The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
CHEMISTRY

Thursday, August 16, 2018 — 8:30 to 11:30 a.m., only

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

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 *2011 Edition Reference Tables for Physical Setting/Chemistry*. You are to answer *all* questions in all parts of this examination according to the directions provided in this examination booklet.

A separate answer sheet for Part A and Part B–1 has been provided to you. Follow the instructions from the proctor for completing the student information on your answer sheet. Record your answers to the Part A and Part B–1 multiple-choice questions on this separate answer sheet. Record your answers for the questions in Part B–2 and Part C in your separate answer booklet. Be sure to fill in the heading on the front of your answer booklet.

All answers in your answer booklet 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 or in your answer booklet as directed.

When you have completed the examination, you must sign the statement printed on 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 *2011 Edition 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, record on your 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 *2011 Edition Reference Tables for Physical Setting/Chemistry*.

1 According to the wave-mechanical model, an orbital is defined as the most probable location of

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

2 The part of an atom that has an overall positive charge is called

(1) an electron
(2) the nucleus
(3) the first shell
(4) the valence shell

3 Which subatomic particles each have a mass of approximately 1 u?

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

4 The discovery of the electron as a subatomic particle was a result of

(1) collision theory
(2) kinetic molecular theory
(3) the gold-foil experiment
(4) experiments with cathode ray tubes

5 The elements on the Periodic Table of the Elements are arranged in order of increasing

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

6 Which element is classified as a metalloid?

(1) Te
(2) S
(3) Hg
(4) I

7 At STP, $O_2(g)$ and $O_3(g)$ are two forms of the same element that have

(1) the same molecular structure and the same properties
(2) the same molecular structure and different properties
(3) different molecular structures and the same properties
(4) different molecular structures and different properties

8 Which substance can be broken down by chemical means?

(1) ammonia
(2) aluminum
(3) antimony
(4) argon

9 Which statement describes $H_2O(\ell)$ and $H_2O_2(\ell)$?

(1) Both are compounds that have the same properties.
(2) Both are compounds that have different properties.
(3) Both are mixtures that have the same properties.
(4) Both are mixtures that have different properties.

10 Which two terms represent major categories of compounds?

(1) ionic and nuclear
(2) ionic and molecular
(3) empirical and nuclear
(4) empirical and molecular

11 Which formula represents an asymmetrical molecule?

(1) CH_4
(2) CO_2
(3) N_2
(4) NH_3

12 Which statement describes the energy changes that occur as bonds are broken and formed during a chemical reaction?

(1) Energy is absorbed when bonds are both broken and formed.
(2) Energy is released when bonds are both broken and formed.
(3) Energy is absorbed when bonds are broken, and energy is released when bonds are formed.
(4) Energy is released when bonds are broken, and energy is absorbed when bonds are formed.

13 A solid sample of copper is an excellent conductor of electric current. Which type of chemical bonds are in the sample?

(1) ionic bonds
(2) metallic bonds
(3) nonpolar covalent bonds
(4) polar covalent bonds

14 Which list includes three forms of energy?

(1) thermal, nuclear, electronegativity
(2) thermal, chemical, electromagnetic
(3) temperature, nuclear, electromagnetic
(4) temperature, chemical, electronegativity

15 Based on Table *S*, an atom of which element has the strongest attraction for electrons in a chemical bond?

(1) chlorine
(2) nitrogen
(3) oxygen
(4) selenium

16 At which temperature and pressure would a sample of helium behave most like an ideal gas?

(1) 75 K and 500. kPa
(2) 150. K and 500. kPa
(3) 300. K and 50. kPa
(4) 600. K and 50. kPa

17 A cube of iron at 20.°C is placed in contact with a cube of copper at 60.°C. Which statement describes the initial flow of heat between the cubes?

(1) Heat flows from the copper cube to the iron cube.
(2) Heat flows from the iron cube to the copper cube.
(3) Heat flows in both directions between the cubes.
(4) Heat does not flow between the cubes.

18 Which sample at STP has the same number of atoms as 18 liters of Ne(g) at STP?

(1) 18 moles of Ar(g)
(2) 18 liters of Ar(g)
(3) 18 grams of $H_2O(g)$
(4) 18 milliliters of $H_2O(g)$

19 Compared to H_2S, the higher boiling point of H_2O is due to the

(1) greater molecular size of water
(2) stronger hydrogen bonding in water
(3) higher molarity of water
(4) larger gram-formula mass of water

20 In terms of entropy and energy, systems in nature tend to undergo changes toward

(1) lower entropy and lower energy
(2) lower entropy and higher energy
(3) higher entropy and lower energy
(4) higher entropy and higher energy

21 Amines, amides, and amino acids are categories of

(1) isomers
(2) isotopes
(3) organic compounds
(4) inorganic compounds

22 A molecule of which compound has a multiple covalent bond?

(1) CH_4
(2) C_2H_4
(3) C_3H_8
(4) C_4H_{10}

23 Which type of reaction produces soap?

(1) polymerization
(2) combustion
(3) fermentation
(4) saponification

24 For a reaction system at equilibrium, LeChatelier's principle can be used to predict the

(1) activation energy for the system
(2) type of bonds in the reactants
(3) effect of a stress on the system
(4) polarity of the product molecules

25 Which value changes when a Cu atom becomes a Cu^{2+} ion?

(1) mass number
(2) oxidation number
(3) number of protons
(4) number of neutrons

26 Which reaction occurs at the anode in an electrochemical cell?

(1) oxidation
(2) reduction
(3) combustion
(4) substitution

27 What evidence indicates that the nuclei of strontium-90 atoms are unstable?

(1) Strontium-90 electrons are in the excited state.
(2) Strontium-90 electrons are in the ground state.
(3) Strontium-90 atoms spontaneously absorb beta particles.
(4) Strontium-90 atoms spontaneously emit beta particles.

