

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

CHEMISTRY

Thursday, June 21, 2001 — 9:15 a.m. to 12:15 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: 1 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.

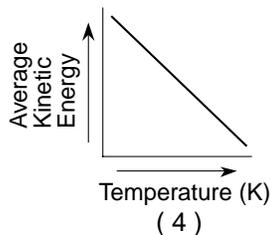
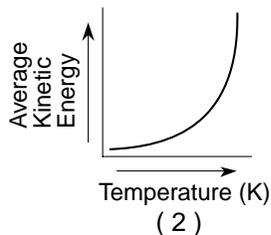
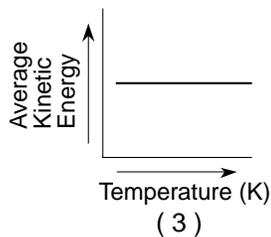
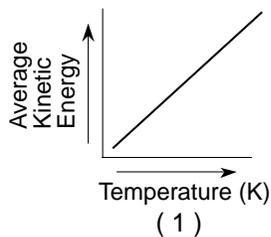
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Part I

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 graph best shows the relationship between Kelvin temperature and average kinetic energy?



- 2 At 1 atmosphere of pressure, water and ice can exist in equilibrium at a temperature of

- (1) 212°C (3) 32°C
(2) 100°C (4) 0°C

- 3 Which unit is used to express the energy absorbed or released during a chemical reaction?

- (1) kelvin (3) volt
(2) calorie (4) torr

- 4 When the vapor pressure of water is 149.4 torr, the temperature of the water is

- (1) 20°C (3) 60°C
(2) 40°C (4) 80°C

- 5 Which substance will readily sublime at STP?

- (1) Fe(s) (3) NaCl(s)
(2) C₆H₁₂O₆(s) (4) CO₂(s)

- 6 Standard temperature and a pressure of 0.5 atmosphere are equal to

- (1) 0°C and 380 torr (3) 0°C and 760 torr
(2) 32°C and 380 torr (4) 32°C and 760 torr

- 7 An atom of fluorine has a mass of 19 atomic mass units. The total number of protons and neutrons in its nucleus is

- (1) 9 (3) 19
(2) 10 (4) 28

- 8 Given the reaction: ${}^{226}_{88}\text{Ra} \rightarrow {}^{222}_{86}\text{Rn} + X$

Which type of emanation is represented by X?

- (1) alpha particle (3) proton
(2) beta particle (4) positron

- 9 What is the atomic number of an element that has six protons and eight neutrons?

- (1) 6 (3) 8
(2) 2 (4) 14

- 10 Which statement about the mass of an electron is correct?

- (1) The mass of an electron is equal to the mass of a proton.
(2) The mass of an electron is less than the mass of a proton.
(3) The mass of an electron is equal to the mass of a neutron.
(4) The mass of an electron is greater than the mass of a neutron.

- 11 How many electrons are in the outermost principal energy level of an atom of carbon in the ground state?

- (1) 6 (3) 3
(2) 2 (4) 4

12 In which group do the particles contain only nucleons?

- (1) protons and electrons
- (2) neutrons and electrons
- (3) protons and neutrons
- (4) protons, neutrons, and electrons

13 Given the electron dot diagram:



The electrons in the bond between hydrogen and fluorine are more strongly attracted to the atom of

- (1) hydrogen, which has the higher electronegativity
- (2) fluorine, which has the higher electronegativity
- (3) hydrogen, which has the lower electronegativity
- (4) fluorine, which has the lower electronegativity

14 In which system do molecule-ion attractions exist?

- (1) $\text{KCl}(s)$
- (2) $\text{KCl}(aq)$
- (3) $\text{KCl}(\ell)$
- (4) $\text{KCl}(g)$

