This is a test of your knowledge of chemistry. Use that knowledge to answer all questions in this examination. Some questions may require the use of the Reference Tables for Physical Setting/Chemistry. You are to answer all questions in all parts of this examination according to the directions provided in the examination booklet.

Your answer sheet for Part A and Part B–1 is the last page of this examination booklet. Turn to the last page and fold it along the perforations. Then, slowly and carefully, tear off your answer sheet and fill in the heading.

The answers to the questions in Part B–2 and Part C are to be written in your separate answer booklet. Be sure to fill in the heading on the front of your answer booklet.

Record the number of your choice for each Part A and Part B–1 multiple-choice question on your separate answer sheet. Write your answers to the Part B–2 and Part C questions in your answer booklet. All work should be written in pen, except for graphs and drawings, which should be done in pencil. You may use scrap paper to work out the answers to the questions, but be sure to record all your answers on your separate answer sheet and in your answer booklet.

When you have completed the examination, you must sign the statement printed at the end of your separate 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 and answer booklet cannot be accepted if you fail to sign this declaration.

Notice...

A four-function or scientific calculator and a copy of the Reference Tables for Physical Setting/Chemistry must be available for you to use while taking this examination.

The use of any communications device is strictly prohibited when taking this examination. If you use any communications device, no matter how briefly, your examination will be invalidated and no score will be calculated for you.

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

Answer all questions in this part.

Directions (1–30): For each statement or question, write on the separate answer sheet the number of the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the Reference Tables for Physical Setting/Chemistry.

1. An atom in the ground state has seven valence electrons. This atom could be an atom of which element?
   (1) calcium    (3) oxygen
   (2) fluorine   (4) sodium

2. What is the total number of electrons in an atom of potassium?
   (1) 18       (3) 20
   (2) 19       (4) 39

3. A proton has a charge that is opposite the charge of
   (1) an alpha particle   (3) an electron
   (2) a neutron           (4) a positron

4. Which conclusion was a direct result of the gold foil experiment?
   (1) An atom is mostly empty space with a dense, positively charged nucleus.
   (2) An atom is composed of at least three types of subatomic particles.
   (3) An electron has a positive charge and is located inside the nucleus.
   (4) An electron has properties of both waves and particles.

5. Which statement identifies the element arsenic?
   (1) Arsenic has an atomic number of 33.
   (2) Arsenic has a melting point of 84 K.
   (3) An atom of arsenic in the ground state has eight valence electrons.
   (4) An atom of arsenic in the ground state has a radius of 146 pm.

6. Which element has an atom with the greatest attraction for electrons in a chemical bond?
   (1) As    (3) N
   (2) Bi    (4) P

7. Given the balanced equation representing a reaction:
   \[ \text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\ell) + \text{energy} \]
   In this reaction there is conservation of
   (1) mass, only
   (2) mass and charge, only
   (3) charge and energy, only
   (4) charge, energy, and mass

8. Which statement describes the composition of potassium chlorate, KClO₃?
   (1) The proportion by mass of elements combined in potassium chlorate is fixed.
   (2) The proportion by mass of elements combined in potassium chlorate varies.
   (3) Potassium chlorate is composed of four elements.
   (4) Potassium chlorate is composed of five elements.

9. As a bond between a hydrogen atom and a sulfur atom is formed, electrons are
   (1) shared to form an ionic bond
   (2) shared to form a covalent bond
   (3) transferred to form an ionic bond
   (4) transferred to form a covalent bond

10. Atoms of which element can bond to each other to form chains, rings, and networks?
    (1) carbon   (3) hydrogen
    (2) fluorine (4) oxygen

11. Which formula represents a polar molecule?
    (1) Br₂     (3) CH₄
    (2) CO₂     (4) NH₃
12 Two solid samples each contain sulfur, oxygen, and sodium, only. These samples have the same color, melting point, density, and reaction with an aqueous barium chloride solution. It can be concluded that the two samples are the same

(1) compound  (3) mixture
(2) element  (4) solution

13 Which equation represents a physical change?

(1) \( \text{H}_2\text{O}(s) + 6.01 \text{ kJ} \rightarrow \text{H}_2\text{O}(\ell) \)
(2) \( 2\text{H}_2(g) + \text{O}_2(g) \rightarrow 2\text{H}_2\text{O}(g) + 483.6 \text{ kJ} \)
(3) \( \text{H}_2(g) + \text{I}_2(g) + 53.0 \text{ kJ} \rightarrow 2\text{HI}(g) \)
(4) \( \text{N}_2(g) + 2\text{O}_2(g) + 66.4 \text{ kJ} \rightarrow 2\text{NO}_2(g) \)

