

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

**PHYSICAL SETTING
CHEMISTRY**

Wednesday, June 21, 2006 — 1:15 to 4:15 p.m., only

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 Which notation represents an atom of sodium with an atomic number of 11 and a mass number of 24?
- (1) ${}_{11}^{24}\text{Na}$ (3) ${}_{11}^{13}\text{Na}$
(2) ${}_{24}^{11}\text{Na}$ (4) ${}_{11}^{35}\text{Na}$
- 2 Which element has chemical properties that are most similar to those of calcium?
- (1) Co (3) N
(2) K (4) Sr
- 3 Which element is malleable and can conduct electricity in the solid phase?
- (1) iodine (3) sulfur
(2) phosphorus (4) tin
- 4 Atoms of different isotopes of the same element differ in their total number of
- (1) electrons (3) protons
(2) neutrons (4) valence electrons
- 5 Which statement correctly describes two forms of oxygen, O_2 and O_3 ?
- (1) They have identical molecular structures and identical properties.
(2) They have identical molecular structures and different properties.
(3) They have different molecular structures and identical properties.
(4) They have different molecular structures and different properties.
- 6 What is the IUPAC name for the compound FeS ?
- (1) iron(II) sulfate (3) iron(II) sulfide
(2) iron(III) sulfate (4) iron(III) sulfide
- 7 Given the balanced equation representing a reaction:
- $$\text{F}_2(\text{g}) + \text{H}_2(\text{g}) \rightarrow 2\text{HF}(\text{g})$$
- What is the mole ratio of $\text{H}_2(\text{g})$ to $\text{HF}(\text{g})$ in this reaction?
- (1) 1:1 (3) 2:1
(2) 1:2 (4) 2:3
- 8 Which list includes three types of chemical reactions?
- (1) condensation, double replacement, and sublimation
(2) condensation, solidification, and synthesis
(3) decomposition, double replacement, and synthesis
(4) decomposition, solidification, and sublimation
- 9 Which type of bond results when one or more valence electrons are transferred from one atom to another?
- (1) a hydrogen bond
(2) an ionic bond
(3) a nonpolar covalent bond
(4) a polar covalent bond
- 10 What is the total number of electrons shared in the bonds between the two carbon atoms in a molecule of $\text{H}-\text{C}\equiv\text{C}-\text{H}$?
- (1) 6 (3) 3
(2) 2 (4) 8
- 11 Which formula represents a nonpolar molecule?
- (1) CH_4 (3) H_2O
(2) HCl (4) NH_3

- 12 Which changes occur as a cadmium atom, Cd, becomes a cadmium ion, Cd²⁺?
- (1) The Cd atom gains two electrons and its radius decreases.
 - (2) The Cd atom gains two electrons and its radius increases.
 - (3) The Cd atom loses two electrons and its radius decreases.
 - (4) The Cd atom loses two electrons and its radius increases.
- 13 Which element has atoms with the greatest attraction for electrons in a chemical bond?
- (1) beryllium
 - (2) fluorine
 - (3) lithium
 - (4) oxygen
- 14 Two substances, A and Z, are to be identified. Substance A can *not* be broken down by a chemical change. Substance Z can be broken down by a chemical change. What can be concluded about these substances?
- (1) Both substances are elements.
 - (2) Both substances are compounds.
 - (3) Substance A is an element and substance Z is a compound.
 - (4) Substance A is a compound and substance Z is an element.
- 15 Which ion, when combined with chloride ions, Cl⁻, forms an insoluble substance in water?
- (1) Fe²⁺
 - (2) Mg²⁺
 - (3) Pb²⁺
 - (4) Zn²⁺
- 16 Molarity is defined as the
- (1) moles of solute per kilogram of solvent
 - (2) moles of solute per liter of solution
 - (3) mass of a solution
 - (4) volume of a solvent
- 17 Which formula represents a hydrocarbon?
- (1) CH₃CH₂CH₂CHO
 - (2) CH₃CH₂CH₂CH₃
 - (3) CH₃CH₂CH₂COOH
 - (4) CH₃CH₂COOCH₃
- 18 Which expression represents the ΔH for a chemical reaction in terms of the potential energy, *PE*, of its products and reactants?
- (1) *PE* of products + *PE* of reactants
 - (2) *PE* of products – *PE* of reactants
 - (3) *PE* of products \times *PE* of reactants
 - (4) *PE* of products \div *PE* of reactants
- 19 Which balanced equation represents an endothermic reaction?
- (1) C(s) + O₂(g) \rightarrow CO₂(g)
 - (2) CH₄(g) + 2O₂(g) \rightarrow CO₂(g) + 2H₂O(ℓ)
 - (3) N₂(g) + 3H₂(g) \rightarrow 2NH₃(g)
 - (4) N₂(g) + O₂(g) \rightarrow 2NO(g)
- 20 Which formula represents propyne?
- (1) C₃H₄
 - (2) C₃H₆
 - (3) C₅H₈
 - (4) C₅H₁₀
- 21 Which factors must be equal in a reversible chemical reaction at equilibrium?
- (1) the activation energies of the forward and reverse reactions
 - (2) the rates of the forward and reverse reactions
 - (3) the concentrations of the reactants and products
 - (4) the potential energies of the reactants and products
- 22 The compounds CH₃OCH₃ and CH₃CH₂OH are isomers of each other. These two compounds must have the same
- (1) density
 - (2) reactivity
 - (3) melting point
 - (4) molecular formula
- 23 Which balanced equation represents a redox reaction?
- (1) AgNO₃ + NaCl \rightarrow AgCl + NaNO₃
 - (2) BaCl₂ + K₂CO₃ \rightarrow BaCO₃ + 2KCl
 - (3) CuO + CO \rightarrow Cu + CO₂
 - (4) HCl + KOH \rightarrow KCl + H₂O