15 In which compound do atoms form bonds by sharing electrons?

- (1) H_2O
- (2) Na_2O
- (3) CaO
- (4) MgO

16 Which type of attraction results from the formation of weak momentary dipoles?

- (1) ionic
- (2) metallic
- (3) molecule-ion
- (4) van der Waals forces

17 Which substance contains nonpolar covalent bonds?

- (1) H_2
- (2) H_2O
- (3) $\text{Ca}(\text{OH})_2$
- (4) CaO

18 Silicon dioxide (SiO_2) and diamonds are best described as

- (1) molecular substances with coordinate covalent bonding
- (2) molecular substances with ionic bonding
- (3) network solids with covalent bonding
- (4) network solids with ionic bonding

19 When a reaction occurs between atoms with ground-state electron configurations of $1s^2 2s^1$ and $1s^2 2s^2 2p^5$, the bond formed is mainly

- (1) polar covalent
- (2) nonpolar covalent
- (3) metallic
- (4) ionic

20 According to Reference Table K, which sequence correctly places the elements in order of increasing ionization energy?

- (1) $\text{H} \rightarrow \text{Li} \rightarrow \text{Na} \rightarrow \text{K}$
- (2) $\text{I} \rightarrow \text{Br} \rightarrow \text{Cl} \rightarrow \text{F}$
- (3) $\text{O} \rightarrow \text{S} \rightarrow \text{Se} \rightarrow \text{Te}$
- (4) $\text{H} \rightarrow \text{Be} \rightarrow \text{Al} \rightarrow \text{Ga}$

21 Which of the following Period 4 elements has the most metallic characteristics?

- (1) Ca
- (2) Ge
- (3) As
- (4) Br

22 Which element is an alkali metal?

- (1) Na
- (2) Mg
- (3) Al
- (4) Cl

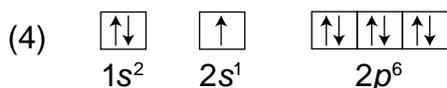
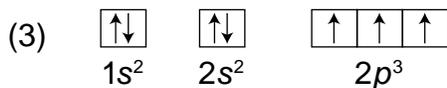
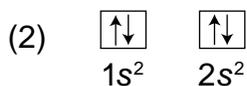
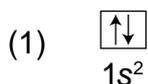
23 In general, atoms of transition elements in Period 5 are characterized by an incomplete

- (1) $3p$ subshell
- (2) $4p$ subshell
- (3) $3d$ subshell
- (4) $4d$ subshell

24 Most of the groups in the Periodic Table of the Elements contain

- (1) nonmetals, only
- (2) metals, only
- (3) nonmetals and metals
- (4) metals and metalloids

25 Which orbital notation represents a noble gas in the ground state?



26 The empirical formula of a compound is CH₃. The molecular formula of this compound could be

- (1) CH₄ (2) C₂H₄ (3) C₂H₆ (4) C₃H₆

27 Given the equation: H₂(g) + Cl₂(g) → 2HCl(g)

What is the total number of moles of HCl(g) produced when 3 moles of H₂(g) is completely consumed?

- (1) 5 moles (2) 2 moles (3) 3 moles (4) 6 moles

28 The number of moles of molecules in a 12.0-gram sample of Cl₂ is

- (1) $\frac{12.0}{35.5}$ mole (2) $\frac{12.0}{71.0}$ mole (3) 12.0 moles (4) 12.0 × 35.5 moles

29 The percent by mass of water in the hydrate Na₂SO₄ · 10H₂O is closest to

- (1) 18% (2) 44% (3) 56% (4) 76%

30 Which compound is *least* soluble in 100 grams of water at 40°C?

- (1) SO₂ (2) NaCl (3) KClO₃ (4) NH₄Cl

31 At STP, 3 × 10²³ molecules of SO₂(g) occupy the same volume as

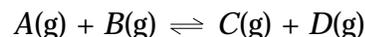
- (1) 1 mole of H₂(g)
(2) 6 × 10²³ molecules of H₂(g)
(3) 0.5 mole of H₂(g)
(4) 4 grams of H₂(g)

