

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

# CHEMISTRY

Wednesday, August 16, 2000 — 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

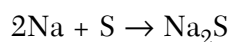
Answer all 56 questions in this part. [65]

*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 If 60. liters of hydrogen gas at 546 K is cooled to 273 K at constant pressure, the new volume of the gas will be
- (1) 120 L (3) 30. L  
(2) 20. L (4) 40. L
- 2 Which phase change at STP represents sublimation?
- (1)  $\text{CO}_2(\text{s}) \rightarrow \text{CO}_2(\text{g})$   
(2)  $\text{H}_2\text{O}(\text{s}) \rightarrow \text{H}_2\text{O}(\ell)$   
(3)  $\text{CO}_2(\ell) \rightarrow \text{CO}_2(\text{g})$   
(4)  $\text{H}_2\text{O}(\ell) \rightarrow \text{H}_2\text{O}(\text{s})$
- 3 Which sample of Fe contains particles having the highest average kinetic energy?
- (1) 5 g at 10°C (3) 5 g at 400 K  
(2) 10 g at 25°C (4) 10 g at 300 K
- 4 An example of a binary compound is
- (1) He (3)  $\text{H}_2$   
(2)  $\text{H}_2\text{O}$  (4)  $\text{H}_2\text{SO}_4$
- 5 Water will boil at 22°C if the pressure on the surface of the water is
- (1) 760.0 mmHg (3) 19.8 mmHg  
(2) 92.5 mmHg (4) 4.6 mmHg
- 6 Which electron configuration represents an atom in the excited state?
- (1)  $1s^2 2s^2 2p^5 3s^1$  (3)  $1s^2 2s^2 2p^6 3s^2$   
(2)  $1s^2 2s^2 2p^6 3s^1$  (4)  $1s^2 2s^2 2p^6 3s^2 3p^1$
- 7 What is the charge and mass of a proton?
- (1) charge of +1 and mass of 1 amu  
(2) charge of +1 and mass of  $\frac{1}{1836}$  amu  
(3) charge of -1 and mass of 1 amu  
(4) charge of -1 and mass of  $\frac{1}{1836}$  amu
- 8 The orbital notation of an atom in the ground state is  $\begin{array}{c} 1s \\ \uparrow\downarrow \end{array} \begin{array}{c} 2s \\ \uparrow\downarrow \end{array}$ .
- Which atom is represented by this notation?
- (1) C (3) B  
(2) N (4) Be
- 9 An experiment in which alpha particles were used to bombard thin sheets of gold foil led to the conclusion that an atom is composed mostly of
- (1) empty space and has a small, negatively charged nucleus  
(2) empty space and has a small, positively charged nucleus  
(3) a large, dense, positively charged nucleus  
(4) a large, dense, negatively charged nucleus
- 10 In which two atoms do both nuclides contain the same number of neutrons?
- (1)  ${}_{10}^{20}\text{Ne}$  and  ${}_{18}^{40}\text{Ar}$  (3)  ${}_{12}^{24}\text{Mg}$  and  ${}_{12}^{26}\text{Mg}$   
(2)  ${}_{29}^{65}\text{Cu}$  and  ${}_{30}^{65}\text{Zn}$  (4)  ${}_{6}^{14}\text{C}$  and  ${}_{8}^{16}\text{O}$
- 11 What is the total number of sublevels in an atom's fourth principal energy level?
- (1) 8 (3) 3  
(2) 16 (4) 4
- 12 The characteristic bright-line spectrum of an element is produced when electrons
- (1) absorb quanta and return to lower energy levels  
(2) absorb quanta and move to higher energy levels  
(3) release quanta and return to lower energy levels  
(4) release quanta and move to higher energy levels