- 24 Which process occurs at the anode in an electrochemical cell?
- (1) the loss of protons
 - (2) the loss of electrons
 - (3) the gain of protons
 - (4) the gain of electrons
- 25 Which substance is an electrolyte?
- (1) CH_3OH
 - (2) $\text{C}_6\text{H}_{12}\text{O}_6$
 - (3) H_2O
 - (4) KOH
- 26 Which ion is the only negative ion present in an aqueous solution of an Arrhenius base?
- (1) hydride ion
 - (2) hydrogen ion
 - (3) hydronium ion
 - (4) hydroxide ion
- 27 According to Reference Table N, which pair of isotopes spontaneously decays?
- (1) C-12 and N-14
 - (2) C-12 and N-16
 - (3) C-14 and N-14
 - (4) C-14 and N-16
- 28 Which equation represents the radioactive decay of $^{226}_{88}\text{Ra}$?
- (1) $^{226}_{88}\text{Ra} \rightarrow ^{222}_{86}\text{Rn} + ^4_2\text{He}$
 - (2) $^{226}_{88}\text{Ra} \rightarrow ^{226}_{89}\text{Ac} + ^0_{-1}\text{e}$
 - (3) $^{226}_{88}\text{Ra} \rightarrow ^{226}_{87}\text{Fr} + ^0_{+1}\text{e}$
 - (4) $^{226}_{88}\text{Ra} \rightarrow ^{225}_{88}\text{Ra} + ^1_0\text{n}$
- 29 Which type of reaction converts one element to another element?
- (1) neutralization
 - (2) polymerization
 - (3) substitution
 - (4) transmutation
- 30 Which nuclear emission has the greatest mass?
- (1) α
 - (2) γ
 - (3) β^-
 - (4) β^+
-

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 Which trends are observed as each of the elements within Group 15 on the Periodic Table is considered in order from top to bottom?

- (1) Their metallic properties decrease and their atomic radii decrease.
- (2) Their metallic properties decrease and their atomic radii increase.
- (3) Their metallic properties increase and their atomic radii decrease.
- (4) Their metallic properties increase and their atomic radii increase.

32 What is the total number of electrons in a S^{2-} ion?

- (1) 10
- (2) 14
- (3) 16
- (4) 18

33 A substance has an empirical formula of CH_2 and a molar mass of 56 grams per mole. The molecular formula for this compound is

- (1) CH_2
- (2) C_4H_6
- (3) C_4H_8
- (4) C_8H_4

34 Compared to an atom of phosphorus-31, an atom of sulfur-32 contains

- (1) one less neutron
- (2) one less proton
- (3) one more neutron
- (4) one more proton

35 In which compound is the percent composition by mass of chlorine equal to 42%?

- (1) $HClO$ (gram-formula mass = 52 g/mol)
- (2) $HClO_2$ (gram-formula mass = 68 g/mol)
- (3) $HClO_3$ (gram-formula mass = 84 g/mol)
- (4) $HClO_4$ (gram-formula mass = 100. g/mol)

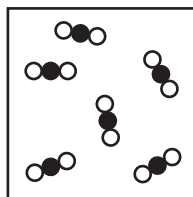
36 A metal, M , forms an oxide compound with the general formula M_2O . In which group on the Periodic Table could metal M be found?

- (1) Group 1
- (2) Group 2
- (3) Group 16
- (4) Group 17

37 Given the key:

Key	
○	= Atom of oxygen
●	= Atom of carbon

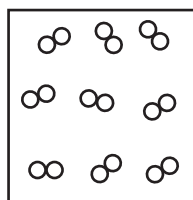
Which particle diagram represents a sample containing the compound $CO(g)$?



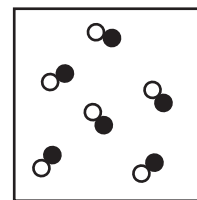
(1)



(3)



(2)

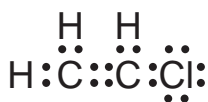


(4)

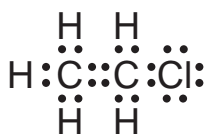
38 At standard pressure, which element has a melting point higher than standard temperature?

