

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

CHEMISTRY

Tuesday, June 23, 1998 — 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: ⊗ 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.

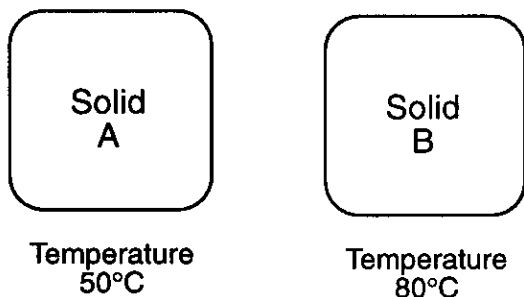
DO NOT OPEN THIS EXAMINATION BOOKLET UNTIL THE SIGNAL IS GIVEN.

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 The diagrams below represent two solids and the temperature of each.



What occurs when the two solids are placed in contact with each other?

- (1) Heat energy flows from solid A to solid B. Solid A decreases in temperature.
 - (2) Heat energy flows from solid A to solid B. Solid A increases in temperature.
 - (3) Heat energy flows from solid B to solid A. Solid B decreases in temperature.
 - (4) Heat energy flows from solid B to solid A. Solid B increases in temperature.
- 2 The particles of a substance are arranged in a definite geometric pattern and are constantly vibrating. This substance can be in
- (1) the solid phase, only
 - (2) the liquid phase, only
 - (3) either the liquid or the solid phase
 - (4) neither the liquid nor the solid phase
- 3 What is the pressure of a mixture of CO_2 , SO_2 , and H_2O gases, if each gas has a partial pressure of 250 torr?
- (1) 250 torr
 - (2) 500 torr
 - (3) 750 torr
 - (4) 1000 torr
- 4 Which substances can be decomposed chemically?
- (1) CaO and Ca
 - (2) MgO and Mg
 - (3) CO and Co
 - (4) CaO and MgO

- 5 A gas sample has a volume of 25.0 milliliters at a pressure of 1.00 atmosphere. If the volume increases to 50.0 milliliters and the temperature remains constant, the new pressure will be

- (1) 1.00 atm
- (2) 2.00 atm
- (3) 0.250 atm
- (4) 0.500 atm

- 6 An atom with the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^2$ has an incomplete

- (1) 2p sublevel
- (2) second principal energy level
- (3) third principal energy level
- (4) 4s sublevel

- 7 Which orbital notation represents a boron atom in the ground state?

(1) $1s \uparrow \quad 2s \uparrow\downarrow \quad 2p \uparrow \quad \square \quad \uparrow$

(2) $1s \uparrow\downarrow \quad 2s \uparrow\downarrow \quad 2p \uparrow \quad \square \quad \square$

(3) $1s \uparrow\downarrow \quad 2s \square \quad 2p \uparrow \quad \uparrow \quad \uparrow$

(4) $1s \uparrow\downarrow \quad 2s \uparrow \quad 2p \uparrow \quad \uparrow \quad \square$

- 8 In the equation ${}^{234}_{90}\text{Th} \rightarrow {}^{234}_{91}\text{Pa} + X$, the symbol X represents

- (1) ${}^0_+1e$
- (2) ${}^0_-1e$
- (3) 1_0n
- (4) 1_1H

- 9 Which subatomic particle is found in the nucleus of all isotopes of hydrogen?
 (1) proton (3) electron
 (2) neutron (4) positron
- 10 What is the highest principal quantum number (n) for an electron in an atom of sulfur in the ground state?
 (1) 1 (3) 3
 (2) 2 (4) 4
- 11 What is the total number of electrons in a completely filled fourth principal energy level?
 (1) 8 (3) 16
 (2) 10 (4) 32
- 12 What is the total number of hydrogen atoms required to form 1 molecule of $C_3H_5(OH)_3$?
 (1) 1 (3) 3
 (2) 5 (4) 8
- 13 Which element is found in both potassium chlorate and zinc nitrate?
 (1) hydrogen (3) potassium
 (2) oxygen (4) zinc
- 14 Which formula represents lead (II) phosphate?
 (1) $PbPO_4$ (3) $Pb_3(PO_4)_2$
 (2) Pb_4PO_4 (4) $Pb_2(PO_4)_3$
- 15 Atoms of which element have the *weakest* attraction for electrons?
 (1) Na (3) Si
 (2) P (4) S
- 16 The ability to conduct electricity in the solid state is a characteristic of metallic bonding. This characteristic is best explained by the presence of
 (1) high ionization energies
 (2) high electronegativities
 (3) mobile electrons
 (4) mobile protons
- 17 When ionic bonds are formed, metallic atoms tend to
 (1) lose electrons and become negative ions
 (2) lose electrons and become positive ions
 (3) gain electrons and become negative ions
 (4) gain electrons and become positive ions
- 18 The bond between hydrogen and oxygen in a water molecule is classified as
 (1) ionic and nonpolar
 (2) ionic and polar
 (3) covalent and nonpolar
 (4) covalent and polar
- 19 According to the Periodic Table, which element has more than one positive oxidation state?
 (1) cadmium (3) silver
 (2) iron (4) zinc
- 20 Which group contains a liquid that is a nonmetal at STP?
 (1) 14 (3) 16
 (2) 15 (4) 17
- 21 Which of these Group 14 elements has the most metallic properties?
 (1) C (3) Si
 (2) Ge (4) Sn
- 22 As the elements in Group 2 are considered in order of increasing atomic number, the atomic radius of each successive element increases. This increase is primarily due to an increase in the number of
 (1) occupied principal energy levels
 (2) electrons in the outermost shell
 (3) neutrons in the nucleus
 (4) unpaired electrons
- 23 Which element is classified as a metalloid (semi-metal)?
 (1) sulfur (3) barium
 (2) silicon (4) bromine