- 13 Which Group 16 element when combined with hydrogen forms a compound that would exhibit the strongest hydrogen bonding?
- (1) selenium (3) oxygen  
(2) tellurium (4) sulfur
- 14 Given the reaction:
- $$\text{Cl}(g) + \text{Cl}(g) \rightarrow \text{Cl}_2(g) + \text{energy}$$
- Which statement best describes the reaction?
- (1) A bond is formed and energy is absorbed.  
(2) A bond is formed and energy is released.  
(3) A bond is broken and energy is absorbed.  
(4) A bond is broken and energy is released.
- 15 Which formula is correct for ammonium sulfate?
- (1)  $\text{NH}_4\text{SO}_4$  (3)  $\text{NH}_4(\text{SO}_4)_2$   
(2)  $(\text{NH}_4)_2\text{SO}_4$  (4)  $(\text{NH}_4)_2(\text{SO}_4)_2$
- 16 An example of an empirical formula is
- (1)  $\text{CH}_4$  (3)  $\text{C}_2\text{H}_4(\text{OH})_2$   
(2)  $\text{C}_2\text{H}_4$  (4)  $\text{C}_6\text{H}_{12}\text{O}_6$
- 17 Which compound is a network solid at STP?
- (1)  $\text{CO}_2$  (3) SiC  
(2)  $\text{H}_2\text{O}$  (4) NaH
- 18 What occurs when a coordinate covalent bond is formed between nitrogen and hydrogen in the ammonium ion,  $\text{NH}_4^+$ ?
- (1) Hydrogen provides a pair of electrons to be shared with nitrogen.  
(2) Nitrogen provides a pair of electrons to be shared with hydrogen.  
(3) Hydrogen transfers a pair of electrons to nitrogen.  
(4) Nitrogen transfers a pair of electrons to hydrogen.
- 19 A hard substance that has a high melting point and is a poor conductor of electricity in the solid phase could be
- (1)  $\text{CO}_2$  (3) NaCl  
(2) Mg (4)  $\text{CCl}_4$
- 20 Which element exhibits both metallic and non-metallic properties?
- (1) bismuth (3) silver  
(2) helium (4) tellurium
- 21 Which statement best describes Group 2 elements as they are considered in order from top to bottom of the Periodic Table?
- (1) The number of principal energy levels increases, and the number of valence electrons increases.  
(2) The number of principal energy levels increases, and the number of valence electrons remains the same.  
(3) The number of principal energy levels remains the same, and the number of valence electrons increases.  
(4) The number of principal energy levels remains the same, and the number of valence electrons decreases.
- 22 Which substance at STP exists in the form of a monatomic gas?
- (1) neon (3) chlorine  
(2) oxygen (4) nitrogen
- 23 Which noble gas has the highest first ionization energy?
- (1) radon (3) neon  
(2) krypton (4) helium
- 24 Atoms of which set of elements all exhibit the same oxidation state?
- (1) actinoid series  
(2) metalloids  
(3) alkaline earth metals  
(4) transition metals
- 25 Given the reactions:
- $$2X(s) + 2\text{H}_2\text{O}(\ell) \rightarrow 2X^+(\text{aq}) + 2\text{OH}^-(\text{aq}) + \text{H}_2(g)$$
- $$2Y(s) + 2\text{H}_2\text{O}(\ell) \rightarrow 2Y^+(\text{aq}) + 2\text{OH}^-(\text{aq}) + \text{H}_2(g)$$
- The unknowns, X and Y, are most likely
- (1) metallic elements in the same group  
(2) metallic elements in the same period  
(3) nonmetallic elements in the same group  
(4) nonmetallic elements in the same period

26 Given the balanced equation:



What is the total number of moles of S that reacted when 4.0 moles of Na were completely consumed?

- (1) 1.0 mole                      (3) 0.5 mole  
(2) 2.0 moles                    (4) 4.0 moles

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

- (1) 196 g                          (3) 245 g  
(2) 214 g                          (4) 310. g

28 Which compound contains the greatest percentage of chlorine by mass?

- (1) HCl                              (3)  $\text{FeCl}_2$   
(2) NaCl                            (4)  $\text{ZnCl}_2$

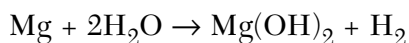
29 What is the total number of grams of HI in 0.500 liter of 1.00 M HI?

- (1) 1.00 g                          (3) 64.0 g  
(2) 0.500 g                        (4) 128 g

30 At STP, what is the total volume occupied by a 2.00-gram sample of  $\text{H}_2(\text{g})$ ?

- (1) 1.00 L                          (3) 11.2 L  
(2) 2.00 L                          (4) 22.4 L

31 Given the reaction:



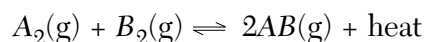
At which temperature will the reaction occur at the greatest rate?

- (1) 25°C                            (3) 75°C  
(2) 50°C                            (4) 100°C

32 After being ignited in a Bunsen burner flame, a piece of magnesium ribbon burns brightly, giving off heat and light. In this situation, the Bunsen burner flame provides

- (1) ionization energy  
(2) activation energy  
(3) heat of reaction  
(4) heat of vaporization

33 Given the reaction:



An increase in the concentration of  $\text{A}_2(\text{g})$  will

- (1) decrease the production of  $\text{AB}(\text{g})$   
(2) decrease the frequency of collisions between  $\text{A}_2(\text{g})$  and  $\text{B}_2(\text{g})$   
(3) increase the production of  $\text{B}_2(\text{g})$   
(4) increase the frequency of collisions between  $\text{A}_2(\text{g})$  and  $\text{B}_2(\text{g})$

34 When an equilibrium exists between the dissolved and the undissolved solute in a solution, the solution must be

- (1) diluted                          (3) supersaturated  
(2) saturated                        (4) unsaturated

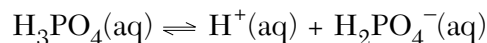
35 Under the same conditions of temperature and pressure, which sample contains particles having the *lowest* entropy?

- (1)  $\text{CO}_2(\text{g})$                         (3)  $\text{CO}_2(\text{s})$   
(2)  $\text{CO}_2(\ell)$                         (4)  $\text{CO}_2(\text{aq})$

36 The heat energy ( $\Delta H$ ) absorbed or released during the formation of products is equal to

- (1)  $(H_{\text{products}}) - (H_{\text{reactants}})$   
(2)  $(H_{\text{reactants}}) - (H_{\text{products}})$   
(3)  $(H_{\text{products}}) \times (H_{\text{reactants}})$   
(4)  $\frac{(H_{\text{products}})}{(H_{\text{reactants}})}$

37 Given the reaction:



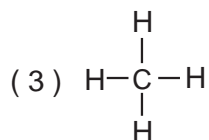
The ionization constant  $K_a$  is equal to