14 Which liquid has the lowest vapor pressure at 65°C?

(1) ethanoic acid  (3) propanone
(2) ethanol  (4) water

15 Which substance can not be broken down by a chemical reaction?

(1) ammonia  (3) methane
(2) argon  (4) water

16 In which sample is the average kinetic energy of the particles greatest?

(1) 10. mL of \( \text{HCl}(aq) \) at 25°C
(2) 15 mL of \( \text{HCl}(aq) \) at 20°C
(3) 10. mL of \( \text{H}_2\text{O}(\ell) \) at 35°C
(4) 15 mL of \( \text{H}_2\text{O}(\ell) \) at 30°C

17 A thermometer is in a beaker of water. Which statement best explains why the thermometer reading initially increases when \( \text{LiBr}(s) \) is dissolved in the water?

(1) The entropy of the \( \text{LiBr}(aq) \) is greater than the entropy of the water.
(2) The entropy of the \( \text{LiBr}(aq) \) is less than the entropy of the water.
(3) The dissolving of the \( \text{LiBr}(s) \) in water is an endothermic process.
(4) The dissolving of the \( \text{LiBr}(s) \) in water is an exothermic process.

18 Which process increases the potential energy of the particles of a sample?

(1) condensation  (3) solidification
(2) deposition  (4) vaporization

19 Which sample at STP has the same number of molecules as 5 liters of \( \text{NO}_2(g) \) at STP?

(1) 5 grams of \( \text{H}_2(g) \)
(2) 5 liters of \( \text{CH}_4(g) \)
(3) 5 moles of \( \text{O}_2(g) \)
(4) \( 5 \times 10^{23} \) molecules of \( \text{CO}_2(g) \)

20 Under which conditions of temperature and pressure does oxygen gas behave least like an ideal gas?

(1) low temperature and low pressure
(2) low temperature and high pressure
(3) high temperature and low pressure
(4) high temperature and high pressure

21 How is a chemical reaction affected by the addition of a catalyst?

(1) The activation energy decreases.
(2) The heat of reaction increases.
(3) The number of collisions between particles decreases.
(4) The potential energy of the reactants increases.

22 Systems in nature tend to undergo changes toward

(1) lower energy and less disorder
(2) lower energy and more disorder
(3) higher energy and less disorder
(4) higher energy and more disorder

23 What can be concluded if an ion of an element is smaller than an atom of the same element?

(1) The ion is negatively charged because it has fewer electrons than the atom.
(2) The ion is negatively charged because it has more electrons than the atom.
(3) The ion is positively charged because it has fewer electrons than the atom.
(4) The ion is positively charged because it has more electrons than the atom.
24. Which class of organic compounds has molecules that contain nitrogen atoms?
   (1) alcohol  (3) ether
   (2) amine    (4) ketone

25. Which two compounds have the same molecular formula but different chemical and physical properties?
   (1) CH₃CH₂Cl and CH₃CH₂Br
   (2) CH₃CHCH₂ and CH₃CH₂CH₃
   (3) CH₃CHO and CH₃COCH₃
   (4) CH₃CH₂OH and CH₃OCH₃

26. Which half-reaction equation represents the reduction of a potassium ion?
   (1) K⁺ + e⁻ → K⁻  (3) K⁺ → K + e⁻
   (2) K + e⁻ → K⁺    (4) K → K⁺ + e⁻

27. According to the Arrhenius theory, an acid is a substance that
   (1) changes litmus from red to blue
   (2) changes phenolphthalein from colorless to pink
   (3) produces hydronium ions as the only positive ions in an aqueous solution
   (4) produces hydroxide ions as the only negative ions in an aqueous solution

28. Which type of reaction occurs when a high-energy particle collides with the nucleus of an atom, converting that atom to an atom of a different element?
   (1) addition  (3) substitution
   (2) neutralization  (4) transmutation

29. Which particle is emitted when an atom of ⁸⁵Kr spontaneously decays?
   (1) an alpha particle  (3) a neutron
   (2) a beta particle    (4) a proton

30. What is a problem commonly associated with nuclear power facilities?
   (1) A small quantity of energy is produced.
   (2) Reaction products contribute to acid rain.
   (3) It is impossible to control nuclear fission.
   (4) It is difficult to dispose of wastes.
Part B–1

Answer all questions in this part.

Directions (31–50): For each statement or question, write on the separate answer sheet the number of the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the Reference Tables for Physical Setting/Chemistry.

