The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
CHEMISTRY

Thursday, January 29, 2009 — 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 On the modern Periodic Table, the elements are arranged in order of increasing

(1) atomic mass
(2) atomic number
(3) mass number
(4) oxidation number

2 Which particle has a mass that is approximately the same as the mass of a proton?

(1) an alpha particle
(2) a beta particle
(3) a neutron
(4) a positron

3 An atom of an element forms a 2^+ ion. In which group on the Periodic Table could this element be located?

(1) 1
(2) 2
(3) 13
(4) 17

4 Which statement describes the relative energy of the electrons in the shells of a calcium atom?

(1) An electron in the first shell has more energy than an electron in the second shell.
(2) An electron in the first shell has the same amount of energy as an electron in the second shell.
(3) An electron in the third shell has more energy than an electron in the second shell.
(4) An electron in the third shell has less energy than an electron in the second shell.

5 According to the electron-cloud model of the atom, an orbital is a

(1) circular path traveled by an electron around the nucleus
(2) spiral path traveled by an electron toward the nucleus
(3) region of the most probable proton location
(4) region of the most probable electron location

6 What can be determined if only the atomic number of an atom is known?

(1) the total number of neutrons in the atom, only
(2) the total number of protons in the atom, only
(3) the total number of protons and the total number of neutrons in the atom
(4) the total number of protons and the total number of electrons in the atom

7 The most common isotope of chromium has a mass number of 52. Which notation represents a different isotope of chromium?

(1) $^{52}_{24}Cr$
(2) $^{54}_{24}Cr$
(3) $^{24}_{52}Cr$
(4) $^{24}_{54}Cr$

8 Which Group 14 element is a metalloid?

(1) tin
(2) silicon
(3) lead
(4) carbon

9 Samples of four Group 15 elements, antimony, arsenic, bismuth, and phosphorus, are in the gaseous phase. An atom in the ground state of which element requires the *least* amount of energy to remove its most loosely held electron?

(1) As
(2) Bi
(3) P
(4) Sb

10 Which substance can be broken down by chemical means?

(1) CO
(2) Ce
(3) Ca
(4) Cu

11 During all chemical reactions, mass, energy, and charge are

(1) absorbed
(2) conserved
(3) formed
(4) released

12 Which formula represents a molecular compound?

(1) Kr
(2) LiOH
(3) N_2O_4
(4) NaI

13 The bonds in BaO are best described as

(1) covalent, because valence electrons are shared
(2) covalent, because valence electrons are transferred
(3) ionic, because valence electrons are shared
(4) ionic, because valence electrons are transferred

14 In which sample of water do the molecules have the highest average kinetic energy?

(1) 20. mL at 100.°C
(2) 40. mL at 80.°C
(3) 60. mL at 60.°C
(4) 80. mL at 40.°C

15 Which compound is insoluble in water?

(1) calcium bromide
(2) potassium bromide
(3) silver bromide
(4) sodium bromide

16 Which element is a brittle solid with low conductivity at STP?

(1) sulfur
(2) sodium
(3) argon
(4) aluminum

17 Which two samples of gas at STP contain the same total number of molecules?

(1) 1 L of CO(g) and 0.5 L of N_2(g)
(2) 2 L of CO(g) and 0.5 L of NH_3(g)
(3) 1 L of H_2(g) and 2 L of Cl_2(g)
(4) 2 L of H_2(g) and 2 L of Cl_2(g)

18 A reaction is most likely to occur when reactant particles collide with

(1) proper energy, only
(2) proper orientation, only
(3) both proper energy and proper orientation
(4) neither proper energy nor proper orientation

19 The net energy released or absorbed during a reversible chemical reaction is equal to

(1) the activation energy of the endothermic reaction
(2) the activation energy of the exothermic reaction
(3) the difference between the potential energy of the products and the potential energy of the reactants
(4) the sum of the potential energy of the products and the potential energy of the reactants

20 A catalyst lowers the activation energy of a reaction by

(1) providing an alternate reaction pathway
(2) decreasing the heat of reaction
(3) increasing the mass of the reactants
(4) changing the mole ratio of the reactants

21 Which element is present in every organic compound?

(1) carbon
(2) fluorine
(3) nitrogen
(4) oxygen

22 Given the balanced equation representing a reaction:

$$2Fe + 3Cu^{2+} \rightarrow 2Fe^{3+} + 3Cu$$

When the iron atoms lose six moles of electrons, how many moles of electrons are gained by the copper ions?

(1) 12 moles
(2) 2 moles
(3) 3 moles
(4) 6 moles

23 Which statement describes electrolysis?

(1) Chemical energy is used to produce an electrical change.
(2) Chemical energy is used to produce a thermal change.
(3) Electrical energy is used to produce a chemical change.
(4) Thermal energy is used to produce a chemical change.

24 During which process does an atom gain one or more electrons?

(1) transmutation (3) oxidation
(2) reduction (4) neutralization

25 Which substance is an Arrhenius base?

(1) CH_3OH (3) LiOH
(2) CH_3Cl (4) LiCl

26 Which statement describes an alternate theory of acids and bases?

(1) Acids and bases are both H^+ acceptors.
(2) Acids and bases are both H^+ donors.
(3) Acids are H^+ acceptors, and bases are H^+ donors.
(4) Acids are H^+ donors, and bases are H^+ acceptors.