32 Given the reaction: 2SO₂(g) + O₂(g) ⇌ 2SO₃(g)

The value of the equilibrium constant (K_{eq}) will be changed by increasing the

- (1) pressure
(2) temperature
(3) concentration of SO₂(g)
(4) concentration of SO₃(g)

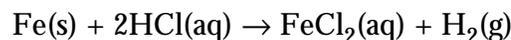
33 Given the reaction at equilibrium:



The addition of a catalyst will

- (1) shift the equilibrium to the right
(2) shift the equilibrium to the left
(3) increase the rate of forward and reverse reactions equally
(4) have no effect on the forward or reverse reactions

34 Given the reaction:



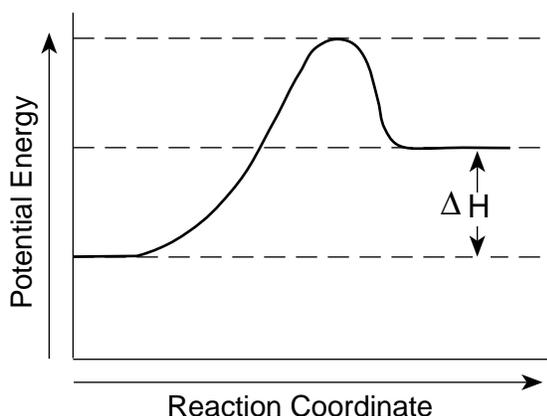
In this reaction, 5 grams of powdered iron will react faster than a 1-gram piece of solid iron because the powdered iron

- (1) has less surface area
(2) has more surface area
(3) is less dense
(4) is more dense

35 What is the total number of moles of solute in 2.0 liters of 3.0 M NaOH?

- (1) 1.0 mole (2) 2.0 moles (3) 3.0 moles (4) 6.0 moles

- 36 The diagram below represents the energy changes that occur during the formation of a certain compound under standard conditions.



According to Reference Table G, the compound could be

- (1) $C_2H_6(g)$ (3) $ICl(g)$
 (2) $CO_2(g)$ (4) $SO_2(g)$
- 37 What is the pH of a solution that results from the complete neutralization of an HCl solution with a KOH solution?
- (1) 1 (3) 10
 (2) 7 (4) 4
- 38 According to Reference Table L, which ion is amphiprotic (amphoteric)?
- (1) HPO_4^{2-} (3) NH_2^-
 (2) PO_4^{3-} (4) S^{2-}
- 39 Given the reaction:
- $$CO_3^{2-} + H_2O \rightleftharpoons HCO_3^- + OH^-$$
- The H_2O molecule serves as a
- (1) weak base (3) proton donor
 (2) strong base (4) proton acceptor
- 40 Under standard conditions, which metal will react with 0.1 M HCl to liberate hydrogen gas?
- (1) Ag (3) Cu
 (2) Au (4) Mg

- 41 Given the ionization constant equation:

$$K_w = [H^+][OH^-] = 1.0 \times 10^{-14}$$

For water at 25°C, which statement is true?

- (1) $[H^+] = [OH^-]$
 (2) $[H^+] > [OH^-]$
 (3) $[H^+] = 1.0 \times 10^{-14} M$
 (4) $[OH^-] = 1.0 \times 10^{-14} M$
- 42 How many milliliters of 0.20 M KOH are needed to completely neutralize 90.0 milliliters of 0.10 M HCl?
- (1) 25 mL (3) 90. mL
 (2) 45 mL (4) 180 mL
- 43 Which 0.1-molar aqueous solution is the best conductor of electricity?
- (1) H_2S (3) H_2SO_4
 (2) HF (4) H_3PO_4
- 44 A chemical cell is made up of two half-cells connected by an external conductor and a salt bridge. The function of the salt bridge is to
- (1) permit the migration of ions
 (2) permit the mixing of solutions
 (3) prevent the migration of ions
 (4) prevent the flow of electrons
- 45 Given the redox reaction:
- $$2Cr(s) + 3Sn^{2+}(aq) \rightarrow 2Cr^{3+}(aq) + 3Sn(s)$$
- Which species serves as the reducing agent?
- (1) Cr (3) Cr^{3+}
 (2) Sn^{2+} (4) Sn
- 46 In which substance does phosphorus have a +3 oxidation state?
- (1) P_4O_{10} (3) $Ca_3(PO_4)_2$
 (2) PCl_5 (4) KH_2PO_3

