

Practice Test

1

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

Part A

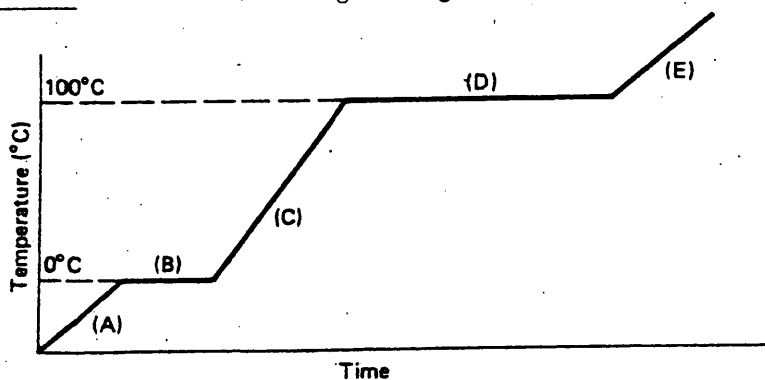
Directions: Each set of lettered choices below refers to the numbered statements or formulas immediately following it. Select the one lettered choice that best fits each statement or formula and then fill in the corresponding oval on the answer sheet. A choice may be used once, more than once, or not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

Questions 1-9

IA	IIA	IIIA	IVA	VA	VIA	VIIA	VIII
${}^3\text{Li}$							${}^{10}\text{Ne}$
	(A)			(C)	(D)		
(B) ${}^{20}\text{Ca}$							(E)

1. The most electronegative element
2. The element with a possible oxidation number of -2
3. The element that would react in a one-to-one ratio with (D)
4. The element with the smallest ionic radius
5. The element with the smallest first ionization potential
6. The element with a complete p orbital as its outermost energy level
7. A member of the alkali-metals family
8. An inert gas
9. The element that would react most actively when placed in water to form a strong base

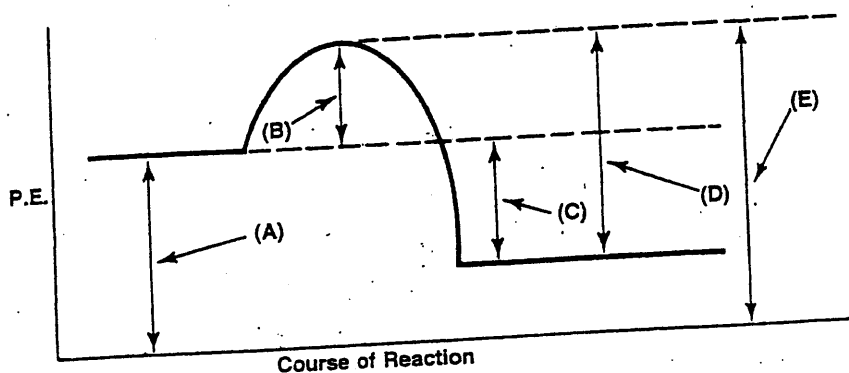
Questions 10-12 refer to the following heating curve:



10. In which part of the curve is the state of H_2O only a solid?
11. When is the heat to change the state of H_2O greater?
12. Where is the temperature of H_2O changing at $1^\circ\text{C}/\text{cal/g}$?

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Questions 13–15 refer to the following diagram:



13. Indicates the activation energy of this reaction
14. Indicates the portion of the curve that would be directly affected by the addition of a catalyst
15. Indicates the net energy released from the reaction

Questions 16–18

- (A) Iron
 - (B) Gold
 - (C) Sodium
 - (D) Helium
 - (E) Uranium
16. An element that resists reaction with acids
 17. A monoatomic element with filled *p* orbitals
 18. A transition element that occurs when the inner 3*d* orbital is partially filled