- (1)  $\frac{[\text{H}^+][\text{H}_2\text{PO}_4^-]}{[\text{H}_3\text{PO}_4]}$                       (3)  $\frac{[\text{H}^+][\text{H}_3\text{PO}_4]}{[\text{H}_2\text{PO}_4^-]}$   
(2)  $\frac{[\text{H}_3\text{PO}_4]}{[\text{H}^+][\text{H}_2\text{PO}_4^-]}$                       (4)  $\frac{[\text{H}_2\text{PO}_4^-]}{[\text{H}^+][\text{H}_3\text{PO}_4]}$

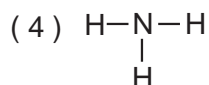
- 38 Based on Reference Table L,  $\text{H}_2\text{O}$  is a stronger acid than
- (1)  $\text{HS}^-$  (3)  $\text{HSO}_3^-$   
 (2)  $\text{OH}^-$  (4)  $\text{NH}_4^+$
- 39 If a given solution at 298 K contains  $[\text{H}^+] = 1.0 \times 10^{-9}$ , what is the  $[\text{OH}^-]$ ?
- (1)  $1.0 \times 10^{-1}$  (3)  $1.0 \times 10^{-9}$   
 (2)  $1.0 \times 10^{-5}$  (4)  $1.0 \times 10^{-14}$
- 40 When  $\text{NH}_4\text{NO}_3$  is added to water, an acidic solution forms. This process is referred to as
- (1) dehydration (3) hydrolysis  
 (2) electrolysis (4) neutralization
- 41 Which solution is the best conductor of electricity?
- (1) 0.1 M  $\text{HCl}(\text{aq})$   
 (2) 0.1 M  $\text{CH}_3\text{OH}(\text{aq})$   
 (3) 0.1 M  $\text{NH}_3(\text{aq})$   
 (4) 0.1 M  $\text{CH}_3\text{COOH}(\text{aq})$
- 42 Given the equilibrium system:
- $$\text{NH}_3(\text{aq}) + \text{H}_2\text{O}(\ell) \rightleftharpoons \text{NH}_4^+(\text{aq}) + \text{OH}^-(\text{aq})$$
- According to the Brønsted-Lowry theory, the  $\text{H}_2\text{O}(\ell)$  acts as
- (1) a base, by receiving a proton  
 (2) a base, by donating a proton  
 (3) an acid, by receiving a proton  
 (4) an acid, by donating a proton
- 43 Which reaction is an example of oxidation-reduction?
- (1)  $\text{KOH} + \text{HCl} \rightarrow \text{KCl} + \text{H}_2\text{O}$   
 (2)  $2\text{KCl} \rightarrow 2\text{K} + \text{Cl}_2$   
 (3)  $\text{BaCl}_2 + \text{K}_2\text{SO}_4 \rightarrow 2\text{KCl} + \text{BaSO}_4$   
 (4)  $\text{KCl} + \text{AgNO}_3 \rightarrow \text{AgCl} + \text{KNO}_3$
- 44 What is the oxidation number of hydrogen in  $\text{CaH}_2$ ?
- (1) +1 (3) -1  
 (2) +2 (4) -2
- 45 What occurs when a substance in an oxidation-reduction reaction is reduced?
- (1) It loses electrons, and its oxidation number decreases.  
 (2) It loses electrons, and its oxidation number increases.  
 (3) It gains electrons, and its oxidation number decreases.  
 (4) It gains electrons, and its oxidation number increases.
- 46 Given the reaction:
- $$\text{F}_2(\text{g}) + 2\text{Br}^-(\text{aq}) \rightarrow \text{Br}_2(\ell) + 2\text{F}^-(\text{aq})$$
- In the reaction, the oxidizing agent is
- (1)  $\text{F}_2(\text{g})$  (3)  $\text{Br}_2(\ell)$   
 (2)  $\text{Br}^-(\text{aq})$  (4)  $\text{F}^-(\text{aq})$
- 47 Which process occurs in an operating electrochemical cell?
- (1) a reduction reaction, only  
 (2) an oxidation reaction, only  
 (3) a chemical reaction produced by an electric current  
 (4) a chemical reaction that produces an electric current
- 48 Given the reaction:
- $$\text{Fe}(\text{s}) + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Fe}^{2+}(\text{aq}) + \text{Cu}(\text{s})$$
- Which half-reaction correctly shows the oxidation that occurs?
- (1)  $\text{Fe}(\text{s}) \rightarrow \text{Fe}^{2+}(\text{aq}) + 2\text{e}^-$   
 (2)  $\text{Fe}(\text{s}) + 2\text{e}^- \rightarrow \text{Fe}^{2+}(\text{aq})$   
 (3)  $\text{Cu}^{2+}(\text{aq}) \rightarrow \text{Cu}(\text{s}) + 2\text{e}^-$   
 (4)  $\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Cu}(\text{s})$
- 49 A molecular formula for an alkene is
- (1)  $\text{C}_2\text{H}_6$  (3)  $\text{C}_2\text{H}_5\text{COOH}$   
 (2)  $\text{C}_2\text{H}_4$  (4)  $\text{C}_6\text{H}_{12}\text{O}_6$
- 50 Which formula represents ethanoic acid?
- (1)  $\text{CH}_3\text{CHO}$  (3)  $\text{CH}_3\text{CH}_2\text{COOH}$   
 (2)  $\text{CH}_3\text{COOH}$  (4)  $\text{CH}_3\text{CH}_2\text{CHO}$