24 Which element in Group 1 has the greatest tendency to lose an electron?

- (1) cesium (3) potassium
(2) rubidium (4) sodium

25 The table below shows some properties of elements A, B, C, and D.

Element	Ionization Energy	Electronegativity	Conductivity of Heat and Electricity
A	low	low	low
B	low	low	high
C	high	high	low
D	high	high	high

Which element is most likely a nonmetal?

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

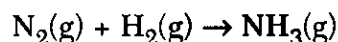
26 What is the gram formula mass of $\text{Ca}_3(\text{PO}_4)_2$?

- (1) 135 g/mol (3) 278 g/mol
(2) 215 g/mol (4) 310. g/mol

27 The gram atomic mass of oxygen is 16.0 grams per mole. How many atoms of oxygen does this mass represent?

- (1) 16.0 (3) 6.02×10^{23}
(2) 32.0 (4) $2(6.02 \times 10^{23})$

28 Given the *unbalanced* equation:



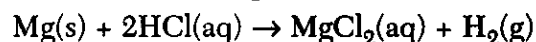
When the equation is balanced using smallest whole-number coefficients, the ratio of moles of hydrogen consumed to moles of ammonia produced is

- (1) 1:3 (3) 3:1
(2) 2:3 (4) 3:2

29 What is the concentration of a solution of 10. moles of copper (II) nitrate in 5.0 liters of solution?

- (1) 0.50 M (3) 5.0 M
(2) 2.0 M (4) 10. M

30 Given the balanced equation:



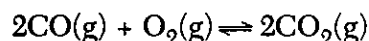
At STP, what is the total number of liters of hydrogen gas produced when 3.00 moles of hydrochloric acid solution is completely consumed?

- (1) 11.2 L (3) 33.6 L
(2) 22.4 L (4) 44.8 L

31 According to Reference Table D, which compound's solubility decreases most rapidly when the temperature increases from 50°C to 70°C ?

- (1) NH_3 (3) SO_2
(2) HCl (4) KNO_3

32 Given the reaction at equilibrium:



When the reaction is subjected to stress, a change will occur in the concentration of

- (1) reactants, only
(2) products, only
(3) both reactants and products
(4) neither reactants nor products

33 An increase in the temperature of a system at equilibrium favors the

- (1) endothermic reaction and decreases its rate
(2) endothermic reaction and increases its rate
(3) exothermic reaction and decreases its rate
(4) exothermic reaction and increases its rate

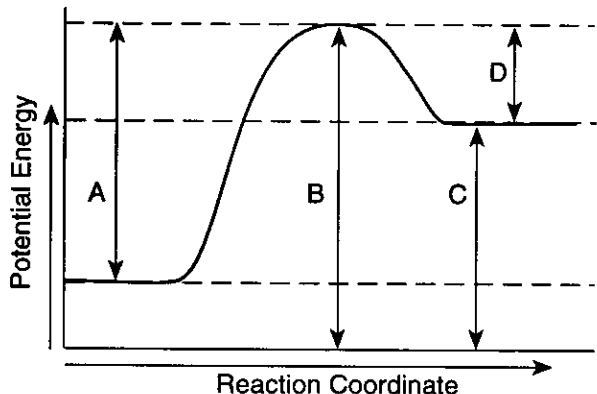
34 Based on Reference Table L, which compound, when in aqueous solution, is the best conductor of electricity?

- (1) HF (3) H_2O
(2) H_2S (4) H_2SO_4

35 A compound that can act as an acid or a base is referred to as

- (1) a neutral substance
(2) an amphoteric substance
(3) a monomer
(4) an isomer

Base your answers to questions 36 and 37 on the potential energy diagram of a chemical reaction shown below.