- (1) F_2
- (2) Br_2
- (3) Fe
- (4) Hg

39 Which Lewis electron-dot diagram represents chloroethene?



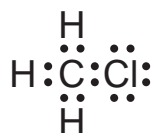
(1)



(3)



(2)



(4)

40 A saturated solution of NaNO_3 is prepared at $60.^\circ\text{C}$ using 100. grams of water. As this solution is cooled to $10.^\circ\text{C}$, NaNO_3 precipitates (settles) out of the solution. The resulting solution is saturated. Approximately how many grams of NaNO_3 settled out of the original solution?

- (1) 46 g (3) 85 g
(2) 61 g (4) 126 g

41 Which kelvin temperature is equivalent to -24°C ?

- (1) 226 K (3) 273 K
(2) 249 K (4) 297 K

42 Which substance has the *lowest* vapor pressure at 75°C ?

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

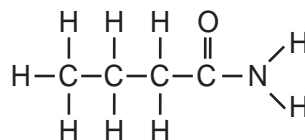
43 What is the IUPAC name for the compound that has the condensed structural formula $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$?

- (1) butanal (3) propanal
(2) butanol (4) propanol

44 What volume of $0.500\text{ M HNO}_3(\text{aq})$ must completely react to neutralize 100.0 milliliters of $0.100\text{ M KOH}(\text{aq})$?

- (1) 10.0 mL (3) 50.0 mL
(2) 20.0 mL (4) 500. mL

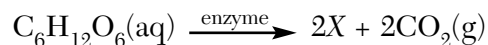
45 Given the formula:



This compound is classified as

- (1) an aldehyde (3) an amine
(2) an amide (4) a ketone

46 Given the balanced equation with an unknown compound represented by X:



Which compound is represented by X?

- (1) $\text{CH}_3\text{OH}(\text{aq})$
(2) $\text{CH}_2(\text{OH})_4(\text{aq})$
(3) $\text{CH}_3\text{CH}_2\text{OH}(\text{aq})$
(4) $\text{CH}_2\text{OHCH}_2\text{OH}(\text{aq})$

47 Which reactants form the salt $\text{CaSO}_4(\text{s})$ in a neutralization reaction?

- (1) $\text{H}_2\text{S}(\text{g})$ and $\text{Ca}(\text{ClO}_4)_2(\text{s})$
(2) $\text{H}_2\text{SO}_3(\text{aq})$ and $\text{Ca}(\text{NO}_3)_2(\text{aq})$
(3) $\text{H}_2\text{SO}_4(\text{aq})$ and $\text{Ca}(\text{OH})_2(\text{aq})$
(4) $\text{SO}_2(\text{g})$ and $\text{CaO}(\text{s})$

48 A student tested a 0.1 M aqueous solution and made the following observations:

- conducts electricity
- turns blue litmus to red
- reacts with $\text{Zn}(\text{s})$ to produce gas bubbles

Which compound could be the solute in this solution?

- (1) CH_3OH (3) HBr
(2) LiBr (4) LiOH

49 What is the half-life of sodium-25 if 1.00 gram of a 16.00-gram sample of sodium-25 remains unchanged after 237 seconds?

- (1) 47.4 s (3) 79.0 s
(2) 59.3 s (4) 118 s

50 Given the table below that shows students' examples of proposed models of the atom:

Proposed Models of the Atom

Model	Location of Protons	Location of Electrons
A	in the nucleus	specific shells
B	in the nucleus	regions of most probable location
C	dispersed throughout the atom	specific shells
D	dispersed throughout the atom	regions of most probable location

Which model correctly describes the locations of protons and electrons in the wave-mechanical model of the atom?

- (1) *A*
(2) *B*

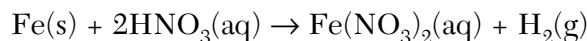
- (3) *C*
(4) *D*
-

Part B–2

Answer all questions in this part.

Directions (51–66): 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 balanced equation below.



- 51 What is the total number of oxygen atoms represented in the formula of the iron compound produced? [1]
- 52 Explain, using information from Reference Table J, why this reaction is spontaneous. [1]
-

Base your answers to questions 53 and 54 on the information below.

An atom has an atomic number of 9, a mass number of 19, and an electron configuration of 2–6–1.

- 53 What is the total number of neutrons in this atom? [1]
- 54 Explain why the number of electrons in the second and third shells shows that this atom is in an excited state. [1]
-
- 55 To which homologous series does $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$ belong? [1]
- 56 What is the mass of 4.76 moles of Na_3PO_4 (gram-formula mass = 164 grams/mole)? [1]
-

Base your answers to questions 57 and 58 on the information below.