Questions 19–20

- (A) Rhombic sulfur
 - (B) Monoclinic sulfur
 - (C) Sulfur trioxide
 - (D) Sulfate
 - (E) Sulfite
19. A substance that exhibits a resonance structure
 20. A product formed from a base reacting with sulfurous acid

Questions 21–23

- (A) Dilute
 - (B) Concentrated
 - (C) Unsaturated
 - (D) Saturated
 - (E) Supersaturated
21. The condition, unrelated to quantities, that indicates that the rate going into solution is equal to the rate coming out of solution
 22. The condition that exists when a water solution that has been at equilibrium is heated to a higher temperature with a higher solubility, but no additional solute is added

The descriptive term that indicates there is a large quantity of solute, compared to the amount of solvent, in a solution

Part B

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 fill in oval

- 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

	<u>Assertion</u>	<u>Reason</u>
A	True	True
B	True	True
C	True	False
D	False	True
E	False	False

Reason is a correct explanation.Reason is NOT a correct explanation.Assertion

24. Nonmetallic oxides are usually acid anhydrides
25. When HCl gas and NH₃ gas come in contact, a white smoke forms
26. The reaction of barium chloride and sodium sulfate does not go to completion
27. When two elements react exothermically to form a compound, the compound should be relatively stable
28. The ion of a nonmetallic atom is larger in radius than the atom
29. Oxidation and reduction occur together

Reason

- BECAUSE they form acids when placed in water.
- BECAUSE they combine to form a white solid, ammonium chloride.
- BECAUSE the compound barium sulfate is formed.
- BECAUSE the release of energy indicates the compound is at a lower energy level than the reactants and thus relatively stable.
- BECAUSE each shell in the atom may have several subshells.
- BECAUSE in these processes electrons must be gained and lost.

Directions Summarized

	<u>Assertion</u>	<u>Reason</u>
A	True	True
B	True	True
C	True	False
D	False	True
E	False	False

Reason is a correct explanationReason is NOT a correct explanation

<u>Assertion</u>	<u>Reason</u>
30. Decreasing the atmospheric pressure on a pot of boiling water causes it to stop boiling	BECAUSE changes in pressure are directly related to the boiling point of water.
31. Catalysts speed up or slow down a reaction	BECAUSE they change the temperature of the reaction.
32. Atoms of different elements can have the same mass number	BECAUSE the atoms of each element have a characteristic number of protons in the nucleus.
33. Isotopes have different atomic numbers	BECAUSE there each has a different number of neutrons.
34. The most active nonmetal in the halogen family is fluorine	BECAUSE it has the greatest electronegativity.
35. The Cu^{2+} ion needs to be oxidized to form Cu metal	BECAUSE oxidation is a gain of electrons.
36. The volume of a gas at 100°C and 600 mm Hg pressure will be decreased at STP	BECAUSE both changes will cause the volume to decrease.
37. The pH of a 0.01 molar solution of HCl will be 2	BECAUSE HCl is made up of two essentially ionic particles.
38. Nuclear fusion on the sun converts hydrogen to helium with a release of energy	BECAUSE Some mass is converted to energy.
39. The "bullet" usually used to initiate the fusion of ^{235}U is a neutron	BECAUSE capture of the neutron by the nucleus causes an unstable condition that leads to its disintegration.

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.

