The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

CHEMISTRY

Thursday, August 12, 1999 — 12:30 to 3:30 p.m., only

The last page of the booklet is the answer sheet. Fold the last page along the perforations and, slowly and carefully, tear off the answer sheet. Then fill in the heading of your answer sheet.

All of your answers are to be recorded on the separate answer sheet. For each question, decide which of the choices given is the best answer. Then on the answer sheet, in the row of numbers for that question, circle with pencil the number of the choice that you have selected. The sample below is an example of the first step in recording your answers.

SAMPLE: (1) 2 3 4

If you wish to change an answer, erase your first penciled circle and then circle with pencil the number of the answer you want. After you have completed the examination and you have decided that all of the circled answers represent your best judgment, signal a proctor and turn in all examination material except your answer sheet. Then and only then, place an X in ink in each penciled circle. Be sure to mark only one answer with an X in ink for each question. No credit will be given for any question with two or more X's marked. The sample below indicates how your final choice should be marked with an X in ink.

SAMPLE: ⊗ 2 3 4

The "Reference Tables for Chemistry," which you may need to answer some questions in this examination, are supplied separately. Be certain you have a copy of these reference tables before you begin the examination.

When you have completed the examination, you must sign the statement printed at the end of the answer sheet, indicating that you had no unlawful knowledge of the questions or answers prior to the examination and that you have neither given nor received assistance in answering any of the questions during the examination. Your answer sheet cannot be accepted if you fail to sign this declaration.

DO NOT OPEN THIS EXAMINATION BOOKLET UNTIL THE SIGNAL IS GIVEN.

Part I

Answer all 56 questions in this part. [65]

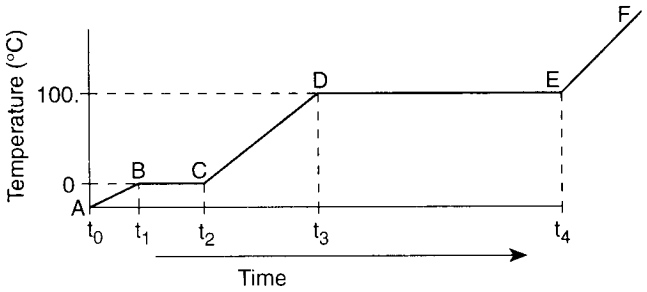
Directions (1–56): For *each* statement or question, select the word or expression that, of those given, best completes the statement or answers the question. Record your answer on the separate answer sheet in accordance with the directions on the front page of this booklet.

1 Which phase change represents sublimation?

(1) $NH_3(\ell) \rightarrow NH_3(g)$ (3) $KI(s) \rightarrow KI(\ell)$

(2) $CO_2(s) \rightarrow CO_2(g)$ (4) $H_2O(\ell) \rightarrow H_2O(s)$

2 The graph below shows the change in temperature of water in an open container as heat is added at a constant rate.



What is the pressure of the system at the temperature represented by segment *DE*?

(1) 0 torr
(2) between 0 and 760 torr
(3) 760 torr
(4) more than 760 torr

3 Which substance is a binary compound?

(1) potassium chlorite
(2) potassium chloride
(3) potassium hydroxide
(4) potassium cyanide

4 Which changes in pressure and temperature occur as a given mass of gas at 380 torr and 546 K is changed to STP?

(1) The pressure is doubled and the temperature is halved.
(2) The pressure is halved and the temperature is doubled.
(3) Both the pressure and the temperature are doubled.
(4) Both the pressure and the temperature are halved.

5 Real gas behavior deviates from ideal gas behavior because real gas particles have

(1) no volume and no attraction for each other
(2) no volume but some attraction for each other
(3) volume but no attraction for each other
(4) volume and some attraction for each other

6 Which type of radiation is most similar to high-energy x rays?

(1) alpha (3) neutron
(2) beta (4) gamma

7 What is the total number of unpaired electrons in an atom of oxygen in the ground state?

(1) 6 (3) 8
(2) 2 (4) 4

8 Which of the following sublevels has the highest energy?

(1) 2*p* (3) 3*p*
(2) 2*s* (4) 3*s*

9 In which pair of elements do the nuclei of the atoms contain the same number of neutrons?

(1) $^{7}_{3}Li$ and $^{9}_{4}Be$ (3) $^{23}_{11}Na$ and $^{24}_{12}Mg$

(2) $^{14}_{7}N$ and $^{16}_{8}O$ (4) $^{32}_{16}S$ and $^{35}_{17}Cl$

10 Which reaction is matched correctly with the particle represented by letter *X*?

(1) $^{226}_{88}Ra \rightarrow {}^{222}_{86}Rn + X$; *X* is an alpha particle.

(2) $^{234}_{90}Th \rightarrow {}^{234}_{91}Pa + X$; *X* is an alpha particle.

(3) $^{230}_{90}Th \rightarrow {}^{226}_{88}Ra + X$; *X* is a beta particle.

(4) $^{234}_{92}U \rightarrow {}^{230}_{90}Th + X$; *X* is a beta particle.

11 What is the maximum number of electrons in an orbital of any atom?

(1) 1 (3) 6
(2) 2 (4) 10

12 In which of the following elements is the *least* amount of energy required to remove the most loosely bound electron from an atom in the gaseous state?