Given the balanced equation for dissolving $\text{NH}_4\text{Cl}(s)$ in water:



- 57 A student is holding a test tube containing 5.0 milliliters of water. When a sample of $\text{NH}_4\text{Cl}(s)$ is placed in the test tube, the test tube feels colder to the student's hand. Describe the direction of heat flow between the test tube and the hand. [1]
- 58 Using the key *in your answer booklet*, draw *at least two* water molecules in the box, showing the correct orientation of each water molecule when it is near the Cl^- ion in the aqueous solution. [1]
-

Base your answers to questions 59 and 60 on the information below.

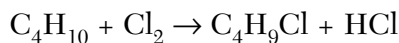
Given the reaction at equilibrium:



- 59 Explain, in terms of energy, why the forward reaction is exothermic. [1]
- 60 Explain, in terms of Le Chatelier's principle, why the equilibrium shifts to the right to relieve the stress when the pressure on the system is increased at constant temperature. [1]
-

Base your answers to questions 61 through 63 on the information below.

Given the balanced equation for an organic reaction between butane and chlorine that takes place at 300.°C and 101.3 kilopascals:



- 61 Identify the type of organic reaction shown. [1]
- 62 In the space *in your answer booklet*, draw a structural formula for the organic product. [1]
- 63 Explain, in terms of collision theory, why the rate of the reaction would *decrease* if the temperature of the reaction mixture was lowered to 200.°C with pressure remaining unchanged. [1]
-

Base your answers to questions 64 through 66 on the information below.

Ethanol, $\text{C}_2\text{H}_5\text{OH}$, is a volatile and flammable liquid with a distinct odor at room temperature. Ethanol is soluble in water. The boiling point of ethanol is 78.2°C at 1 atmosphere. Ethanol can be used as a fuel to produce heat energy, as shown by the balanced equation below.



- 64 At 1 atmosphere, compare the boiling point of pure ethanol to the boiling point of a solution in which a nonvolatile substance is dissolved in ethanol. [1]
- 65 Determine the total amount of heat produced by the complete combustion of 2.00 moles of ethanol. [1]
- 66 Identify *one* physical property of ethanol, stated in the passage, that can be explained in terms of chemical bonds and intermolecular forces. [1]
-

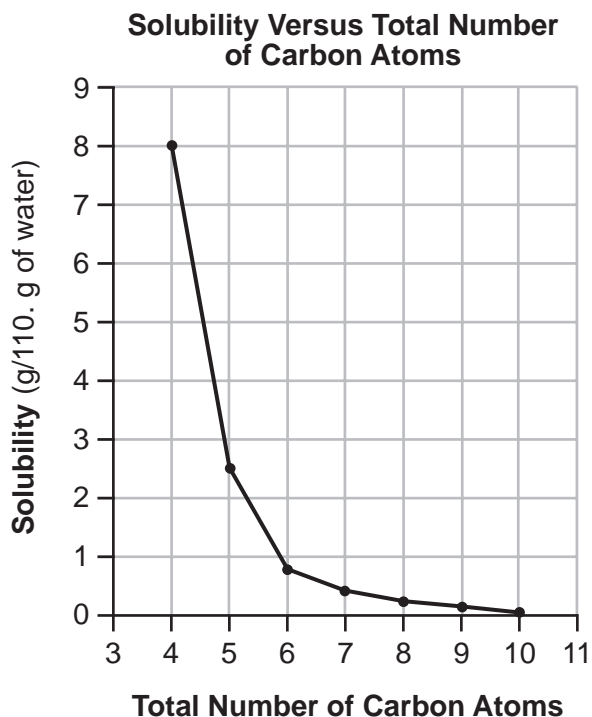
Part C

Answer all questions in this part.

Directions (67–84): 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 67 and 68 on the information below.

The graph shows the relationship between the solubility of a sequence of primary alcohols in water and the total number of carbon atoms in a molecule of the corresponding alcohol at the same temperature and pressure. A primary alcohol has the —OH group located on an end carbon of the hydrocarbon chain.

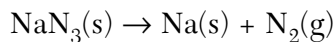


Adapted from *Chemistry*, Collins Educational Publishing, pp. 227-231

- 67 Describe the relationship between the solubility of a primary alcohol in water and the total number of carbon atoms in the primary alcohol. [1]
- 68 Determine the total mass of 1-pentanol that will dissolve in 110. grams of water to produce a saturated solution. [1]
-

Base your answers to questions 69 and 70 on the information below.

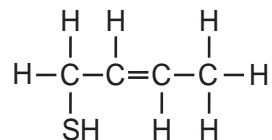
Air bags are an important safety feature in modern automobiles. An air bag is inflated in milliseconds by the explosive decomposition of $\text{NaN}_3(\text{s})$. The decomposition reaction produces $\text{N}_2(\text{g})$, as well as $\text{Na}(\text{s})$, according to the unbalanced equation below.