27 Which two compounds are electrolytes?

(1) $C_6H_{12}O_6$ and CH_3CH_2OH
(2) $C_6H_{12}O_6$ and HCl
(3) NaOH and HCl
(4) NaOH and CH_3CH_2OH

28 The only positive ion found in $H_2SO_4(aq)$ is the

(1) ammonium ion (3) hydroxide ion
(2) hydronium ion (4) sulfate ion

29 Which risk is associated with using nuclear fission to produce energy in a power plant?

(1) depletion of hydrocarbons
(2) depletion of atmospheric oxygen
(3) exposure of workers to radiation
(4) exposure of workers to sulfur dioxide

30 An unstable nucleus loses the most mass if the nucleus emits

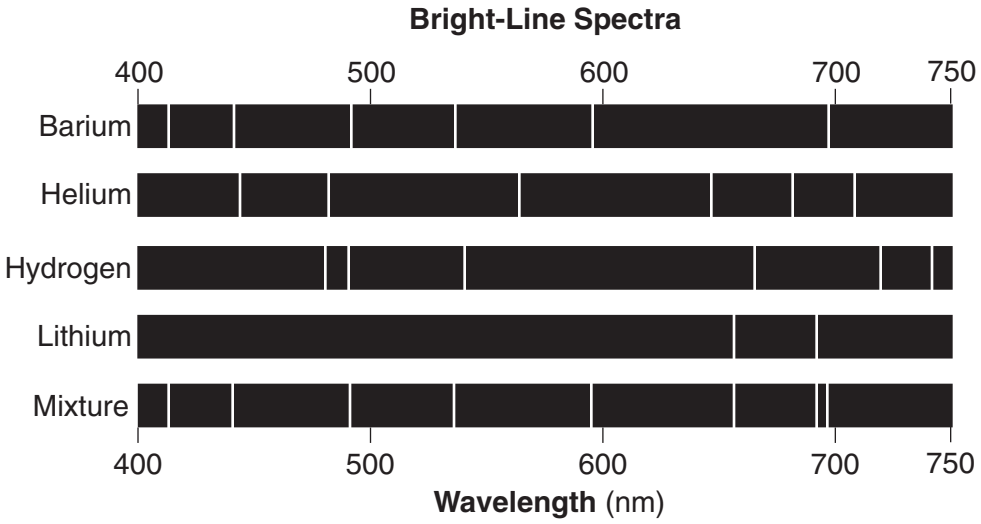
(1) an alpha particle (3) a positron
(2) a beta particle (4) a gamma ray

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 diagram below represents the bright-line spectra of four elements and a bright-line spectrum produced by a mixture of two of these elements.



Which two elements are in this mixture?

(1) barium and hydrogen
(2) barium and lithium
(3) helium and hydrogen
(4) helium and lithium

32 The table below gives information about the nucleus of each of four atoms.

Nuclei of Four Atoms

Atom	Number of Protons	Number of Neutrons
A	6	6
D	6	7
E	7	7
G	7	8

How many different elements are represented by the nuclei in the table?

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

33 What is the total number of valence electrons in an atom of germanium in the ground state?

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

34 In the formula X_2O_5, the symbol X could represent an element in Group

(1) 1
(2) 2
(3) 15
(4) 18

35 A 50.0-gram block of copper at 10.0°C is carefully lowered into 100.0 grams of water at 90.0°C in an insulated container. Which statement describes the transfer of heat in this system?

(1) The water loses heat to the block until both are at 10.0°C.
(2) The block gains heat from the water until both are at 90.0°C.
(3) The water loses heat and the block gains heat until both are at the same temperature that is between 10.0°C and 90.0°C.
(4) The water gains heat and the block loses heat until both are at the same temperature that is between 10.0°C and 90.0°C.

36 The compounds C_2H_4 and C_4H_8 have the same

(1) freezing point at standard pressure
(2) boiling point at standard pressure
(3) molecular formula
(4) empirical formula

37 The chemical bond between which two atoms is most polar?

(1) C–N
(2) H–H
(3) S–Cl
(4) Si–O

38 What is the total amount of heat absorbed by 100.0 grams of water when the temperature of the water is increased from 30.0°C to 45.0°C?

(1) 418 J
(2) 6270 J
(3) 12 500 J
(4) 18 800 J

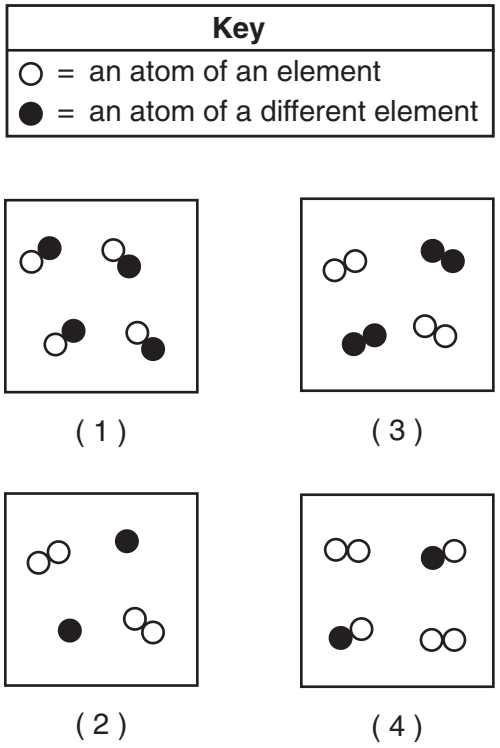
39 Which process is exothermic?