36 Which arrow represents the activation energy for the forward reaction?

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

37 The forward reaction is best described as an

- (1) exothermic reaction in which energy is released
(2) exothermic reaction in which energy is absorbed
(3) endothermic reaction in which energy is released
(4) endothermic reaction in which energy is absorbed

38 In the reaction $\text{HNO}_3 + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{NO}_3^-$, the two Brønsted acids are

- (1) H_2O and HNO_3 (3) H_2O and H_3O^+
(2) H_2O and NO_3^- (4) HNO_3 and H_3O^+

39 Which substance can be classified as an Arrhenius acid?

- (1) HCl (3) LiOH
(2) NaCl (4) KOH

40 How many milliliters of 0.20 M HCl are needed to exactly neutralize 40. milliliters of 0.40 M KOH?

- (1) 20. mL (3) 80. mL
(2) 40. mL (4) 160 mL

41 Which 0.1 M solution will turn phenolphthalein pink?

- (1) $\text{HBr}(\text{aq})$ (3) $\text{LiOH}(\text{aq})$
(2) $\text{CO}_2(\text{aq})$ (4) $\text{CH}_3\text{OH}(\text{aq})$

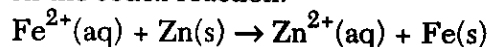
42 Which compound is an electrolyte?

- (1) CH_3OH (3) $\text{C}_3\text{H}_5(\text{OH})_3$
(2) CH_3COOH (4) $\text{C}_{12}\text{H}_{22}\text{O}_{11}$

43 What is the oxidation number of chlorine in HClO_4 ?

- (1) +1 (3) +3
(2) +5 (4) +7

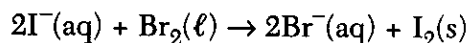
44 Given the redox reaction:



Which species acts as a reducing agent?

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

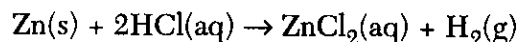
45 Given the redox reaction:



What occurs during this reaction?

- (1) The I^- ion is oxidized, and its oxidation number increases.
(2) The I^- ion is oxidized, and its oxidation number decreases.
(3) The I^- ion is reduced, and its oxidation number increases.
(4) The I^- ion is reduced, and its oxidation number decreases.

46 Given the reaction:



Which equation represents the correct oxidation half-reaction?

- (1) $\text{Zn}(\text{s}) \rightarrow \text{Zn}^{2+} + 2\text{e}^-$
(2) $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2(\text{g})$
(3) $\text{Zn}^{2+} + 2\text{e}^- \rightarrow \text{Zn}(\text{s})$
(4) $2\text{Cl}^- \rightarrow \text{Cl}_2(\text{g}) + 2\text{e}^-$

47 According to Reference Table N, which redox reaction occurs spontaneously?

- (1) $\text{Cu}(s) + 2\text{H}^+ \rightarrow \text{Cu}^{2+} + \text{H}_2(g)$
- (2) $\text{Mg}(s) + 2\text{H}^+ \rightarrow \text{Mg}^{2+} + \text{H}_2(g)$
- (3) $2\text{Ag}(s) + 2\text{H}^+ \rightarrow 2\text{Ag}^+ + \text{H}_2(g)$
- (4) $\text{Hg}(\ell) + 2\text{H}^+ \rightarrow \text{Hg}^{2+} + \text{H}_2(g)$

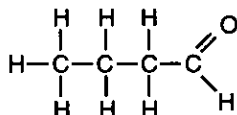
48 Which quantities are conserved in all oxidation-reduction reactions?

- (1) charge, only
- (2) mass, only
- (3) both charge and mass
- (4) neither charge nor mass

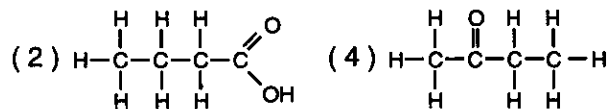
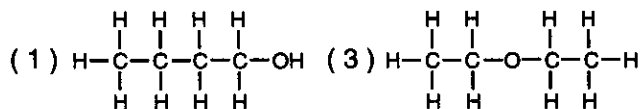
49 The reaction $\text{CH}_2\text{CH}_2 + \text{H}_2 \rightarrow \text{CH}_3\text{CH}_3$ is an example of

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

50 Given the compound:



Which structural formula represents an isomer?



51 In which pair of hydrocarbons does each compound contain only one double bond per molecule?

- (1) C_2H_2 and C_2H_6
- (2) C_2H_2 and C_3H_6
- (3) C_4H_8 and C_2H_4
- (4) C_6H_6 and C_7H_8

52 Which organic compound is classified as an acid?

- (1) $\text{CH}_3\text{CH}_2\text{COOH}$
- (2) $\text{CH}_3\text{CH}_2\text{OH}$
- (3) $\text{C}_{12}\text{H}_{22}\text{O}_{11}$
- (4) $\text{C}_6\text{H}_{12}\text{O}_6$

53 The products of the fermentation of a sugar are ethanol and

- (1) water
- (2) oxygen
- (3) carbon dioxide
- (4) sulfur dioxide

Note that questions 54 through 56 have only three choices.

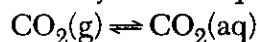
54 As the temperature of $\text{H}_2\text{O}(\ell)$ in a closed system decreases, the vapor pressure of the $\text{H}_2\text{O}(\ell)$

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

55 As the number of neutrons in the nucleus of a given atom of an element increases, the atomic number of that element

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

56 Given the closed system at equilibrium:



As the pressure on the system increases, the solubility of the $\text{CO}_2(g)$

- (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 The table below shows the temperature, pressure, and volume of five samples.