51 Which representation is the structural formula of an organic compound?

(1) CH<sub>4</sub>



(2) NH<sub>3</sub>



52 In the presence of excess oxygen, hydrocarbons burn completely to form water and

(1) CO

(3) C

(2) CO<sub>2</sub>

(4) CO<sub>3</sub><sup>2-</sup>

53 Which hydrocarbon has more than one possible structural formula?

(1) CH<sub>4</sub>

(3) C<sub>3</sub>H<sub>8</sub>

(2) C<sub>2</sub>H<sub>6</sub>

(4) C<sub>4</sub>H<sub>10</sub>

**Note that questions 54 through 56 have only three choices.**

54 As elements of Group 15 of the Periodic Table are considered in order from top to bottom, the metallic character of the atoms of each successive element generally

(1) decreases

(2) increases

(3) remains the same

55 As HCl(g) is added to water, the pH of the water solution

(1) decreases

(2) increases

(3) remains the same

56 As the volume of a fixed mass of a gas increases at constant temperature, the pressure of the gas

(1) decreases

(2) increases

(3) remains the same

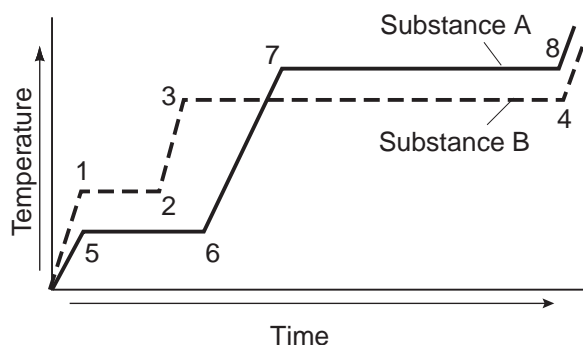
## Part II

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.

Base your answers to questions 57 and 58 on the graph below. The graph shows heat being added at a constant rate to substance A and to substance B, which begin as solids below their melting point temperatures.



- 57 Compared to substance B, substance A has a
- (1) lower melting point and a lower boiling point
  - (2) lower melting point and a higher boiling point
  - (3) higher melting point and a lower boiling point
  - (4) higher melting point and a higher boiling point
- 58 During which interval is the greatest amount of energy absorbed?
- (1) 1–2
  - (2) 2–3
  - (3) 3–4
  - (4) 7–8

- 59 At STP, a 22.4-liter sample of  $\text{NH}_3(\text{g})$  contains the same number of molecules as
- (1) 11.2 L of  $\text{H}_2(\text{g})$
  - (2) 22.4 L of  $\text{CO}_2(\text{g})$
  - (3) 33.6 L of  $\text{CH}_4(\text{g})$
  - (4) 44.8 L of  $\text{O}_2(\text{g})$
- 60 Which sample is composed of particles arranged in a regular geometric pattern?
- (1)  $\text{Cl}_2(\text{g})$
  - (2)  $\text{CCl}_4(\ell)$
  - (3)  $\text{LiCl}(\text{s})$
  - (4)  $\text{LiCl}(\text{aq})$
- 61 When  $\text{KCl}(\text{s})$  is dissolved in water, the resulting solution is classified as a
- (1) heterogeneous compound
  - (2) homogeneous compound
  - (3) heterogeneous mixture
  - (4) homogeneous mixture

## Group 2 — Atomic Structure

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

62 What is the total number of orbitals in the  $d$  sublevel of an atom?

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

63 An atom contains 22 neutrons and 40 nucleons. What is the total number of protons in the atom?

- (1) 18 (3) 40  
(2) 22 (4) 62

64 Which principal quantum number is assigned to the valence electrons of a carbon atom in the ground state?

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

65 Compared to the maximum number of electrons that can occupy the  $d$  sublevel, the maximum number of electrons that can occupy the  $p$  sublevel is

- (1) smaller by two electrons  
(2) smaller by four electrons  
(3) greater by two electrons  
(4) greater by four electrons

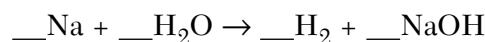
66 What was the original mass of a radioactive sample that decayed to 25 grams in four half-life periods?

- (1) 50 g (3) 200 g  
(2) 100 g (4) 400 g
- 

## Group 3 — Bonding

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

67 Given the unbalanced equation:



When the equation is correctly balanced using the *smallest* whole-number coefficients, the coefficient for  $\text{H}_2\text{O}$  is

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

68 Which ion contains the same total number of electrons as  $\text{Cl}^-$ ?

- (1)  $\text{S}^{2-}$  (3)  $\text{Mg}^{2+}$   
(2)  $\text{Br}^-$  (4)  $\text{Na}^+$

69 Which substance at STP conducts electricity because the substance contains mobile electrons?

- (1) H (3) K  
(2) He (4) Kr

70 Two fluorine atoms are held together by a covalent bond. Which statement correctly describes this bond?

- (1) It is polar and forms a polar molecule.  
(2) It is polar and forms a nonpolar molecule.  
(3) It is nonpolar and forms a polar molecule.  
(4) It is nonpolar and forms a nonpolar molecule.

