The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
CHEMISTRY

Thursday, January 27, 2005 — 9:15 a.m. to 12:15 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.

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 As an electron in an atom moves from the ground state to the excited state, the electron
   (1) gains energy as it moves to a higher energy level
   (2) gains energy as it moves to a lower energy level
   (3) loses energy as it moves to a higher energy level
   (4) loses energy as it moves to a lower energy level

2 Which subatomic particle will be attracted by a positively charged object?
   (1) proton   (3) electron
   (2) neutron   (4) positron

3 Which conclusion is based on the "gold foil experiment" and the resulting model of the atom?
   (1) An atom is mainly empty space, and the nucleus has a positive charge.
   (2) An atom is mainly empty space, and the nucleus has a negative charge.
   (3) An atom has hardly any empty space, and the nucleus has a positive charge.
   (4) An atom has hardly any empty space, and the nucleus has a negative charge.

4 Which two particles have approximately the same mass?
   (1) proton and neutron
   (2) proton and electron
   (3) neutron and electron
   (4) neutron and positron

5 Which element has chemical properties that are most similar to the chemical properties of sodium?
   (1) Mg   (3) Se
   (2) K   (4) Cl

6 Germanium is classified as a
   (1) metal   (3) nonmetal
   (2) metalloid   (4) noble gas

7 Which statement correctly describes diamond and graphite, which are different forms of solid carbon?
   (1) They differ in their molecular structure, only.
   (2) They differ in their properties, only.
   (3) They differ in their molecular structure and properties.
   (4) They do not differ in their molecular structure or properties.

8 What is the chemical formula for copper(II) hydroxide?
   (1) $CuOH$ (3) $Cu_2(OH)$
   (2) $CuOH_2$ (4) $Cu(OH)_2$

9 What is the percent composition by mass of aluminum in $Al_2(SO_4)_3$ (gram-formula mass = 342 grams/mole)?
   (1) 7.89%   (3) 20.8%
   (2) 15.8%   (4) 36.0%

10 Which statement describes a chemical property that can be used to distinguish between compound *A* and compound *B*?
   (1) *A* is a blue solid, and *B* is a white solid.
   (2) *A* has a high melting point, and *B* has a low melting point.
   (3) *A* dissolves in water, and *B* does not dissolve in water.
   (4) *A* does not burn in air, and *B* does burn in air.

11 Which compound contains both ionic and covalent bonds?

(1) $CaCO_3$ (3) MgF_2

(2) PCl_3 (4) CH_2O

12 Which formula represents a nonpolar molecule?

(1) HCl   (3) NH_3

(2) H_2O (4) CF_4

13 When a lithium atom forms an Li^+ ion, the lithium atom

(1) gains a proton
(2) gains an electron
(3) loses a proton
(4) loses an electron

14 Which Lewis electron-dot diagram represents a boron atom in the ground state?

(1) ·B   (3) :B·

(2) :B·   (4) :B·

15 A sample is prepared by completely dissolving 10.0 grams of NaCl in 1.0 liter of H_2O. Which classification best describes this sample?

(1) homogeneous compound
(2) homogeneous mixture
(3) heterogeneous compound
(4) heterogeneous mixture

16 Which form of energy is converted to thermal energy when propane burns in air?

(1) electromagnetic   (3) electrical
(2) nuclear   (4) chemical

17 Which physical changes are endothermic?

(1) melting and freezing
(2) melting and evaporating
(3) condensation and sublimation
(4) condensation and deposition

18 Which transfer of energy occurs when ice cubes are placed in water that has a temperature of 45°C?

(1) Chemical energy is transferred from the ice to the water.
(2) Chemical energy is transferred from the water to the ice.
(3) Thermal energy is transferred from the ice to the water.
(4) Thermal energy is transferred from the water to the ice.

19 At STP, 4 liters of O_2 contains the same total number of molecules as

(1) 1 L of NH_3 (3) 8 L of He
(2) 2 L of Cl_2 (4) 4 L of CO_2

20 What is the total number of electron pairs that are shared between the two carbon atoms in a molecule of ethyne?

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

21 Which pair of compounds are isomers?

(1) NO_2 and N_2O_4
(2) P_2O_5 and P_4O_{10}
(3) HCOOH and CH_3COOH
(4) CH_3OCH_3 and C_2H_5OH

22 Which organic compound is unsaturated?

(1) 2-methylbutane   (3) 2-hexanol
(2) 2-chloropropane   (4) 2-pentene

23 Which change in oxidation number indicates oxidation?

(1) –1 to +2   (3) +2 to –3
(2) –1 to –2   (4) +3 to +2

24 Given the redox reaction:

$$Cr^{3+} + Al \rightarrow Cr + Al^{3+}$$
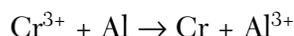
As the reaction takes place, there is a transfer of

(1) electrons from Al to Cr^{3+}
(2) electrons from Cr^{3+} to Al
(3) protons from Al to Cr^{3+}
(4) protons from Cr^{3+} to Al

25 The compound HNO_3 can be described as an

(1) Arrhenius acid and an electrolyte
(2) Arrhenius acid and a nonelectrolyte
(3) Arrhenius base and an electrolyte
(4) Arrhenius base and a nonelectrolyte