Sample	Substance	Temperature (K)	Pressure (atm)	Volume (L)
A	He	273	1	22.4
B	O ₂	273	1	22.4
C	Ne	273	2	22.4
D	N ₂	546	2	44.8
E	Ar	546	2	44.8

Which sample contains the same number of molecules as sample A?

- | | |
|-------|-------|
| (1) E | (3) C |
| (2) B | (4) D |

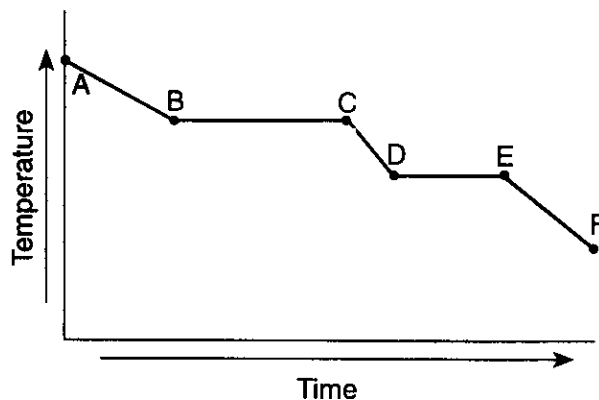
58 The energy absorbed when ammonium chloride dissolves in water can be measured in

- | | |
|------------------|---------------------|
| (1) degrees | (3) moles per liter |
| (2) kilocalories | (4) liters per mole |

59 At 1 atmosphere of pressure, the steam-water equilibrium occurs at a temperature of

- | | |
|-----------|-----------|
| (1) 0 K | (3) 273 K |
| (2) 100 K | (4) 373 K |

60 The graph below represents the uniform cooling of a substance, starting with the substance as a gas above its boiling point.



During which interval is the substance completely in the liquid phase?

- | | |
|--------|--------|
| (1) AB | (3) CD |
| (2) BC | (4) DE |

61 Which two compounds readily sublime at room temperature (25°C)?

- (1) CO₂(s) and I₂(s)
- (2) CO₂(s) and C₆H₁₂O₆(s)
- (3) NaCl(s) and I₂(s)
- (4) NaCl(s) and C₆H₁₂O₆(s)

Group 2 — Atomic Structure

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

62 Which electron configuration is possible for a nitrogen atom in the excited state?

- (1) $1s^2 2s^2 2p^3$ (3) $1s^2 2s^2 2p^4$
(2) $1s^2 2s^2 2p^2 3s^1$ (4) $1s^2 2s^2 2p^2$

63 What is the total amount of energy required to remove the most loosely bound electron from each atom in a mole of gaseous Ca?

- (1) 100 kcal/mol (3) 141 kcal/mol
(2) 119 kcal/mol (4) 176 kcal/mol

64 What is the total number of unpaired electrons in an atom of nickel in the ground state?

- (1) 0 (3) 3
(2) 2 (4) 4

65 The characteristic bright-line spectrum of an element is produced when its electrons

- (1) form a covalent bond
(2) form an ionic bond
(3) move to a higher energy state
(4) return to a lower energy state

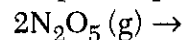
66 Which emanation has *no* mass and *no* charge?

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

Group 3 — Bonding

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

67 Given the incomplete equation:



Which set of products completes and balances the incomplete equation?

- (1) $2\text{N}_2(\text{g}) + 3\text{H}_2(\text{g})$ (3) $4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$
(2) $2\text{N}_2(\text{g}) + 2\text{O}_2(\text{g})$ (4) $4\text{NO}(\text{g}) + 5\text{O}_2(\text{g})$

68 Which structural formula represents a nonpolar molecule?

- (1) H—Cl (3) H—H

- (2) $\begin{array}{c} \text{H} - \text{O} \\ | \\ \text{H} \end{array}$ (4) $\begin{array}{c} \text{H} - \text{N} - \text{H} \\ | \\ \text{H} \end{array}$

69 Compared to the boiling point of H_2S , the boiling point of H_2O is relatively high. Which type of bonding causes this difference?

- (1) covalent (3) ionic
(2) hydrogen (4) network

70 In which system do molecule-ion attractions exist?

- (1) $\text{NaCl}(\text{aq})$ (3) $\text{C}_6\text{H}_{12}\text{O}_6(\text{aq})$
(2) $\text{NaCl}(\text{s})$ (4) $\text{C}_6\text{H}_{12}\text{O}_6(\text{s})$

71 An example of an empirical formula is

- (1) C_4H_{10} (3) $\text{HC}_2\text{H}_3\text{O}_2$
(2) $\text{C}_6\text{H}_{12}\text{O}_6$ (4) CH_2O
-

Group 4 — Periodic Table

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

72 The elements from which two groups of the Periodic Table are most similar in their chemical properties?

- (1) 1 and 2 (3) 2 and 17
(2) 1 and 17 (4) 17 and 18

73 Which metal is most likely obtained by the electrolysis of its fused salt?

- (1) Au (3) Li
(2) Ag (4) Zn

74 Which aqueous solution is colored?

- (1) $\text{CuSO}_4(\text{aq})$ (3) $\text{KCl}(\text{aq})$
(2) $\text{BaCl}_2(\text{aq})$ (4) $\text{MgSO}_4(\text{aq})$