- 69 Balance the equation *in your answer booklet* for the decomposition of NaN_3 , using the smallest whole-number coefficients. [1]
- 70 When the air bag inflates, the nitrogen gas is at a pressure of 1.30 atmospheres, a temperature of 301 K, and has a volume of 40.0 liters. In the space *in your answer booklet*, calculate the volume of the nitrogen gas at STP. Your response must include *both* a correct numerical setup and the calculated volume. [2]
-

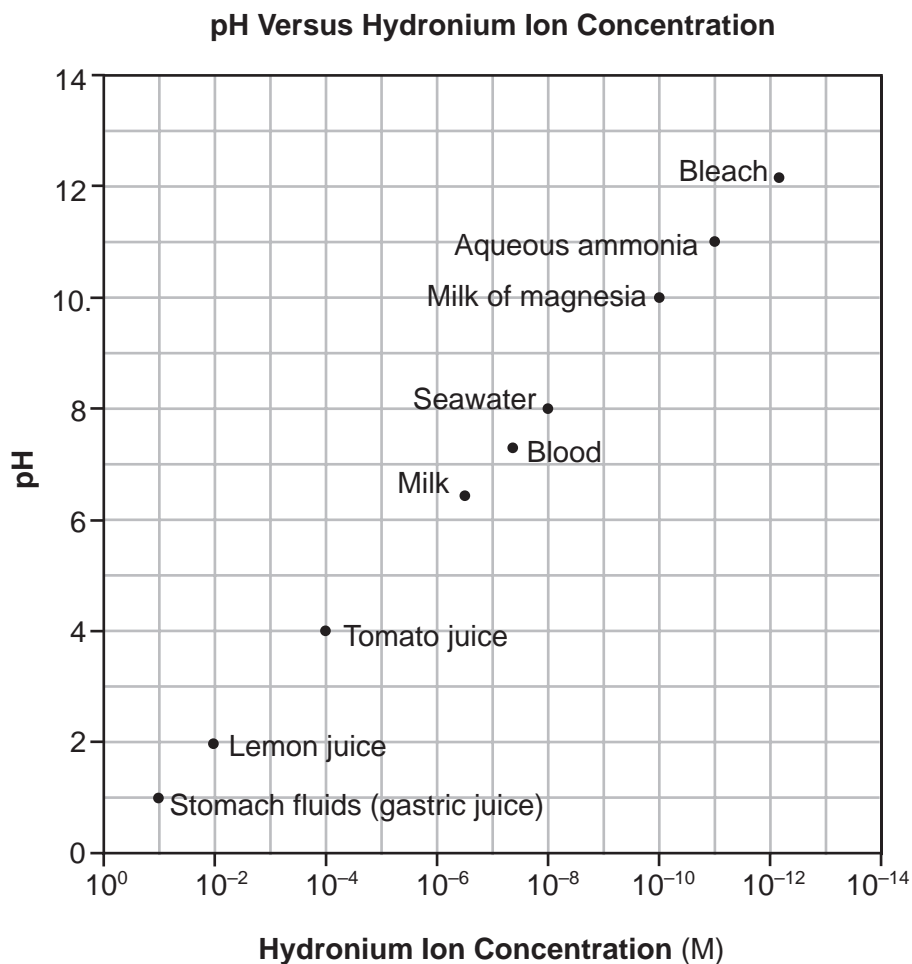
Base your answers to questions 71 and 72 on the information below.

A thiol is very similar to an alcohol, but a thiol has a sulfur atom instead of an oxygen atom in the functional group. One of the compounds in a skunk's spray is 2-butene-1-thiol. The formula of this compound is shown below.



- 71 Explain, in terms of composition, why this compound is a thiol. [1]
- 72 Explain, in terms of electron configuration, why oxygen atoms and sulfur atoms form compounds with similar molecular structures. [1]
-

Base your answers to questions 73 through 75 on the graph below. The graph shows the relationship between pH value and hydronium ion concentration for common aqueous solutions and mixtures.



73 What is the hydronium ion concentration of tomato juice? [1]

74 What color is thymol blue when added to milk of magnesia? [1]

75 According to this graph, which mixture is approximately 100 times more acidic than milk of magnesia? [1]

Base your answers to questions 76 and 77 on the information below.

Archimedes (287–212 BC), a Greek inventor and mathematician, made several discoveries important to science today. According to a legend, Hiero, the king of Syracuse, commanded Archimedes to find out if the royal crown was made of gold, only. The king suspected that the crown consisted of a mixture of gold, tin, and copper.

Archimedes measured the mass of the crown and the total amount of water displaced by the crown when it was completely submerged. He repeated the procedure using individual samples, one of gold, one of tin, and one of copper. Archimedes was able to determine that the crown was not made entirely of gold without damaging it.

76 Identify *one* physical property that Archimedes used in his comparison of the metal samples. [1]

77 Determine the volume of a 75-gram sample of gold at STP. [1]

Base your answers to questions 78 through 81 on the information below.

