The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
CHEMISTRY

Wednesday, June 17, 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 Which subatomic particle is negatively charged?

(1) electron (3) positron
(2) neutron (4) proton

2 Which element has the greatest density at STP?

(1) barium (3) magnesium
(2) beryllium (4) radium

3 What is the mass number of a carbon atom that contains six protons, eight neutrons, and six electrons?

(1) 6 (3) 14
(2) 8 (4) 20

4 Which element is a metalloid?

(1) Al (3) As
(2) Ar (4) Au

5 Which substance can be decomposed by chemical means?

(1) aluminum (3) silicon
(2) octane (4) xenon

6 An element that is malleable and a good conductor of heat and electricity could have an atomic number of

(1) 16 (3) 29
(2) 18 (4) 35

7 A 1.0-mole sample of krypton gas has a mass of

(1) 19 g (3) 39 g
(2) 36 g (4) 84 g

8 An atom in the ground state has a stable valence electron configuration. This atom could be an atom of

(1) Al (3) Na
(2) Cl (4) Ne

9 An atom of an element has a total of 12 electrons. An ion of the same element has a total of 10 electrons. Which statement describes the charge and radius of the ion?

(1) The ion is positively charged and its radius is smaller than the radius of the atom.
(2) The ion is positively charged and its radius is larger than the radius of the atom.
(3) The ion is negatively charged and its radius is smaller than the radius of the atom.
(4) The ion is negatively charged and its radius is larger than the radius of the atom.

10 Which formula represents a nonpolar molecule?

(1) CH_4 (3) H_2O
(2) HCl (4) NH_3

11 The compound XCl is classified as ionic if X represents the element

(1) H (3) Rb
(2) I (4) Br

12 The chemical bonding in sodium phosphate, Na_3PO_4, is classified as

(1) ionic, only
(2) metallic, only
(3) both covalent and ionic
(4) both covalent and metallic

13 Which element is composed of molecules that each contain a multiple covalent bond?

(1) chlorine
(2) fluorine
(3) hydrogen
(4) nitrogen

14 Which equation represents an exothermic reaction at 298 K?

(1) $N_2(g) + O_2(g) \rightarrow 2NO(g)$

(2) $C(s) + O_2(g) \rightarrow CO_2(g)$

(3) $KNO_3(s) \xrightarrow{H_2O} K^+(aq) + NO_3^-(aq)$

(4) $NH_4Cl(s) \xrightarrow{H_2O} NH_4^+(aq) + Cl^-(aq)$

15 Standard pressure is equal to

(1) 1 atm
(2) 1 kPa
(3) 273 atm
(4) 273 kPa

16 A large sample of solid calcium sulfate is crushed into smaller pieces for testing. Which two physical properties are the same for both the large sample and one of the smaller pieces?

(1) mass and density
(2) mass and volume
(3) solubility and density
(4) solubility and volume

17 According to the kinetic molecular theory, the molecules of an ideal gas

(1) have a strong attraction for each other
(2) have significant volume
(3) move in random, constant, straight-line motion
(4) are closely packed in a regular repeating pattern

18 At 65°C, which compound has a vapor pressure of 58 kilopascals?

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

19 At STP, which 2.0-gram sample of matter uniformly fills a 340-milliliter closed container?

(1) $Br_2(\ell)$
(2) $Fe(NO_3)_2(s)$
(3) KCl(aq)
(4) Xe(g)

20 Compared to the freezing point and boiling point of water at 1 atmosphere, a solution of a salt and water at 1 atmosphere has a

(1) lower freezing point and a lower boiling point
(2) lower freezing point and a higher boiling point
(3) higher freezing point and a lower boiling point
(4) higher freezing point and a higher boiling point

21 Changes in activation energy during a chemical reaction are represented by a

(1) cooling curve
(2) heating curve
(3) ionization energy diagram
(4) potential energy diagram

22 Under which conditions of temperature and pressure would a real gas behave most like an ideal gas?

(1) 200. K and 50.0 kPa
(2) 200. K and 200.0 kPa
(3) 600. K and 50.0 kPa
(4) 600. K and 200.0 kPa

23 Given the equation representing a reaction:

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

Which statement describes this reaction at equilibrium?

(1) The concentration of $N_2O_4(g)$ must equal the concentration of $NO_2(g)$.
(2) The concentration of $N_2O_4(g)$ and the concentration of $NO_2(g)$ must be constant.
(3) The rate of the forward reaction is greater than the rate of the reverse reaction.
(4) The rate of the reverse reaction is greater than the rate of the forward reaction.