75 Because of its high reactivity, which element is *never* found free in nature?

- (1) O (3) N
(2) F (4) Ne

76 Which Group 18 element is most likely to form a compound with the element fluorine?

- (1) He (3) Ar
(2) Ne (4) Kr
-

Group 5 — Mathematics of Chemistry

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

77 At STP, which gas will diffuse more rapidly than Ne?

- (1) He (3) Kr
(2) Ar (4) Xe

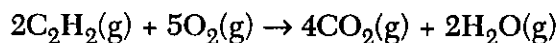
78 The heat of fusion of a compound is 30.0 calories per gram. What is the total number of calories of heat that must be absorbed by a 15.0-gram sample to change the compound from solid to liquid at its melting point?

- (1) 15.0 cal (3) 150. cal
(2) 45.0 cal (4) 450. cal

79 Which gas has a density of 1.70 grams per liter at STP?

- (1) $\text{F}_2(\text{g})$ (3) $\text{N}_2(\text{g})$
(2) $\text{He}(\text{g})$ (4) $\text{SO}_2(\text{g})$

80 Given the reaction:



What is the total number of grams of $\text{O}_2(\text{g})$ needed to react completely with 0.50 mole of $\text{C}_2\text{H}_2(\text{g})$?

- (1) 10. g (3) 80. g
(2) 40. g (4) 160 g

81 Which statement describes $\text{KCl}(\text{aq})$?

- (1) KCl is the **solute** in a homogeneous mixture.
(2) KCl is the **solute** in a heterogeneous mixture.
(3) KCl is the **solvent** in a homogeneous mixture.
(4) KCl is the **solvent** in a heterogeneous mixture.
-

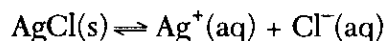
Group 6 — Kinetics and Equilibrium

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

82 According to Reference Table G, which compound will form spontaneously from its elements?

- (1) ethene (3) nitrogen (II) oxide
(2) hydrogen iodide (4) magnesium oxide

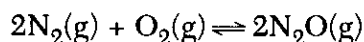
83 Given the equilibrium reaction:



At 25°C, the K_{sp} is equal to

- (1) 6.0×10^{-23} (3) 1.0×10^{-7}
(2) 1.8×10^{-10} (4) 9.6×10^{-4}

84 Given the reaction:



Which statement is true when this closed system reaches equilibrium?

- (1) All of the $\text{N}_2(g)$ has been consumed.
(2) All of the $\text{O}_2(g)$ has been consumed.
(3) Pressure changes no longer occur.
(4) The forward reaction no longer occurs.

85 Which equation is used to determine the free energy change during a chemical reaction?

- (1) $\Delta G = \Delta H - \Delta S$ (3) $\Delta G = \Delta H - T\Delta S$
(2) $\Delta G = \Delta H + \Delta S$ (4) $\Delta G = \Delta H + T\Delta S$

86 Which is the correct equilibrium expression for the reaction $2A(g) + 3B(g) \rightleftharpoons C(g) + 3D(g)$?

- (1) $K = \frac{[2A] + [3B]}{[C] + [3D]}$ (3) $K = \frac{[A]^2 [B]^3}{[C] [D]^3}$
(2) $K = \frac{[C] + [3D]}{[2A] + [3B]}$ (4) $K = \frac{[C] [D]^3}{[A]^2 [B]^3}$
-

Group 7 — Acids and Bases

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

87 According to Reference Table L, what is the conjugate acid of the hydroxide ion (OH^-)?

- (1) O^{2-} (3) H_2O
(2) H^+ (4) H_3O^+

88 Which of the following is the *weakest* Brønsted acid?

- (1) NH_4^+ (3) H_2SO_4
(2) HSO_4^- (4) HNO_3

89 Which compound is a salt?

- (1) CH_3OH (3) $\text{H}_2\text{C}_2\text{O}_4$
(2) $\text{C}_6\text{H}_{12}\text{O}_6$ (4) $\text{KC}_2\text{H}_3\text{O}_2$

90 What is the pH of a solution with a hydronium ion concentration of 0.01 mole per liter?

- (1) 1 (3) 10
(2) 2 (4) 14

91 Given the equation: $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$

Which type of reaction does the equation represent?