47 Which half-reaction correctly represents oxidation?

- (1) $\text{Fe(s)} \rightarrow \text{Fe}^{2+}(\text{aq}) + 2\text{e}^-$
- (2) $\text{Fe}^{2+}(\text{aq}) \rightarrow \text{Fe(s)} + 2\text{e}^-$
- (3) $\text{Fe(s)} + 2\text{e}^- \rightarrow \text{Fe}^{2+}(\text{aq})$
- (4) $\text{Fe}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Fe(s)}$

48 The four single bonds of a carbon atom in CH_4 are directed toward the corners of a

- (1) square
- (2) tetrahedron
- (3) rectangle
- (4) parallelogram

49 In which group could the hydrocarbons all belong to the same homologous series?

- (1) $\text{C}_2\text{H}_2, \text{C}_2\text{H}_4, \text{C}_2\text{H}_6$
- (2) $\text{C}_2\text{H}_2, \text{C}_2\text{H}_4, \text{C}_4\text{H}_8$
- (3) $\text{C}_2\text{H}_4, \text{C}_2\text{H}_6, \text{C}_3\text{H}_6$
- (4) $\text{C}_2\text{H}_4, \text{C}_3\text{H}_6, \text{C}_4\text{H}_8$

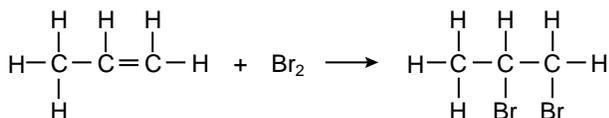
50 The formula for a saturated hydrocarbon is

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

51 Which compound is an isomer of $\text{CH}_3\text{CH}_2\text{OH}$?

- (1) CH_3COOH
- (2) $\text{CH}_3\text{CH}_2\text{CH}_3$
- (3) CH_3OCH_3
- (4) CH_3COCH_3

52 Given the organic reaction:



This reaction is an example of

- (1) fermentation
- (2) addition
- (3) substitution
- (4) saponification

Note that questions 53 through 56 have only three choices.

53 As the atoms of the elements in Group 1 of the Periodic Table are considered from top to bottom, the number of valence electrons in the atoms of each successive element

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

54 As an electrochemical cell approaches equilibrium, the electrical energy supplied by the cell

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

55 In an oxidation-reduction reaction, the oxidation number of the oxidizing agent

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

56 As ^{14}C decays to ^{14}N , the number of protons in the nucleus

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

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 Which phase change is accompanied by the release of heat?
- (1) $\text{H}_2\text{O}(\text{s}) \rightarrow \text{H}_2\text{O}(\text{g})$
 - (2) $\text{H}_2\text{O}(\text{s}) \rightarrow \text{H}_2\text{O}(\ell)$
 - (3) $\text{H}_2\text{O}(\ell) \rightarrow \text{H}_2\text{O}(\text{g})$
 - (4) $\text{H}_2\text{O}(\ell) \rightarrow \text{H}_2\text{O}(\text{s})$
- 58 What will be the new volume of a 1.00-mole sample of a gas at STP if the pressure remains constant and the Kelvin temperature is halved?
- (1) 11.2 L
 - (2) 22.4 L
 - (3) 33.6 L
 - (4) 44.8 L
- 59 At constant temperature, the relationship between the volume (V) of a given mass of gas and its pressure (P) is
- (1) $V = kP$
 - (2) $P = kV$
 - (3) $PV = k$
 - (4) $\frac{V}{P} = k$
- 60 Which formula represents a homogeneous mixture?
- (1) $\text{H}_2\text{O}(\ell)$
 - (2) $\text{H}_2\text{S}(\text{g})$
 - (3) $\text{NaH}(\text{s})$
 - (4) $\text{HCl}(\text{aq})$
- 61 When a substance melts, it undergoes the process called
- (1) condensation
 - (2) fusion
 - (3) sublimation
 - (4) vaporization
-