(1) boiling of water
(2) melting of copper
(3) condensation of ethanol vapor
(4) sublimation of iodine

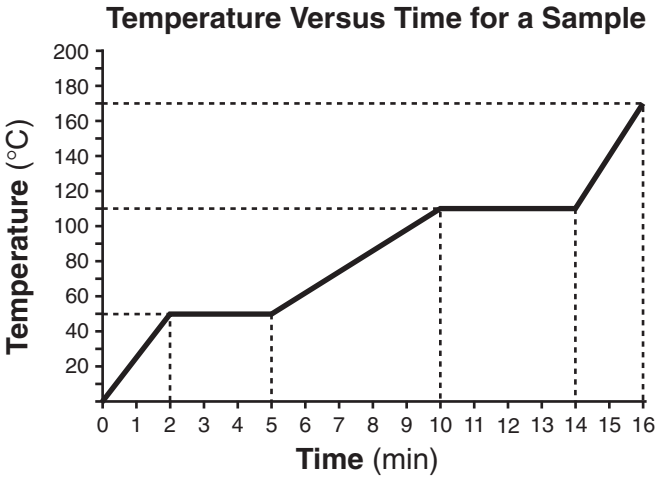
40 Which sample, when dissolved in 1.0 liter of water, produces a solution with the *lowest* freezing point?

(1) 0.1 mol of C_2H_5OH
(2) 0.1 mol of LiBr
(3) 0.2 mol of $C_6H_{12}O_6$
(4) 0.2 mol of $CaCl_2$

41 Which particle diagram represents a mixture of an element and a compound?



42 Starting as a solid, a sample of a substance is heated at a constant rate. The graph below shows the changes in temperature of this sample.



What is the melting point of the sample and the total time required to completely melt the sample after it has reached its melting point?

(1) 50°C and 3 min
(2) 50°C and 5 min
(3) 110°C and 4 min
(4) 110°C and 14 min

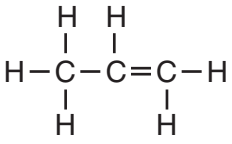
43 Which compound is an alkyne?

(1) C_2H_2
(2) C_2H_4
(3) C_4H_8
(4) C_4H_{10}

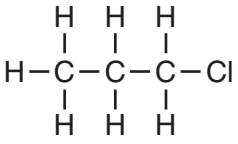
44 What is the oxidation number of sulfur in $Na_2S_2O_3$?

(1) −1
(2) +2
(3) +6
(4) +4

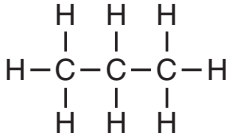
45 Which formula represents an unsaturated hydrocarbon?



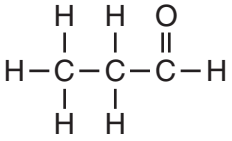
(1)



(3)



(2)



(4)

46 Which balanced equation represents a redox reaction?

(1) $PCl_5 \rightarrow PCl_3 + Cl_2$
(2) $KOH + HCl \rightarrow KCl + H_2O$
(3) $LiBr \rightarrow Li^+ + Br^-$
(4) $Ca^{2+} + SO_4^{2-} \rightarrow CaSO_4$

47 A 25.0-milliliter sample of $HNO_3(aq)$ is neutralized by 32.1 milliliters of 0.150 M KOH(aq). What is the molarity of the $HNO_3(aq)$?

(1) 0.117 M
(2) 0.150 M
(3) 0.193 M
(4) 0.300 M

48 Which nuclide has a half-life that is *less* than one minute?

(1) cesium-137
(2) francium-220
(3) phosphorus-32
(4) strontium-90

49 The table below indicates the stability of six nuclides.

Stability of Six Nuclides

Nuclide	Stability
C-12	stable
C-14	unstable
N-14	stable
N-16	unstable
O-16	stable
O-19	unstable

All atoms of the unstable nuclides listed in this table have

(1) an odd number of neutrons
(2) an odd number of protons
(3) more neutrons than protons
(4) more protons than neutrons

50 Cobalt-60 and iodine-131 are radioactive isotopes that are used in

(1) dating geologic formations
(2) industrial measurements
(3) medical procedures
(4) nuclear power

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.*

51 In the box *in your answer booklet*, draw a Lewis electron-dot diagram for an atom of boron. [1]

52 Explain, in terms of atomic structure, why the noble gas neon is an unreactive element. [1]

53 Given the equation representing a reaction at equilibrium:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

Explain, in terms of collision theory, why the rate of the forward reaction *decreases* when the concentration of $N_2(g)$ is decreased. [1]

Base your answers to questions 54 and 55 on the information below.

A 4.86-gram sample of calcium reacted completely with oxygen to form 6.80 grams of calcium oxide. This reaction is represented by the balanced equation below.

$$2Ca(s) + O_2(g) \rightarrow 2CaO(s)$$

54 Determine the total mass of oxygen that reacted. [1]

55 Explain, in terms of electrons, why the radius of a calcium ion is smaller than the radius of a calcium atom. [1]

Base your answers to questions 56 through 58 on the information below.