71 At  $25^\circ\text{C}$ , iodine exists as a solid and bromine as a liquid. This difference in phase is due to the presence of stronger

- (1) covalent bonds in iodine  
(2) covalent bonds in bromine  
(3) van der Waals forces in iodine  
(4) van der Waals forces in bromine
-



### Group 4 — Periodic Table

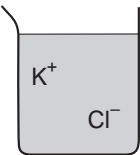
If you choose this group, be sure to answer questions 72–76.

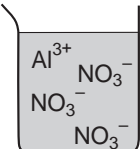
- 72 A characteristic of a nonmetal is
- (1) low ionization energy
  - (2) high electronegativity
  - (3) high electrical conductivity
  - (4) the ability to form positive ions
- 73 Which ionic compound dissolves in water to form a colored solution?
- (1)  $\text{Ca}(\text{NO}_3)_2$
  - (2)  $\text{Cu}(\text{NO}_3)_2$
  - (3)  $\text{KNO}_3$
  - (4)  $\text{Al}(\text{NO}_3)_3$
- 74 Which element has a total of 5 valence electrons present in the fifth energy level?
- (1) Sb
  - (2) Bi
  - (3) I
  - (4) Br
- 75 For which element is the ionic radius larger than the atomic radius?
- (1) Na
  - (2) Mg
  - (3) Al
  - (4) Cl
- 76 Element X is in Group 2 and element Y is in Group 17. What happens when a compound is formed between these two atoms?
- (1) X loses electrons to Y to form an ionic bond.
  - (2) X loses electrons to Y to form a covalent bond.
  - (3) X gains electrons from Y to form an ionic bond.
  - (4) X gains electrons from Y to form a covalent bond.
- 

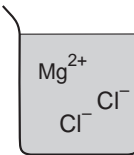
### Group 5 — Mathematics of Chemistry

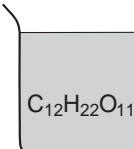
If you choose this group, be sure to answer questions 77–81.

- 77 Approximately how many calories of heat are needed to completely change 10 grams of ice to water at the melting point temperature?
- (1) 1 cal
  - (2) 8 cal
  - (3) 80 cal
  - (4) 800 cal
- 78 What is the gram molecular mass of a gas that has a density of 5.00 grams per liter at STP?
- (1) 27.4 g
  - (2) 56.0 g
  - (3) 112 g
  - (4) 223 g
- 79 A compound consists of 25.9% nitrogen and 74.1% oxygen by mass. What is the empirical formula of the compound?
- (1) NO
  - (2)  $\text{NO}_2$
  - (3)  $\text{N}_2\text{O}$
  - (4)  $\text{N}_2\text{O}_5$
- 80 A solution is formed by dissolving 45 grams of  $\text{NH}_4\text{Cl}$  in 100 grams of  $\text{H}_2\text{O}$  at  $70^\circ\text{C}$ . Which statement correctly describes this solution?
- (1)  $\text{NH}_4\text{Cl}$  is the solute, and the solution is saturated.
  - (2)  $\text{NH}_4\text{Cl}$  is the solute, and the solution is unsaturated.
  - (3)  $\text{NH}_4\text{Cl}$  is the solvent, and the solution is saturated.
  - (4)  $\text{NH}_4\text{Cl}$  is the solvent, and the solution is unsaturated.
- 81 Which 1-molal aqueous solution has the *lowest* freezing point?

(1) 

(2) 

(3) 

(4) 

---

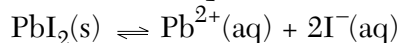
## Group 6 — Kinetics and Equilibrium

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

82 According to Reference Table G, which gas is formed from its elements by a spontaneous reaction?

- |                         |                                       |
|-------------------------|---------------------------------------|
| (1) NO(g)               | (3) C <sub>2</sub> H <sub>4</sub> (g) |
| (2) NO <sub>2</sub> (g) | (4) C <sub>2</sub> H <sub>6</sub> (g) |

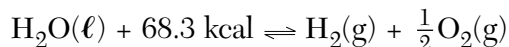
83 Given the solution at equilibrium:



The addition of which nitrate salt will cause a decrease in the concentration of I<sup>-</sup>(aq) ?

- |                                       |                       |
|---------------------------------------|-----------------------|
| (1) Pb(NO <sub>3</sub> ) <sub>2</sub> | (3) LiNO <sub>3</sub> |
| (2) Ca(NO <sub>3</sub> ) <sub>2</sub> | (4) KNO <sub>3</sub>  |

84 Given the reaction:



Which statement describes the reverse reaction?

- (1) It is endothermic and releases 68.3 kilocalories.
- (2) It is endothermic and absorbs 68.3 kilocalories.
- (3) It is exothermic and releases 68.3 kilocalories.
- (4) It is exothermic and absorbs 68.3 kilocalories.