24 Which compound is a saturated hydrocarbon?

(1) propanal
(2) propane
(3) propene
(4) propyne

25 The isomers butane and methylpropane differ in their

(1) molecular formulas
(2) structural formulas
(3) total number of atoms per molecule
(4) total number of bonds per molecule

26 Which word equation represents a neutralization reaction?

(1) base + acid → salt + water
(2) base + salt → water + acid
(3) salt + acid → base + water
(4) salt + water → acid + base

27 An aqueous solution of lithium hydroxide contains hydroxide ions as the only negative ion in the solution. Lithium hydroxide is classified as an

(1) aldehyde
(2) alcohol
(3) Arrhenius acid
(4) Arrhenius base

28 One alternate acid-base theory states that an acid is an

(1) H^+ donor
(2) H^+ acceptor
(3) OH^- donor
(4) OH^- acceptor

29 Which particle has the greatest mass?

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

30 A beta particle may be spontaneously emitted from

(1) a ground-state electron
(2) a stable nucleus
(3) an excited electron
(4) an unstable nucleus

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 electron configuration represents an atom in an excited state?

(1) 2–7
(2) 2–6–2
(3) 2–8–1
(4) 2–8–8–2

32 Magnesium and calcium have similar chemical properties because a magnesium atom and a calcium atom have the same

(1) atomic number
(2) mass number
(3) total number of electron shells
(4) total number of valence electrons

33 What is the empirical formula for a compound with the molecular formula $C_6H_{12}Cl_2O_2$?

(1) CHClO
(2) CH_2ClO
(3) C_3H_6ClO
(4) $C_6H_{12}Cl_2O_2$

34 Given the balanced equation representing a reaction:

$$4Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$$

Which type of chemical reaction is represented by this equation?

(1) double replacement
(2) single replacement
(3) substitution
(4) synthesis

35 A person with a body temperature of 37°C holds an ice cube with a temperature of 0°C in a room where the air temperature is 20.°C. The direction of heat flow is

(1) from the person to the ice, only
(2) from the person to the ice and air, and from the air to the ice
(3) from the ice to the person, only
(4) from the ice to the person and air, and from the air to the person

36 What is the total mass of solute in 1000. grams of a solution having a concentration of 5 parts per million?

(1) 0.005 g
(2) 0.05 g
(3) 0.5 g
(4) 5 g

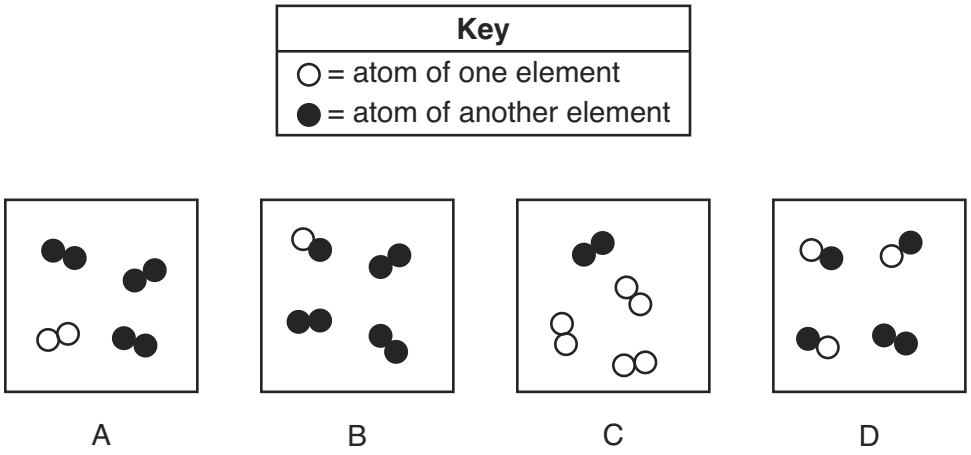
37 Which compound is *least* soluble in water at 60.°C?

(1) $KClO_3$
(2) KNO_3
(3) NaCl
(4) NH_4Cl

38 At standard pressure, which element has a freezing point *below* standard temperature?

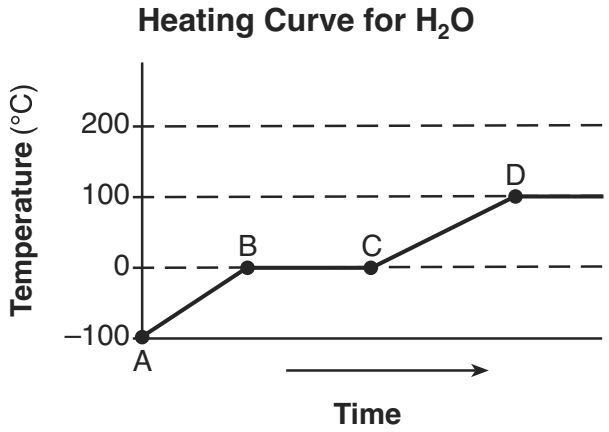
(1) In
(2) Ir
(3) Hf
(4) Hg

39 Which two particle diagrams represent mixtures of diatomic elements?



(1) *A* and *B*
(2) *A* and *C*
(3) *B* and *C*
(4) *B* and *D*

40 The graph below represents the relationship between temperature and time as heat is added to a sample of H_2O.



Which statement correctly describes the energy of the particles of the sample during interval *BC*?

(1) Potential energy decreases and average kinetic energy increases.
(2) Potential energy increases and average kinetic energy increases.
(3) Potential energy increases and average kinetic energy remains the same.
(4) Potential energy remains the same and average kinetic energy increases.