Group 2 — Atomic Structure

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

- 62 What is the most probable location of an electron?
- (1) an orbital
 - (2) a nucleus
 - (3) a sublevel
 - (4) a principal energy level
- 63 In Period 2 of the Periodic Table, which Group contains the element with the highest first ionization energy?
- (1) alkali metals
 - (2) alkaline earth metals
 - (3) halogens
 - (4) noble gases
- 64 Isotopes are atoms that have the same number of protons but a different
- (1) number of electrons
 - (2) number of neutrons
 - (3) atomic number
 - (4) nuclear charge
- 65 What is the total number of atoms contained in a 1.00-mole sample of helium?
- (1) 1.00 atom
 - (2) 2.00 atoms
 - (3) 1.20×10^{24} atoms
 - (4) 6.02×10^{23} atoms
- 66 The light produced by signs using neon gas results from electrons that are
- (1) moving from a higher to a lower principal energy level
 - (2) moving from a lower to a higher principal energy level
 - (3) being lost by the $\text{Ne}(\text{g})$ atoms
 - (4) being gained by the $\text{Ne}(\text{g})$ atoms
-

Group 3 — Bonding

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

- 67 Which formula correctly represents antimony (V) oxide?
- (1) SbO_5 (3) Sb_2O_5
(2) Sb_5O (4) Sb_5O_2
- 68 Metallic bonding occurs between metal atoms that have
- (1) full valence orbitals and low ionization energies
(2) full valence orbitals and high ionization energies
(3) vacant valence orbitals and low ionization energies
(4) vacant valence orbitals and high ionization energies
- 69 Which substance contains a bond with the greatest ionic character?
- (1) KCl (3) Cl_2
(2) HCl (4) F_2
- 70 When a sodium atom reacts with a chlorine atom to form a compound, the electron configurations of the ions forming the compound are the same as those in which noble gas atoms?
- (1) krypton and neon (3) neon and helium
(2) krypton and argon (4) neon and argon
- 71 Which type of substance is soft, has a low melting point, and is a poor conductor of heat and electricity?
- (1) network solid (3) metallic solid
(2) molecular solid (4) ionic solid
-

Group 4 — Periodic Table

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

- 72 The elements in Period 3 all contain the same number of
- (1) protons
(2) neutrons
(3) valence electrons
(4) occupied principal energy levels
- 73 Compared to atoms of metals, atoms of non-metals generally
- (1) have higher electronegativities
(2) have lower first ionization energies
(3) conduct electricity more readily
(4) lose electrons more readily
- 74 Aqueous solutions of compounds containing element X are blue. Element X could be
- (1) carbon (3) sodium
(2) copper (4) sulfur
- 75 Which element attains the structure of a noble gas when it becomes a $1+$ ion?
- (1) K (3) F
(2) Ca (4) Ne
- 76 Compared to an atom of potassium, an atom of calcium has a
- (1) larger radius and lower reactivity
(2) larger radius and higher reactivity
(3) smaller radius and lower reactivity
(4) smaller radius and higher reactivity
-