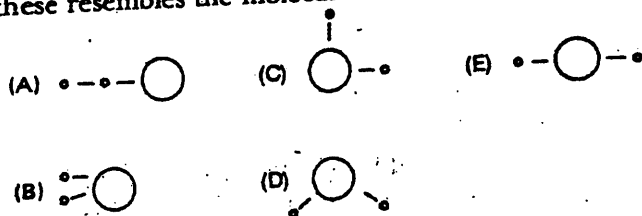
40. What is the approximate formula weight of $\text{Ca}(\text{NO}_3)_2$?
- (A) 70
 (B) 82
 (C) 102
 (D) 150
 (E) 164
41. In this reaction: $\text{XClO}_3 + \text{A} \rightarrow \text{XCl} + \text{O}_2 \uparrow + \text{A}$, which substance is the catalyst?
- (A) X
 (B) XClO_3
 (C) A
 (D) XCl
 (E) O_2
42. The normal electron configuration for ethyne (acetylene) is
- (A) $\text{H}:\text{C}::\text{C}:\text{H}$
 (B) $\text{H}:\ddot{\text{C}}:\ddot{\text{C}}:\text{H}$
 (C) $\text{H}\cdot\text{C}:::\text{C}\cdot\text{H}$
 (D) $\text{H}:\text{C}::\text{C}:\text{H}$
 (E) $\text{H}:\ddot{\text{C}}:\ddot{\text{C}}:\text{H}$
43. According to the kinetic molecular theory, molecules increase in kinetic energy when they
- (A) are mixed with other molecules at lower temperature
 (B) are frozen into a solid
 (C) are condensed into a liquid
 (D) are melted from a solid to a liquid state
 (E) collide with each other in a container at low temperature
44. How many atoms are represented in the formula $\text{Ca}_3(\text{PO}_4)_2$?
- (A) 5
 (B) 8
 (C) 9
 (D) 12
 (E) 13
45. All of the following have covalent bonds EXCEPT
- (A) HCl
 (B) CCl_4
 (C) H_2O
 (D) CsF
 (E) CO_2

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46. Which of the following bonds is (are) the weakest attractive force?

- (A) van der Waals forces
- (B) coordinate covalent bonding
- (C) covalent bonding
- (D) polar covalent bonding
- (E) ionic bonding

47. Which of these resembles the molecular structure of the water molecule?



48. The two most important considerations in deciding whether a reaction will occur spontaneously are

- (A) the stability and state of the reactants
- (B) the energy gained and the heat evolved
- (C) the exothermic energy and the randomness of the products
- (D) the endothermic energy and the randomness of the products
- (E) the endothermic energy and the structure of the products

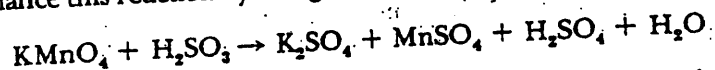
49. The reaction of an acid like HCl and a base like NaOH always

- (A) forms a precipitate
- (B) forms a volatile product
- (C) forms a soluble salt and water
- (D) forms a sulfate salt and water
- (E) forms a salt and water

50. The oxidation number of sulfur in H_2SO_4 is

- (A) +2
- (B) +3
- (C) +4
- (D) +6
- (E) +8

51. Balance this reaction by using the oxidation-reduction method of electron exchange:



Which of the following partial equations is the correct reduction half-reaction for the *balanced* equation?

- (A) $5 \text{SO}_3^{2-} + 5 \text{H}_2\text{O} \rightarrow 5 \text{SO}_4^{2-} + 2 \text{H}^+ + 10 \text{e}^-$
- (B) $2 \text{MnO}_4^- + 16 \text{H}^+ + 10 \text{e}^- \rightarrow 2 \text{Mn}^{2+} + 8 \text{H}_2\text{O}$
- (C) $\text{SO}_3^{2-} \rightarrow \text{SO}_4^{2-} + 2 \text{e}^-$
- (D) $\text{SO}_3^{2-} + 2 \text{H}^+ \rightarrow \text{SO}_4^{2-} + \text{H}_2\text{O} + 2 \text{e}^-$
- (E) $\text{Mn}^{7+} \rightarrow \text{Mn}^{2+} + 5 \text{e}^-$