The compounds $NH_4Br(s)$ and $NH_3(g)$ are soluble in water. Solubility data for $NH_4Br(s)$ in water are listed in the table below.

Solubility of NH_4Br in H_2O

Temperature (°C)	Mass of NH_4Br per 100. g of H_2O (g)
0	60.
20.	75
40.	90.
60.	105
80.	120.
100.	135

56 On the grid *in your answer booklet*, plot the data from the data table. Circle and connect the points. [1]

57 Determine the total mass of $NH_4Br(s)$ that must be dissolved in 200. grams of H_2O at 60.°C to produce a saturated solution. [1]

58 Compare the solubilities of $NH_4Br(s)$ and $NH_3(g)$, each in 100. grams of H_2O, as temperature increases at standard pressure. Your response must include *both* $NH_4Br(s)$ and $NH_3(g)$. [1]

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

Carbon forms molecular compounds with some elements from Group 16. Two of these compounds are carbon dioxide, CO_2, and carbon disulfide, CS_2.

Carbon dioxide is a colorless, odorless gas at room temperature. At standard temperature and pressure, $CO_2(s)$ changes directly to $CO_2(g)$.

Carbon disulfide is formed by a direct reaction of carbon and sulfur. At room temperature, CS_2 is a colorless liquid with an offensive odor. Carbon disulfide vapors are flammable.

59 Identify *one* physical property and *one* chemical property of CS_2. [1]

60 State what happens to the potential energy of CO_2 molecules during this phase change of CO_2. [1]

61 Compare the intermolecular forces in CO_2 and CS_2 at room temperature. [1]

Base your answers to questions 62 through 64 on the data table below.

Formulas and Boiling Points of Selected Alkanes

Name	Formula	Boiling Point at 1 Atm (°C)
methane	CH_4	–162
ethane	C_2H_6	–89
propane	C_3H_8	–42
butane	C_4H_{10}	–0.5
pentane	C_5H_{12}	36

62 In the space *in your answer booklet*, draw a structural formula for butane. [1]

63 At standard pressure and 298 K, which alkane is a liquid? [1]

64 What is the boiling point of propane at 1 atmosphere, in kelvins? [1]

Base your answers to questions 65 and 66 on the information below.

The balanced equation below represents the reaction between magnesium metal and hydrochloric acid to produce aqueous magnesium chloride and hydrogen gas.

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

A piece of Mg(s) has a volume of 0.0640 cubic centimeters. This piece of Mg(s) reacts completely with HCl(aq) to produce $H_2(g)$. The $H_2(g)$ produced has a volume of 112 milliliters and a pressure of 1.00 atmosphere at 298 K.

65 The volume of the piece of Mg(s) is expressed to what number of significant figures? [1]

66 In the space *in your answer booklet*, show a correct numerical setup for calculating the volume of the $H_2(g)$ produced if the conditions are changed to STP. [1]

Part C

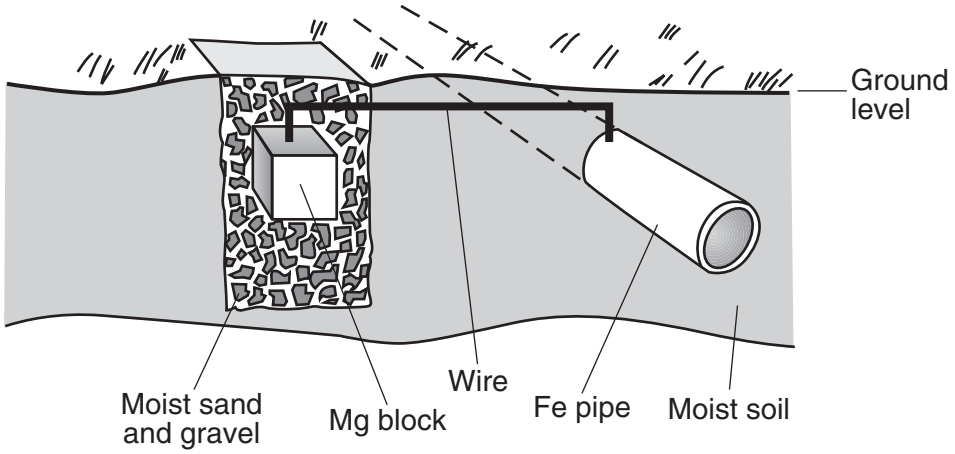
Answer all questions in this part.

Directions (67–81): 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.

Underground iron pipes in contact with moist soil are likely to corrode. This corrosion can be prevented by applying the principles of electrochemistry. Connecting an iron pipe to a magnesium block with a wire creates an electrochemical cell. The magnesium block acts as the anode and the iron pipe acts as the cathode. A diagram of this system is shown below.