41 Given the balanced equation representing a reaction:

$$2HCl(aq) + Na_2S_2O_3(aq) \rightarrow S(s) + H_2SO_3(aq) + 2NaCl(aq)$$

Decreasing the concentration of $Na_2S_2O_3(aq)$ *decreases* the rate of reaction because the

(1) activation energy decreases
(2) activation energy increases
(3) frequency of effective collisions decreases
(4) frequency of effective collisions increases

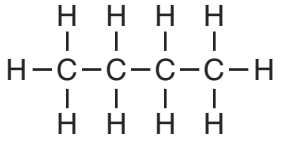
42 Given the equation representing a reaction at equilibrium:

$$H_2(g) + I_2(g) + \text{heat} \rightleftharpoons 2HI(g)$$

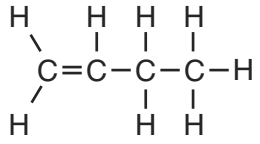
Which change favors the reverse reaction?

(1) decreasing the concentration of HI(g)
(2) decreasing the temperature
(3) increasing the concentration of $I_2(g)$
(4) increasing the pressure

43 Which formula represents 2-butene?



(1)



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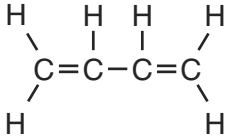
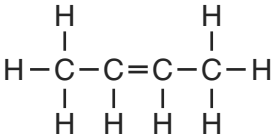


(2)



(4)

44 Given the balanced equation representing a reaction:

$$Fe_2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe$$

During this reaction, the oxidation number of Fe changes from

(1) +2 to 0 as electrons are transferred
(2) +2 to 0 as protons are transferred
(3) +3 to 0 as electrons are transferred
(4) +3 to 0 as protons are transferred

45 Which reaction occurs spontaneously?

(1) $Cl_2(g) + 2NaBr(aq) \rightarrow Br_2(\ell) + 2NaCl(aq)$
(2) $Cl_2(g) + 2NaF(aq) \rightarrow F_2(g) + 2NaCl(aq)$
(3) $I_2(s) + 2NaBr(aq) \rightarrow Br_2(\ell) + 2NaI(aq)$
(4) $I_2(s) + 2NaF(aq) \rightarrow F_2(g) + 2NaI(aq)$

46 Which sample of HCl(aq) contains the greatest number of moles of solute particles?

(1) 1.0 L of 2.0 M HCl(aq)
(2) 2.0 L of 2.0 M HCl(aq)
(3) 3.0 L of 0.50 M HCl(aq)
(4) 4.0 L of 0.50 M HCl(aq)

47 Which change in pH represents a hundredfold increase in the concentration of hydronium ions in a solution?

(1) pH 1 to pH 2
(2) pH 1 to pH 3
(3) pH 2 to pH 1
(4) pH 3 to pH 1

48 Which indicator would best distinguish between a solution with a pH of 3.5 and a solution with a pH of 5.5?

(1) bromthymol blue
(2) bromcresol green
(3) litmus
(4) thymol blue

49 Given the equation:

$$HCl(g) + H_2O(\ell) \rightarrow X(aq) + Cl^-(aq)$$

Which ion is represented by *X*?

(1) hydroxide
(2) hydronium
(3) hypochlorite
(4) perchlorate

50 Which nuclide is used to investigate human thyroid gland disorders?

(1) carbon-14
(2) potassium-37
(3) cobalt-60
(4) iodine-131

Part B–2

Answer all questions in this part.

Directions (51–65): 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 through 53 on the information below.

A sample of helium gas is in a closed system with a movable piston. The volume of the gas sample is changed when both the temperature and the pressure of the sample are increased. The table below shows the initial temperature, pressure, and volume of the gas sample, as well as the final temperature and pressure of the sample.

Helium Gas in a Closed System

Condition	Temperature (K)	Pressure (atm)	Volume (mL)
initial	200.	2.0	500.
final	300.	7.0	?

51 In the space *in your answer booklet*, show a correct numerical setup for calculating the final volume of the helium gas sample. [1]

52 Convert the final temperature of the helium gas sample to degrees Celsius. [1]

53 Compare the total number of gas particles in the sample under the initial conditions to the total number of gas particles in the sample under the final conditions. [1]

Base your answers to questions 54 through 57 on the information below.

Molar Mass and Boiling Point of Four Substances

Substance	**Molar Mass** (g/mol)	**Boiling Point at 1 atm** (K)
methane	16	112
ethane	30.	185
propane	44	231
butane	58	273

54 On the grid *in your answer booklet*, mark an appropriate scale on the axis labeled "Boiling Point (K)." [1]

55 On the same grid, plot the data from the data table. Circle and connect the points. [1]

56 Based on the data in the table, state the relationship between the boiling point at 1 atmosphere and molar mass for these four substances. [1]

57 State, in terms of intermolecular forces, why the boiling point of propane at 1 atmosphere is *lower* than the boiling point of butane at 1 atmosphere. [1]

Base your answers to questions 58 and 59 on the information below.