31 The wave-mechanical model of the atom is required to explain the
(1) mass number and atomic number of an atom
(2) organization of atoms in a crystal
(3) radioactive nature of some atoms
(4) spectra of elements with multielectron atoms

32 Magnesium and calcium have similar chemical properties because an atom of each element has the same total number of
(1) electron shells
(2) valence electrons
(3) neutrons
(4) protons

33 The diagram below represents the nucleus of an atom.

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<table>
<thead>
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<th>Key</th>
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<tbody>
<tr>
<td>● = proton</td>
</tr>
<tr>
<td>○ = neutron</td>
</tr>
</tbody>
</table>
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What are the atomic number and mass number of this atom?
(1) The atomic number is 9 and the mass number is 19.
(2) The atomic number is 9 and the mass number is 20.
(3) The atomic number is 11 and the mass number is 19.
(4) The atomic number is 11 and the mass number is 20.

34 A barium atom attains a stable electron configuration when it bonds with
(1) one chlorine atom
(2) two chlorine atoms
(3) one sodium atom
(4) two sodium atoms

35 A student measures the mass and volume of a piece of aluminum. The measurements are 25.6 grams and 9.1 cubic centimeters. The student calculates the density of the aluminum. What is the percent error of the student’s calculated density of aluminum?
(1) 1%
(2) 2%
(3) 3%
(4) 4%

36 Given the balanced equation representing a reaction:

```
2H₂ + O₂ → 2H₂O
```

What is the total mass of water formed when 8 grams of hydrogen reacts completely with 64 grams of oxygen?
(1) 18 g
(2) 36 g
(3) 56 g
(4) 72 g

37 Which compound contains both ionic and covalent bonds?
(1) ammonia
(2) methane
(3) sodium nitrate
(4) potassium chloride

38 An iron bar at 325 K is placed in a sample of water. The iron bar gains energy from the water if the temperature of the water is
(1) 65 K
(2) 45 K
(3) 65°C
(4) 45°C
39 Which particle model diagram represents only one compound composed of elements X and Z?

![Key](image)

<table>
<thead>
<tr>
<th>Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>● = atom of element X</td>
</tr>
<tr>
<td>○ = atom of element Z</td>
</tr>
</tbody>
</table>

(1) ![Diagram 1](image)
(2) ![Diagram 2](image)
(3) ![Diagram 3](image)
(4) ![Diagram 4](image)

40 Given the balanced equation representing a reaction:

\[ \text{Cu} + \text{S} \rightarrow \text{CuS} + \text{energy} \]

Which statement explains why the energy term is written to the right of the arrow?

(1) The compound CuS is composed of two metals.
(2) The compound CuS is composed of two nonmetals.
(3) Energy is absorbed as the bonds in CuS form.
(4) Energy is released as the bonds in CuS form.

41 A 1.0-gram sample of which element will uniformly fill a closed 2.0-liter container at STP?

(1) antimony  (3) tellurium
(2) sulfur    (4) xenon

42 Given the balanced equation representing a reaction:

\[ \text{C}_3\text{H}_8(g) + 5\text{O}_2(g) \rightarrow 3\text{CO}_2(g) + 4\text{H}_2\text{O}(g) \]

What is the total number of moles of \( \text{O}_2(g) \) required for the complete combustion of 1.5 moles of \( \text{C}_3\text{H}_8(g) \)?

(1) 0.30 mol  (3) 4.5 mol
(2) 1.5 mol    (4) 7.5 mol

43 A sample of gas occupies a volume of 50.0 milliliters in a cylinder with a movable piston. The pressure of the sample is 0.90 atmosphere and the temperature is 298 K. What is the volume of the sample at STP?

(1) 41 mL  (3) 51 mL
(2) 49 mL    (4) 55 mL

44 Which solution has the lowest freezing point?

(1) 10. g ofKI dissolved in 100. g of water
(2) 20. g of KI dissolved in 200. g of water
(3) 30. g of KI dissolved in 100. g of water
(4) 40. g of KI dissolved in 200. g of water

45 Which 1-mole sample has the least entropy?

(1) \( \text{Br}_2(s) \) at 266 K  (3) \( \text{Br}_2(\ell) \) at 332 K
(2) \( \text{Br}_2(\ell) \) at 266 K    (4) \( \text{Br}_2(g) \) at 332 K

46 At 20.°C, a 1.2-gram sample of Mg ribbon reacts rapidly with 10.0 milliliters of 1.0 M HCl(aq). Which change in conditions would have caused the reaction to proceed more slowly?

(1) increasing the initial temperature to 25°C
(2) decreasing the concentration of HCl(aq) to 0.1 M
(3) using 1.2 g of powdered Mg
(4) using 2.4 g of Mg ribbon

47 Which general formula represents the compound CH₃CH₂CCH?

(1) \( C_n \text{H}_n \)  (3) \( C_n \text{H}_{2n-2} \)
(2) \( C_n \text{H}_{2n} \)    (4) \( C_n \text{H}_{2n+2} \)
48 Which compound dissolves in water to form an aqueous solution that can conduct an electric current?