85 Based on Reference Table M, which salt is the most soluble?

- |          |                       |
|----------|-----------------------|
| (1) AgI  | (3) ZnCO <sub>3</sub> |
| (2) AgBr | (4) CaSO <sub>4</sub> |

86 In a reversible chemical reaction, which factors must be equal when the reaction is at equilibrium?

- (1) rate at which reactants are formed and rate at which products are formed
  - (2) concentration of reactants and concentration of products
  - (3) potential energy of reactants and potential energy of products
  - (4) activation energy of reactants and activation energy of products
- 

## Group 7 — Acids and Bases

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

87 How many milliliters of 0.010 M NaOH are required to exactly neutralize 20.0 milliliters of 0.020 M HCl?

- |            |            |
|------------|------------|
| (1) 10. mL | (3) 30. mL |
| (2) 20. mL | (4) 40. mL |

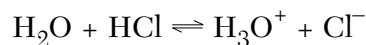
88 Which of the following is the *weakest* Brønsted-Lowry acid?

- |                                    |        |
|------------------------------------|--------|
| (1) H <sub>2</sub> SO <sub>4</sub> | (3) HF |
| (2) HNO <sub>3</sub>               | (4) HI |

89 Which species is amphoteric?

- |                      |                     |
|----------------------|---------------------|
| (1) H <sub>2</sub> S | (3) Cl <sup>-</sup> |
| (2) HS <sup>-</sup>  | (4) HCl             |

90 Given the reaction:



The Brønsted-Lowry base for the forward reaction is

- |                      |                                   |
|----------------------|-----------------------------------|
| (1) H <sub>2</sub> O | (3) H <sub>3</sub> O <sup>+</sup> |
| (2) HCl              | (4) Cl <sup>-</sup>               |

91 The ability of H<sub>2</sub>SO<sub>4</sub>(aq) to change blue litmus red is mainly due to the presence of

- |                                |   |
|--------------------------------|---|
| (1) SO <sub>2</sub> molecules  | (3) H <sub>3</sub> O <sup>+</sup> (aq) ions |
| (2) H <sub>2</sub> O molecules | (4) SO <sub>4</sub> <sup>2-</sup> (aq) ions |
-

## Group 8 — Redox and Electrochemistry

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

92 What is the voltage for a chemical cell that has reached equilibrium?

- (1) 1.00 V
- (2) greater than 1.00 V
- (3) greater than 0.00 V and less than 1.00 V
- (4) 0.00 V

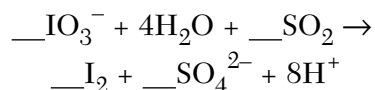
93 Based on Reference Table N, what is the standard electrode potential ( $E^0$ ) for the oxidation of  $\text{Cu}(s)$  to  $\text{Cu}^{2+}(\text{aq})$ ?

- (1) +0.52 V
- (2) +0.34 V
- (3) -0.52 V
- (4) -0.34 V

94 When an equation is correctly balanced, it must show conservation of

- (1) charge but not of mass
- (2) mass but not of charge
- (3) both charge and mass
- (4) neither charge nor mass

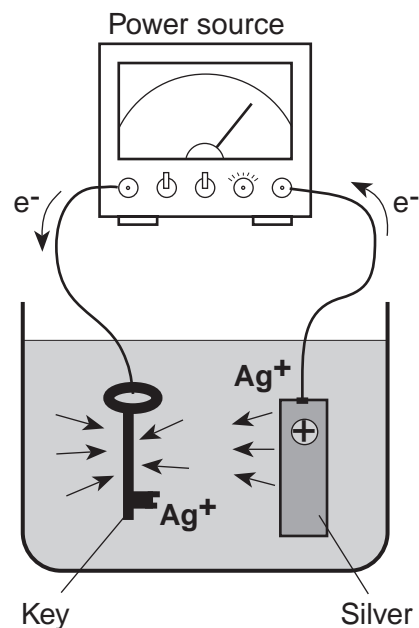
95 Given the unbalanced equation:



What is the coefficient of  $\text{SO}_2$  when the equation is correctly balanced?

- (1) 1
- (2) 2
- (3) 5
- (4) 8

96 Which statement best describes the key?



- (1) It acts as the cathode and is negative.
- (2) It acts as the cathode and is positive.
- (3) It acts as the anode and is negative.
- (4) It acts as the anode and is positive.

## Group 9 — Organic Chemistry

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

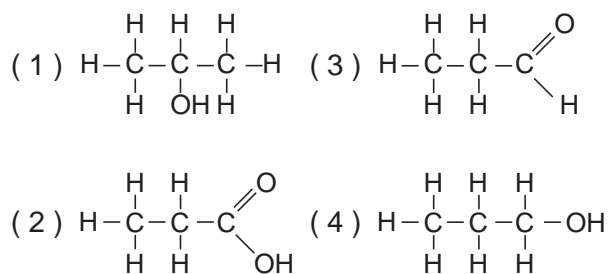
97 Which material is a synthetic polymer?