52. Acid solutions in water are exemplified by which of the following?
- HCl
 - Excess H_3O^+
 - CuSO_4
- I only
 - III only
 - I and II only
 - II and III only
 - I, II, and III
53. The property of matter that is independent of its surrounding conditions and position is
- volume
 - density
 - mass
 - weight
 - velocity
-
54. Where are the highest ionization energies found in the periodic chart?
- upper left corner
 - lower left corner
 - upper right corner
 - lower right corner
 - middle of transition elements
55. Which of the following pairs of compounds can be used to illustrate the Law of Multiple Proportions?
- NO and NO_2
 - CH_4 and CO_2
 - ZnO_2 and ZnCl_2
 - NH_4 and NH_4Cl
 - H_2O and HCl
56. In this equilibrium reaction: $\text{A} + \text{B} \rightleftharpoons \text{AB} + \text{heat}$ (in a closed container), how could the forward reaction rate be increased?
- By increasing the concentration of AB .
 - By increasing the concentration of A .
 - By removing some of product AB .
- I only
 - III only
 - I and III only
 - II and III only
 - I, II, and III

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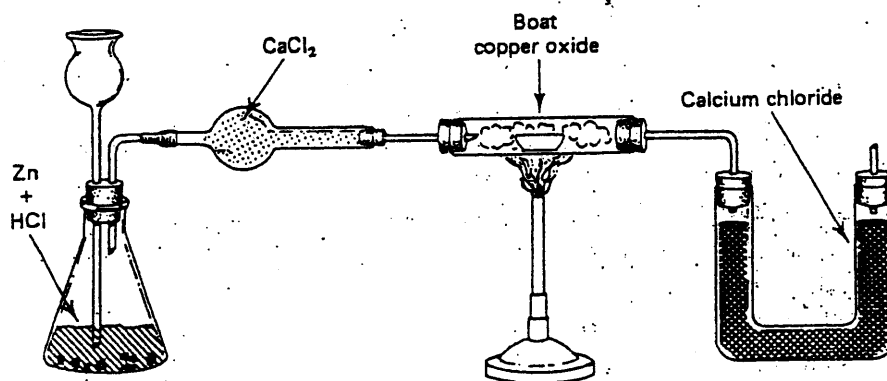
57. In the reaction of sodium with water, the balanced equation has which of the following coefficients?
- I. 1
 - II. 2
 - III. 3
- (A) I only
 - (B) III only
 - (C) I and II only
 - (D) II and III only
 - (E) I, II, and III
58. If 10 liters of CO gas react with sufficient oxygen to completely react, how many liters of CO₂ gas are formed?
- (A) 5 liters
 - (B) 10 liters
 - (C) 15 liters
 - (D) 20 liters
 - (E) 40 liters
59. If 49 grams of H₂SO₄ react with 80 grams of NaOH, how much reactant will be left over after the reaction is complete?
- (A) 24.5 g H₂SO₄
 - (B) none of either compound
 - (C) 20 g NaOH
 - (D) 40 g NaOH
 - (E) 60 g NaOH
60. The K_{sp} of AgCl is 1.9×10^{-10} . What is the molar concentration of Ag⁺ in 1 liter of a saturated water solution of silver chloride?
- (A) 0.44×10^{-5}
 - (B) 0.95×10^{-5}
 - (C) 1.38×10^{-5}
 - (D) 0.95×10^{-10}
 - (E) 3.81×10^{-10}
61. If the density of a diatomic gas is 1.43 grams/liter, what is its gram-molecular weight?
- (A) 16 g
 - (B) 32 g
 - (C) 48 g
 - (D) 64 g
 - (E) 14.3 g
62. From 2 moles of KClO₃ how many liters of O₂ can be produced by decomposition of all the KClO₃?
- (A) 11.2
 - (B) 22.4
 - (C) 33.6
 - (D) 44.8
 - (E) 67.2

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63. The reaction $\text{Fe} \rightarrow \text{Fe}^{2+} + 2e^-$ (+ 0.44 volt) would occur spontaneously with which of the following?