- (1) esterification (3) hydrolysis
(2) decomposition (4) neutralization
-

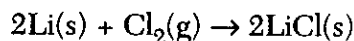
Group 8 — Redox and Electricity

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

92 Which reduction half-reaction has a standard electrode potential (E^0) of 1.50 volts?

- (1) $\text{Au}^{3+} + 3e^- \rightarrow \text{Au}(s)$
- (2) $\text{Al}^{3+} + 3e^- \rightarrow \text{Al}(s)$
- (3) $\text{Co}^{2+} + 2e^- \rightarrow \text{Co}(s)$
- (4) $\text{Ca}^{2+} + 2e^- \rightarrow \text{Ca}(s)$

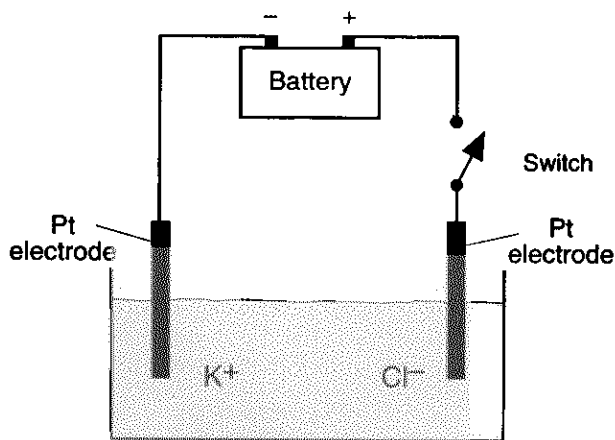
93 Given the reaction:



As the reaction takes place, the $\text{Cl}_2(g)$ will

- | | |
|--------------------|------------------|
| (1) gain electrons | (3) gain protons |
| (2) lose electrons | (4) lose protons |

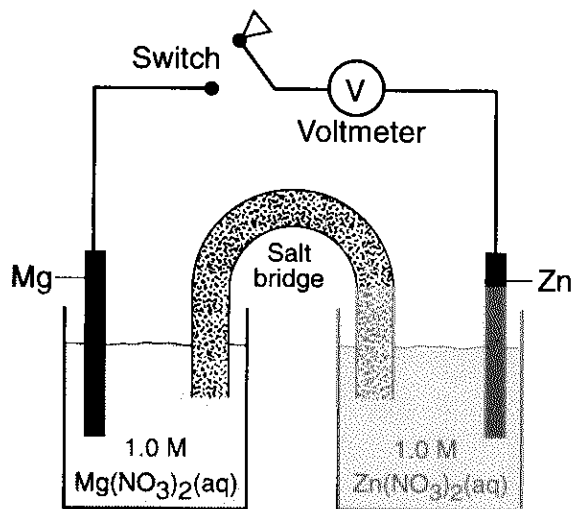
94 The diagram below shows the electrolysis of fused KCl .



What occurs when the switch is closed?

- (1) Positive ions migrate toward the anode, where they lose electrons.
- (2) Positive ions migrate toward the anode, where they gain electrons.
- (3) Positive ions migrate toward the cathode, where they lose electrons.
- (4) Positive ions migrate toward the cathode, where they gain electrons.

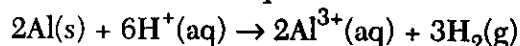
95 The diagram below represents an electrochemical cell at 298 K and 1 atmosphere.



What is the maximum cell voltage (E^0) when the switch is closed?

- | | |
|-------------|-------------|
| (1) +1.61 V | (3) +3.13 V |
| (2) -1.61 V | (4) -3.13 V |

96 Given the balanced equation:



When 2 moles of $\text{Al}(s)$ completely reacts, what is the total number of moles of electrons transferred from $\text{Al}(s)$ to $\text{H}^+(aq)$?

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

Group 9 — Organic Chemistry

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

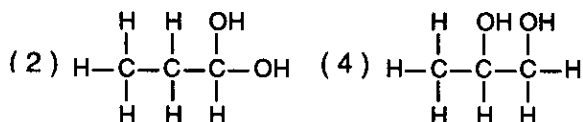
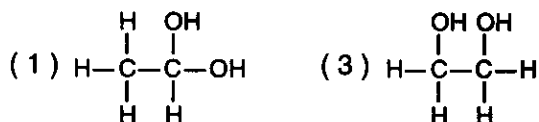
97 A condensation polymerization reaction produces a polymer and

- (1) H_2 (3) CO_2
(2) O_2 (4) H_2O

98 Which organic compound is classified as a primary alcohol?

- (1) ethylene glycol (3) glycerol
(2) ethanol (4) 2-butanol

99 What is the structural formula for 1,2-ethanediol?



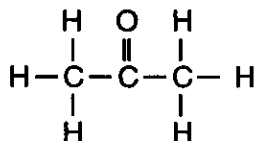
100 Given the structural formula for ethyne:



What is the total number of electrons shared between the carbon atoms?

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

101 What is the name of the compound with the following formula?

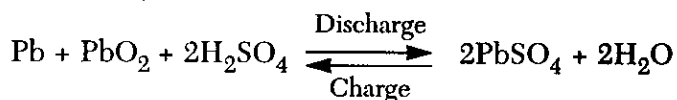


- (1) propanone (3) propanal
(2) propanol (4) propanoic acid

Group 10 — Applications of Chemical Principles

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

102 Given the overall reaction for the lead-acid battery:



Which element changes oxidation state when electric energy is produced?