Cross-Sectional View of Underground Pipe Protection System



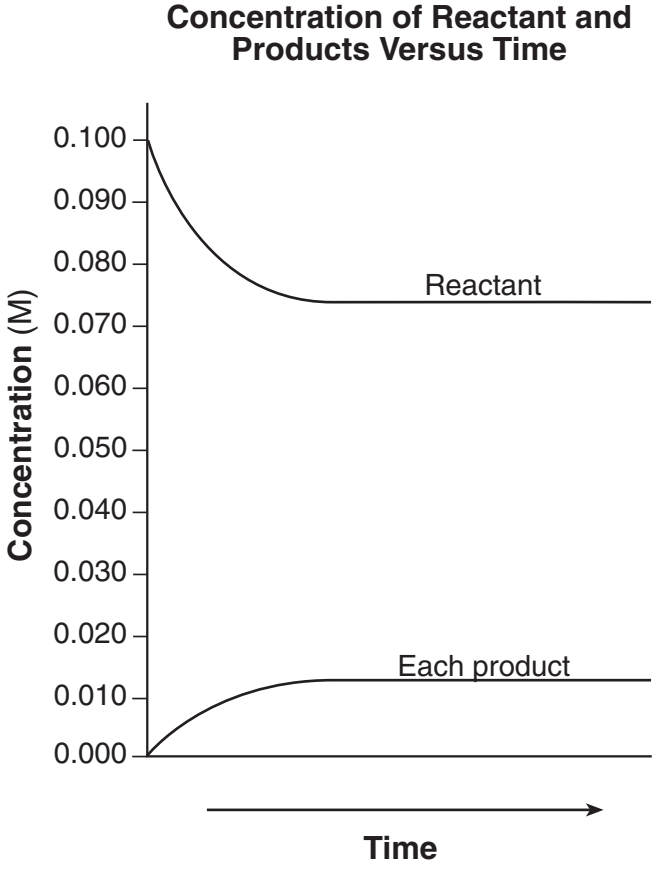
67 State the direction of the flow of electrons between the electrodes in this cell. [1]

68 Explain, in terms of reactivity, why magnesium is preferred over zinc to protect underground iron pipes. Your response must include *both* magnesium and zinc. [1]

Base your answers to questions 69 through 71 on the information below.

In a laboratory, 0.100 mole of colorless hydrogen iodide gas at room temperature is placed in a 1.00-liter flask. The flask is sealed and warmed, causing the HI(g) to start decomposing to $H_2(g)$ and $I_2(g)$. Then the temperature of the contents of the flask is kept constant.

During this reaction, the contents of the flask change to a pale purple-colored mixture of HI(g), $H_2(g)$, and $I_2(g)$. When the color of the mixture in the flask stops changing, the concentration of $I_2(g)$ is determined to be 0.013 mole per liter. The relationship between concentration and time for the reactant and products is shown in the graph below.



69 Write a balanced equation to represent the decomposition reaction occurring in the flask. [1]

70 State, in terms of concentration, evidence that indicates the system in the flask has reached equilibrium. [1]

71 Calculate the mass of $I_2(g)$ in the flask at equilibrium. Your response must include *both* a correct numerical setup and the calculated result. [2]

Base your answers to questions 72 through 74 on the information below.

Soil pH can affect the development of plants. For example, a hydrangea plant produces blue flowers when grown in acidic soil but pink flowers when grown in basic soil. Evergreen plants can show a yellowing of foliage, called chlorosis, when grown in soil that is too basic.

Acidic soil can be neutralized by treating it with calcium hydroxide, $Ca(OH)_2$, commonly called slaked lime. Slaked lime is slightly soluble in water.

72 Compare the hydrogen ion concentration to the hydroxide ion concentration in soil when a hydrangea plant produces pink flowers. [1]

73 An evergreen plant has yellowing foliage. The soil surrounding the plant is tested with methyl orange and bromthymol blue. Both indicators turn yellow in the soil tests. State, in terms of pH value, why the yellowing of the plant is *not* due to chlorosis. [1]

74 Write an equation, using symbols *or* words, for the neutralization of the ions in acidic soil by the ions released by slaked lime in water. [1]

Base your answers to questions 75 through 77 on the information below.

A fluorescent light tube contains a noble gas and a drop of mercury. When the fluorescent light operates, the Hg is a vapor and there are free-flowing Hg ions and electrons in the tube. The electrons collide with Hg atoms that then emit ultraviolet (UV) radiation.

The inside of the tube is coated with a mixture of several compounds that absorbs UV radiation. Ions in the coating emit a blend of red, green, and blue light that together appears as white light. The compound that produces red light is Y_2O_3. The compound that produces green light is $CeMgAl_{11}O_{19}$. The compound that produces blue light is $BaMgAl_{10}O_{17}$.

75 Write the chemical name of the compound that produces red light. [1]

76 Calculate the percent composition by mass of aluminum in the compound that produces green light. Your response must include *both* a correct numerical setup and the calculated result. [2]

77 Explain, in terms of *both* electrons and energy, how ions in the coating emit light. [1]

Base your answers to questions 78 and 79 on the information below.

A substance known as heavy water can be obtained from ordinary water and could be a significant source of energy in the future. Heavy water contains deuterium, H-2. Instead of the two hydrogen atoms in a typical water molecule, a heavy water molecule has two deuterium atoms. In 3.78 kilograms of ordinary water, the percent composition by mass of heavy water is approximately 0.0156%.