Group 5 — Mathematics of Chemistry

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

- 77 What is the density of N_2 at STP?
- (1) 1.00 g/L (3) 1.43 g/L
(2) 1.25 g/L (4) 1.98 g/L
- 78 Which concentration of a sugar solution has a boiling point of 100.52°C at standard pressure?
- (1) 1.0 molal (3) 3.0 molal
(2) 2.0 molal (4) 4.0 molal
- 79 How much energy is required to vaporize 10.00 grams of water at its boiling point?
- (1) 53.94 cal (3) 5,394 cal
(2) 79.92 cal (4) 7,972 cal
- 80 A gas has a volume of 1,400 milliliters at a temperature of 20. K and a pressure of 760 mmHg. What will be the new volume when the temperature is changed to 40. K and the pressure is changed to 380 mmHg?
- (1) 350 mL (3) 1,400 mL
(2) 750 mL (4) 5,600 mL
- 81 What is the empirical formula of a compound that contains 30.4% nitrogen and 69.6% oxygen by mass?
- (1) NO (3) N_2O_3
(2) NO_2 (4) N_2O_5
-

Group 6 — Kinetics and Equilibrium

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

- 82 Given the reaction at equilibrium:
- $$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$
- Which expression correctly represents the K_{eq} for this reaction?
- (1) $K_{eq} = \frac{[2HI]}{[H_2][I_2]}$ (3) $K_{eq} = \frac{[HI]^2}{[H_2][I_2]}$
(2) $K_{eq} = \frac{[H_2][I_2]}{[HI]^2}$ (4) $K_{eq} = \frac{[H][I]}{[HI]^2}$
- 83 Which statement best describes a chemical reaction in which energy is released?
- (1) It is exothermic and has a negative ΔH .
(2) It is exothermic and has a positive ΔH .
(3) It is endothermic and has a negative ΔH .
(4) It is endothermic and has a positive ΔH .
- 84 Which compound forms spontaneously from its elements at 1 atm and 298 K?
- (1) $C_2H_2(g)$ (3) $HF(g)$
(2) $C_2H_4(g)$ (4) $HI(g)$
- 85 A solute is added to water and a portion of the solute remains undissolved. When equilibrium between the dissolved and undissolved solute is reached, the solution must be
- (1) dilute (3) unsaturated
(2) saturated (4) supersaturated
- 86 According to Reference Table M, which substance is most soluble?
- (1) AgI (3) $PbCl_2$
(2) $CaSO_4$ (4) $ZnCO_3$
-

Group 7 — Acids and Bases

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

87 A solution has a hydroxide ion concentration of 1×10^{-5} M. What is the hydrogen ion concentration of the solution?

- (1) 1×10^{-1} M (3) 1×10^{-9} M
(2) 1×10^{-5} M (4) 1×10^{-14} M

88 Based on Reference Table L, the K_a of H_2S is 9.5×10^{-8} . This value indicates that H_2S is a

- (1) highly ionized strong acid
(2) highly ionized weak acid
(3) slightly ionized strong acid
(4) slightly ionized weak acid

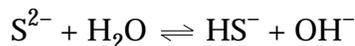
89 How many hydroxide ions are needed to completely neutralize 1.0 liter of 0.50 M HCl?

- (1) 1.5×10^{23} ions (3) 6.0×10^{23} ions
(2) 3.0×10^{23} ions (4) 12×10^{23} ions

90 What is the pH of a 0.001 M HNO_3 solution?

- (1) 1 (3) 3
(2) 2 (4) 11

91 Given the reaction at equilibrium:



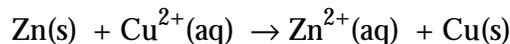
Which species acts as a Brønsted base in the forward reaction?

- (1) S^{2-} (3) HS^-
(2) H_2O (4) OH^-
-

Group 8 — Redox and Electrochemistry

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

92 Given the reaction:



What is the net potential (E^0) for the overall reaction?