- I. $\text{Pb} \rightarrow \text{Pb}^{2+} + 2e^-$ (+ 0.13 volt)
 - II. $\text{Cu} \rightarrow \text{Cu}^{2+} + 2e^-$ (- 0.34 volt)
 - III. $2\text{Ag} + 2e^- \rightarrow 2\text{Ag}^0$ (+ 0.80 volt)
- (A) I only
 (B) III only
 (C) I and III only
 (D) II and III only
 (E) I, II, and III

Questions 64–68 refer to the following experimental setup and data:



Recorded data:

Before: $\text{CuO} + \text{porcelain boat} = 62.869 \text{ g}$
 $\text{CaCl}_2 + \text{U tube} = 80.483 \text{ g}$

After: $\text{Porcelain boat} + \text{contents} = 54.869 \text{ g}$
 $\text{CaCl}_2 + \text{U tube} = 89.483 \text{ g}$

Reactions: $\text{Zn} + 2 \text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2 \uparrow =$
 $\text{H}_2 + \text{CuO} \rightarrow \text{H}_2\text{O} + \text{Cu}$

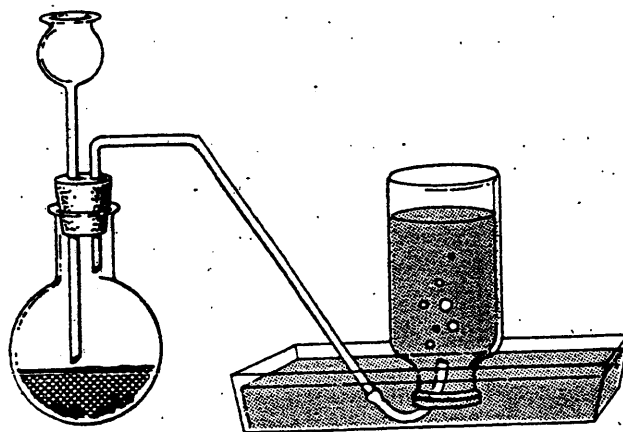
64. What type of reaction occurred in the porcelain boat?
- (A) electrolysis
 - (B) double displacement
 - (C) reduction and oxidation
 - (D) decomposition or analysis
 - (E) combination or synthesis
65. Why was the CaCl_2 tube placed between the generator and the tube containing the porcelain boat?
- (A) to absorb evaporated HCl
 - (B) to absorb evaporated H_2O
 - (C) to slow down the gases released
 - (D) to adsorb the evaporated Zn particles
 - (E) to remove the initial air that passes through the tube

66. How many grams of hydrogen were used in the formation of the water that was a product?
- (A) 1
 - (B) 2
 - (C) 4
 - (D) 8
 - (E) 9
67. What conclusion can you draw from this experiment?
- (A) Hydrogen diffuses faster than oxygen.
 - (B) Hydrogen is lighter than oxygen.
 - (C) The gram-molecular weight of oxygen is 32 g.
 - (D) Water is a triatomic molecule with polar characteristics.
 - (E) Water is formed in a ratio of 1:8 from hydrogen and oxygen.
68. Which of the following is an observation rather than a conclusion?
- (A) A substance is an acid if it changes litmus paper from blue to red.
 - (B) A gas is lighter than air if it escapes from a bottle left mouth upward.
 - (C) The gas H_2 forms an explosive mixture with air.
 - (D) Air is mixed with hydrogen gas and ignited; it explodes.
 - (E) An oil liquid is immiscible with water because it separates into a layer above the water.
69. When HCl fumes and NH_3 fumes are introduced into opposite ends of a long, dry glass tube, a white ring forms in the tube. Which answer explains this phenomenon?
- (A) NH_4Cl forms.
 - (B) HCl diffuses faster.
 - (C) NH_3 diffuses faster.
 - (D) The ring occurs closer to the end into which HCl was introduced.
 - (E) The ring occurs in the very middle of the tube.
70. The correct formula for calcium hydrogen sulfate is
- (A) CaH_2SO_4
 - (B) $CaHSO_4$
 - (C) $Ca(HSO_4)_2$
 - (D) Ca_2HSO_4
 - (E) $Ca_2H_2SO_4$
71. Ten grams of sodium hydroxide dissolved in 1 liter of water makes a solution that is
- (A) 0.25 M
 - (B) 0.5 M
 - (C) 1 M
 - (D) 1.5 M
 - (E) 4 M
72. For a saturated solution, which statement is true?
- (A) All dissolving has stopped.
 - (B) Crystals begin to grow.
 - (C) An equilibrium has been established.
 - (D) Crystals of the solute will continue to dissolve.
 - (E) The solute is exceeding its solubility.

