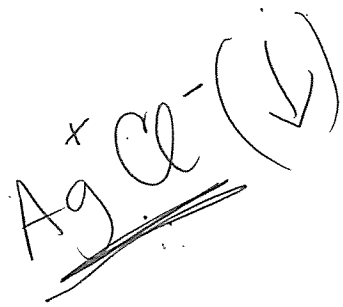
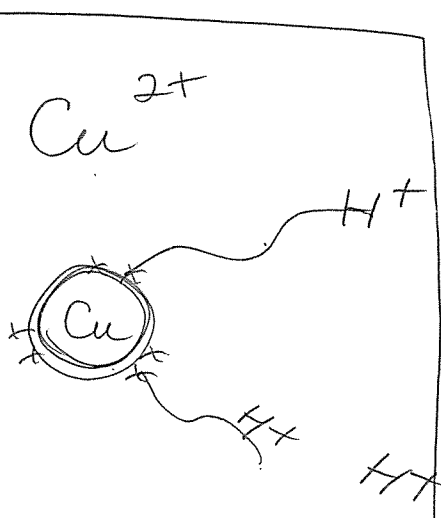
84. A battery jar contained a solution of copper sulfate. Two electrodes, one made of copper, the other a metal object to be copper plated, were placed in the jar and connected to a source of direct current. Which of the following statements concerning this system is correct?

B

- (A) The object to be plated is the anode.
- (B) Oxidation occurs at the anode.
- (C) The sulfate ions migrate toward the cathode.
- (D) The concentration of the copper sulfate solution increases as electrolysis proceeds.
- (E) The copper electrode increases in mass.

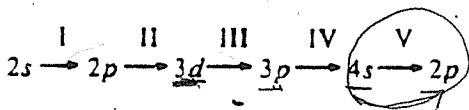
85. Which of the following contains the greatest total number of atoms?

- B (A) One mole of CO₂ (molecular weight = 44)
- (B) One mole of H₂O₂ (molecular weight = 34)
- (C) One molecule of glucose, C₆H₁₂O₆ (molecular weight = 180)
- (D) One gram of helium (atomic weight = 4)
- (E) One gram of H₂O (molecular weight = 18)



CHEMISTRY TEST—Continued

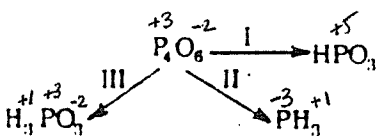
86.



The electronic transitions shown above are observed when lithium atoms are sprayed into a hot flame. The various transitions are numbered for identification. Which of these transitions would result in emission of electromagnetic radiation (light)?

- (A) I and II only
- (B) I and III only
- (C) I and V only
- (D) III and IV only
- (E) III and V only

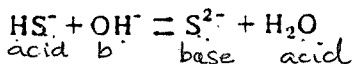
87.



The compound P_4O_6 may be chemically converted into a variety of other species by processes I-III, indicated above. In which of the conversions above is phosphorus reduced?

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

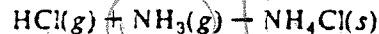
88.



In the system indicated by the equation above, which of the substances are Brønsted acids?

- (A) HS^- and H_2O
- (B) HS^- and S^{2-}
- (C) HS^- and OH^-
- (D) S^{2-} and H_2O
- (E) OH^- and H_2O

89.



If 3.0 moles of HCl gas and 5.0 moles of NH_3 gas, each measured at $20^\circ C$ and 1.0 atmosphere pressure, are allowed to react completely according to the equation above, the final mixture will contain

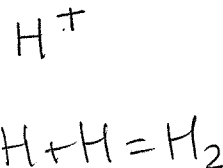
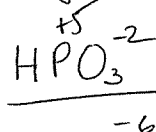
- (A) 3 moles of solid NH_4Cl only
- (B) 5 moles of solid NH_4Cl only
- (C) 3 moles of solid NH_4Cl + 2 moles of NH_3 gas
- (D) 3 moles of solid NH_4Cl + 2 moles of HCl gas
- (E) 2 moles of HCl gas, 4 moles of NH_3 gas, and 1 mole of solid NH_4Cl

90.

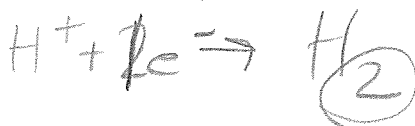
In an electrolysis cell, the passage of 6.02×10^{23} electrons can produce

- (A) 22.4 liters of H_2 gas (measured at standard conditions) from dilute H_2SO_4 solution
- (B) 22.4 liters of O_2 gas (measured at standard conditions) from dilute H_2SO_4 solution
- (C) 1 mole of Cl_2 gas from HCl solution
- (D) 1 mole of metallic silver from $AgNO_3$ solution
- (E) 1 mole of metallic copper from $CuSO_4$ solution

Faraday -



$$\begin{array}{c}
 (n-2)(n-1) \\
 7-2 \quad 6d \quad 10 \quad 7s^2 \\
 5f^3
 \end{array}$$



$$\begin{array}{c}
 Ag^+ NO_3^- \\
 Ag^+ + 1e^- \rightarrow Ag(s) \\
 Cu^{2+} + 2e^- \rightarrow
 \end{array}$$

S T O P

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON THIS TEST ONLY. DO NOT WORK ON ANY OTHER TEST IN THIS BOOK.

$$\begin{array}{ccc}
 \underline{IV} & \underline{1} & \underline{1} \\
 & \underline{0} &
 \end{array}$$

$$\begin{array}{ccc}
 \underline{1} & \underline{1} & \underline{1} \\
 & \underline{N} &
 \end{array}$$