- (1) -1.10 V (3) $+0.42$ V
(2) -0.42 V (4) $+1.10$ V

93 Which reaction occurs at the anode in electrochemical cells and in electrolytic cells?

- (1) reduction, only
(2) oxidation, only
(3) both reduction and oxidation
(4) neither reduction nor oxidation

94 What occurs during the reaction below?



- (1) The manganese is reduced and its oxidation number changes from +4 to +2.
(2) The manganese is oxidized and its oxidation number changes from +4 to +2.
(3) The manganese is reduced and its oxidation number changes from +2 to +4.
(4) The manganese is oxidized and its oxidation number changes from +2 to +4.

95 Based on Reference Table N, which metal will react spontaneously with Al^{3+} ?

- (1) Co(s) (3) Cu(s)
(2) Cr(s) (4) Ca(s)

96 Which statement describes the redox reaction that occurs when an object is electroplated?

- (1) It is spontaneous and requires an electric current.
(2) It is spontaneous and produces an electric current.
(3) It is nonspontaneous and requires an electric current.
(4) It is nonspontaneous and produces an electric current.
-

Group 9 — Organic Chemistry

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

97 Cellulose, protein, and starch are classified as

- (1) aldehydes
- (2) esters
- (3) synthetic polymers
- (4) natural polymers

98 An example of a secondary alcohol is

- (1) 1-propanol
- (2) 2-propanol
- (3) 1,2-propanediol
- (4) 1,2,3-propanetriol

99 What is the correct formula for butene?

- (1) C_4H_4
- (2) C_4H_6
- (3) C_4H_8
- (4) C_4H_{10}

100 Which hydrocarbon is a member of the benzene series?

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

101 Which formula represents a ketone?

- (1) HCOOH
 - (2) HCHO
 - (3) CH_3COCH_3
 - (4) CH_3CH_2OH
-

Group 10 — Applications of Chemical Principles

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

102 Which type of reaction produces electrical energy in a nickel-cadmium battery?

- (1) redox
- (2) hydrolysis
- (3) neutralization
- (4) combustion

103 Which equation represents a cracking reaction?

- (1) $C_{22}H_{44} + HBr \rightarrow C_{22}H_{45}Br$
- (2) $C_{22}H_{46} \rightarrow C_8H_{18} + C_{14}H_{28}$
- (3) $C_5H_{10} + Br_2 \rightarrow C_5H_{10}Br_2$
- (4) $C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$

104 Petroleum is a complex mixture of

- (1) hydroxides
- (2) hydrocarbons
- (3) esters
- (4) ethers

105 Which metal can be produced only by the electrolysis of its fused salt?

- (1) Ag
- (2) Zn
- (3) Pb
- (4) K

106 Which compound is produced in the contact process?

- (1) HCl
 - (2) HNO_3
 - (3) H_2SO_4
 - (4) H_3PO_4
-

Group 11 — Nuclear Chemistry

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

107 Which substance can be used as both a coolant and a moderator in a nuclear reactor?

- (1) heavy water (3) graphite
(2) carbon dioxide (4) helium

108 A radioactive isotope used in the study of many organic reaction mechanisms is

- (1) carbon-12 (3) oxygen-16
(2) carbon-14 (4) oxygen-18

109 High energy is a requirement for fusion reactions to occur because the nuclei involved

- (1) attract each other because they have like charges
(2) attract each other because they have unlike charges
(3) repel each other because they have like charges
(4) repel each other because they have unlike charges

110 Which equation represents artificial transmutation?

- (1) ${}_{92}^{238}\text{U} \rightarrow {}_{90}^{234}\text{Th} + {}_2^4\text{He}$
(2) ${}_{90}^{234}\text{Th} \rightarrow {}_{91}^{234}\text{Pa} + {}_{-1}^0\text{e}$
(3) ${}_{84}^{218}\text{Po} \rightarrow {}_{82}^{214}\text{Pb} + {}_2^4\text{He}$
(4) ${}_4^9\text{Be} + {}_2^4\text{He} \rightarrow {}_6^{12}\text{C} + {}_0^1\text{n}$

111 Which substance is a gaseous radioactive waste product that is released into the atmosphere after it has decayed to a safe radiation level?