- (1) hydrogen (3) sulfur
(2) oxygen (4) lead

103 Which substance is produced by the Haber process?

- (1) aluminum (3) nitric acid
(2) ammonia (4) sulfuric acid

104 Iron corrodes more easily than aluminum and zinc because aluminum and zinc both

- (1) are reduced
(2) are oxidizing agents
(3) form oxides that are self-protective
(4) form oxides that are very reactive

105 Which balanced equation represents a cracking reaction?

- (1) $2C_3H_6 + 9O_2 \rightarrow 6H_2O + 6CO_2$
(2) $C_{14}H_{30} \rightarrow C_7H_{16} + C_7H_{14}$
(3) $C_{14}H_{28} + Cl_2 \rightarrow C_{14}H_{28}Cl_2$
(4) $C_2H_6 + Cl_2 \rightarrow C_2H_5Cl + HCl$

106 During fractional distillation, hydrocarbons are separated according to their

- (1) boiling points (3) triple points
(2) melting points (4) saturation points

Group 11 — Nuclear Chemistry

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

- 107 In a fusion reaction, reacting nuclei must collide. Collisions between two nuclei are difficult to achieve because the nuclei are
- (1) both negatively charged and repel each other
 - (2) both positively charged and repel each other
 - (3) oppositely charged and attract each other
 - (4) oppositely charged and repel each other
- 108 A particle accelerator can increase the kinetic energy of
- (1) an alpha particle and a beta particle
 - (2) an alpha particle and a neutron
 - (3) a gamma ray and a beta particle
 - (4) a neutron and a gamma ray
- 109 Which nuclide is a radioisotope used in the study of organic reaction mechanisms?
- (1) carbon-12
 - (2) carbon-14
 - (3) uranium-235
 - (4) uranium-238
- 110 To make nuclear fission more efficient, which device is used in a nuclear reactor to slow the speed of neutrons?
- (1) internal shield
 - (2) external shield
 - (3) control rod
 - (4) moderator
- 111 Which equation is an example of artificial transmutation?
- (1) ${}_{92}^{238}\text{U} \rightarrow {}_2^4\text{He} + {}_{90}^{234}\text{Th}$
 - (2) ${}_{13}^{27}\text{Al} + {}_2^4\text{He} \rightarrow {}_{15}^{30}\text{P} + {}_0^1\text{n}$
 - (3) ${}_{6}^{14}\text{C} \rightarrow {}_{7}^{14}\text{N} + {}_{-1}^0\text{e}$
 - (4) ${}_{88}^{226}\text{Ra} \rightarrow {}_2^4\text{He} + {}_{86}^{222}\text{Rn}$
-

Group 12 — Laboratory Activities

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

112 Which measurement contains three significant figures?

- (1) 0.08 cm (3) 800 cm
(2) 0.080 cm (4) 8.08 cm

113 A student investigated the physical and chemical properties of a sample of an unknown gas and then identified the gas. Which statement represents a conclusion rather than an experimental observation?

- (1) The gas is colorless.
(2) The gas is carbon dioxide.
(3) When the gas is bubbled into limewater, the liquid becomes cloudy.
(4) When placed in the gas, a flaming splint stops burning.

114 The table below shows properties of four solids, A, B, C, and D.

Substance	Melting Point	Conductivity in Solid State	Solubility in Water
A	high	no	soluble
B	high	yes	insoluble
C	high	no	insoluble
D	low	no	insoluble

Which substance could represent diamond, a network solid?

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

115 A student obtained the following data to determine the percent by mass of water in a hydrate.

Mass of empty crucible + cover	11.70 g
Mass of crucible + cover + hydrated salt before heating	14.90 g
Mass of crucible + cover + anhydrous salt after thorough heating	14.53 g

What is the approximate percent by mass of the water in the hydrated salt?

- (1) 2.5% (3) 88%
(2) 12% (4) 98%

116 A student wishes to prepare approximately 100 milliliters of an aqueous solution of 6 M HCl using 12 M HCl. Which procedure is correct?

- (1) adding 50 mL of 12 M HCl to 50 mL of water while stirring the mixture steadily
(2) adding 50 mL of 12 M HCl to 50 mL of water, and then stirring the mixture steadily
(3) adding 50 mL of water to 50 mL of 12 M HCl while stirring the mixture steadily
(4) adding 50 mL of water to 50 mL of 12 M HCl, and then stirring the mixture steadily

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

CHEMISTRY

Tuesday, June 23, 1998 — 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 | 4 |
| 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 | | | | | |