Aluminum is one of the most abundant metals in Earth's crust. The aluminum compound found in bauxite ore is Al_2O_3 . Over one hundred years ago, it was difficult and expensive to isolate aluminum from bauxite ore. In 1886, a brother and sister team, Charles and Julia Hall, found that molten (melted) cryolite, Na_3AlF_6 , would dissolve bauxite ore. Electrolysis of the resulting mixture caused the aluminum ions in the Al_2O_3 to be reduced to molten aluminum metal. This less expensive process is known as the Hall process.

78 Write the oxidation state for *each* of the elements in cryolite. [1]

79 Write the balanced half-reaction equation for the reduction of Al^{3+} to Al. [1]

80 Explain, in terms of ions, why molten cryolite conducts electricity. [1]

81 Explain, in terms of electrical energy, how the operation of a voltaic cell differs from the operation of an electrolytic cell used in the Hall process. Include *both* the voltaic cell and the electrolytic cell in your answer. [1]

Base your answers to questions 82 through 84 on the information below.

A glass tube is filled with hydrogen gas at low pressure. An electric current is passed through the gas, causing it to emit light. This light is passed through a prism to separate the light into the bright, colored lines of hydrogen's visible spectrum. Each colored line corresponds to a particular wavelength of light. One of hydrogen's spectral lines is red light with a wavelength of 656 nanometers.

Tubes filled with other gases produce different bright-line spectra that are characteristic of each kind of gas. These spectra have been observed and recorded.

82 Explain, in terms of electron energy states and energy changes, how hydrogen's bright-line spectrum is produced. [1]

83 Explain how the elements present on the surface of a star can be identified using bright-line spectra. [1]

84 A student measured the wavelength of hydrogen's visible red spectral line to be 647 nanometers. In the space *in your answer booklet*, show a correct numerical setup for calculating the student's percent error. [1]

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The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING CHEMISTRY

Wednesday, June 21, 2006 — 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

- 1 11 21
2 12 22
3 13 23
4 14 24
5 15 25
6 16 26
7 17 27
8 18 28
9 19 29
10 20 30

Part A Score

[Box for Part A Score]

Part B-1

- 31 41
32 42
33 43
34 44
35 45
36 46
37 47
38 48
39 49
40 50

Part B-1 Score

[Box for 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

Tear Here

PHYSICAL SETTING CHEMISTRY

Wednesday, June 21, 2006 — 1:15 to 4:15 p.m., only

ANSWER BOOKLET

Student Sex: Male
 Female

Teacher

School Grade

Answer all questions in Part B-2 and Part C. Record your answers
in this booklet.

Part	Maximum Score	Student's Score
A	30	
B-1	20	
B-2	16	
C	19	
Total Written Test Score (Maximum Raw Score: 85)		<input type="text"/>
Final Score (from conversion chart)		<input type="text"/>
Raters' Initials: Rater 1 Rater 2		

Part B-2		For Raters Only
51	_____	51 <input type="text"/>
52	_____ _____ _____	52 <input type="text"/>
53	_____	53 <input type="text"/>
54	_____ _____ _____	54 <input type="text"/>

For Raters
Only

55 _____

55


56 _____ g

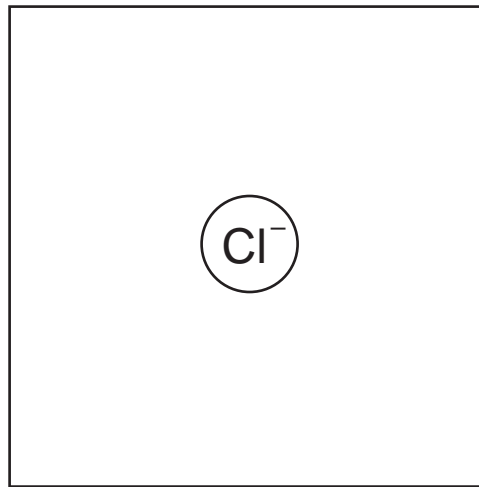
56

57 _____

57

58

Key	
●	= Hydrogen atom
○	= Oxygen atom
	= Water molecule



58

59 _____

59

60 _____

60

**For Raters
Only**

61 _____

61

62

62

63 _____

63

64 _____

64

65 _____ kJ

65

66 _____

66

**Total Score
for Part B-2**

Part C

For Raters Only

67 _____

67

68 _____ g

68

69 _____ $\text{NaN}_3(\text{s}) \rightarrow$ _____ $\text{Na}(\text{s}) +$ _____ $\text{N}_2(\text{g})$

69

70

70

_____ L

71 _____

71

72 _____

72

**For Raters
Only**

73 _____ M

73

74 _____

74

75 _____

75

76 _____

76

77 _____ cm³

77

78 Na₃AlF₆ Na: _____

78

Al: _____

F: _____

79 _____

79

80 _____

80

81 _____

81

**For Raters
Only**

82

82

83

83

84

84

**Total Score
for Part C**

FOR TEACHERS ONLY

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

PS-CH

PHYSICAL SETTING/CHEMISTRY

Wednesday, June 21, 2006 — 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/> 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.