(1) Sr (3) Al
(2) Ar (4) Cl

13 What is the approximate total number of atoms in 1.0 mole of lithium?

(1) 1.0×10^{23} (3) 3.0
(2) 6.0×10^{23} (4) 6.9

14 The potential chemical energy possessed by a substance is dependent on

(1) the composition of the substance, only
(2) the structure of the substance, only
(3) both the composition and structure of the substance
(4) neither the composition nor structure of the substance

15 Between the molecules of which compound is hydrogen bonding strongest?

(1) HF (3) HBr
(2) HCl (4) HI

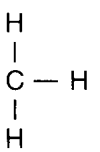
16 Which compound has a high melting point?

(1) SiO_2 (3) SO_2
(2) CO_2 (4) NO_2

17 Which structural formula represents a polar molecule?

(1) H—H

(2) H—C≡C—H

(3)


(4)


18 Which of the following elements has the greatest ability to attract electrons?

(1) Li (3) Na
(2) Be (4) Mg

19 The correct name of the compound with the formula PbO_2 is

(1) lead (I) oxide (3) lead (III) oxide
(2) lead (II) oxide (4) lead (IV) oxide

20 Which element in Group 18 is naturally radioactive and has no stable isotopes?

(1) Ar (3) Xe
(2) Kr (4) Rn

21 Which two elements have chemical properties that are most similar?

(1) Cl and Ar (3) K and Ca
(2) Li and Na (4) C and N

22 Which list of elements contains two metalloids (semimetals)?

(1) Ga, Ge, Sn (3) C, Si, Ge
(2) Si, P, S (4) B, C, N

23 When a potassium atom reacts with bromine, the potassium atom will

(1) lose only 1 electron
(2) lose 2 electrons
(3) gain only 1 electron
(4) gain 2 electrons

24 If *M* represents an alkali metal, what is the formula for the compound formed by *M* and oxygen?

(1) MO_2 (3) M_2O_3
(2) M_2O (4) M_3O_2

25 Properties of nonmetal atoms include

(1) low ionization energy and low electronegativity
(2) low ionization energy and high electronegativity
(3) high ionization energy and low electronegativity
(4) high ionization energy and high electronegativity

26 What is the total number of elements in Group 17 that are gases at room temperature and standard pressure?

(1) 1 (3) 3
(2) 2 (4) 4

27 What is the gram formula mass of $Ca(OH)_2$?

(1) 29 g (3) 57 g
(2) 34 g (4) 74 g

28 What is the empirical formula for C_3H_6?

(1) CH (3) CH_3
(2) CH_2 (4) CH_6

29 What is the percent by mass of carbon in CO_2?

(1) 12 (3) 44
(2) 27 (4) 73

30 Given the reaction:

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

What is the total number of moles of $NH_3(g)$ produced when 10. moles of $H_2(g)$ reacts completely with $N_2(g)$?

(1) 6.7 (3) 3.0
(2) 2.0 (4) 15

31 The volume occupied by 9.03×10^{23} molecules of N_2 gas at STP is closest to

(1) 0.500 liter (3) 22.4 liters
(2) 1.50 liters (4) 33.6 liters

32 A catalyst will affect the rate of the forward reaction by changing the

(1) activation energy
(2) heat of reaction
(3) heat of formation
(4) potential energy of the products

33 For any chemical reaction at equilibrium, the rate of the forward reaction is

(1) less than the rate of the reverse reaction
(2) greater than the rate of the reverse reaction
(3) equal to the rate of the reverse reaction
(4) unrelated to the rate of the reverse reaction

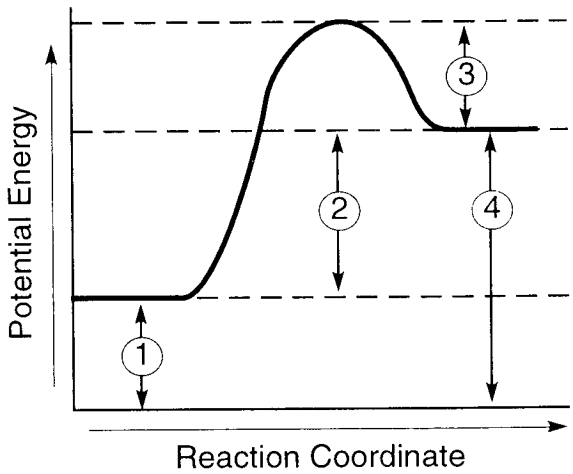
34 In which type of solution does an equilibrium always exist?

(1) supersaturated (3) saturated
(2) unsaturated (4) dilute

35 Given the reaction:

$$N_2(g) + 2O_2(g) \rightleftharpoons 2NO_2(g)$$
$$\Delta H = +7.9 \text{ kcal/mole}$$

The potential energy diagram of the reaction is shown below.



Which arrow represents the heat of reaction (ΔH) for the reverse reaction?

(1) 1 (3) 3
(2) 2 (4) 4

36 Given the reaction at equilibrium:

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) + \text{heat}$$

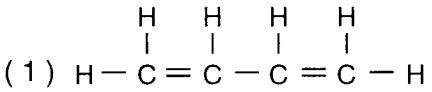
The concentration of $SO_3(g)$ may be increased by

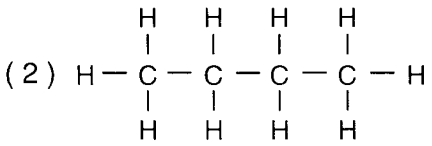
(1) decreasing the concentration of $SO_2(g)$
(2) decreasing the concentration of $O_2(g)$
(3) increasing the pressure
(4) increasing the temperature

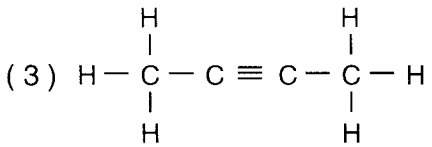
37 According to Reference Table *L*, which of the following Brönsted acids is strongest?