Deuterium atoms completely ionize at approximately 10^8 K. The result is an ionized gas consisting of electrons and deuterons (the nuclei of deuterium). A triton is the nucleus of a tritium atom, H-3. These particles react according to the equations below. In the second equation, *X* represents an unidentified product.

$$^{2}_{1}\mathrm{H} + {}^{2}_{1}\mathrm{H} \rightarrow {}^{3}_{1}\mathrm{H} + {}^{1}_{1}\mathrm{H} + \text{energy}$$

$$^{2}_{1}\mathrm{H} + {}^{3}_{1}\mathrm{H} \rightarrow {}^{4}_{2}\mathrm{He} + X + \text{energy}$$

78 Calculate the mass of heavy water in a 3.78-kilogram sample of ordinary water. Your response must include *both* a correct numerical setup and the calculated result. [2]

79 Identify particle *X* in the second nuclear equation. Your response must include the symbol, atomic number, and mass number of the particle. [1]

Base your answers to questions 80 and 81 on the information below.

Ethyl butanoate is an organic compound that contributes to the odor of pineapple. Ethyl butanoate is one of the products formed by the reaction of butanoic acid with ethanol.

80 Identify *two* differences in the structures between a molecule of butanoic acid and a molecule of ethanol. *Each* of your responses must include *both* compounds. [2]

81 Identify the type of organic reaction that produces the compound that contributes to the odor of pineapple. [1]

Tear Here

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
CHEMISTRY

Thursday, January 29, 2009 — 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

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

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

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REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
CHEMISTRY

Thursday, January 29, 2009 — 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)

Final Score (from conversion chart)

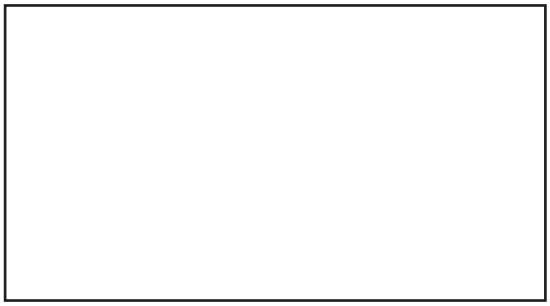
Raters' Initials:

Rater 1 . . . . . Rater 2 . . . . . .

For Raters Only

Part B–2

51



51

52 _____

_____

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52

53 _____

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53

For Raters Only

54 _____ g

54

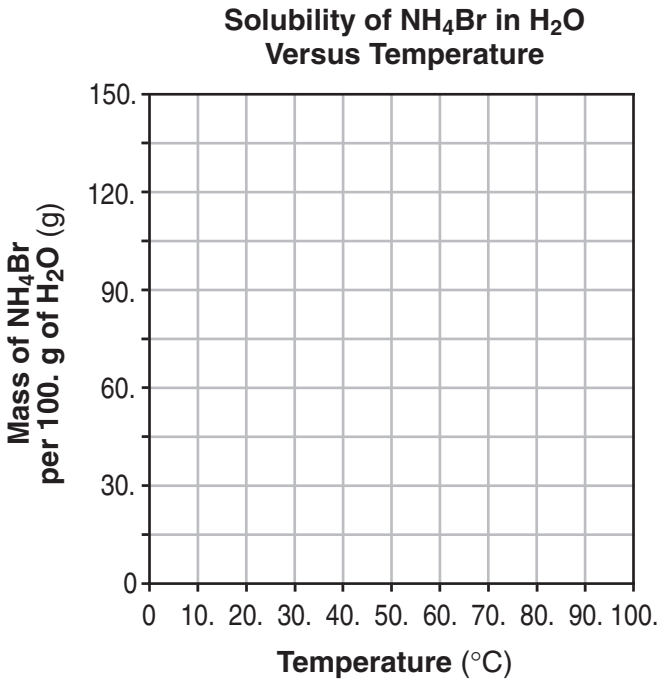
55 _____

_____

_____

55

56



56

57 _____ g

57

58 _____

_____

_____

58

[2]

For Raters Only

59 Physical property: _____

Chemical property: _____

59 ☐

60 _____

_____

60 ☐

61 _____

_____

_____

61 ☐

62

62 ☐

63 _____

63 ☐

64 _____ **K**

64 ☐

65 _____

65 ☐

66

66 ☐

Total Score for Part B–2

Part C

For Raters Only

67 _____

_____

67 ☐

68 _____

_____

68 ☐

_____

69 _____

69 ☐

70 _____

70 ☐

_____

71

71 ☐

_____ **g**

For Raters Only

72 _____

_____ **72** ☐

_____

73 _____

_____ **73** ☐

74 _____ **74** ☐

75 _____ **75** ☐

76

76 ☐

_____ **%**

77 _____

_____ **77** ☐

_____

For Raters Only

78

78

_____ **kg**

79 _____ **79**

80 Difference 1: _____

_____

_____

Difference 2: _____ **80**

_____

_____

81 _____ **81**

Total Score for Part C

PS/CHEMISTRY

FOR TEACHERS ONLY

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

PS–CH PHYSICAL SETTING/CHEMISTRY

Thursday, January 29, 2009 — 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	2	11	2	21	1	31	2	41	4
2	3	12	3	22	4	32	2	42	1
3	2	13	4	23	3	33	4	43	1
4	3	14	1	24	2	34	3	44	2
5	4	15	3	25	3	35	3	45	1
6	4	16	1	26	4	36	4	46	1
7	2	17	4	27	3	37	4	47	3
8	2	18	3	28	2	38	2	48	2
9	2	19	3	29	3	39	3	49	3
10	1	20	1	30	1	40	4	50	3

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/osa/ on Thursday, January 29, 2009. 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. The specific positioning of the dots may vary.