- (1) starch (3) cellulose  
(2) nylon (4) protein

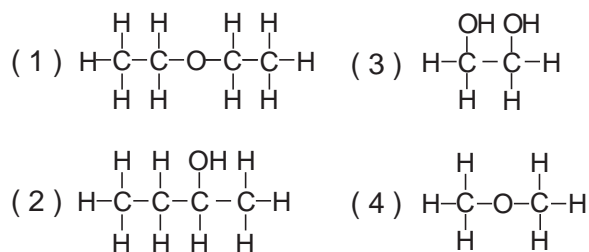
98 An example of a ketone is

- (1) propanone (3) propanal  
(2) propane (4) propanol

99 Which compound is a primary alcohol?



100 Which structural formula represents diethyl ether?



101 In which kind of reaction is soap one of the products?

- (1) oxidation (3) neutralization  
(2) saponification (4) fermentation

## Group 10 — Applications of Chemical Principles

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

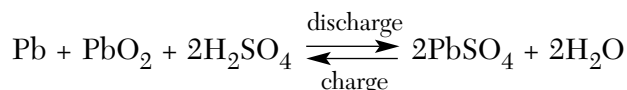
102 Natural gas is mostly comprised of

- (1) butane (3) methane  
(2) ethane (4) propane

103 Which equation represents a simple example of cracking?

- (1)  $\text{S} + \text{O}_2 \rightarrow \text{SO}_2$   
(2)  $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$   
(3)  $\text{N}_2 + 3\text{H}_2 \xrightarrow{600^\circ\text{C}} 2\text{NH}_3$   
(4)  $\text{C}_{14}\text{H}_{30} \xrightarrow{600^\circ\text{C}} \text{C}_7\text{H}_{16} + \text{C}_7\text{H}_{14}$

104 Given the lead-acid battery reaction:



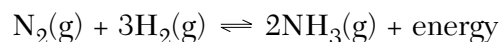
When the reaction produces electricity, which element changes its oxidation state?

- (1) Pb (3) O  
(2) S (4) H

105 Which metal is produced by the electrolytic reduction of its fused salt?

- (1) Fe (3) K  
(2) Zn (4) Cr

106 Given the reaction:



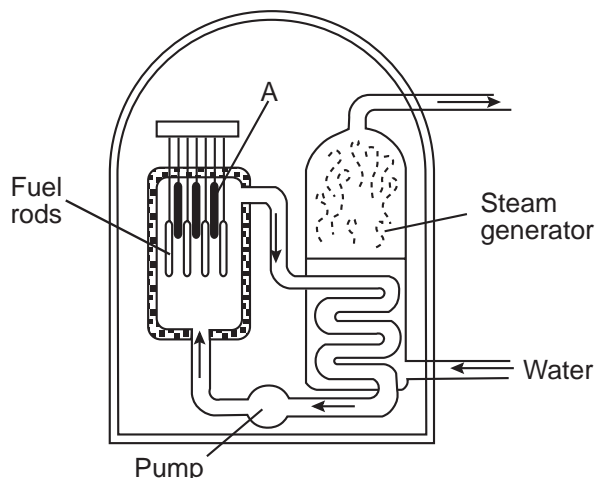
If the temperature is increased and the pressure is kept constant, the new equilibrium concentration will be

- (1) less for  $\text{NH}_3(\text{g})$   
(2) the same for  $\text{NH}_3(\text{g})$   
(3) less for  $\text{N}_2(\text{g})$   
(4) the same for  $\text{N}_2(\text{g})$

## Group 11 — Nuclear Chemistry

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

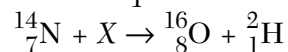
- 107 The diagram below represents a nuclear reactor. The arrows indicate the direction of the flow of water.



Which structure is indicated by letter A?

- (1) turbine (3) control rod  
(2) moderator (4) internal shield
- 108 The main function of a coolant in a nuclear fission reactor is to
- (1) slow down the speed of the neutrons  
(2) absorb energy produced by the reaction  
(3) shield the wall of the reactor from radiation damage  
(4) adjust the number of neutrons available for reaction

- 109 Given the nuclear equation:



What is particle X?

- (1) an alpha particle (3) a deuteron  
(2) a beta particle (4) a triton
- 110 Which two substances are most commonly used for shielding in a nuclear reactor?
- (1) water and heavy water  
(2) beryllium and graphite  
(3) molten sodium and molten lithium  
(4) steel and high-density concrete
- 111 Which statement best describes what happens in a fission reaction?
- (1) Heavy nuclei split into lighter nuclei.  
(2) Light nuclei form into heavier nuclei.  
(3) Energy is released and less stable elements are formed.  
(4) Energy is absorbed and more stable elements are formed.

## Group 12 — Laboratory Activities

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

112 If a student pours a mixture of sand and salt water through a filter paper into a beaker, what will be found in the beaker after filtering?

- (1) salt, only                      (3) salt and water  
(2) sand, only                      (4) salt and sand

113 The table below shows the data collected during the heating of a 10.0-gram sample of a hydrated salt.

Heating Time (min)	Mass of Salt (g)
0.0	10.0
4.0	9.2
8.0	8.6
12.0	8.0
20.0	8.0
30.0	8.0

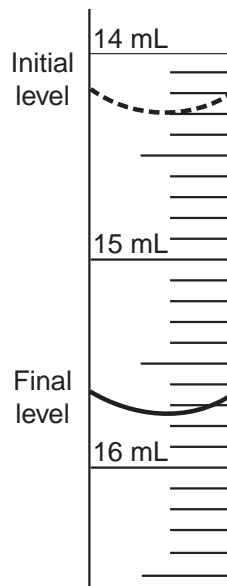
What is the percent of water in the original sample?