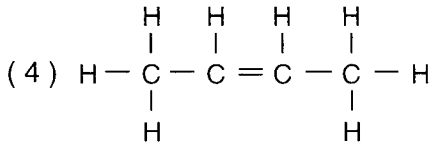
(1) HBr (3) H_2S
(2) HF (4) NH_3

51 Which structural formula represents a member of the alkene series?

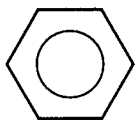
(1)


(2)


(3)


(4)


52 Which molecular formula can be represented by the structural formula shown below?



(1) C_6H_6
(2) C_6H_{10}
(3) C_6H_{12}
(4) C_6H_{14}

Note that questions 53 through 56 have only three choices.

53 As the temperature of a sample of $H_2O(\ell)$ decreases, the average kinetic energy of its molecules will

(1) decrease
(2) increase
(3) remain the same

54 As $NaC_2H_3O_2(s)$ is stirred into water and dissolves, the electrical conductivity of the solution

(1) decreases
(2) increases
(3) remains the same

55 As a substitution reaction occurs, the number of electrons shared between adjacent carbon atoms

(1) decreases
(2) increases
(3) remains the same

56 Given the phase equilibrium in a closed container:

$$H_2O(g) \rightleftharpoons H_2O(\ell)$$

Compared to the rate of gas formation, the rate of liquid formation is

(1) slower
(2) faster
(3) the same

38 A student records the following observations about an unknown solution:

- conducts electricity
- turns blue litmus red

The student should conclude that the unknown solution is most likely

(1) an acid
(2) a base
(3) an ester
(4) an alcohol

39 If 50. milliliters of a 1.0 M NaOH solution is needed to exactly neutralize 10. milliliters of an HCl solution, the molarity of the HCl solution is

(1) 1.0 M
(2) 0.20 M
(3) 5.0 M
(4) 10. M

40 Which compound is a strong Arrhenius base?

(1) C_2H_5OH
(2) CH_3OH
(3) HOH
(4) NaOH

41 What is the pH of a 0.01 M solution of KOH?

(1) 1
(2) 2
(3) 12
(4) 13

42 What are the two Brönsted bases in the reaction $HF(g) + H_2O(\ell) \rightleftharpoons H_3O^+(aq) + F^-(aq)$?

(1) HF(g) and $H_3O^+(aq)$
(2) HF(g) and $F^-(aq)$
(3) $H_2O(\ell)$ and $H_3O^+(aq)$
(4) $H_2O(\ell)$ and $F^-(aq)$

43 In an electrochemical cell, what is the purpose of the salt bridge?

(1) It is the anode.
(2) It is the cathode.
(3) It permits the mixing of solutions between the half-cells.
(4) It permits the migration of ions between the half-cells.

44 What are the two oxidation states of nitrogen in the compound NH_4NO_3?

(1) –3 and –5
(2) –3 and +5
(3) +3 and –5
(4) +3 and +5

45 Given the reaction:

$$4HCl(aq) + MnO_2(s) \rightarrow MnCl_2(aq) + 2H_2O(\ell) + Cl_2(g)$$

The manganese is

(1) reduced and its oxidation number changes from +4 to +2
(2) reduced and its oxidation number changes from +2 to +4
(3) oxidized and its oxidation number changes from +4 to +2
(4) oxidized and its oxidation number changes from +2 to +4

46 Given the reaction:

$$Pb^0(s) + Cu^{2+}(aq) \rightarrow Pb^{2+}(aq) + Cu^0(s)$$

What is the reducing agent?

(1) $Pb^{2+}(aq)$
(2) $Cu^{2+}(aq)$
(3) $Pb^0(s)$
(4) $Cu^0(s)$

47 What occurs when an atom is oxidized in a chemical reaction?

(1) a loss of electrons and a decrease in oxidation number
(2) a loss of electrons and an increase in oxidation number
(3) a gain in electrons and a decrease in oxidation number
(4) a gain in electrons and an increase in oxidation number

48 Given the reaction:

$$2Al^0(s) + 3Ni^{2+}(aq) \rightarrow 2Al^{3+}(aq) + 3Ni^0(s)$$

What is the total number of moles of electrons lost by 2 moles of $Al^0(s)$?

(1) 6
(2) 2
(3) 3
(4) 8

49 Organic compounds always contain the element

(1) hydrogen
(2) carbon
(3) oxygen
(4) sulfur

50 What is the maximum number of covalent bonds that a carbon atom can form?

(1) 1
(2) 2
(3) 3
(4) 4

Part II

This part consists of twelve groups, each containing five questions. Each group tests a major area of the course. Choose seven of these twelve groups. Be sure that you answer all five questions in each group chosen. Record the answers to these questions on the separate answer sheet in accordance with the directions on the front page of this booklet. [35]

Group 1 — Matter and Energy

If you choose this group, be sure to answer questions 57–61.