Examples of 1-credit responses:

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

Neon has atoms with a complete outer shell of electrons.

Neon has a complete octet.

Neon has eight valence electrons.

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

The rate of the forward reaction decreases because there are fewer N_2 molecules to collide with H_2 molecules.

The rate slows down because collisions are less frequent.

fewer effective collisions

54 [1] Allow 1 credit for 1.94 g.

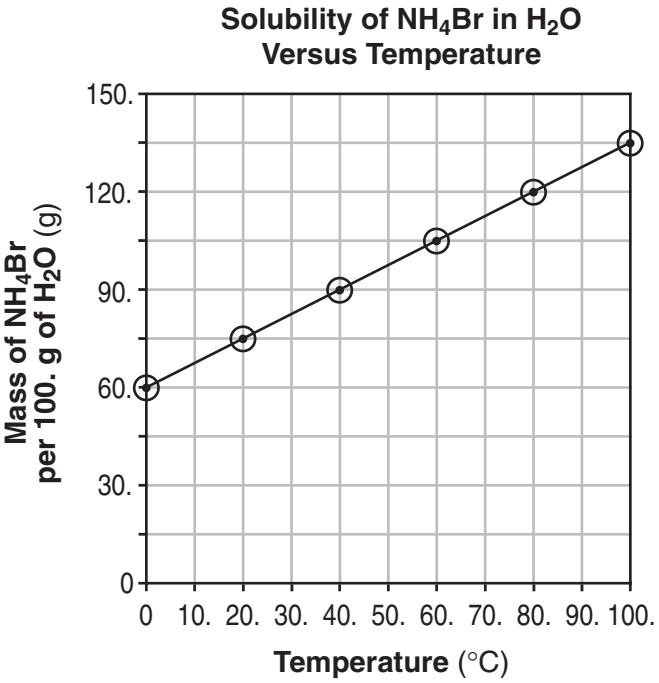
55 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

A Ca^{2+} ion has two fewer electrons than a Ca atom, so the ion is smaller.

Ca has an electron configuration of 2-8-8-2, and Ca^{2+} has an electron configuration of 2-8-8, so the ion is smaller.

56 [1] Allow 1 credit for correctly plotting all six points ± 0.1 grid space. Plotted points do *not* need to be circled or connected.

Example of a 1-credit response:



57 [1] Allow 1 credit for 210. g *or* for a response consistent with the student's graph in question 56. Significant figures do *not* need to be shown.

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

As temperature increases, the solubility of $NH_4Br(s)$ in H_2O increases and the solubility of $NH_3(g)$ in H_2O decreases.

NH_4Br becomes more soluble and NH_3 becomes less soluble.

59 [1] Allow 1 credit for identifying *one* physical property and *one* chemical property of CS_2. Acceptable responses include, but are not limited to:

Physical property:

liquid at room temperature
colorless
odor
boiling point above room temperature

Chemical property:

CS_2 can be decomposed into C and S.
flammable

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

The potential energy of the CO_2 molecules increases.

PE increases.

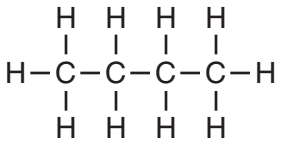
61 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

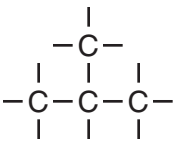
Carbon disulfide has stronger intermolecular forces than carbon dioxide.

CO_2 has weaker intermolecular forces.

62 [1] Allow 1 credit.

Examples of 1-credit responses:





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

pentane

C_5H_{12}

64 [1] Allow 1 credit for 231 K.

65 [1] Allow 1 credit for 3 *or* three.

66 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

$$\frac{112 \text{ mL}}{298 \text{ K}} = \frac{V_2}{273 \text{ K}}$$

$$\frac{(112)(273)(1)}{(298)(1)}$$

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:

Electrons flow from the magnesium block to the iron pipe.

Electrons flow from the Mg to the Fe through the wire.

Electrons flow from the anode to the cathode in a voltaic cell.

from the block to the pipe

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

Magnesium atoms lose electrons more easily than zinc atoms.

Mg oxidizes more readily than Zn.

Mg is more active than Zn.

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

$2HI(g) \rightarrow H_2(g) + I_2(g)$

$2HI \rightarrow I_2 + H_2$

70 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

The concentration of each product and the concentration of the reactant remain the same.

The concentrations have reached constant levels.

The horizontal lines on the graph show that the concentrations are constant.

Note: Do *not* allow credit for a response stating the color of the gas is not changing, without including a reference to concentration.

71 [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:

  $126.905 \times 2 = 253.810$ g/mol
  (0.013 M)(1.00 L)(253.810 g/mol)

  mass = 0.013×254

- Allow 1 credit for 3.3 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.

72 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

The hydroxide ion concentration is greater than the hydrogen ion concentration.

The H_3O^+ concentration is less than the OH^- concentration.