At a pressure of 101.3 kilopascals and a temperature of 373 K, heat is removed from a sample of water vapor, causing the sample to change from the gaseous phase to the liquid phase. This phase change is represented by the equation below.

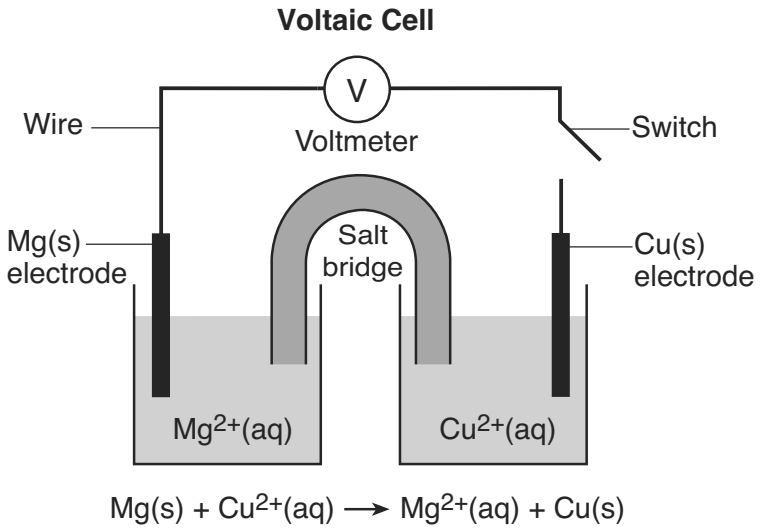
$$H_2O(g) \rightarrow H_2O(\ell) + \text{heat}$$

58 Explain, in terms of particle arrangement, why entropy *decreases* during this phase change. [1]

59 Determine the total amount of heat released by 5.00 grams of water vapor during this phase change. [1]

Base your answers to questions 60 through 62 on the information below.

A voltaic cell with magnesium and copper electrodes is shown in the diagram below. The copper electrode has a mass of 15.0 grams.



When the switch is closed, the reaction in the cell begins. The balanced ionic equation for the reaction in the cell is shown below the cell diagram. After several hours, the copper electrode is removed, rinsed with water, and dried. At this time, the mass of the copper electrode is greater than 15.0 grams.

60 State the direction of electron flow through the wire between the electrodes when the switch is closed. [1]

61 State the purpose of the salt bridge in this cell. [1]

62 Explain, in terms of copper ions and copper atoms, why the mass of the copper electrode increases as the cell operates. Your response must include information about *both* copper ions and copper atoms. [1]

Base your answers to questions 63 through 65 on the information below.

Naturally Occurring Isotopes of Sulfur

Isotope	Atomic Mass (atomic mass units, u)	Natural Abundance (%)
^{32}S	31.97	94.93
^{33}S	32.97	0.76
^{34}S	33.97	4.29
^{36}S	35.97	0.02

63 State, in terms of the number of subatomic particles, *one* similarity and *one* difference between the atoms of these isotopes of sulfur. [1]

64 In the space *in your answer booklet*, draw a Lewis electron-dot diagram for an atom of sulfur-33. [1]

65 In the space *in your answer booklet*, show a correct numerical setup for calculating the atomic mass of sulfur. [1]

Part C

Answer all questions in this part.

Directions (66–83): 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 66 and 67 on the information below.

In 1897, J. J. Thomson demonstrated in an experiment that cathode rays were deflected by an electric field. This suggested that cathode rays were composed of negatively charged particles found in all atoms. Thomson concluded that the atom was a positively charged sphere of almost uniform density in which negatively charged particles were embedded. The total negative charge in the atom was balanced by the positive charge, making the atom electrically neutral.

In the early 1900s, Ernest Rutherford bombarded a very thin sheet of gold foil with alpha particles. After interpreting the results of the gold foil experiment, Rutherford proposed a more sophisticated model of the atom.

66 State *one* conclusion from Rutherford's experiment that contradicts one conclusion made by Thomson. [1]

67 State *one* aspect of the modern model of the atom that agrees with a conclusion made by Thomson. [1]

Base your answers to questions 68 through 70 on the information below.

Cobalt-60 is commonly used as a source of radiation for the prevention of food spoilage. Bombarding cobalt-59 nuclei with neutrons produces the nuclide cobalt-60. A food irradiation facility replaces the cobalt-60, a source of gamma rays, when the radioactivity level falls to $\frac{1}{8}$ of its initial level. The nuclide cesium-137 is also a source of radiation for the prevention of food spoilage.

68 Identify *one* emission spontaneously released by a cobalt-60 nucleus. [1]

69 Determine the total number of years that elapse before an original cobalt-60 source in an irradiation facility must be replaced. [1]

70 Complete the nuclear equation *in your answer booklet* for the decay of cesium-137. Your response must include the symbol, atomic number, and mass number of the missing particle. [1]

Base your answers to questions 71 through 73 on the information below.

A soft-drink bottling plant makes a colorless, slightly acidic carbonated beverage called soda water. During production of the beverage, $CO_2(g)$ is dissolved in water at a pressure greater than 1 atmosphere. The bottle containing the solution is capped to maintain that pressure above the solution. As soon as the bottle is opened, fizzing occurs due to $CO_2(g)$ being released from the solution.