57 At which temperature does an aqueous solution of LiCl have the highest average kinetic energy?

(1) 100°C
(2) 200°C
(3) 273 K
(4) 373 K

58 Which phase change is exothermic?

(1) $H_2O(s) \rightarrow H_2O(\ell)$
(2) $H_2O(\ell) \rightarrow H_2O(s)$
(3) $H_2O(s) \rightarrow H_2O(g)$
(4) $H_2O(\ell) \rightarrow H_2O(g)$

59 A 2.5-liter sample of gas is at STP. When the temperature is raised to 273°C and the pressure remains constant, the new volume of the gas will be

(1) 1.25 L
(2) 2.5 L
(3) 5.0 L
(4) 10. L

60 Which sample is a homogeneous mixture?

(1) NaCl(s)
(2) NaCl(ℓ)
(3) NaCl(g)
(4) NaCl(aq)

61 Gases *X*, *Y*, and *Z*, in a closed system at constant temperature, have a total pressure of 800 torr. The partial pressure of each gas is shown below.

Gas	Partial Pressure (torr)
X	*A*
Y	*B*
Z	*C*

The partial pressure of gas *X*, in torr, is equal to

(1) $800 - (B + C)$
(2) $(B + C) - 800$
(3) $\frac{(B + C)}{800}$
(4) $\frac{800}{(B + C)}$

Group 2 — Atomic Structure

If you choose this group, be sure to answer questions 62–66.

62 The mass of one carbon atom is approximately equal to the total mass of

(1) 6 neutrons
(2) 6 alpha particles
(3) 12 nucleons
(4) 12 beta particles

63 When an electron in an atom moves from a lower energy state to a higher energy state, the electron will

(1) absorb energy, only
(2) release energy, only
(3) both absorb and release energy
(4) neither absorb nor release energy

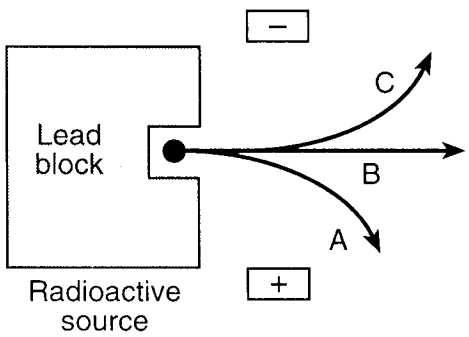
64 What is the total number of valence electrons in an atom of xenon?

(1) 0
(2) 2
(3) 8
(4) 18

65 Which species has the same electron configuration as a Cl^- ion?

(1) S
(2) Ar
(3) Br^-
(4) F^-

66 The diagram below represents radiation passing through an electric field.



The arrow labeled *A* most likely represents

(1) a positron
(2) an electron
(3) alpha radiation
(4) gamma radiation

Group 3 — Bonding

If you choose this group, be sure to answer questions 67–71.

67 What is the total number of moles of atoms represented by the formula $Al(C_2H_3O_2)_3$?

(1) 22
(2) 11
(3) 8
(4) 4

68 What is the formula for lead (II) oxide?

(1) PbO
(2) PbO_2
(3) Pb_2O
(4) Pb_2O_3

69 Which pair of atoms will share electrons when a bond is formed between them?

(1) Ba and I
(2) Br and Cl
(3) K and Cl
(4) Li and I

70 Which formula is described correctly?

(1) $BaCl_2$ is covalent and molecular.
(2) H_2O_2 is covalent and empirical.
(3) H_2O is ionic and molecular.
(4) NaCl is ionic and empirical.

71 The bond between which two elements is the *least* ionic in character?

(1) H–F
(2) H–Cl
(3) H–I
(4) H–O

Group 4 — Periodic Table

If you choose this group, be sure to answer questions 72–76.

72 Atoms of an element in the ground state found in Period 4 of the Periodic Table must have

(1) a 3*d* sublevel
(2) 4 valence electrons
(3) electrons in the fourth principal energy level
(4) similar properties to the other elements in the period

73 Atoms of which of the following elements have the *smallest* covalent radius?

(1) Si
(2) P
(3) S
(4) Cl

74 Which salt contains an ion that forms a colored solution?

(1) $Mg(NO_3)_2$
(2) $Ca(NO_3)_2$
(3) $Ni(NO_3)_3$
(4) $Al(NO_3)_3$

75 Which number represents the first ionization energy of a nonmetal?

(1) 119 kcal/mol
(2) 138 kcal/mol
(3) 194 kcal/mol
(4) 239 kcal/mol

76 A Mg atom differs from a Mg^{2+} ion in that the atom has a

(1) smaller radius
(2) larger radius
(3) smaller nucleus
(4) larger nucleus

Group 5 — Mathematics of Chemistry

If you choose this group, be sure to answer questions 77–81.

77 At STP, which gas diffuses at the fastest rate?

(1) H_2
(2) N_2
(3) CO_2
(4) NH_3

78 Which solution has the highest boiling point?

(1) 1.0 M KNO_3
(2) 2.0 M KNO_3
(3) 1.0 M $Ca(NO_3)_2$
(4) 2.0 M $Ca(NO_3)_2$

79 Given the reaction:

$$C_3H_8(g) + 5O_2(g) \rightarrow 4H_2O(g) + 3CO_2(g)$$

What is the total number of liters of $H_2O(g)$ produced when 1.0 liter of $C_3H_8(g)$ reacts completely with 5.0 liters of $O_2(g)$?

(1) 1.0
(2) 5.0
(3) 3.0
(4) 4.0

80 What is the total number of kilocalories of heat needed to change 150 grams of ice to water at 0°C? [Heat of fusion = 80. calories per gram]

(1) 12
(2) 2.0
(3) 70.
(4) 230

81 A gas occupies a volume of 500. milliliters at a pressure of 380. torr and a temperature of 298 K. At what temperature will the gas occupy a volume of 250. milliliters and have a pressure of 760. torr?