$[OH^-] > [H_3O^+]$

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

The pH is between 4.4 and 6.0, which indicates an acidic soil.

The pH of the soil surrounding the plant is below 6.0.

For chlorosis, the soil pH must be above 7.

74 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

$H_3O^+(aq) + OH^-(aq) \rightarrow 2H_2O(\ell)$

$H^+ + OH^- \rightarrow HOH$

hydrogen ions + hydroxide ions → water

hydroxide ions + hydronium ions → water

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

yttrium oxide

76 [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:

$$\frac{(11)(26.981\ 54\ \text{g/mol})}{(140.12\ \text{g/mol}) + (24.305\ \text{g/mol}) + 11(26.981\ 54\ \text{g/mol}) + 19(15.9994\ \text{g/mol})} \times 100$$

$$\frac{297}{765} \times 100$$

- Allow 1 credit for 38.8% *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.

77 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

Electrons move from the ground state to an excited state as the compounds gain energy. Light energy is released when the electrons return to lower states.

Electrons lose energy as they move to lower shells.

Light is emitted as electrons return from higher to lower energy states.

78 [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:

(0.000 156)(3.78 kg)

$$\frac{0.0156}{100} \times 3.78$$

- Allow 1 credit for 5.90×10^{-4} kg *or* 0.000 590 kg *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.

79 [1] Allow 1 credit for $^{1}_{0}n$.

80 [2] Allow a maximum of 2 credits, 1 credit for *each* acceptable response. Acceptable responses include, but are not limited to:

A butanoic acid molecule has four carbon atoms and an ethanol molecule has two carbon atoms.

Butanoic acid has a different functional group than ethanol.

A butanoic acid molecule has more hydrogen atoms than an ethanol molecule.

In a butanoic acid molecule, one oxygen atom has a double bond and in an ethanol molecule, the oxygen atom has two single bonds.

81 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

esterification

dehydration synthesis

Regents Examination in Physical Setting/Chemistry

January 2009

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

The *Chart for Determining the Final Examination Score for the January 2009 Regents Examination in Physical Setting/Chemistry* will be posted on the Department's web site http://www.emsc.nysed.gov/osa/ on Thursday, January 29, 2009. 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.

Online Submission of 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:

1. Go to www.emsc.nysed.gov/osa/exameval.
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.

Map to Core Curriculum

January 2009 Physical Setting/Chemistry			
Question Numbers			
Key Ideas/Performance Indicators	Part A	Part B	Part C
Standard 1			
Math Key Idea 1		37,38,49,56,64,65	76
Math Key Idea 2		35,58	70
Math Key Idea 3		37,44,54,57,64,66	71,76,78
Science Inquiry Key Idea 1		41,53,55	68,77,80
Science Inquiry Key Idea 2			
Science Inquiry Key Idea 3		32,36,37,46,48,49, 57,63	68,69,72,73,75
Engineering Design Key Idea 1			
Standard 2			
Key Idea 1		59	
Key Idea 2			
Standard 6			
Key Idea 1			
Key Idea 2			
Key Idea 3			
Key Idea 4			
Key Idea 5		42	
Standard 7			
Key Idea 1			
Key Idea 2			
Standard 4 Process Skills			
Key Idea 3		31,32,33,34,39,40, 41,43,45,47,52,53, 54,57,58,62,66	67,69,70,71,73,74, 80,81
Key Idea 4		38,39,42,50,60	79
Key Idea 5		45,51,61	
Standard 4			
Key Idea 3	1,2,3,4,5,6,7,8,9, 10,11,15,16,17,18, 20,21,22,23,24,25, 26,27,28,30	31,32,33,34,36,40, 41,43,44,46,47,49, 53,54,56,57,58,59, 62,65,66	67,68,69,70,71,72, 73,74,75,76,77,78, 80,81
Key Idea 4	14,19,29	35,38,39,42,48,50, 60,63,64	79
Key Idea 5	12,13	37,45,51,52,55,61	
Reference Tables			
2002 Edition	2,6,7,8,9,12,13,15, 25,27,28,30	33,34,37,38,43,44, 45,46,47,48,49,51, 55,62,64,66	67,68,71,73,74,75, 76,78,79,80,81

University of the State of New York
State Education Department

Regents Examination in Physical Setting/Chemistry
January 2009

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

Raw Score	Scale Score	Raw Score	Scale Score	Raw Score	Scale Score	Raw Score	Scale Score
85	100	63	75	41	60	19	39
84	98	62	74	40	59	18	38
83	96	61	73	39	59	17	37
82	95	60	72	38	58	16	35
81	93	59	72	37	57	15	34
80	92	58	71	36	56	14	32
79	90	57	70	35	56	13	30
78	89	56	70	34	55	12	29
77	88	55	69	33	54	11	27
76	86	54	68	32	53	10	25
75	85	53	68	31	52	9	23
74	84	52	67	30	51	8	21
73	83	51	66	29	51	7	19
72	82	50	66	28	50	6	16
71	81	49	66	27	49	5	14
70	80	48	65	26	48	4	11
69	80	47	64	25	47	3	9
68	79	46	63	24	46	2	6
67	78	45	63	23	44	1	3
66	77	44	62	22	43	0	0
65	76	43	61	21	42		
64	75	42	61	20	41		

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 to ensure the accuracy of the score. 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.