6. In which of the following series is the pi bond found in the bonding structure?

- I. Alkane
 - II. Alkene
 - III. Alkyne
- (A) I only
 - (B) III only
 - (C) I and III only
 - (D) II and III only
 - (E) I, II, and III

Questions 74–76 refer to the following setup:



74. Why could you *not* use this setup for preparing H_2 if the generator contained Zn + vinegar?
- (A) Hydrogen would not be produced.
 - (B) The setup of the generator is improper.
 - (C) The generator must be heated with a burner.
 - (D) The delivery tube setup is wrong.
 - (E) The gas cannot be collected over water.
75. If the setup were corrected, which of these gases could not be collected over H_2O because of its solubility?
- (A) CO_2
 - (B) NO
 - (C) O_2
 - (D) NH_3
 - (E) CH_4
76. If the setup were corrected, what reactants would you use to produce CO_2 in this setup?
- (A) C + $HClO_3$
 - (B) Ca + H_2O
 - (C) CH_4 + H_2O
 - (D) C + $KClO_3$
 - (E) $CaCO_3$ + HCl

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77. For the following reaction: $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2 \text{NO}_2(\text{g})$, the K_c expression is

(A) $K_c = \frac{[\text{N}_2\text{O}_4]}{[\text{NO}_2]}$

(B) $K_c = \frac{[\text{N}_2\text{O}_4]}{[\text{NO}_2]^2}$

(C) $K_c = \frac{[\text{NO}_2]}{[\text{N}_2\text{O}_4]}$

(D) $K_c = \frac{[\text{NO}_2]^2}{[\text{N}_2\text{O}_4]}$

(E) $K_c = \frac{[\text{N}_2\text{O}_4]^2}{[\text{NO}_2]}$

78. What is the K_c for the above reaction if at equilibrium the concentration of N_2O_4 is 4×10^{-2} mole/liter and that of NO_2 is 2×10^{-2} mole/liter?

(A) 1×10^{-2}

(B) 2×10^{-2}

(C) 4×10^{-2}

(D) 4×10^{-4}

(E) 8×10^{-2}

79. How much water, in liters, must be added to 0.5 liter of 6 M HCl to make it 2 M?

(A) 0.33

(B) 0.5

(C) 1

(D) 1.5

(E) 2

80. Four grams of hydrogen are ignited with 4 grams of oxygen. How many grams of water can be formed?

(A) 0.5 g

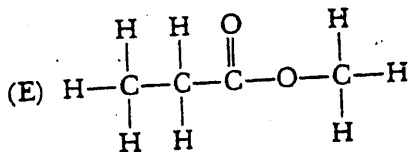
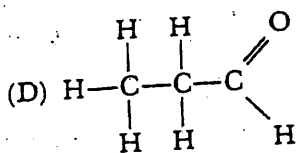
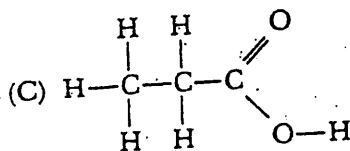
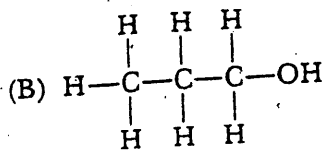
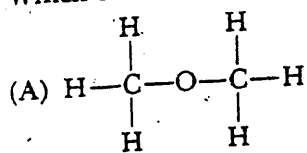
(B) 2.5 g