(1) 149 K
(2) 298 K
(3) 447 K
(4) 596 K

Group 6 — Kinetics and Equilibrium

If you choose this group, be sure to answer questions 82–86.

82 According to Reference Table *G*, which compound is formed from its elements during an exothermic reaction?

(1) HI(g)
(2) $CO_2(g)$
(3) NO(g)
(4) $NO_2(g)$

83 Which is the correct equilibrium expression for the system $AB(s) \rightleftharpoons A^+(aq) + B^-(aq)$?

(1) $K_{sp} = [AB]$
(2) $K_{sp} = \frac{[A^+]}{[AB]}$
(3) $K_{sp} = [A^+][B^-]$
(4) $K_{sp} = \frac{[AB]}{[B^-]}$

84 Based on Reference Table *D*, a solution of $NaNO_3$ that contains 120 grams of solute dissolved in 100 grams of H_2O at 50°C is best described as

(1) saturated and dilute
(2) saturated and concentrated
(3) supersaturated and dilute
(4) supersaturated and concentrated

85 Given the reaction at equilibrium:

$$AgBr(s) \rightleftharpoons Ag^+(aq) + Br^-(aq)$$

Which change occurs when KBr(s) is dissolved in the reaction mixture?

(1) The amount of AgBr(s) decreases.
(2) The amount of AgBr(s) remains the same.
(3) The concentration of $Ag^+(aq)$ decreases.
(4) The concentration of $Ag^+(aq)$ remains the same.

86 When a reaction is exothermic and the products have more entropy than the reactants, the reaction is

(1) spontaneous, with a negative ΔG
(2) spontaneous, with a positive ΔG
(3) nonspontaneous, with a negative ΔG
(4) nonspontaneous, with a positive ΔG

Group 7 — Acids and Bases

If you choose this group, be sure to answer questions 87–91.

87 Which formula represents a compound that is a strong electrolyte?

(1) $C_6H_{12}O_6$
(2) $C_{12}H_{22}O_{11}$
(3) HNO_2
(4) HNO_3

88 Which is the conjugate acid of HSO_4^-?

(1) H_2SO_4
(2) H_3O^+
(3) HSO_3^-
(4) SO_4^{2-}

89 According to Reference Table *L*, which substance is amphoteric (amphiprotic)?

(1) H_3PO_4
(2) HPO_4^{2-}
(3) H_2SO_4
(4) SO_4^{2-}

90 The table below gives data on the conductivity and pH of solutions *A*, *B*, *C*, and *D*.

Solution	Conductivity	pH
A	good	greater than 7
B	good	7
C	good	less than 7
D	poor	less than 7

Which solution is most likely ammonium chloride?

(1) *A*
(2) *B*
(3) *C*
(4) *D*

91 Water containing phenolphthalein will change from colorless to pink with the addition of

(1) HOH
(2) HCl
(3) KOH
(4) KCl

Group 8 — Redox and Electrochemistry

If you choose this group, be sure to answer questions 92–96.

92 What is indicated when a chemical cell's voltage (E^0) has dropped to zero?

(1) The concentration of the reactants has increased.
(2) The concentration of the products has decreased.
(3) The cell reaction has reached equilibrium.
(4) The cell reaction has completely stopped.

93 What is the standard electrode potential (E^0) assigned to the half-reaction $Fe^{2+} + 2e^- \rightarrow Fe(s)$, as compared to the standard hydrogen half-reaction?

(1) −0.45 V
(2) +0.45 V
(3) −0.77 V
(4) +0.77 V

94 Which of the following ions is the *weakest* oxidizing agent?

(1) Au^{3+}
(2) Cr^{3+}
(3) Hg^{2+}
(4) Ba^{2+}

95 Given the redox reaction:

$$2Cr(s) + 3Cu^{2+}(aq) \rightarrow 2Cr^{3+}(aq) + 3Cu(s)$$

Which reaction occurs at the cathode in an electrochemical cell?

(1) reduction of $Cu^{2+}(aq)$
(2) reduction of Cu(s)
(3) oxidation of $Cr^{3+}(aq)$
(4) oxidation of Cr(s)

96 Given the cell reaction:

$$2H_2O(\ell) + \text{electricity} \rightarrow 2H_2(g) + O_2(g)$$

This cell is best described as

(1) an electrolytic cell in which an exothermic reaction occurs
(2) an electrolytic cell in which an endothermic reaction occurs
(3) a chemical cell in which an exothermic reaction occurs
(4) a chemical cell in which an endothermic reaction occurs

Group 9 — Organic Chemistry

If you choose this group, be sure to answer questions 97–101.