26 According to Reference Table M, what is the color of the indicator methyl orange in a solution that has a pH of 2?

(1) blue   (3) orange
(2) yellow   (4) red

27 Given the reaction:

$$NH_3 + HCl \rightarrow NH_4Cl$$

In this reaction, ammonia molecules (NH_3) act as a base because they

(1) accept hydrogen ions (H^+)
(2) accept hydroxide ions (OH^-)
(3) donate hydrogen ions (H^+)
(4) donate hydroxide ions (OH^-)

28 Which reaction is an example of natural transmutation?

(1) $^{239}_{94}Pu \rightarrow ^{235}_{92}U + ^{4}_{2}He$
(2) $^{27}_{13}Al + ^{4}_{2}He \rightarrow ^{30}_{15}P + ^{1}_{0}n$
(3) $^{238}_{92}U + ^{1}_{0}n \rightarrow ^{239}_{94}Pu + 2^{0}_{-1}e$
(4) $^{239}_{94}Pu + ^{1}_{0}n \rightarrow ^{147}_{56}Ba + ^{90}_{38}Sr + 3^{1}_{0}n$

29 Which statement best describes gamma radiation?

(1) It has a mass of 1 and a charge of 1.
(2) It has a mass of 0 and a charge of −1.
(3) It has a mass of 0 and a charge of 0.
(4) It has a mass of 4 and a charge of +2.

30 Which change takes place in a nuclear fusion reaction?

(1) Matter is converted to energy.
(2) Energy is converted to matter.
(3) Ionic bonds are converted to covalent bonds.
(4) Covalent bonds are converted to ionic bonds.

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 What is the total number of neutrons in the nucleus of a neutral atom that has 19 electrons and a mass number of 39?

(1) 19   (3) 39
(2) 20   (4) 58

32 An unknown element *X* can form a compound with the formula XBr_3. In which group on the Periodic Table would element *X* be found?

(1) 1   (3) 13
(2) 2   (4) 14

33 As the elements in Group 17 on the Periodic Table are considered from top to bottom, what happens to the atomic radius and the metallic character of each successive element?

(1) The atomic radius and the metallic character both increase.
(2) The atomic radius increases and the metallic character decreases.
(3) The atomic radius decreases and the metallic character increases.
(4) The atomic radius and the metallic character both decrease.

34 Which pair of compounds has the same empirical formula?

(1) C_2H_2 and C_6H_6
(2) C_2H_6 and C_3H_8
(3) CH_3OH and C_2H_5OH
(4) CH_3CHO and CH_3COOH

35 Which equation shows a conservation of mass?

(1) $Na + Cl_2 \rightarrow NaCl$
(2) $Al + Br_2 \rightarrow AlBr_3$
(3) $H_2O \rightarrow H_2 + O_2$
(4) $PCl_5 \rightarrow PCl_3 + Cl_2$

36 How many electrons are in an Fe^{2+} ion?

(1) 24   (3) 28
(2) 26   (4) 56

37 A substance that does not conduct electricity as a solid but does conduct electricity when melted is most likely classified as

(1) an ionic compound
(2) a molecular compound
(3) a metal
(4) a nonmetal

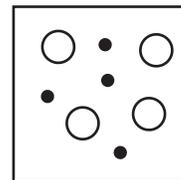38 According to Reference Table *H*, what is the boiling point of ethanoic acid at 80 kPa?

(1) 28°C   (3) 111°C
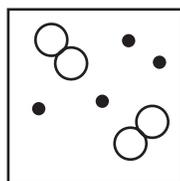(2) 100°C   (4) 125°C

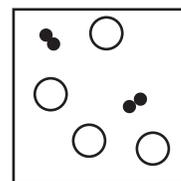39 Which particle diagram represents one pure substance, only?
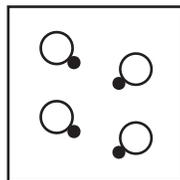
(1)   (3)

(2)   (4)

40 A sample of helium gas has a volume of 900. milliliters and a pressure of 2.50 atm at 298 K. What is the new pressure when the temperature is changed to 336 K and the volume is decreased to 450. milliliters?

(1) 0.177 atm   (3) 5.64 atm
(2) 4.43 atm   (4) 14.1 atm

41 Given the particle diagram:

Key
● atom

At 101.3 kPa and 298 K, which element could this diagram represent?

(1) Rn   (3) Ag
(2) Xe   (4) Kr

42 For most atoms with an atomic number less than 20, nuclear stability occurs when the ratio of neutrons to protons is 1:1. Which of the following atoms would be most likely to have an unstable nucleus?