(C) 4.5 g

(D) 8 g

(E) 36 g

81. Which structure is an ester?



82. What piece of apparatus can be used to introduce more liquid into a reaction and also serve as a pressure valve?

- (A) stopcock
- (B) pinchcock
- (C) thistle tube
- (D) retort
- (E) condenser

83. Which formulas could represent the empirical formula and the molecular formula of a given compound?

- (A) CH_2O and $\text{C}_4\text{H}_6\text{O}_4$
- (B) CHO and $\text{C}_6\text{H}_{12}\text{O}_6$
- (C) CH_4 and C_5H_{12}
- (D) CH_2 and C_3H_6
- (E) CO and CO_2

84. Which pair of atoms are isotopes of element X?

- (A) ${}^{226}_{90}\text{X}$ and ${}^{226}_{91}\text{X}$
- (B) ${}^{226}_{91}\text{X}$ and ${}^{227}_{91}\text{X}$
- (C) ${}^{227}_{91}\text{X}$ and ${}^{227}_{90}\text{X}$
- (D) ${}^{226}_{90}\text{X}$ and ${}^{227}_{91}\text{X}$
- (E) ${}^{226}_{91}\text{X}$ and ${}^{227}_{90}\text{X}$

85. A binary compound of sodium is

- (A) sodium chlorate
- (B) sodium chlorite
- (C) sodium hypochlorite
- (D) sodium chloride
- (E) sodium perchlorate

DIAGNOSING YOUR NEEDS

After taking Practice Test 1, 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	6	8	28	32	33	34	47	54	
<input type="checkbox"/> No. of checks + 8 × 100 = _____%									
II. Nuclear Reactions							58	59	
<input type="checkbox"/> No. of checks + 2 × 100 = _____%									
III. Chemical Bonding and Molecular Structure	3	17	18	19	45	46	55	70	73
<input type="checkbox"/> No. of checks + 9 × 100 = _____%									
IV. States of Matter and Kinetic Molecular Theory	10	11	12	30	31	36	43		
<input type="checkbox"/> No. of checks + 7 × 100 = _____%									
V. Solutions, including concentration units, solubility, and colligative properties	21	26	60	71	79				
<input type="checkbox"/> No. of checks + 5 × 100 = _____%									
VI. Acids and Bases	20	24	25	37	52	49	69	76	
<input type="checkbox"/> No. of checks + 8 × 100 = _____%									
VII. Oxidation-Reduction and Electrochemistry	29	35	50	51	63	64			
<input type="checkbox"/> No. of checks + 6 × 100 = _____%									

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SUBJECT AREA

(✓) QUESTIONS ANSWERED CORRECTLY

VIII. Stoichiometry	40	44	57	58	59	61	62	66	80		
<input type="checkbox"/> No. of checks + 9 × 100 = _____%											
IX. Reaction Rates								41	48		
<input type="checkbox"/> No. of checks + 2 × 100 = _____%											
X. Equilibrium							22	56	72	77	78
<input type="checkbox"/> No. of checks + 5 × 100 = _____%											
XI. Thermodynamics: energy changes in chemical reactions, randomness, and criteria for spontaneity								13	14	15	27
<input type="checkbox"/> No. of checks + 4 × 100 = _____%											
XII. Descriptive Chemistry: physical and chemical properties of elements and their familiar compounds; organic chemistry; periodic properties	1	2	4	5	7	9	16				
	25	42	53	81	83	84	85				
<input type="checkbox"/> No. of checks + 14 × 100 = _____%											
XIII. Laboratory: equipment, procedures, observations, safety, calculations, and interpretation of results	65	67	68	74	75	82					
<input type="checkbox"/> No. of checks + 6 × 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.