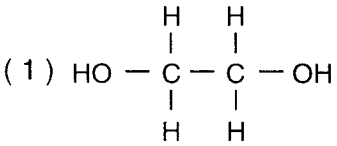
97 Given the reaction:

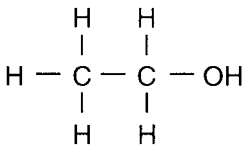
$$C_2H_2 + 2H_2 \rightarrow C_2H_6$$

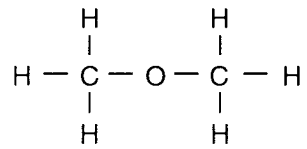
This reaction represents

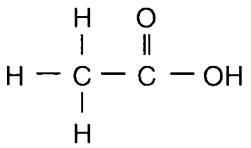
(1) substitution
(2) addition
(3) esterification
(4) saponification

98 Which structural formula represents a monohydroxy alcohol?

(1)


(2)


(3)


(4)


99 Which pair of names refers to the same compound?

(1) ethyne and acetylene
(2) ethyne and ethene
(3) ethane and acetylene
(4) ethane and ethene

100 A condensation polymerization reaction is best described as the

(1) joining of monomers by the removal of oxygen
(2) joining of monomers by the removal of water
(3) oxidation of a hydrocarbon by oxygen
(4) oxidation of a hydrocarbon by water

101 Which formula represents a ketone?

(1) CH_3COOH
(2) C_2H_5OH
(3) CH_3COCH_3
(4) CH_3COOCH_3

Group 10 — Applications of Chemical Principles

If you choose this group, be sure to answer questions 102–106.

102 Which metal is used as a coating on steel to limit corrosion?

(1) Na
(2) Ca
(3) K
(4) Zn

103 Which substance is obtained primarily by the fractional distillation of petroleum?

(1) glycerine
(2) kerosene
(3) ethanol
(4) acetone

104 Given the Haber reaction at equilibrium:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) + \text{heat}$$

Which stress on the system will decrease the production of $NH_3(g)$?

(1) increasing the concentration of $N_2(g)$
(2) increasing the pressure on the system
(3) decreasing the concentration of $H_2(g)$
(4) decreasing the temperature on the system

105 Given the nickel-cadmium battery reaction:

$$2NiOOH + Cd + 2H_2O \underset{\text{charge}}{\overset{\text{discharge}}{\rightleftharpoons}} 2Ni(OH)_2 + Cd(OH)_2$$

What occurs during discharge in the nickel-cadmium battery?

(1) Ni^{3+} is reduced to Ni^{2+}.
(2) Ni^{2+} is reduced to Ni^{3+}.
(3) Ni^{3+} is oxidized to Ni^{2+}.
(4) Ni^{2+} is oxidized to Ni^{3+}.

106 Which element is obtained only by the electrolysis of its fused salt?

(1) lithium
(2) gold
(3) silver
(4) zinc

Group 11 — Nuclear Chemistry

If you choose this group, be sure to answer questions 107–111.

107 In a nuclear reactor, water can serve as

(1) a moderator, only
(2) a coolant, only
(3) both a moderator and a coolant
(4) neither a moderator nor a coolant

108 The course of a chemical reaction can be traced by using a

(1) polar molecule
(2) diatomic molecule
(3) stable isotope
(4) radioisotope

109 The primary use of a particle accelerator is to

(1) detect a radioactive particle
(2) isolate a radioactive particle
(3) increase the kinetic energy of a charged particle
(4) increase the potential energy of a charged particle

110 Given the reaction:

$$^{2}_{1}H + {}^{2}_{1}H \rightarrow {}^{4}_{2}He + \text{energy}$$

The process represented by the reaction is called

(1) fission
(2) fusion
(3) artificial transmutation
(4) alpha decay

111 Given the correctly balanced nuclear equation:

$$^{12}_{6}C + {}^{249}_{98}Cf \rightarrow {}^{257}_{104}Unq + 4X$$

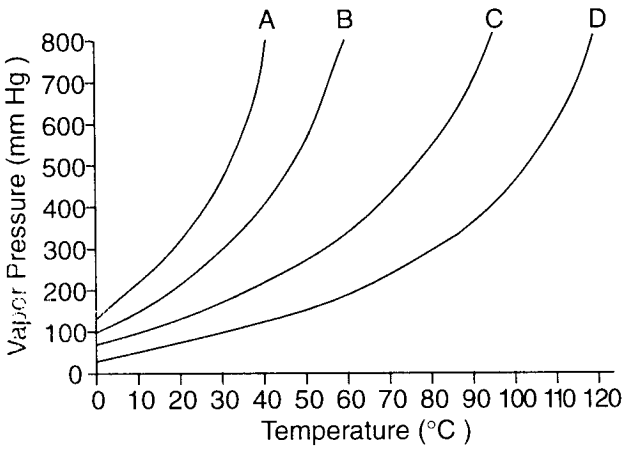
Which particle is represented by the X?

(1) $^{1}_{1}H$
(2) $^{1}_{0}n$
(3) $^{4}_{2}He$
(4) $^{0}_{-1}e$

Group 12 — Laboratory Activities

If you choose this group, be sure to answer questions 112–116.

112 The graph below represents the vapor curves of four liquids.



Which liquid has the highest normal boiling point?

(1) *A* (3) *C*
(2) *B* (4) *D*

113 When ammonium chloride crystals are dissolved in water, the temperature of the water decreases. What does this temperature change indicate about the dissolving of ammonium chloride in water?

(1) It is an endothermic reaction because it absorbs heat.
(2) It is an endothermic reaction because it releases heat.
(3) It is an exothermic reaction because it absorbs heat.
(4) It is an exothermic reaction because it releases heat.

114 Which process can be used to separate water from $BaCl_2 \cdot 2H_2O$?

(1) dehydration (3) sublimation
(2) condensation (4) filtration

115 What is the quotient of 8.01 grams divided by 3.127 grams, expressed to the correct number of significant figures?

(1) 2.6 (3) 2.562
(2) 2.56 (4) 2.5616

116 The following data were collected by a student performing an acid-base titration:

Volume of the acid, HCl = 20.0 mL
Molarity of the acid = 0.50 M
Volume of the base, NaOH = 40.0 mL

From the collected data, the concentration of the base should be calculated as

(1) 1.0 M (3) 0.25 M
(2) 2.0 M (4) 0.50 M

Part II (35 credits)

Answer the questions in only seven of the twelve groups in this part. Be sure to mark the answers to the groups of questions you choose in accordance with the instructions on the front cover of the test booklet. Leave blank the five groups of questions you do not choose to answer.