(1) CCl₄ (3) CH₃COOH
(2) C₂H₅OH (4) CH₄

49 Given the equation representing a reaction at equilibrium:

\[ \text{NH}_3(g) + \text{H}_2\text{O}(\ell) \rightleftharpoons \text{NH}_4^+(aq) + \text{OH}^-(aq) \]

The H⁺ acceptor for the forward reaction is

(1) H₂O(ℓ) (3) NH₄⁺(aq)
(2) NH₃(g) (4) OH⁻(aq)

50 An original sample of K-40 has a mass of 25.00 grams. After \(3.9 \times 10^9\) years, 3.125 grams of the original sample remains unchanged. What is the half-life of K-40?

(1) \(1.3 \times 10^9\) y (3) \(3.9 \times 10^9\) y
(2) \(2.6 \times 10^9\) y (4) \(1.2 \times 10^{10}\) y
Part B–2

Answer all questions in this part.

Directions (51–64): Record your answers in the spaces provided in your answer booklet. Some questions may require the use of the Reference Tables for Physical Setting/Chemistry.

Base your answers to questions 51 and 52 on the information below.

In a titration, 15.65 milliliters of a KOH(aq) solution exactly neutralized 10.00 milliliters of a 1.22 M HCl(aq) solution.

51 Complete the equation in your answer booklet for the titration reaction by writing the formula of each product. [1]

52 In the space in your answer booklet, show a correct numerical setup for calculating the molarity of the KOH(aq) solution. [1]

Base your answers to questions 53 through 55 on the information below.

A 150.-gram liquid sample of stearic acid, C_{17}H_{35}COOH, is cooled at a constant rate. The temperature of the sample is recorded at 2-minute intervals in the data table below.

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>75.0</td>
</tr>
<tr>
<td>2</td>
<td>72.0</td>
</tr>
<tr>
<td>4</td>
<td>69.3</td>
</tr>
<tr>
<td>6</td>
<td>69.3</td>
</tr>
<tr>
<td>8</td>
<td>69.3</td>
</tr>
<tr>
<td>10</td>
<td>69.3</td>
</tr>
<tr>
<td>12</td>
<td>65.0</td>
</tr>
</tbody>
</table>

53 Identify the physical change occurring during the time interval 4 minutes to 10. minutes. [1]

54 On the grid in your answer booklet:
   • Mark an appropriate scale on the axis labeled “Temperature (°C).” [1]
   • Plot the data from the data table. Circle and connect the points. [1]

55 Determine the gram-formula mass of stearic acid. [1]
Base your answers to questions 56 through 58 on the information below.

An unsaturated solution is made by completely dissolving 20.0 grams of NaNO₃ in 100.0 grams of water at 20.0°C.

56 In the space in your answer booklet, show a correct numerical setup for calculating the number of moles of NaNO₃ (gram-formula mass = 85.0 grams per mole) used to make this unsaturated solution. [1]

57 Determine the minimum mass of NaNO₃ that must be added to this unsaturated solution to make a saturated solution at 20.0°C. [1]

58 Identify one process that can be used to recover the NaNO₃ from the unsaturated solution. [1]

Base your answers to questions 59 through 61 on the information below.

The hydrocarbon 2-methylpropane reacts with iodine as represented by the balanced equation below. At standard pressure, the boiling point of 2-methylpropane is lower than the boiling point of 2-iodo-2-methylpropane.

\[
\begin{align*}
\text{H} & \quad \text{H} \\
\text{H} & \quad \text{H} \\
\text{H} & \quad \text{H} \\
\text{H} & \quad \text{H} \\
\text{H} & \quad \text{H} \\
\text{H} & \quad \text{H} \\
\text{H} & \quad \text{H}
\end{align*}
\]  

\[
\text{2-methylpropane}
\]

\[
\begin{align*}
\text{H} & \quad \text{H} \\
\text{H} & \quad \text{H} \\
\text{H} & \quad \text{H} \\
\text{H} & \quad \text{H} \\
\text{H} & \quad \text{H} \\
\text{H} & \quad \text{H}
\end{align*}
\]  

\[
\text{2-iodo-2-methylpropane}
\]

59 To which class of organic compounds does this organic product belong? [1]

60 Explain, in terms of bonding, why the hydrocarbon 2-methylpropane is saturated. [1]

61 Explain the difference in the boiling points of 2-methylpropane and 2-iodo-2-methylpropane in terms of both molecular polarity and intermolecular forces. [2]
Base your answers to questions 62 through 64 on the information below.

Nitrogen gas, hydrogen gas, and ammonia gas are in equilibrium in a closed container at constant temperature and pressure. The equation below represents this equilibrium.

\[ \text{N}_2(g) + 3\text{H}_2(g) \rightleftharpoons 2\text{NH}_3(g) \]

The graph below shows the initial concentration of each gas, the changes that occur as a result of adding \( \text{H}_2(g) \) to the system, and the final concentrations when equilibrium is reestablished.