(1) $^{4}_{2}$He   (3) $^{16}_{7}$N

(2) $^{12}_{6}$C   (4) $^{24}_{12}$Mg

43 Which of these changes produces the greatest increase in entropy?

(1) $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$
(2) $2\ Mg(s) + O_2(g) \rightarrow 2\ MgO(s)$
(3) $H_2O(g) \rightarrow H_2O(\ell)$
(4) $CO_2(g) \rightarrow CO_2(s)$
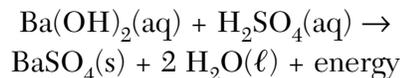
44 Given the structural formula:
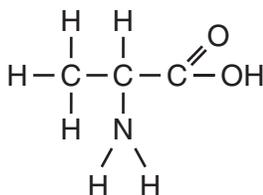
This structural formula represents a molecule of

(1) an aldehyde   (3) a ketone
(2) an ester   (4) an amino acid

45 Which half-reaction can occur at the anode in a voltaic cell?

(1) $Ni^{2+} + 2e^- \rightarrow Ni$ (3) $Zn \rightarrow Zn^{2+} + 2e^-$
(2) $Sn + 2e^- \rightarrow Sn^{2+}$ (4) $Fe^{3+} \rightarrow Fe^{2+} + e^-$

46 Given the reaction:

$$Ba(OH)_2(aq) + H_2SO_4(aq) \rightarrow$$
$$BaSO_4(s) + 2\ H_2O(\ell) + energy$$

As the barium hydroxide solution is added to the solution of sulfuric acid, the electrical conductivity of the acid solution decreases because the

(1) volume of the reaction mixture increases
(2) temperature of the reaction mixture decreases
(3) concentration of ions increases
(4) concentration of ions decreases

47 Which chemical equation represents the reaction of an Arrhenius acid and an Arrhenius base?

(1) $HC_2H_3O_2(aq) + NaOH(aq) \rightarrow$
     $NaC_2H_3O_2(aq) + H_2O(\ell)$
(2) $C_3H_8(g) + 5\ O_2(g) \rightarrow 3\ CO_2(g) + 4\ H_2O(\ell)$
(3) $Zn(s) + 2\ HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$
(4) $BaCl_2(aq) + Na_2SO_4(aq) \rightarrow$
     $BaSO_4(s) + 2\ NaCl(aq)$

48 Based on Reference Table F, which of these saturated solutions has the *lowest* concentration of dissolved ions?

(1) NaCl(aq)   (3) $NiCl_2$(aq)
(2) $MgCl_2$(aq)   (4) AgCl(aq)

49 Based on Reference Table N, what fraction of a radioactive ^{90}Sr sample would remain unchanged after 56.2 years?

(1) $\frac{1}{2}$ (3) $\frac{1}{8}$

(2) $\frac{1}{4}$ (4) $\frac{1}{16}$

50 Given the nuclear equation:

$$^{19}_{10}Ne \rightarrow X + ^{19}_{9}F$$
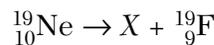
Which particle is represented by X?

(1) alpha   (3) neutron
(2) beta   (4) positron

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 your knowledge of chemical bonding and on the Lewis electron-dot diagrams of H_2S, CO_2, and F_2 below.

$$H : \ddot{S} :$$
$$H$$

$$: \ddot{O} :: C :: \ddot{O} :$$

$$: \ddot{F} : \ddot{F} :$$

51 Which atom, when bonded as shown, has the same electron configuration as an atom of argon?   [1]

52 Explain, in terms of *structure* and/or *distribution of charge*, why CO_2 is a nonpolar molecule.   [1]

53 Explain, in terms of *electronegativity*, why a C=O bond in CO_2 is more polar than the F–F bond in F_2.   [1]

Base your answers to questions 54 and 55 on the heating curve below, which represents a substance starting as a solid below its melting point and being heated at a constant rate over a period of time.
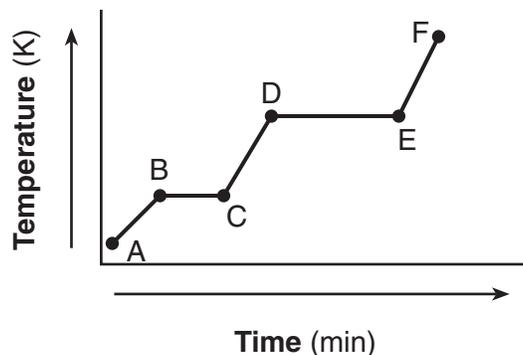
54 What is happening to the average kinetic energy of the particles during segment $\overline{BC}$?   [1]

55 How does this heating curve illustrate that the heat of vaporization is greater than the heat of fusion?   [1]

Base your answers to questions 56 through 58 on the potential energy diagram and the equation below.

$$2 \; C(s) + H_2(g) + 227.4 \; kJ \rightarrow C_2H_2(g)$$
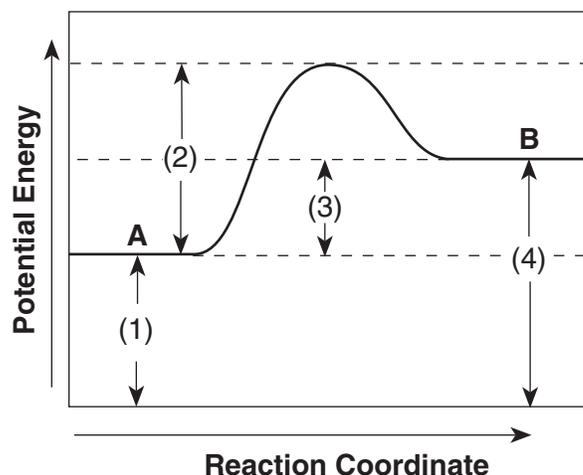
56 The letter *B* represents which chemical formula or formulas in the equation?   [1]