71 Explain why $CO_2(g)$ is released when a bottle of soda water is opened. [1]

72 Write the chemical name of the acid in soda water. [1]

73 State the relationship between the solubility of $CO_2(g)$ in water and the temperature of the aqueous solution. [1]

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

During a bread-making process, glucose is converted to ethanol and carbon dioxide, causing the bread dough to rise. Zymase, an enzyme produced by yeast, is a catalyst needed for this reaction.

74 Balance the equation *in your answer booklet* for the reaction that causes bread dough to rise, using the smallest whole-number coefficients. [1]

75 In the space *in your answer booklet*, draw a structural formula for the alcohol formed in this reaction. [1]

76 State the effect of zymase on the activation energy for this reaction. [1]

Base your answers to questions 77 and 78 on the information below.

In performing a titration, a student adds three drops of phenolphthalein to a flask containing 25.00 milliliters of HCl(aq). Using a buret, the student slowly adds 0.150 M NaOH(aq) to the flask until one drop causes the indicator to turn light pink. The student determines that a total volume of 20.20 milliliters of NaOH(aq) was used in this titration.

77 The concentration of the NaOH(aq) used in the titration is expressed to what number of significant figures? [1]

78 Calculate the molarity of the HCl(aq) used in this titration. Your response must include *both* a correct numerical setup and the calculated result. [2]

Base your answers to questions 79 through 83 on the information below.

Arsenic is often obtained by heating the ore arsenopyrite, FeAsS. The decomposition of FeAsS is represented by the balanced equation below.

$$FeAsS(s) \xrightarrow{heat} FeS(s) + As(g)$$

In the solid phase, arsenic occurs in two forms. One form, yellow arsenic, has a density of 1.97 g/cm^3 at STP. The other form, gray arsenic, has a density of 5.78 g/cm^3 at STP. When arsenic is heated rapidly in air, arsenic(III) oxide is formed.

Although arsenic is toxic, it is needed by the human body in very small amounts. The body of a healthy human adult contains approximately 5 milligrams of arsenic.

79 Convert the mass of arsenic found in the body of a healthy human adult to grams. [1]

80 When heated, a 125.0-kilogram sample of arsenopyrite yields 67.5 kilograms of FeS. Determine the total mass of arsenic produced in this reaction. [1]

81 Write the formula for the compound produced when arsenic is heated rapidly in air. [1]

82 Explain, in terms of the arrangement of atoms, why the two forms of arsenic have different densities at STP. [1]

83 Calculate the percent composition by mass of arsenic in arsenopyrite. Your response must include *both* a correct numerical setup and the calculated result. [2]

Tear Here

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
CHEMISTRY

Wednesday, June 17, 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

PS/CHEMISTRY

The University of the State of New York

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CHEMISTRY

Wednesday, June 17, 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	15	
C	20	

Total Written Test Score (Maximum Raw Score: 85)

Final Score (from conversion chart)

Raters' Initials:

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

Part B–2

51

52 _____ °C

53 _____

_____

For Raters Only

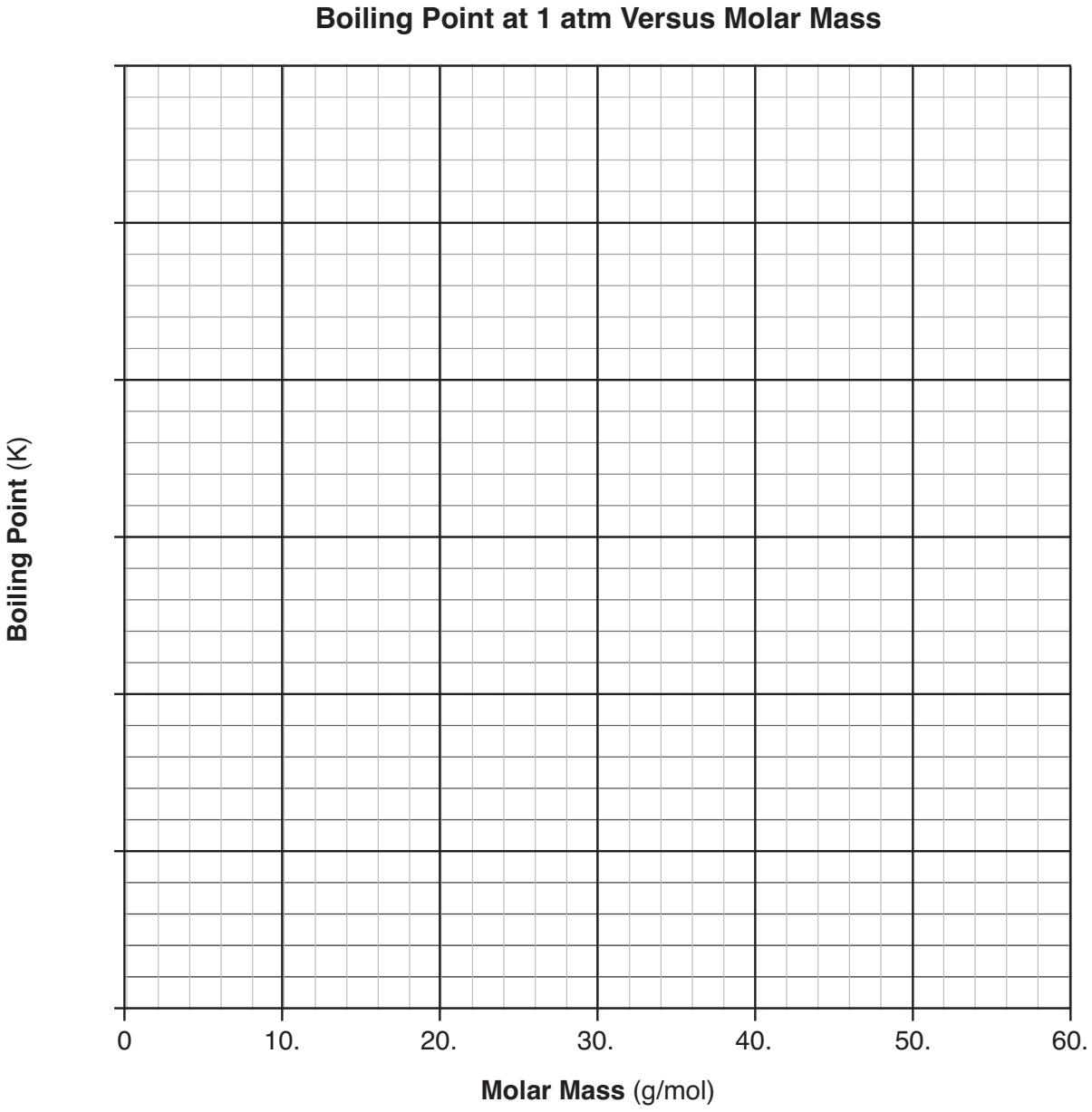
51 ☐

52 ☐

53 ☐

For Raters Only

54 and **55**



54 ☐

55 ☐

56 _____

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56 ☐

57 _____

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57 ☐

[2]

For Raters Only

58 _____

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59 _____ **J**

60 _____

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62 _____

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58 ☐

59 ☐

60 ☐

61 ☐

62 ☐

63 Similarity: _____

_____

Difference: _____

_____

64

65

For Raters Only

63 ☐

64 ☐

65 ☐

☐

Total Score for Part B–2

Part C

For Raters Only

66 _____

_____

66 ☐

67 _____

_____

67 ☐

68 _____ **68** ☐

69 _____ **y** **69** ☐

70 $^{137}_{55}Cs \rightarrow {}^{0}_{-1}e +$ _____ **70** ☐

71 _____

_____

_____

71 ☐

72 _____ **72** ☐

73 _____

_____

73 ☐

For Raters Only

74 _____ $C_6H_{12}O_6$ $\xrightarrow{\text{zymase}}$ _____ C_2H_5OH + _____ CO_2 + energy

74 ☐

75

75 ☐

76 _____

_____

76 ☐

77 _____

77 ☐

78

78 ☐

_____ **M**

For Raters Only

79 _____ **g** — **79** ☐

80 _____ **kg** — **80** ☐

81 _____ — **81** ☐

82 _____

_____ — **82** ☐

_____

83 — **83** ☐

_____ **%**

☐

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

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

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 Wednesday, June 17, 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 15 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:

$$\frac{(2.0\text{ atm})(500.\text{ mL})}{200.\text{ K}} = \frac{(7.0\text{ atm})(V_2)}{300.\text{ K}}$$

$$\frac{(2)(500)(300)}{200(7)}$$

52 [1] Allow 1 credit for 27°C.