62 What information on the graph indicates that the system was initially at equilibrium? [1]

63 Explain, in terms of LeChatelier's principle, why the final concentration of \( \text{NH}_3(g) \) is greater than the initial concentration of \( \text{NH}_3(g) \). [1]

64 Explain, in terms of collision theory, why the concentration of \( \text{H}_2(g) \) begins to decrease immediately after more \( \text{H}_2(g) \) is added to the system. [1]
Part C

Answer all questions in this part.

Directions (65–79): Record your answers in the spaces provided in your answer booklet. Some questions may require the use of the Reference Tables for Physical Setting/Chemistry.

Base your answers to questions 65 through 67 on the information below.

An unlit candle is secured to the bottom of a 200-milliliter glass beaker. Baking soda (sodium hydrogen carbonate) is added around the base of the candle as shown below.

![Image of a beaker with a candle and baking soda]

The candle is lit and dilute ethanoic acid is poured down the inside of the beaker. As the acid reacts with the baking soda, bubbles of CO₂ gas form. After a few seconds, the air in the beaker is replaced by 0.20 liter of CO₂ gas, causing the candle flame to go out. The density of CO₂ gas is 1.8 grams per liter at room temperature.

65 Write the chemical formula for baking soda. [1]

66 In the space in your answer booklet, draw a structural formula for the acid that was poured into the beaker. [1]

67 Calculate the mass of the CO₂ gas that replaced the air in the beaker. Your response must include both a correct numerical setup and the calculated result. [2]
The health of fish depends on the amount of oxygen dissolved in the water. A dissolved oxygen (DO) concentration between 6 parts per million and 8 parts per million is best for fish health. A DO concentration greater than 1 part per million is necessary for fish survival.

Fish health is also affected by water temperature and concentrations of dissolved ammonia, hydrogen sulfide, chloride compounds, and nitrate compounds. Most freshwater fish thrive in water with a pH between 6.5 and 8.5.

A student’s fish tank contains fish, green plants, and 3800 grams of fish-tank water with \(2.7 \times 10^{-2}\) gram of dissolved oxygen. Phenolphthalein tests colorless and bromthymol blue tests blue in samples of the fish-tank water.

68 Based on the test results for the indicators phenolphthalein and bromthymol blue, what is the pH range of the fish-tank water? [1]

69 When the fish-tank water has a pH of 8.0, the hydronium ion concentration is \(1.0 \times 10^{-8}\) mole per liter. What is the hydronium ion concentration when the water has a pH of 7.0? [1]

70 State how an increase in the temperature of the fish-tank water affects the solubility of oxygen in the water. [1]

71 Determine if the DO concentration in the fish tank is healthy for fish. Your response must include:
- a correct numerical setup to calculate the DO concentration in the water in parts per million [1]
- the calculated result [1]
- a statement using your calculated result that tells why the DO concentration in the water is or is not healthy for fish [1]
Base your answers to questions 72 and 73 on the information below.

The Balmer series refers to the visible bright lines in the spectrum produced by hydrogen atoms. The color and wavelength of each line in this series are given in the table below.

<table>
<thead>
<tr>
<th>Color</th>
<th>Wavelength (nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>red</td>
<td>656.3</td>
</tr>
<tr>
<td>blue green</td>
<td>486.1</td>
</tr>
<tr>
<td>blue</td>
<td>434.1</td>
</tr>
<tr>
<td>violet</td>
<td>410.2</td>
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</table>

72 On the diagram in your answer booklet, draw four vertical lines to represent the Balmer series. [1]

73 Explain, in terms of both subatomic particles and energy states, how the Balmer series is produced. [1]

Base your answers to questions 74 through 76 on the information below.

A flashlight can be powered by a rechargeable nickel-cadmium battery. In the battery, the anode is Cd(s) and the cathode is NiO₂(s). The unbalanced equation below represents the reaction that occurs as the battery produces electricity. When a nickel-cadmium battery is recharged, the reverse reaction occurs.

\[
\text{Cd(s) + NiO}_2(s) + \text{H}_2\text{O}(l) \rightarrow \text{Cd(OH)}_2(s) + \text{Ni(OH)}_2(s)
\]

74 Balance the equation in your answer booklet for the reaction that produces electricity, using the smallest whole-number coefficients. [1]

75 Determine the change in oxidation number for the element that makes up the anode in the reaction that produces electricity. [1]

76 Explain why Cd would be above Ni if placed on Table J. [1]
A battery-operated smoke detector produces an alarming sound when its electrical sensor detects smoke particles. Some ionizing smoke detectors contain the radioisotope americium-241, which undergoes alpha decay and has a half-life of 433 years. The emitted alpha particles ionize gas molecules in the air. As a result, an electric current flows through the detector. When smoke particles enter the detector, the flow of ions is interrupted, causing the alarm to sound.