57 If 682.2 kilojoules are absorbed, how many moles of $C_2H_2(g)$ are produced?   [1]

58 Describe how the potential energy diagram will change if a catalyst is added.   [1]

Base your answers to questions 59 and 60 on the condensed structural formula below.

$$CH_3CH_2CHCH_2$$

59 In the space provided *in your answer booklet*, draw the structural formula for this compound.   [1]

60 The formula below represents a product formed when HCl reacts with $CH_3CH_2CHCH_2$.
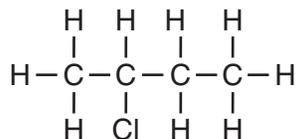
What is an IUPAC name for this product?   [1]

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61 Given the equation:

butanoic acid + 1-pentanol $\xrightarrow{\text{catalyst}}$ water + X

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

62 Identify the homologous series of hydrocarbons to which CH_3CHCH_2 belongs. [1]

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

In a titration experiment, a student uses a 1.4 M HBr(aq) solution and the indicator phenolphthalein to determine the concentration of a KOH(aq) solution. The data for trial 1 is recorded in the table below.

Trial 1

Buret Readings	HBr(aq)	KOH(aq)
Initial volume (mL)	7.50	11.00
Final volume (mL)	22.90	33.10
Volume used (mL)	15.40	22.10

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

64 Why is it better to use several trials of a titration rather than one trial to determine the molarity of a solution of an unknown concentration? [1]

65 In a second trial of this experiment, the molarity of KOH(aq) was determined to be 0.95 M. The actual molarity was 0.83 M. What is the percent error in the second trial? [1]

Part C

Answer all questions in this part.

Directions (66–84): 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 66 and 67 on the information below.

Naturally occurring elemental carbon is a mixture of isotopes. The percent composition of the two most abundant isotopes is listed below.

• 98.93% of the carbon atoms have a mass of 12.00 atomic mass units.
• 1.07% of the carbon atoms have a mass of 13.00 atomic mass units.

66 In the space provided *in your answer booklet*, show a correct numerical setup for calculating the average atomic mass of carbon.   [1]

67 Describe, in terms of *subatomic particles found in the nucleus*, one difference between the nuclei of carbon-12 atoms and the nuclei of carbon-13 atoms. The response must include both isotopes.   [1]

Base your answers to questions 68 and 69 on the information below.

A scientist in a chemistry laboratory determined the molecular formulas for two compounds containing nitrogen and oxygen to be NO_2 and N_2O_5.

68 Write an IUPAC name for the compound N_2O_5.   [1]

69 In the space provided *in your answer booklet*, show a correct numerical setup for calculating the percent composition by mass of oxygen in NO_2.   [1]

Base your answers to questions 70 through 72 on the information below.

In a laboratory experiment, 10.00 grams of an unknown solid is added to 100.0 milliliters of water and the temperature of the resulting solution is measured over several minutes, as recorded in the table below.

Data Table

Time (minutes)	Temperature (°C)
0	24.0
0.5	28.5
1.0	31.0
1.5	34.5
2.0	41.0
2.5	45.5
3.0	46.5

70 On the grid provided *in your answer booklet*, mark an appropriate scale on the axis labeled "Temperature (°C)." An appropriate scale is one that allows a trend to be seen. [1]

71 Plot the data from the data table. Circle and connect the points. [1]

Example:

72 Given the statement:

The unknown solid is either sodium hydroxide or lithium bromide, and both of these compounds dissolve in water exothermically.

a Explain how the experimental data support the statement. [1]

b State specific information from Reference Table *I* to support the statement. [1]

Base your answers to questions 73 through 76 on the information below.

Figure 1

50.0 g Cu(s) at 100.0°C
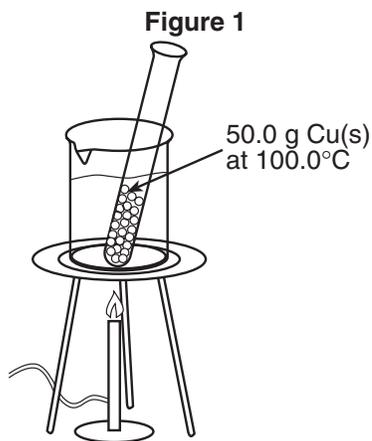
In a laboratory investigation, a 50.0-gram sample of copper is at 100.0°C in a boiling water bath.

Figure 2

100.0 g $H_2O(\ell)$ at 23.2°C
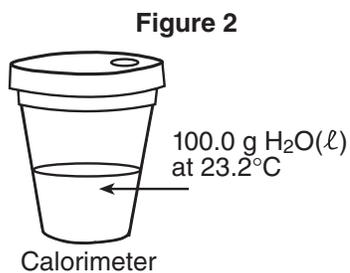
Calorimeter

A Styrofoam cup with a lid is used as a calorimeter. The cup contains 100.0 grams of distilled water at 23.2°C.

Figure 3

Calorimeter
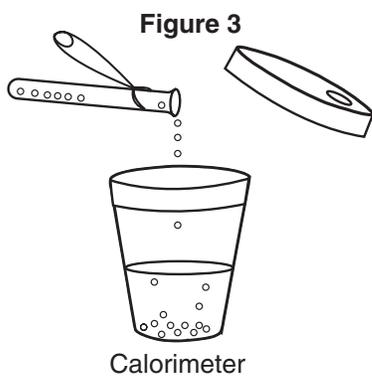
The hot copper is poured into the cup of water, and the cup is quickly covered with the lid.