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

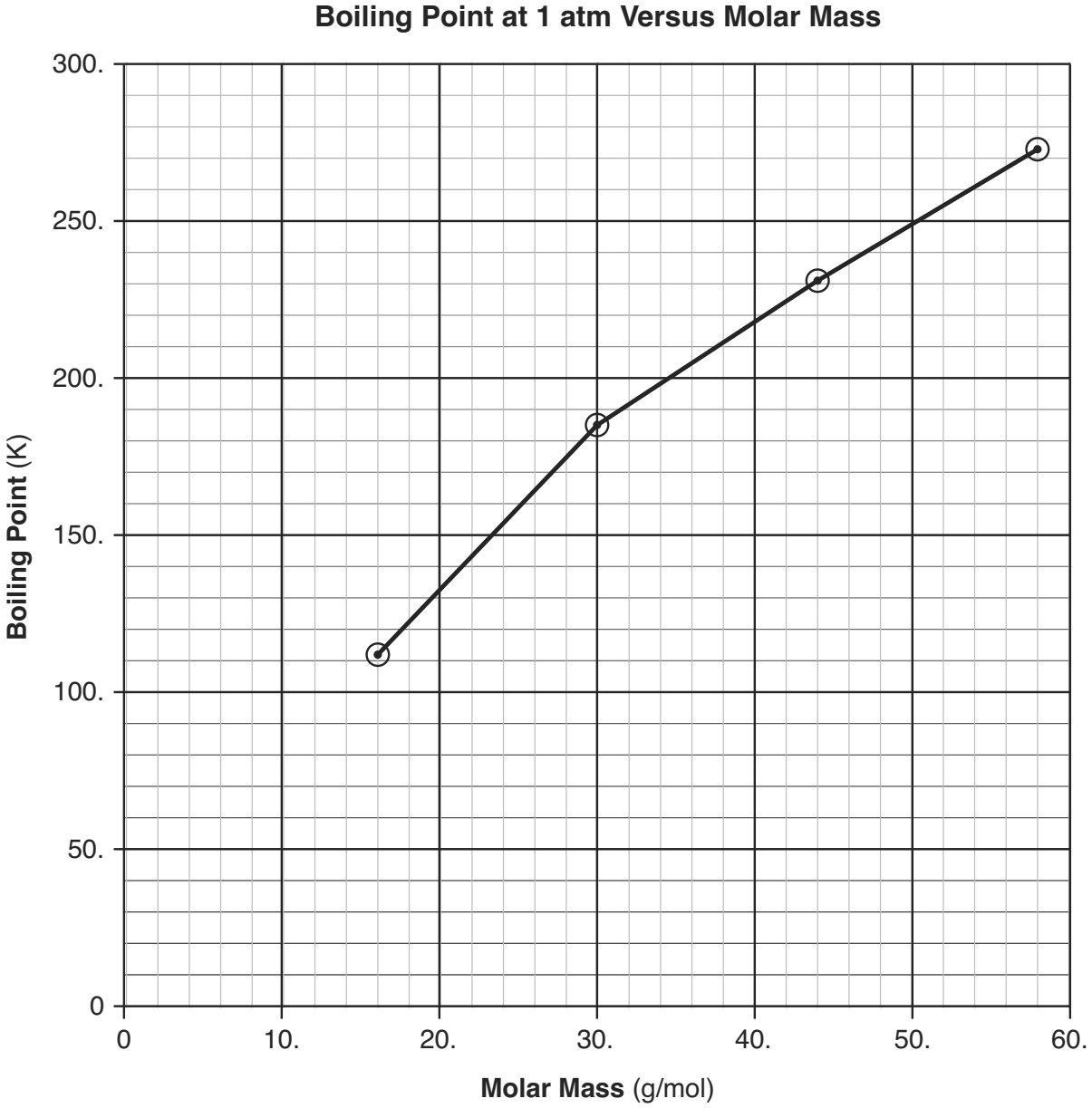
The total number of gas particles is the same under the initial and final conditions.

The total number of particles before and after is the same.

54 [1] Allow 1 credit for marking an appropriate scale. An appropriate scale is linear and allows a trend to be seen.

55 [1] Allow 1 credit for plotting all four points correctly ± 0.3 grid space. Plotted points do *not* need to be circled or connected.

Example of a 2-credit response for questions 54 and 55:



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

As molar mass increases, boiling point at 1 atm increases.

the smaller the molar mass, the lower the boiling point

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

The boiling point of propane at 1 atm is lower than the boiling point of butane at 1 atm because propane has weaker intermolecular forces than butane.

Butane has stronger intermolecular forces.

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

The arrangement of the H_2O molecules becomes more ordered as liquid water forms.

As a liquid, the movement of the particles is less random.

59 [1] Allow 1 credit for 11 300 J. Significant figures do *not* need to be shown.

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

The electrons flow from the Mg electrode to the Cu electrode.

from anode to cathode

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

The salt bridge allows ions to flow between the half-cells.

preventing polarization

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

Copper ions from the solution are reduced to copper atoms at the electrode, increasing the mass of the electrode.

Copper ions become copper atoms.

The number of copper ions decreases, and the number of copper atoms increases.

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

Similarity: All atoms of these isotopes have the same number of protons.

Difference: An S-32 atom has 16 neutrons, an S-33 atom has 17 neutrons, an S-34 atom has 18 neutrons, and an S-36 atom has 20 neutrons.

Similarity: Every sulfur atom has 16 protons.

Difference: The number of neutrons in an atom of one isotope is different than the number of neutrons in an atom of a different isotope.

64 [1] Allow 1 credit.

Example of a 1-credit response:

65 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

$(31.97)(0.9493) + (32.97)(0.0076) + (33.97)(0.0429) + (35.97)(0.0002)$

$$\frac{(31.97)(94.93) + (32.97)(0.76) + (33.97)(4.29) + (35.97)(0.02)}{100}$$

Part C

Allow a total of 20 credits for this part. The student must answer all questions in this part.

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

An atom has a nucleus that is positively charged.

An atom is mostly empty space.

Negatively charged particles are located outside the positive nucleus.

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

An atom has equal amounts of negative and positive charge.

An atom has an equal number of protons and electrons.

All atoms contain electrons.

Electrons are negatively charged.