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

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 checkmark 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/osa/> on Wednesday, June 21, 2006. 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 for 6 or six.

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

Iron is more active than hydrogen.

Fe is higher on Table *J* than H₂.

53 [1] Allow 1 credit for 10 or ten.

54 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

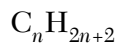
The third shell has one electron before the second shell is completely filled.

The electron configuration is not 2-7, which is the ground state for an atom with atomic number 9.

Note: Do *not* allow credit for a response that simply restates that the electron configuration is 2-6-1.

55 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

alkanes



56 [1] Allow 1 credit for 781 g. Significant figures do *not* need to be shown.

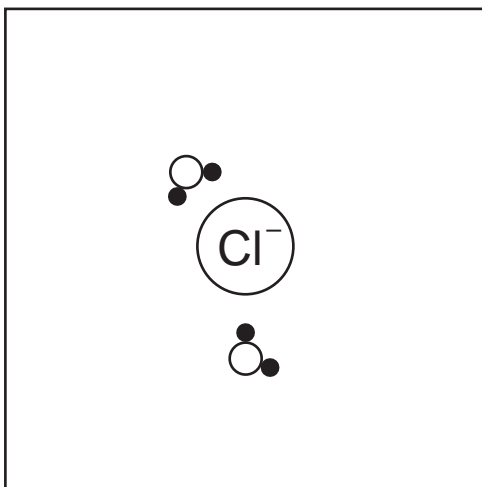
57 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

Heat flows from the student's hand to the test tube.

The test tube absorbs heat from the hand.

- 58 [1] Allow 1 credit. Acceptable responses must show *at least two* water molecules with at least one hydrogen atom of each water molecule facing toward the Cl^- ion.

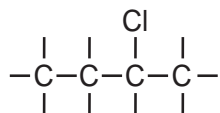
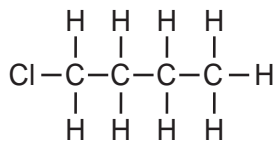
Example of a 1-credit response:



- 59 [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- Potential energy of the product is less than potential energy of the reactant.
 - More energy is released than absorbed.
 - Energy appears on the right.
- 60 [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- Equilibrium shifts toward the fewer number of moles of gas.
 - The reaction shifts to the side that would result in a reduction of pressure.
 - fewer moles of gas, less pressure
- 61 [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- substitution
 - chlorination
 - halogenation

- 62 [1] Allow 1 credit.

Examples of a 1-credit response:



- 63 [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- Particles move slower and collide less frequently.
 - fewer effective collisions between molecules
- 64 [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- Ethanol's boiling point is lower than the boiling point of the solution.
 - The solution's boiling point is higher than 78.2°C.
- 65 [1] Allow 1 credit for 2730 kJ. Significant figures do *not* need to be shown.
- 66 [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- soluble in water
 - boiling point
 - volatility

Part C

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

- 67** [1] Allow 1 credit. Acceptable responses include, but are not limited to:

The greater the total number of carbon atoms in a molecule of a primary alcohol, the less soluble the alcohol is in water.

number of carbons ↓, solubility ↑

- 68** [1] Allow 1 credit for $2.5 \text{ g} \pm 0.1 \text{ g}$.

- 69** [1] Allow 1 credit for $\underline{2} \text{ NaN}_3(\text{s}) \rightarrow \underline{2} \text{ Na}(\text{s}) + \underline{3} \text{ N}_2(\text{g})$.

- 70** [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:

$$V_2 = \frac{(273 \text{ K})(1.30 \text{ atm})(40.0 \text{ L})}{(301 \text{ K})(1.00 \text{ atm})}$$

$$\frac{(273)(1.30)(40.0)}{(301)(1.00)}$$

- Allow 1 credit for 47.2 L. Significant figures do *not* need to be shown.

or

Allow credit for a response consistent with the student's numerical setup.

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

- 71** [1] Allow 1 credit. Acceptable responses include, but are not limited to:

This compound contains an —SH functional group.

There is a sulfur atom instead of an oxygen atom in the functional group.

- 72** [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- Oxygen and sulfur atoms have the same number (six) of valence electrons.
- Atoms of both elements need two more valence electrons to complete their outer shells.
- 73** [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- 10^{-4} M
- 0.0001 M
- 74** [1] Allow 1 credit for blue.
- 75** [1] Allow 1 credit for seawater.
- 76** [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- density
- mass
- volume
- 77** [1] Allow 1 credit. Significant figures do *not* need to be shown. Acceptable responses include, but are not limited to:
- 3.9 cm^3
- 3.88 cm^3
- 78** [1] Allow 1 credit. All three oxidation states must be correct to receive credit. Acceptable responses include, but are not limited to:
- Na: +1
- Al: +3
- F: -1
- 79** [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- $\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}$

- 80** [1] Allow 1 credit. Acceptable responses include, but are not limited to:

There are freely moving ions in the molten cryolite.