77 Complete the nuclear equation in your answer booklet for the decay of Am-241. Your response must include the symbol, mass number, and atomic number for each product. [2]

78 State one scientific reason why Am-241 is a more appropriate radioactive source than Fr-220 in an ionizing smoke detector. [1]

79 Explain, in terms of particle behavior, why smoke particles cause the detector alarm to sound. [1]

__________________________________________
The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
CHEMISTRY

Tuesday, June 17, 2008 — 1:15 to 4:15 p.m., only

ANSWER SHEET

Student ......................................................... Sex: □ Male □ Female Grade ............

Teacher ......................................................... School ........................................

Record your answers to Part A and Part B–1 on this answer sheet.

Part A

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Part A Score

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</table>

Part B–1 Score

Write your answers to Part B–2 and Part C in your answer booklet.

The declaration below should be signed when you have completed the examination.

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
HCl(aq) + KOH(aq) → __________________ + __________________

Part B–2

51  HCl(aq) + KOH(aq) → __________________ + __________________

52
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<tr>
<th>Time (min)</th>
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**Cooling Curve for Stearic Acid**

55 \[ \text{g/mol} \]

57 \[ \text{g} \]
61 Molecular polarity: ____________________________
   ____________________________
   ____________________________
   ____________________________
   ____________________________
   ____________________________
   ____________________________

Intermolecular forces: ____________________________
   ____________________________
   ____________________________
   ____________________________
   ____________________________
   ____________________________
   ____________________________
   ____________________________
   ____________________________
   ____________________________
   ____________________________
   ____________________________
   ____________________________
pH between ____________ and ____________

________________________ mol/L

________________________ ppm

________________________ ppm

Wavelength (nm)

400. 500. 600. 700.
74 $\text{Cd(s)} + \text{NiO}_2(s) + \text{H}_2\text{O(ℓ)} \rightarrow \text{Cd(OH)}_2(s) + \text{Ni(OH)}_2(s)$

75 From __________ to __________

76 

77 $^{241}_{\text{Am}} \rightarrow \text{__________} + \text{__________}$

78 

79 

Total Score for Part C
### FOR TEACHERS ONLY

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

**PHYSICAL SETTING/CHEMISTRY**  

Tuesday, June 17, 2008 — 1:15 to 4:15 p.m., only

### SCORING KEY AND RATING GUIDE

**Directions to the Teacher:**  
Refer to the directions on page 3 before rating student papers.

Updated information regarding the rating of this examination may be posted on the New York State Education Department’s web site during the rating period. Check this web site [http://www.emsc.nysed.gov/osa/](http://www.emsc.nysed.gov/osa/) and select the link “Examination Scoring Information” for any recently posted information regarding this examination. This site should be checked before the rating process for this examination begins and several times throughout the Regents examination period.

### Part A and Part B–1

Allow 1 credit for each correct response.

<table>
<thead>
<tr>
<th>Part A</th>
<th>Part B–1</th>
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<tbody>
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</table>
Directions to the Teacher

Follow the procedures below for scoring student answer papers for the Physical Setting/Chemistry examination. Additional information about scoring is provided in the publication Information Booklet for Scoring Regents Examinations in the Sciences.

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

On the detachable answer sheet for Part A and Part B–1, indicate by means of a check mark each incorrect or omitted answer. In the box provided at the end of each part, record the number of questions the student answered correctly for that part.

At least two science teachers must participate in the scoring of each student’s responses to the Part B–2 and Part C open-ended questions. Each of these teachers should be responsible for scoring a selected number of the open-ended questions on each answer paper. No one teacher is to score all the open-ended questions on a student’s answer paper.

Students’ responses must be scored strictly according to the Scoring Key and Rating Guide. For open-ended questions, credit may be allowed for responses other than those given in the rating guide if the response is a scientifically accurate answer to the question and demonstrates adequate knowledge as indicated by the examples in the rating guide. Complete sentences are not required. Phrases, diagrams, and symbols may be used. In the student’s answer booklet, record the number of credits earned for each answer in the box printed to the right of the answer lines or spaces for that question.

Fractional credit is not allowed. Only whole-number credit may be given to a response. Units need not be given when the wording of the questions allows such omissions.

Raters should enter the scores earned for Part A, Part B–1, Part B–2, and Part C on the appropriate lines in the box printed on the answer booklet and then should add these four scores and enter the total in the box labeled “Total Written Test Score.” Then, the student’s raw score should be converted to a scaled score by using the conversion chart that will be posted on the Department’s web site http://www.emsc.nysed.gov/osaa/ on Tuesday, June 17, 2008. The student’s scaled score should be entered in the labeled box on the student’s answer booklet. The scaled score is the student’s final examination score.