Figure 4

Calorimeter

A thermometer is inserted through the lid. The copper and water are gently stirred in the cup. The temperature is checked periodically. The highest temperature noted is 26.3°C.

73 In terms of *energy flow,* explain why the temperature of the water in the calorimeter increases. [1]

74 Using the information given, complete the data table provided *in your answer booklet.* [1]

75 In the space provided *in your answer booklet*, show a correct numerical setup for calculating the number of joules of heat gained by the water. [1]

76 In this investigation, the change in heat of the copper is greater than the change in heat of the water. What error could account for this apparent violation of the Law of Conservation of Energy? Do *not* use human error as part of the answer. [1]

_____

Base your answers to questions 77 through 79 on the information below.

Two alcohols that are used in our everyday lives are rubbing alcohol and ethylene glycol. Rubbing alcohol is used as an antiseptic. Ethylene glycol is the main ingredient in antifreeze, which is used in automobile cooling systems.

77 Explain, in terms of *molecular polarity,* why rubbing alcohol, 2-propanol, is soluble in water. [1]

78 What is the gram-formula mass of ethylene glycol, $C_2H_4(OH)_2$? [1]

79 In the space provided *in your answer booklet,* show a correct numerical setup for calculating the total number of moles of ethylene glycol needed to prepare 2.50 liters of a 10.0 M solution. [1]

_____

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

The outer structure of the Statue of Liberty is made of copper metal. The framework is made of iron. Over time, a thin green layer (patina) forms on the copper surface.

80 When copper oxidized to form this patina layer, the copper atoms became copper(II) ions (Cu^{2+}). Write a balanced half-reaction for this oxidation of copper. [1]

81 Where the iron framework came in contact with the copper surface, a reaction occurred in which iron was oxidized. Using information from Reference Table *J*, explain why the iron was oxidized. [1]

_____

Base your answers to questions 82 through 84 on the information below, the *Reference Tables for Physical Setting/Chemistry*, and your knowledge of chemistry.

Radioactivity and radioactive isotopes have the potential for both benefiting and harming living organisms. One use of radioactive isotopes is in radiation therapy as a treatment for cancer. Cesium-137 is sometimes used in radiation therapy.

A sample of cesium-137 was left in an abandoned clinic in Brazil in 1987. Cesium-137 gives off a blue glow because of its radioactivity. The people who discovered the sample were attracted by the blue glow and had no idea of any danger. Hundreds of people were treated for overexposure to radiation, and four people died.

82 Using Reference Table *N*, complete the equation provided *in your answer booklet* for the radioactive decay of $^{137}_{55}$Cs. Include *both* atomic number and mass number for *each* particle. [1]

83 If 12.5 grams of the original sample of cesium-137 remained after 90.69 years, what was the mass of the original sample? [1]

84 Suppose a 40-gram sample of iodine-131 and a 40-gram sample of cesium-137 were both abandoned in the clinic in 1987. Explain why the sample of iodine-131 would *not* pose as great a radiation risk to people today as the sample of cesium-137 would. [1]

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
CHEMISTRY

Thursday, January 27, 2005 — 9:15 a.m. to 12:15 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			Part B–1	
1	11	21	31	41 . . . .
2	12	22	32	42 . . . .
3	13	23	33	43 . . . .
4	14	24	34	44 . . . .
5	15	25	35	45 . . . .
6	16	26	36	46 . . . .
7	17	27	37	47 . . . .
8	18	28	38	48 . . . .
9	19	29	39	49 . . . .
10	20	30	40	50 . . . .

Part A Score

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

PHYSICAL SETTING
CHEMISTRY

Thursday, January 27, 2005 — 9:15 a.m. to 12:15 p.m., only

ANSWER 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 . . . .

Student . . . . Sex: ☐ Male ☐ Female

Teacher . . . .

School . . . . Grade . . . .

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

Part B–2

For Raters Only

51 _____   51 ☐

52 _____   52 ☐

_____

_____

53 _____   53 ☐

_____

54 _____

54

55 _____

_____

55

56 _____

56

57 _____ **mol**

57

58 _____

_____

58

59

59

60 _____

60

61 _____

61

62 _____

62

63

64 _____

_____

_____

65 _____ %

Part C

66

67 _____

_____

_____

68 _____

69

70 and **71**

**Change in Temperature
During the Dissolving of a Solid**

Temperature (°C)

0   0.5   1.0   1.5   2.0   2.5   3.0   3.5

Time (min)