Ions are no longer held together in a crystal lattice.

- 81** [1] Allow 1 credit for a correct response that includes both processes. Acceptable responses include, but are not limited to:

A voltaic cell produces electrical energy and an electrolytic cell used in the Hall process requires electrical energy.

Electrolysis uses electrical energy. Voltaic cells produce electrical energy.

- 82** [1] Allow 1 credit. Acceptable responses include, but are not limited to:

The electron of hydrogen absorbs energy and jumps to a higher energy state. The excited electron returns to a lower energy state, releasing light energy.

The e^- absorbs energy and jumps to a higher level. The e^- falls back to a lower level and releases energy related to a particular color.

- 83** [1] Allow 1 credit. Acceptable responses include, but are not limited to:

The spectrum from a star is compared to spectra of known elements.

- 84** [1] Allow 1 credit. Acceptable responses include, but are not limited to:

$$\% \text{ error} = \frac{647 \text{ nm} - 656 \text{ nm}}{656 \text{ nm}} \times 100$$

$$\frac{647 - 656}{656} \times 100$$

The *Chart for Determining the Final Examination Score for the June 2006 Regents Examination in Physical Setting/Chemistry* will be posted on the Department's web site <http://www.emsc.nysed.gov/osa/> on Wednesday, June 21, 2006. 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.

The *Teacher Evaluation of State Examinations* forms will also be posted on the same web site. Please select the link "Teacher Evaluation Forms" and then the examination title to complete the evaluation form for the *June 2006 Regents Examination in Physical Setting/Chemistry*.

Map to Core Curriculum

June 2006 Physical Setting/ Chemistry			
Question Numbers			
Key Ideas	Part A	Part B	Part C
Standard 1			
Math Key Idea 1		44, 65	78, 84
Math Key Idea 2			
Math Key Idea 3		35	70, 77
Sci. Inq. Key Idea 1		42, 59, 64	76, 82
Sci. Inq. Key Idea 2			
Sci. Inq. Key Idea 3		43, 50, 51, 55	67, 68, 73
Eng. Des. Key Idea 1			
Standard 2			
Key Idea 1		40	
Key Idea 2			
Standard 6			
Key Idea 1		57	
Key Idea 2			
Key Idea 3			75
Key Idea 4			
Key Idea 5			
Standard 7			
Key Idea 1			
Key Idea 2			
Standard 4 Process Skills			
Key Idea 3		31, 32, 33, 34, 36, 37, 38, 40, 41, 44, 45, 46, 47, 48, 52, 53, 54, 56, 58, 60, 61, 62, 63, 64, 65	69, 70, 71, 72, 74, 79, 81, 83
Key Idea 4		49, 59	
Key Idea 5		39, 42, 66	80
Standard 4			
Key Idea 3	1, 2, 3, 4, 6, 7, 8, 14, 15, 16, 17, 20, 21, 22, 23, 24, 25, 26, 27, 30	31, 32, 33, 34, 35, 36, 37, 38, 40, 43, 44, 45, 46, 47, 48, 50, 51, 52, 53, 54, 55, 56, 58, 59, 60, 61, 62, 63, 64, 65	68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 81, 82, 83, 84
Key Idea 4	18, 19, 28	41, 49, 57	
Key Idea 5	5, 9, 10, 11, 12, 13, 29	39, 42, 66	67, 80
Reference Tables			
2002 Edition	10, 15, 16, 19, 20, 25, 27, 28, 30	31, 32, 33, 34, 38, 40, 44, 45, 52, 56, 62	72, 74, 78, 84



Regents Examination in Physical Setting/Chemistry June 2006

Chart for Converting Total Test Raw Scores to
Final Examination Scores (Scaled Scores)

Raw Score	Scaled Score	Raw Score	Scaled Score	Raw Score	Scaled Score	Raw Score	Scaled Score
85	100	63	76	41	60	19	40
84	99	62	75	40	60	18	39
83	97	61	74	39	59	17	37
82	96	60	73	38	58	16	36
81	94	59	73	37	57	15	34
80	93	58	72	36	57	14	33
79	92	57	71	35	56	13	31
78	90	56	70	34	55	12	29
77	89	55	70	33	54	11	28
76	88	54	69	32	53	10	26
75	87	53	68	31	53	9	24
74	86	52	68	30	52	8	22
73	85	51	67	29	51	7	19
72	84	50	66	28	50	6	17
71	83	49	66	27	49	5	15
70	82	48	65	26	48	4	12
69	81	47	64	25	47	3	9
68	80	46	64	24	46	2	6
67	79	45	63	23	45	1	3
66	78	44	62	22	44	0	0
65	77	43	62	21	42		
64	76	42	61	20	41		

To determine the student's final examination score, find the student's total written test raw score in the column labeled "Raw Score" and then locate the scaled score that corresponds to that raw score. The scaled 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 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. The chart above is usable only for this administration of the Physical Setting/Chemistry Examination.