All student answer papers that receive a scaled score of 60 through 64 must be scored a second time. For the second scoring, a different committee of teachers may score the student’s paper or the original committee may score the paper, except that no teacher may score the same open-ended questions that he/she scored in the first rating of the paper. The school principal is responsible for assuring that the student’s final examination score is based on a fair, accurate, and reliable scoring of the student’s answer paper.

Because scaled scores corresponding to raw scores in the conversion chart may change from one examination to another, it is crucial that for each administration, the conversion chart provided for that administration be used to determine the student’s final score.
Part B–2

Allow a total of 16 credits for this part. The student must answer all questions in this part.

51 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

\[ \text{H}_2\text{O} + \text{KCl} \]
\[ \text{KCl(aq)} + \text{H}_{2}\text{O(ℓ)} \]

52 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

\[ (1.22 \text{ M})(10.00 \text{ mL}) = M_B(15.65 \text{ mL}) \]
\[ \frac{(1.22)(10)}{15.65} \]

53 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

solidification
freezing
crystallization
54 [2] Allow a maximum of 2 credits, allocated as follows:

- Allow 1 credit for marking an appropriate scale on the axis labeled “Temperature (°C).” An appropriate scale is linear and allows a trend to be seen.

- Allow 1 credit for plotting all seven points correctly ± 0.3 grid space. Plotted points do not need to be circled or connected.

**Example of a 2-credit response:**

![Cooling Curve for Stearic Acid](image)

55 [1] Allow 1 credit for 284 g/mol. Significant figures do not need to be shown.

56 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

\[
20.0 \text{ g} \times \frac{1\text{ mol}}{85.0\text{ g}}
\]

\[
\frac{20}{85}
\]

57 [1] Allow 1 credit for 68 g ± 1 g.

58 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- evaporation of the water
59 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- halide
- halocarbon
- alkyl halide

60 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- A 2-methylpropane molecule has only single carbon-carbon bonds.
- There are only single bonds in methylpropane.
- no multiple bonds between carbon atoms

61 [2] Allow a maximum of 2 credits, allocated as follows:

- Allow 1 credit for correctly describing the molecular polarities. Acceptable responses include, but are not limited to:
  
  The molecules of 2-iodo-2-methylpropane are more polar than the molecules of 2-methylpropane.

- Allow 1 credit for correctly describing the intermolecular forces. Acceptable responses include, but are not limited to:
  
  There are stronger intermolecular forces between molecules of 2-iodo-2-methylpropane.

62 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- The initial concentration of each gas is constant.
- Concentrations stay the same.

**Note:** Do not allow credit for a response stating the rate of the forward reaction equals the rate of the reverse reaction or for stating the concentrations are equal.

63 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- The stress of adding \( \text{H}_2(\text{g}) \) shifts the reaction to the right, producing \( \text{NH}_3(\text{g}) \).
- The reaction shifts to the right to relieve the stress.
Allow 1 credit. Acceptable responses include, but are not limited to:

Adding $\text{H}_2(\text{g})$ causes more collisions between $\text{H}_2(\text{g})$ molecules and $\text{N}_2(\text{g})$ molecules. Therefore, more $\text{H}_2(\text{g})$ reacts, reducing the $\text{H}_2(\text{g})$ concentration.

More collisions between $\text{H}_2$ and $\text{N}_2$ produce $\text{NH}_3$, so more $\text{H}_2$ is used up.
Part C

Allow a total of 19 credits for this part. The student must answer all questions in this part.


Examples of 1-credit responses:

![Chemical structure diagram]

67 [2] Allow a maximum of 2 credits, allocated as follows:

• Allow 1 credit for a correct numerical setup. Acceptable responses include, but are not limited to:

\[ m = Vd = (0.20 \text{ L})(1.8 \text{ g/L}) \]

\[ (0.2)(1.8) \]

• Allow 1 credit for 0.36 g or for a response consistent with the student’s numerical setup. Significant figures do not need to be shown.

Note: Do not allow credit for a numerical setup and calculated result that are not related to the concept assessed by the question.

68 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

7.6 and 8.2

8.1 and 7.7

69 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

\[ 1 \times 10^{-7} \text{ mol/L} \]

0.000 000 1 mol/L

\[ 10^{-7} \text{ mol/L} \]
70  [1] Allow 1 credit. Acceptable responses include, but are not limited to:

When the temperature of the water increases, oxygen is less soluble.

Oxygen is less soluble in warmer water.