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

beta particle

γ

69 [1] Allow 1 credit for 15.78 y. Significant figures do *not* need to be shown.

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

$^{137}_{56}Ba$

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

The pressure above the solution decreases, so the $CO_2(g)$ is less soluble in the solution.

The pressure is less, so the CO_2 has lower solubility.

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

carbonic acid

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

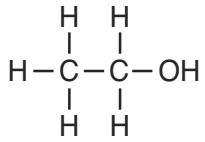
The solubility of $CO_2(g)$ decreases as the temperature of the solution increases.

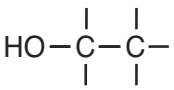
As temperature decreases, solubility of CO_2 increases.

74 [1] Allow 1 credit for: $\_\_\_\_\_C_6H_{12}O_6 \xrightarrow{\text{zymase}} \_\_2\_\_C_2H_5OH + \_\_2\_\_CO_2$ + energy.
Allow credit even if the coefficient "1" is written in front of $C_6H_{12}O_6$.

75 [1] Allow 1 credit.

Examples of 1-credit responses:





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

Zymase lowers the activation energy.

77 [1] Allow 1 credit for 3 *or* three.

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:

$(M_A)(25.00\text{ mL}) = (0.150\ M)(20.20\text{ mL})$

$\frac{(0.150)(20.20)}{25}$

- Allow 1 credit for 0.121 M *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 5×10^{-3} g *or* 0.005 g.

80 [1] Allow 1 credit for 57.5 kg.

81 [1] Allow 1 credit for As_2O_3.

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

In gray arsenic, the atoms are arranged closer together so there is more mass in a unit volume.

The atoms in yellow As are farther apart; therefore, there is less mass per volume than in gray As.

83 [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:

$$\%\text{ As} = \frac{74.9\text{ g/mol}}{(55.8 + 32.1 + 74.9)\text{ g/mol}} \times 100$$

$$\frac{75}{163} \times 100$$

- Allow 1 credit for 46.0% *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.

Regents Examination in Physical Setting/Chemistry

June 2009

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

The *Chart for Determining the Final Examination Score for the June 2009 Regents Examination in Physical Setting/Chemistry* will be posted on the Department's web site http://www.emsc.nysed.gov/osa/ on Wednesday, June 17, 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

June 2009 Physical Setting/Chemistry			
Question Numbers			
Key Ideas/Performance Indicators	Part A	Part B	Part C
Standard 1			
Math Key Idea 1		51,52,54,55	77,78,79,83
Math Key Idea 2		56	
Math Key Idea 3		33,36,44,46,51, 59,65	71,78,80,81,83
Science Inquiry Key Idea 1		53,57,61,62	66,67,72,73,82
Science Inquiry Key Idea 2			
Science Inquiry Key Idea 3		35,37,38,40,43, 48,53	68,73,81
Engineering Design Key Idea 1			
Standard 2			
Key Idea 1			79
Key Idea 2			
Standard 6			
Key Idea 1		35	
Key Idea 2		39,63	
Key Idea 3		47	
Key Idea 4		42	
Key Idea 5			
Standard 7			
Key Idea 1			
Key Idea 2			
Standard 4 Process Skills			
Key Idea 3		31,32,33,34,37, 38,39,41,42,45, 46,49,51,52,58, 60,61,62,63,64, 65	66,68,73,74,75, 78,80
Key Idea 4		40,50,59	69,70,76
Key Idea 5			
Key Idea 3	1,2,3,4,5,6,7,15, 16,17,19,20,22, 23,24,25,26,27, 28,29,30	31,32,33,34,36, 37,39,41,42,43, 44,45,46,47,48, 49,51,53,58,60 61,62,63,65	66,67,68,71,72, 73,74,75,76,77, 78,79,80,81,83
Key Idea 4	14,21	35,40,50,52,59	68,69,70
Key Idea 5	8,9,10,11,12,13, 18	38,54,55,56,57, 64	82
2002 Edition	1,2,3,4,5,6,7,8,9, 11,12,13,14,15, 18,24,29	31,32,36,37,38, 43,44,45,46,48, 49,51,52,59,62, 63,64	68,69,70,72,73, 75,78,79,83

University of the State of New York
State Education Department

Regents Examination in Physical Setting/Chemistry
June 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	59	19	37
84	98	62	74	40	58	18	36
83	97	61	73	39	58	17	35
82	95	60	72	38	57	16	33
81	94	59	72	37	56	15	31
80	92	58	71	36	55	14	30
79	91	57	70	35	54	13	28
78	89	56	69	34	54	12	26
77	88	55	69	33	53	11	25
76	87	54	68	32	52	10	23
75	86	53	67	31	51	9	21
74	85	52	67	30	50	8	19
73	84	51	66	29	49	7	17
72	83	50	66	28	48	6	15
71	82	49	65	27	47	5	12
70	81	48	64	26	46	4	10
69	80	47	63	25	45	3	8
68	79	46	63	24	44	2	5
67	78	45	62	23	42	1	3
66	77	44	61	22	41	0	0
65	76	43	60	21	40		
64	75	42	60	20	39		

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.