Group 1 Matter and Energy				
57	1	2	3	4
58	1	2	3	4
59	1	2	3	4
60	1	2	3	4
61	1	2	3	4

Group 2 Atomic Structure				
62	1	2	3	4
63	1	2	3	4
64	1	2	3	4
65	1	2	3	4
66	1	2	3	4

Group 3 Bonding				
67	1	2	3	4
68	1	2	3	4
69	1	2	3	4
70	1	2	3	4
71	1	2	3	4

Group 4 Periodic Table				
72	1	2	3	4
73	1	2	3	4
74	1	2	3	4
75	1	2	3	4
76	1	2	3	4

Group 5 Mathematics of Chemistry				
77	1	2	3	4
78	1	2	3	4
79	1	2	3	4
80	1	2	3	4
81	1	2	3	4

Group 6 Kinetics and Equilibrium				
82	1	2	3	4
83	1	2	3	4
84	1	2	3	4
85	1	2	3	4
86	1	2	3	4

Group 7 Acids and Bases				
87	1	2	3	4
88	1	2	3	4
89	1	2	3	4
90	1	2	3	4
91	1	2	3	4

Group 8 Redox and Electrochemistry				
92	1	2	3	4
93	1	2	3	4
94	1	2	3	4
95	1	2	3	4
96	1	2	3	4

Group 9 Organic Chemistry				
97	1	2	3	4
98	1	2	3	4
99	1	2	3	4
100	1	2	3	4
101	1	2	3	4

Group 10 Applications of Chemical Principles				
102	1	2	3	4
103	1	2	3	4
104	1	2	3	4
105	1	2	3	4
106	1	2	3	4

Group 11 Nuclear Chemistry				
107	1	2	3	4
108	1	2	3	4
109	1	2	3	4
110	1	2	3	4
111	1	2	3	4

Group 12 Laboratory Activities				
112	1	2	3	4
113	1	2	3	4
114	1	2	3	4
115	1	2	3	4
116	1	2	3	4

I do hereby affirm, at the close of this examination, that I had no unlawful knowledge of the questions or answers prior to the examination and that I have neither given nor received assistance in answering any of the questions during the examination.

_____

Signature

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

CHEMISTRY

Thursday, August 12, 1999 — 12:30 to 3:30 p.m., only

ANSWER SHEET

Student ..... Sex: ☐ Male ☐ Female

Teacher .....

School .....

Record all of your answers on this answer sheet in accordance with the instructions on the front cover of the test booklet.

Part I (65 credits)

1	1	2	3	4	**21**	1	2	3	4	**41**	1	2	3	4
2	1	2	3	4	**22**	1	2	3	4	**42**	1	2	3	4
3	1	2	3	4	**23**	1	2	3	4	**43**	1	2	3	4
4	1	2	3	4	**24**	1	2	3	4	**44**	1	2	3	4
5	1	2	3	4	**25**	1	2	3	4	**45**	1	2	3	4
6	1	2	3	4	**26**	1	2	3	4	**46**	1	2	3	4
7	1	2	3	4	**27**	1	2	3	4	**47**	1	2	3	4
8	1	2	3	4	**28**	1	2	3	4	**48**	1	2	3	4
9	1	2	3	4	**29**	1	2	3	4	**49**	1	2	3	4
10	1	2	3	4	**30**	1	2	3	4	**50**	1	2	3	4
11	1	2	3	4	**31**	1	2	3	4	**51**	1	2	3	4
12	1	2	3	4	**32**	1	2	3	4	**52**	1	2	3	4
13	1	2	3	4	**33**	1	2	3	4	**53**	1	2	3	
14	1	2	3	4	**34**	1	2	3	4	**54**	1	2	3	
15	1	2	3	4	**35**	1	2	3	4	**55**	1	2	3	
16	1	2	3	4	**36**	1	2	3	4	**56**	1	2	3	
17	1	2	3	4	**37**	1	2	3	4					
18	1	2	3	4	**38**	1	2	3	4					
19	1	2	3	4	**39**	1	2	3	4					
20	1	2	3	4	**40**	1	2	3	4					

Your answers for Part II should be placed in the proper spaces on the back of this sheet.

FOR TEACHER USE ONLY

Credits

Part I ....
(Use table below)

Part II ....

Total ....

Rater's Initials: .....

Part I Credits

Directions to Teacher:

In the table below, draw a circle around the number of right answers and the adjacent number of credits. Then write the number of credits (not the number right) in the space provided above.

No. Right	Credits	No. Right	Credits
56	**65**	28	**41**
55	**64**	27	**40**
54	**63**	26	**39**
53	**62**	25	**39**
52	**62**	24	**38**
51	**61**	23	**37**
50	**60**	22	**36**
49	**59**	21	**35**
48	**58**	20	**34**
47	**57**	19	**33**
46	**56**	18	**33**
45	**56**	17	**32**
44	**55**	16	**31**
43	**54**	15	**30**
42	**53**	14	**29**
41	**52**	13	**27**
40	**51**	12	**25**
39	**51**	11	**23**
38	**50**	10	**21**
37	**49**	9	**19**
36	**48**	8	**17**
35	**47**	7	**14**
34	**46**	6	**12**
33	**45**	5	**10**
32	**45**	4	**8**
31	**44**	3	**6**
30	**43**	2	**4**
29	**42**	1	**2**
		0	**0**

No. right .....