72 a _____

_____

_____

b _____

_____

_____
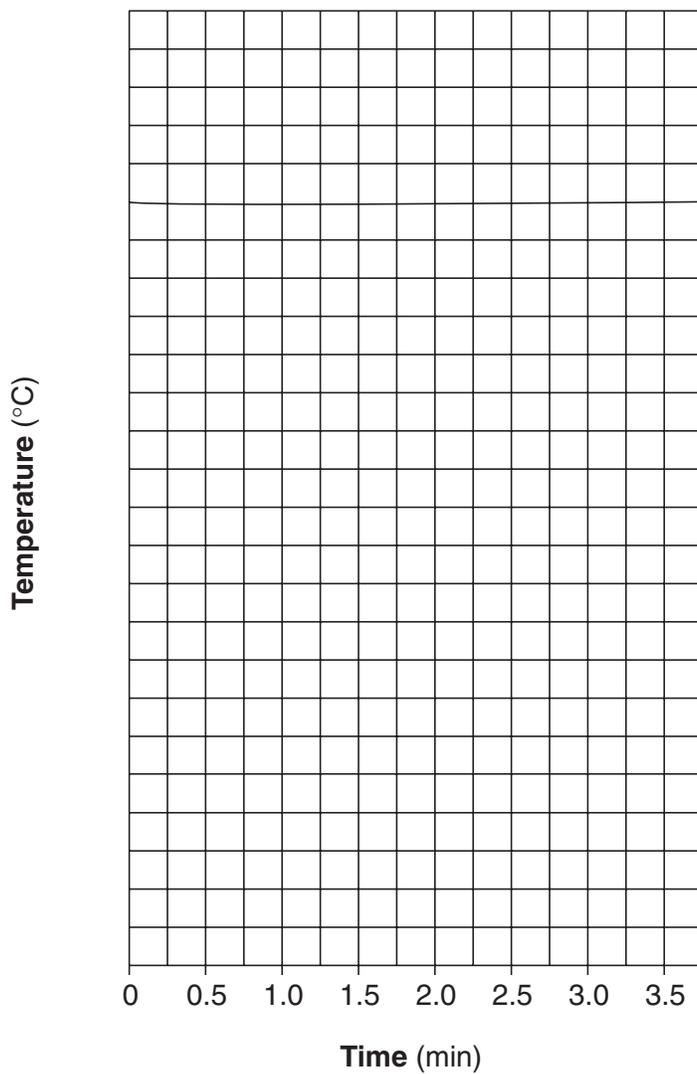
73 _____

_____

_____

74 <div align="center">**Data Table**</div>

Quantity Measured	**Data** (units are given)
Mass of copper	g
Temperature of hot copper	°C
Mass of H_2O in calorimeter	g
Initial temperature of H_2O in calorimeter	°C
Final temperature of H_2O and copper	°C

75

76 _____

_____

77 _____

_____

_____

78 _____ **g/mol**

79

80 _____

81 _____

_____

_____

82 $^{137}_{55}$Cs → _____ **+** _____

83 _____ **g**

84 _____

_____

_____

FOR TEACHERS ONLY

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

PS–CH   PHYSICAL SETTING/CHEMISTRY

Thursday, January 27, 2005 — 9:15 a.m. to 12:15 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. Visit the site http://www.emsc.nysed.gov/osa/ and select the link "Latest Information" for any recently posted information regarding this examination. This site should be checked before the rating process for this examination begins and at least one more time before the final scores for the examination are recorded.

Part A and Part B–1
Allow 1 credit for each correct response.

Part A			Part B–1	
1 . . . . . . **1**	11 . . . . . . **1**	21 . . . . . **4**	31 . . . . . **2**	41 . . . . . **3** . . . . . .
2 . . . . . . **3**	12 . . . . . . **4**	22 . . . . . **4**	32 . . . . **3**	42 . . . . . **3** . . . . . .
3 . . . . . . **1**	13 . . . . . . **4**	23 . . . . . . **1**	33 . . . . . **1**	43 . . . . . **1** . . . . . .
4 . . . . . . **1**	14 . . . . . . **2**	24 . . . . . . **1**	34 . . . . . **1**	44 . . . . . **4** . . . . . .
5 . . . . . . **2**	15 . . . . . . **2**	25 . . . . . . **1**	35 . . . . **4**	45 . . . . . **3** . . . . . .
6 . . . . . . **2**	16 . . . . . . **4**	26 . . . . . **4**	36 . . . . . **1**	46 . . . . . **4** . . . . . .
7 . . . . . . **3**	17 . . . . . . **2**	27 . . . . . . **1**	37 . . . . . **1**	47 . . . . . **1** . . . . . .
8 . . . . . . **4**	18 . . . . . . **4**	28 . . . . . . **1**	38 . . . . **3**	48 . . . . . **4** . . . . . .
9 . . . . . . **2**	19 . . . . . . **4**	29 . . . . . **3**	39 . . . . . **1**	49 . . . . **2** . . . . . .
10 . . . . . . **4**	20 . . . . . . **3**	30 . . . . . . **1**	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 Administering and 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 27, 2005. 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.

[OVER]

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 for a correct response. Acceptable responses include, but are not limited to, these examples:

        S

        sulfur

52   [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

        CO_2 is symmetrical.

        CO_2 has an even distribution of charge.

        CO_2 is linear with O at each end.

53   [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

        The electronegativity difference in a carbon-oxygen bond is greater than the electronegativity difference in a fluorine-fluorine bond.

        The EN difference for C and O is 0.9 and the EN difference for F and F is 0.

54   [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

        remains the same

        It does not change.