- (1) 10.%                              (3) 60.%  
(2) 20.%                              (4) 80.%

114 A student observed that when sodium hydroxide was dissolved in water, the temperature of the water increased. The student should conclude that the dissolving of sodium hydroxide

- (1) is endothermic  
(2) is exothermic  
(3) produces an acid solution  
(4) produces a salt solution

115 The diagram below represents a section of a buret containing acid used in an acid-base titration.



What is the total volume of acid that was used?

- (1) 1.10 mL                          (3) 1.40 mL  
(2) 1.30 mL                          (4) 1.45 mL

116 Which technique is safest for diluting a concentrated acid with water?

- (1) add the acid to the water quickly  
(2) add the water to the acid quickly  
(3) add the acid to the water slowly while stirring constantly  
(4) add the water to the acid slowly while stirring constantly

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.

Tear Here

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**

Wednesday, August 16, 2000 — 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	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					

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 .....

Tear Here

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# FOR TEACHERS ONLY

# C

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

## CHEMISTRY

Wednesday, August 16, 2000—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	2	X	4	21	1	X	3	4	41	X	2	3	4
2	X	2	3	4	22	X	2	3	4	42	1	2	3	X
3	1	2	X	4	23	1	2	3	X	43	1	X	3	4
4	1	X	3	4	24	1	2	X	4	44	1	2	X	4
5	1	2	X	4	25	X	2	3	4	45	1	2	X	4
6	X	2	3	4	26	1	X	3	4	46	X	2	3	4
7	X	2	3	4	27	1	2	3	X	47	1	2	3	X
8	1	2	3	X	28	X	2	3	4	48	X	2	3	4
9	1	X	3	4	29	1	2	X	4	49	1	X	3	4
10	1	2	3	X	30	1	2	3	X	50	1	X	3	4
11	1	2	3	X	31	1	2	3	X	51	1	2	X	4
12	1	2	X	4	32	1	X	3	4	52	1	X	3	4
13	1	2	X	4	33	1	2	3	X	53	1	2	3	X
14	1	X	3	4	34	1	X	3	4	54	1	X	3	
15	1	X	3	4	35	1	2	X	4	55	X	2	3	
16	X	2	3	4	36	X	2	3	4	56	X	2	3	
17	1	2	X	4	37	X	2	3	4					
18	1	X	3	4	38	1	X	3	4					
19	1	2	X	4	39	1	X	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	<b>X</b>	3	4	
58	1	2	<b>X</b>	4	
59	1	<b>X</b>	3	4	
60	1	2	<b>X</b>	4	
61	1	2	3	<b>X</b>	

Group 2 Atomic Structure					
62	1	2	3	<b>X</b>	
63	<b>X</b>	2	3	4	
64	1	<b>X</b>	3	4	
65	1	<b>X</b>	3	4	
66	1	2	3	<b>X</b>	

Group 3 Bonding					
67	1	<b>X</b>	3	4	
68	<b>X</b>	2	3	4	
69	1	2	<b>X</b>	4	
70	1	2	3	<b>X</b>	
71	1	2	<b>X</b>	4	

Group 4 Periodic Table					
72	1	<b>X</b>	3	4	
73	1	<b>X</b>	3	4	
74	<b>X</b>	2	3	4	
75	1	2	3	<b>X</b>	
76	<b>X</b>	2	3	4	

Group 5 Mathematics of Chemistry					
77	1	2	3	<b>X</b>	
78	1	2	<b>X</b>	4	
79	1	2	3	<b>X</b>	
80	1	<b>X</b>	3	4	
81	1	<b>X</b>	3	4	

Group 6 Kinetics and Equilibrium					
82	1	2	3	<b>X</b>	
83	<b>X</b>	2	3	4	
84	1	2	<b>X</b>	4	
85	1	2	3	<b>X</b>	
86	<b>X</b>	2	3	4	

Group 7 Acids and Bases					
87	1	2	3	<b>X</b>	
88	1	2	<b>X</b>	4	
89	1	<b>X</b>	3	4	
90	<b>X</b>	2	3	4	
91	1	2	<b>X</b>	4	

Group 8 Redox and Electrochemistry					
92	1	2	3	<b>X</b>	
93	1	2	3	<b>X</b>	
94	1	2	<b>X</b>	4	
95	1	2	<b>X</b>	4	
96	<b>X</b>	2	3	4	

Group 9 Organic Chemistry					
97	1	<b>X</b>	3	4	
98	<b>X</b>	2	3	4	
99	1	2	3	<b>X</b>	
100	<b>X</b>	2	3	4	
101	1	<b>X</b>	3	4	

Group 10 Applications of Chemical Principles					
102	1	2	<b>X</b>	4	
103	1	2	3	<b>X</b>	
104	<b>X</b>	2	3	4	
105	1	2	<b>X</b>	4	
106	<b>X</b>	2	3	4	

Group 11 Nuclear Chemistry					
107	1	2	<b>X</b>	4	
108	1	<b>X</b>	3	4	
109	<b>X</b>	2	3	4	
110	1	2	3	<b>X</b>	
111	<b>X</b>	2	3	4	

Group 12 Laboratory Activities					
112	1	2	<b>X</b>	4	
113	1	<b>X</b>	3	4	
114	1	<b>X</b>	3	4	
115	1	2	3	<b>X</b>	
116	1	2	<b>X</b>	4	