FOR TEACHERS ONLY

C

The University of the State of New York
REGENTS HIGH SCHOOL EXAMINATION

CHEMISTRY

Thursday, August 12, 1999—12:30 to 3:30 p.m., only

SCORING KEY

Part I

Refer to the table on the answer sheet for the number of credits to be given on Part I.

Part I (65 credits)

1	1	**X**	3	4	21	1	**X**	3	4	41	1	2	**X**	4
2	1	2	**X**	4	22	1	2	**X**	4	42	1	2	3	**X**
3	1	**X**	3	4	23	**X**	2	3	4	43	1	2	3	**X**
4	**X**	2	3	4	24	1	**X**	3	4	44	1	**X**	3	4
5	1	2	3	**X**	25	1	2	3	**X**	45	**X**	2	3	4
6	1	2	3	**X**	26	1	**X**	3	4	46	1	2	**X**	4
7	1	**X**	3	4	27	1	2	3	**X**	47	1	**X**	3	4
8	1	2	**X**	4	28	1	**X**	3	4	48	**X**	2	3	4
9	1	2	**X**	4	29	1	**X**	3	4	49	1	**X**	3	4
10	**X**	2	3	4	30	**X**	2	3	4	50	1	2	3	**X**
11	1	**X**	3	4	31	1	2	3	**X**	51	1	2	3	**X**
12	**X**	2	3	4	32	**X**	2	3	4	52	**X**	2	3	4
13	1	**X**	3	4	33	1	2	**X**	4	53	**X**	2	3	
14	1	2	**X**	4	34	1	2	**X**	4	54	1	**X**	3	
15	**X**	2	3	4	35	1	**X**	3	4	55	1	2	**X**	
16	**X**	2	3	4	36	1	2	**X**	4	56	1	2	**X**	
17	1	2	3	**X**	37	**X**	2	3	4					
18	1	**X**	3	4	38	**X**	2	3	4					
19	1	2	3	**X**	39	1	2	**X**	4					
20	1	2	3	**X**	40	1	2	3	**X**					

Directions to the teacher:

Use only *red* ink or *red* pencil in rating Regents examination papers. Do *not* correct the student's work by making insertions or changes of any kind.

Scan each answer sheet to make certain that the student has marked only one answer for each question. If a student has marked two or more answers with an X in ink, draw a red line through the row of numbers for that question to indicate that no credit is to be allowed for that question when the answer sheet is scored.

To facilitate scoring, the scoring key has been printed in the same format as the answer sheet. The scoring key may be made into a scoring stencil by punching out the correct answers. Be sure that the stencil is aligned with the answer sheet so that the holes correspond to the correct answers. To aid in proper alignment, punch out the first and last item numbers in each part and place the stencil on the answer sheet so that these item numbers appear through the appropriate holes.

Part II

Allow a total of 35 credits, one credit for each question, for only seven of the twelve groups in this part. If more than seven groups are answered, only the first seven answered should be considered.

Group 1 Matter and Energy				
57	1	**X**	3	4
58	1	**X**	3	4
59	1	2	**X**	4
60	1	2	3	**X**
61	**X**	2	3	4

Group 2 Atomic Structure				
62	1	2	**X**	4
63	**X**	2	3	4
64	1	2	**X**	4
65	1	**X**	3	4
66	1	**X**	3	4

Group 3 Bonding				
67	**X**	2	3	4
68	**X**	2	3	4
69	1	**X**	3	4
70	1	2	3	**X**
71	1	2	**X**	4

Group 4 Periodic Table				
72	1	2	**X**	4
73	1	2	3	**X**
74	1	2	**X**	4
75	1	2	3	**X**
76	1	**X**	3	4

Group 5 Mathematics of Chemistry				
77	**X**	2	3	4
78	1	2	3	**X**
79	1	2	3	**X**
80	**X**	2	3	4
81	1	**X**	3	4

Group 6 Kinetics and Equilibrium				
82	1	**X**	3	4
83	1	2	**X**	4
84	1	2	3	**X**
85	1	2	**X**	4
86	**X**	2	3	4

Group 7 Acids and Bases				
87	1	2	3	**X**
88	**X**	2	3	4
89	1	**X**	3	4
90	1	2	**X**	4
91	1	2	**X**	4

Group 8 Redox and Electrochemistry				
92	1	2	**X**	4
93	**X**	2	3	4
94	1	2	3	**X**
95	**X**	2	3	4
96	1	**X**	3	4

Group 9 Organic Chemistry				
97	1	**X**	3	4
98	1	**X**	3	4
99	**X**	2	3	4
100	1	**X**	3	4
101	1	2	**X**	4

Group 10 Applications of Chemical Principles				
102	1	2	3	**X**
103	1	**X**	3	4
104	1	2	**X**	4
105	**X**	2	3	4
106	**X**	2	3	4

Group 11 Nuclear Chemistry				
107	1	2	**X**	4
108	1	2	3	**X**
109	1	2	**X**	4
110	1	**X**	3	4
111	1	**X**	3	4

Group 12 Laboratory Activities				
112	1	2	3	**X**
113	**X**	2	3	4
114	**X**	2	3	4
115	1	**X**	3	4
116	1	2	**X**	4