55   [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

        $\overline{DE}$ is longer than $\overline{BC}$.

        more time to boil than to melt

56 [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

C_2H_2

$C_2H_2(g)$
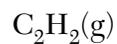
57 [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:
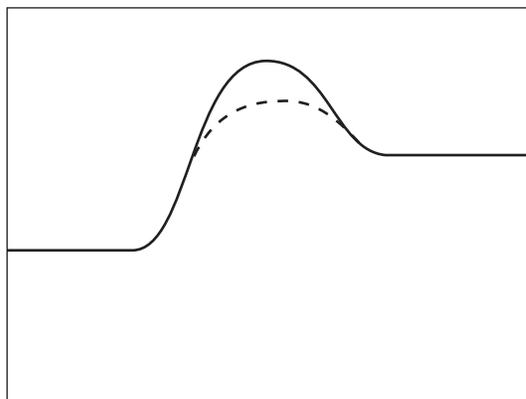
3

three

58 [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:
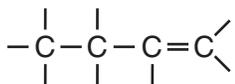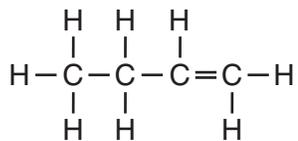
Arrow 2 gets shorter.

The activation energy would be lower.

The peak of the curve is lower.

59 [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

60   [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, this example:

2-chlorobutane

61   [1]   Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

ester

esters

62   [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

alkene

alkenes

C_nH_{2n}

olefins

63   [1] Allow 1 credit for a correct numerical setup. Acceptable responses include, but are not limited to, these examples:

$$\frac{(1.4)(15.40)}{22.10}$$

$(1.4\text{ M})(15.40\text{ mL}) = M_B(22.10\text{ mL})$

$(1.4)(15.40) = X(22.10)$

64   [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

Multiple trials improve precision of results.

to see if results are repeatable

more trials, less error

65   [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

14.46

14.5

14

[6]

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 for a correct numerical setup. Acceptable responses include, but are not limited to, these examples:

$(12.00)(0.9893) + (13.00)(0.0107)$

$\dfrac{(12.00)(98.93) + (13.00)(1.07)}{100}$

67 [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

Carbon-12 has six neutrons and carbon-13 has seven neutrons.

Carbon-13 has one more neutron than carbon-12.

C-12 has 6n; C-13 has 7n.

68 [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:
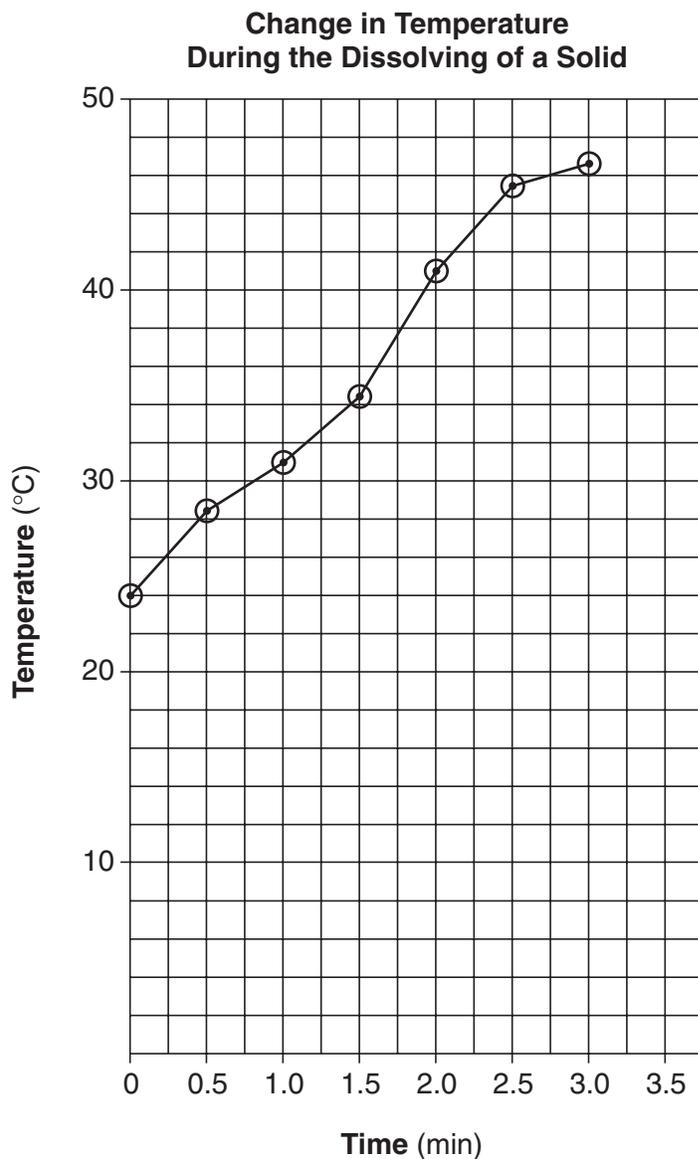
dinitrogen pentoxide

nitrogen(V) oxide

69 [1] Allow 1 credit for a correct numerical setup. Acceptable responses include, but are not limited to, this example:

$\frac{32}{46} \times 100$

70 and **71**   An example of an acceptable response is shown below.

**Change in Temperature
During the Dissolving of a Solid**

70   [1] Allow 1 credit for marking an appropriate scale on the axis labeled "Temperature (°C)." An appropriate scale is one that allows a trend to be seen.

71   [1] Allow 1 credit for plotting six or seven points correctly (±0.3 grid space). Plotted points do *not* need to be circled or connected.