- (1) radon-222 (3) cesium-137
(2) radium-226 (4) cobalt-60

Group 12 — Laboratory Activities

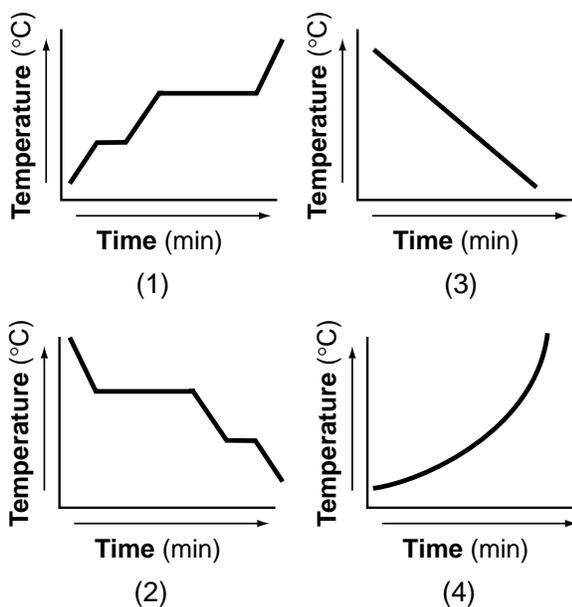
If you choose this group, be sure to answer questions 112–116.

- 112 Salt *A* and salt *B* were each dissolved in separate beakers of water at 21°C. The temperature of the salt *A* solution decreased, and the temperature of the salt *B* solution increased.

Based on these results, which conclusion is correct?

- (1) The water gained energy from both salt *A* and salt *B*.
- (2) The water lost energy to both salt *A* and salt *B*.
- (3) The water gained energy from salt *A* and lost energy to salt *B*.
- (4) The water lost energy to salt *A* and gained energy from salt *B*.

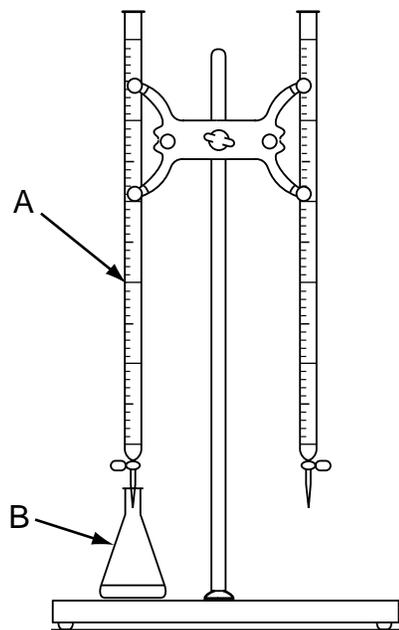
- 113 Which graph could represent the uniform cooling of a substance, starting with the gaseous phase and ending with the solid phase?



- 114 A student determined in the laboratory that the percent by mass of water in $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ is 40.0%. If the accepted value is 36%, what is the percent of error?

- (1) 0.11%
- (2) 1.1%
- (3) 11%
- (4) 4.0%

- 115 The diagram below shows a laboratory setup that can be used in a titration.



Which pieces of equipment are indicated by arrows *A* and *B*, respectively?

- (1) buret and Erlenmeyer flask
 - (2) buret and volumetric flask
 - (3) pipet and Erlenmeyer flask
 - (4) pipet and volumetric flask
- 116 A solution contains 12.55 grams of a solid dissolved in 50.0 milliliters of water. What is the number of grams of solid dissolved per milliliter of water, rounded to the correct number of significant figures?

- (1) 0.25 g/mL
- (2) 0.251 g/mL
- (3) 0.3 g/mL
- (4) 0.2510 g/mL

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.

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| 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

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The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

CHEMISTRY

Thursday, June 21, 2001 — 9:15 a.m. to 12:15 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

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