71  [3] Allow a maximum of 3 credits, allocated as follows:

- Allow 1 credit for a correct numerical setup.
- Allow 1 credit for 7.1 ppm or for a response consistent with the student’s numerical setup. Significant figures do not need to be shown.
- Allow 1 credit for a statement indicating the DO concentration in the water is healthy for fish to survive, based on the calculated result.

or

Allow 1 credit for a response consistent with the student’s calculated result.

Note: Do not allow credit for a numerical setup and calculated result that are not related to the concept assessed by the question.

Example of a 3-credit response:

\[
\text{ppm} = \frac{2.7 \times 10^{-2}}{3800 \text{ g}} \times 10^6
\]

7.1 ppm

The water is healthy for fish because the DO is 7.1 ppm, which is within the range of DO concentrations best for fish.
72 [1] Allow 1 credit for all four lines drawn correctly ± 0.3 division. The lines can be drawn above, through, or below the scale.

**Example of a 1-credit response:**

![Graph](graph.png)

73 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

When the electron in an excited hydrogen atom returns from a higher energy state to a lower energy state, a specific amount of energy is emitted.

Light is emitted when the excited electron drops from a higher electron shell to a lower electron shell.

74 [1] Allow 1 credit for \[ \text{_____Cd(s)} + \text{_____NiO}_2(s) + \frac{2}{2} \text{H}_2\text{O(\ell)} \rightarrow \text{_____Cd(OH)}_2(s) + \text{_____Ni(OH)}_2(s) \].

**Note:** Allow credit even if the coefficient “1” is written in front of Cd(s), NiO\(_2\)(s), Cd(OH)\(_2\)(s), and/or Ni(OH)\(_2\)(s).

75 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

from 0 to +2

76 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

Cadmium oxidizes in the presence of Ni\(^{4+}\).

Cd is more reactive than Ni.
77  [2] Allow a maximum of 2 credits, allocated as follows:

- Allow 1 credit for the decay mode $^4_2\alpha$ or $^4_2$He.
- Allow 1 credit for the nuclide $^{237}_{93}$Np or for a nuclide consistent with the student's response for the decay mode.

78  [1] Allow 1 credit. Acceptable responses include, but are not limited to:

Am-241 has a longer half-life so the sample emits alpha particles for a longer period of time.

Fr-220 has a much shorter half-life and decays more rapidly.

The half-life of Am-241 is 433 years. The half-life of Fr-220 is only 27.5 s.

79  [1] Allow 1 credit. Acceptable responses include, but are not limited to:

Smoke particles interrupt the flow of ions required to maintain an electric current.

fewer freely moving charged particles in the detector
The Chart for Determining the Final Examination Score for the June 2008 Regents Examination in Physical Setting/Chemistry will be posted on the Department’s web site http://www.emsc.nysed.gov/osa/ on Tuesday, June 17, 2008. Conversion charts provided for previous administrations of the Regents Examination in Physical Setting/Chemistry must NOT be used to determine students’ final scores for this administration.

Submitting Teacher Evaluations of the Test to the Department

Suggestions and feedback from teachers provide an important contribution to the test development process. The Department provides an online evaluation form for State assessments. It contains spaces for teachers to respond to several specific questions and to make suggestions. Instructions for completing the evaluation form are as follows:

2. Select the test title.
3. Complete the required demographic fields.
4. Complete each evaluation question and provide comments in the space provided.
5. Click the SUBMIT button at the bottom of the page to submit the completed form.
<table>
<thead>
<tr>
<th>Key Ideas/Performance Indicators</th>
<th>Part A</th>
<th>Part B</th>
<th>Part C</th>
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<tbody>
<tr>
<td><strong>Standard 1</strong></td>
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<td>Math Key Idea 1</td>
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<td>67,71,72</td>
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<td>Math Key Idea 2</td>
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<td><strong>Standard 2</strong></td>
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<td>65,66,67,68,75,76,77,78</td>
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</tbody>
</table>
To determine the student’s final examination score, find the student’s total test raw score in the column labeled “Raw Score” and then locate the scale score that corresponds to that raw score. The scale score is the student’s final examination score. Enter this score in the space labeled “Final Score” on the student’s answer sheet.

All student answer papers that receive a scale score of 60 through 64 must be scored a second time. For the second scoring, a different committee of teachers may score the student’s paper or the original committee may score the paper, except that no teacher may score the same open-ended questions that he/she scored in the first rating of the paper. The school principal is responsible for assuring that the student’s final examination score is based on a fair, accurate and reliable scoring of the student’s answer paper.

Because scale scores corresponding to raw scores in the conversion chart change from one examination to another, it is crucial that for each administration, the conversion chart provided for that administration be used to determine the student’s final score. The chart above is usable only for this administration of the Physical Setting/Chemistry Examination.

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<th>Scale Score</th>
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