72   [2] ***a*** Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

   The data show an increase in temperature, which indicates an exothermic reaction.

   solution temperature goes up, exothermic

   b Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

   Table I shows that ΔH is negative for NaOH and LiBr, which indicates an exothermic reaction.

   ΔH is negative for both.

   NaOH: ΔH = −44.51 kJ/mol

73   [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

   Heat is transferred from the copper to the water.

   Heat flows from the hotter object to the cooler object.

   copper heat $\rightarrow$ water

74 [1] Allow 1 credit if all values are correctly placed in the data table as shown below.

Data Table

Quantity Measured	Data (units are given)
Mass of copper	**50.0** or **50** g
Temperature of hot copper	**100.0** or **100**°C
Mass of H_2O in calorimeter	**100.0** or **100** g
Initial temperature of H_2O in calorimeter	**23.2**°C
Final temperature of H_2O and copper	**26.3**°C

75 [1] Allow 1 credit for a correct numerical setup. Acceptable responses include, but are not limited to, these examples:

$q = (100.0 \text{ g}) (4.18 \text{ J/g} \bullet °C) (3.1°C)$

$(100)(4.18) (26.3\text{-}23.2)$

or

Allow 1 credit for a setup consistent with the student's data in question 74.

76 [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

heat lost to surroundings

heat absorbed by the thermometer

heat absorbed by the calorimeter

77 [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

Both 2-propanol and water are polar.

2-propanol has an uneven distribution of charge.

—OH functional group is polar.

Like dissolves like.

78 [1] Allow 1 credit for a correct response. Significant figures do *not* need to be shown. Acceptable responses include, but are not limited to, these examples:
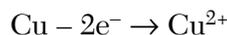
62

62.06864

62.1

79 [1] Allow 1 credit for a correct numerical setup. Acceptable responses include, but are not limited to, these examples:

$$10.0 \text{ M} = \frac{x \text{ mol}}{2.50 \text{ L}}$$

(2.5) (10)

80 [1] Allow 1 credit for a correct response. The half-reaction must include electrons. Acceptable responses include, but are not limited to, these examples:

$Cu \rightarrow Cu^{2+} + 2e^-$

$Cu - 2e^- \rightarrow Cu^{2+}$

81 [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

Iron is a more active metal.

Fe above Cu

Iron metal loses electrons more easily than copper metal.

copper less active

82 [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

$^{137}_{55}Cs \rightarrow {}^{0}_{-1}e + {}^{137}_{56}Ba$

$^{137}_{55}Cs \rightarrow {}^{0}_{-1}\beta + {}^{137}_{56}Ba$

83 [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:

one hundred

100

[11]   [OVER]

84 [1] Allow 1 credit for a correct response. Acceptable responses include, but are not limited to, these examples:
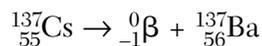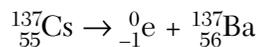
Iodine-131 would decay faster.

Iodine has a much shorter half-life.

Most of the I-131 would be gone.

The *Chart for Determining the Final Examination Score for the January 2005 Regents Examination in Physical Setting/Chemistry* will be posted on the Department's web site http://www.emsc.nysed.gov/osa/ on Thursday, January 27, 2005. 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.

Map to Core Curriculum

January 2005 Physical Setting/ Chemistry			
Question Numbers			
Key Ideas	Part A	Part B	Part C
Standard 1			
Math Key Idea 1		63,65	66,69,70,71,74, 75,79
Math Key Idea 2			
Math Key Idea 3		57,63	66,68,69
Sci. Inq. Key Idea 1		52	77,81,84
Sci. Inq. Key Idea 2			
Sci. Inq. Key Idea 3		46,48,64	72a,72b,76,81
Eng. Des. Key Idea 1			
Standard 2			
Key Idea 1		61	
Key Idea 2			
Standard 6			
Key Idea 1			73
Key Idea 2			
Key Idea 3			
Key Idea 4			
Key Idea 5			
Standard 7			
Key Idea 1			
Key Idea 2			
Standard 4 Process Skills			
Key Idea 3		31,32,33,34,35, 36,37,39,40,41, 42,43,44,45,47, 59,60,62	66,67,70,78,79, 80,82
Key Idea 4		49,50,54,55,56, 58	75,83,84
Key Idea 5		38,51,53	
Standard 4			
Key Idea 3	1,2,3,4,5,6,8,9, 10,15,19,21,23, 24,25,26,27,29	31,32,33,34,35, 37,39,40,41,42, 43,44,45,46,47, 48,57,58,59,60, 61,62,63,64,65	66,67,68,69,70,71, 77,78,79, 80,81
Key Idea 4	16,17,18	49,50,54,55,56	72a,72b,73,74,75, 76,82,83,84
Key Idea 5	7,11,12,13,14, 20,22,28,30	36,38,51,52,53	
Reference Tables			
2002 Edition	2,4,5,6,8,9,11, 12,14,20,22,23, 25,26,28,29	32,33,36,38,41, 44,46,47,48,49, 50,51,53,59,60, 61,62,63,65	68,69,72b,75,77, 78,79,80,81,82, 83,84

University of the State of New York
State Education Department

Regents Examination in Physical Setting / Chemistry
January 2005

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