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

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

Tear Here

Tear Here

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

FOR TEACHERS ONLY

C

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

CHEMISTRY

Tuesday, June 23, 1998—9:15 a.m. to 12:15 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	2	X	4	21	1	2	3	X	41	1	2	X	4
2	X	2	3	4	22	X	2	3	4	42	1	X	3	4
3	1	2	X	4	23	1	X	3	4	43	1	2	3	X
4	1	2	3	X	24	X	2	3	4	44	1	2	X	4
5	1	2	3	X	25	1	2	X	4	45	X	2	3	4
6	1	2	X	4	26	1	2	3	X	46	X	2	3	4
7	1	X	3	4	27	1	2	X	4	47	1	X	3	4
8	1	X	3	4	28	1	2	3	X	48	1	2	X	4
9	X	2	3	4	29	1	X	3	4	49	1	X	3	4
10	1	2	X	4	30	1	2	X	4	50	1	2	3	X
11	1	2	3	X	31	X	2	3	4	51	1	2	X	4
12	1	2	3	X	32	1	2	X	4	52	X	2	3	4
13	1	X	3	4	33	1	X	3	4	53	1	2	X	4
14	1	2	X	4	34	1	2	3	X	54	X	2	3	
15	X	2	3	4	35	1	X	3	4	55	1	2	X	
16	1	2	X	4	36	X	2	3	4	56	1	X	3	
17	1	X	3	4	37	1	2	3	X					
18	1	2	3	X	38	1	2	3	X					
19	1	X	3	4	39	X	2	3	4					
20	1	2	3	X	40	1	2	X	4					

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.

CHEMISTRY — *concluded*

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	<input checked="" type="checkbox"/>	3	4
58	1	<input checked="" type="checkbox"/>	3	4
59	1	2	3	<input checked="" type="checkbox"/>
60	1	2	<input checked="" type="checkbox"/>	4
61	<input checked="" type="checkbox"/>	2	3	4

Group 2 Atomic Structure				
62	1	<input checked="" type="checkbox"/>	3	4
63	1	2	<input checked="" type="checkbox"/>	4
64	1	<input checked="" type="checkbox"/>	3	4
65	1	2	3	<input checked="" type="checkbox"/>
66	1	2	<input checked="" type="checkbox"/>	4

Group 3 Bonding				
67	1	2	<input checked="" type="checkbox"/>	4
68	1	2	<input checked="" type="checkbox"/>	4
69	1	<input checked="" type="checkbox"/>	3	4
70	<input checked="" type="checkbox"/>	2	3	4
71	1	2	3	<input checked="" type="checkbox"/>

Group 4 Periodic Table				
72	<input checked="" type="checkbox"/>	2	3	4
73	1	2	<input checked="" type="checkbox"/>	4
74	<input checked="" type="checkbox"/>	2	3	4
75	1	<input checked="" type="checkbox"/>	3	4
76	1	2	3	<input checked="" type="checkbox"/>

Group 5 Mathematics of Chemistry				
77	<input checked="" type="checkbox"/>	2	3	4
78	1	2	3	<input checked="" type="checkbox"/>
79	<input checked="" type="checkbox"/>	2	3	4
80	1	<input checked="" type="checkbox"/>	3	4
81	<input checked="" type="checkbox"/>	2	3	4

Group 6 Kinetics and Equilibrium				
82	1	2	3	<input checked="" type="checkbox"/>
83	1	<input checked="" type="checkbox"/>	3	4
84	1	2	<input checked="" type="checkbox"/>	4
85	1	2	<input checked="" type="checkbox"/>	4
86	1	2	3	<input checked="" type="checkbox"/>

Group 7 Acids and Bases				
87	1	2	<input checked="" type="checkbox"/>	4
88	<input checked="" type="checkbox"/>	2	3	4
89	1	2	3	<input checked="" type="checkbox"/>
90	1	<input checked="" type="checkbox"/>	3	4
91	1	2	3	<input checked="" type="checkbox"/>

Group 8 Redox and Electrochemistry				
92	<input checked="" type="checkbox"/>	2	3	4
93	<input checked="" type="checkbox"/>	2	3	4
94	1	2	3	<input checked="" type="checkbox"/>
95	<input checked="" type="checkbox"/>	2	3	4
96	1	<input checked="" type="checkbox"/>	3	4

Group 9 Organic Chemistry				
97	1	2	3	<input checked="" type="checkbox"/>
98	1	<input checked="" type="checkbox"/>	3	4
99	1	2	<input checked="" type="checkbox"/>	4
100	<input checked="" type="checkbox"/>	2	3	4
101	<input checked="" type="checkbox"/>	2	3	4

Group 10 Applications of Chemical Principles				
102	1	2	3	<input checked="" type="checkbox"/>
103	1	<input checked="" type="checkbox"/>	3	4
104	1	2	<input checked="" type="checkbox"/>	4
105	1	<input checked="" type="checkbox"/>	3	4
106	<input checked="" type="checkbox"/>	2	3	4

Group 11 Nuclear Chemistry				
107	1	<input checked="" type="checkbox"/>	3	4
108	<input checked="" type="checkbox"/>	2	3	4
109	1	<input checked="" type="checkbox"/>	3	4
110	1	2	3	<input checked="" type="checkbox"/>
111	1	<input checked="" type="checkbox"/>	3	4

Group 12 Laboratory Activities				
112	1	2	3	<input checked="" type="checkbox"/>
113	1	<input checked="" type="checkbox"/>	3	4
114	1	2	<input checked="" type="checkbox"/>	4
115	1	<input checked="" type="checkbox"/>	3	4
116	<input checked="" type="checkbox"/>	2	3	4