28 Which nuclear emission is listed with its notation?

(1) gamma radiation, ${}^{0}_{0}\gamma$
(2) proton, ${}^{4}_{2}He$
(3) neutron, ${}^{0}_{-1}\beta$
(4) alpha particle, ${}^{1}_{1}H$

29 The energy released by a nuclear fusion reaction is produced when

(1) energy is converted to mass
(2) mass is converted to energy
(3) heat is converted to temperature
(4) temperature is converted to heat

30 Dating once-living organisms is an example of a beneficial use of

(1) redox reactions
(2) organic isomers
(3) radioactive isotopes
(4) neutralization reactions

Part B–1

Answer all questions in this part.

Directions (31–50): For *each* statement or question, record on your 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 *2011 Edition Reference Tables for Physical Setting/Chemistry*.

31 What is the net charge of an ion that has 11 protons, 10 electrons, and 12 neutrons?

(1) 1+ (3) 1−
(2) 2+ (4) 2−

32 Which electron configuration represents the electrons of an atom in an excited state?

(1) 2-5 (3) 2-5-1
(2) 2-8-5 (4) 2-6

33 Which element is a liquid at 1000. K?

(1) Ag (3) Ca
(2) Al (4) Ni

34 Which formula represents ammonium nitrate?

(1) NH_4NO_3 (3) $NH_4(NO_3)_2$
(2) NH_4NO_2 (4) $NH_4(NO_2)_2$

35 The empirical formula for butene is

(1) CH_2 (3) C_4H_6
(2) C_2H_4 (4) C_4H_8

36 Which equation represents a conservation of charge?

(1) $2Fe^{3+} + Al \rightarrow 2Fe^{2+} + Al^{3+}$
(2) $2Fe^{3+} + 2Al \rightarrow 3Fe^{2+} + 2Al^{3+}$
(3) $3Fe^{3+} + 2Al \rightarrow 2Fe^{2+} + 2Al^{3+}$
(4) $3Fe^{3+} + Al \rightarrow 3Fe^{2+} + Al^{3+}$

37 Given the balanced equation representing a reaction:

$$2H_2 + O_2 \rightarrow 2H_2O + \text{energy}$$

Which type of reaction is represented by this equation?

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

38 When a Mg^{2+} ion becomes a Mg atom, the radius increases because the Mg^{2+} ion

(1) gains 2 protons (3) loses 2 protons
(2) gains 2 electrons (4) loses 2 electrons

39 The *least* polar bond is found in a molecule of

(1) HI (3) HCl
(2) HF (4) HBr

40 A solution is prepared using 0.125 g of glucose, $C_6H_{12}O_6$, in enough water to make 250. g of total solution. The concentration of this solution, expressed in parts per million, is

(1) 5.00×10^1 ppm (3) 5.00×10^3 ppm
(2) 5.00×10^2 ppm (4) 5.00×10^4 ppm

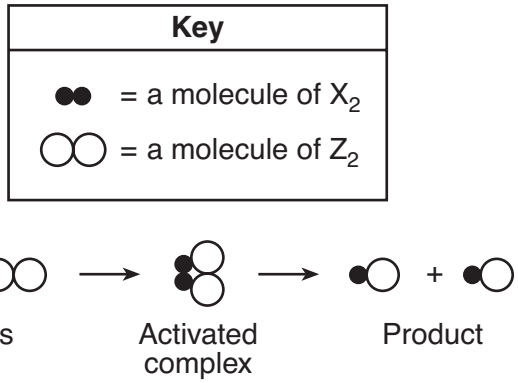
41 What is the amount of heat, in joules, required to increase the temperature of a 49.5-gram sample of water from 22°C to 66°C?

(1) 2.2×10^3 J (3) 9.1×10^3 J
(2) 4.6×10^3 J (4) 1.4×10^4 J

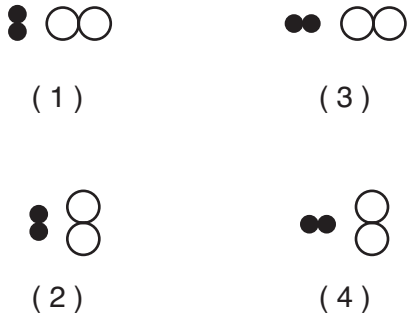
42 A sample of a gas in a rigid cylinder with a movable piston has a volume of 11.2 liters at STP. What is the volume of this gas at 202.6 kPa and 300. K?

(1) 5.10 L
(2) 6.15 L
(3) 22.4 L
(4) 24.6 L

43 The equation below represents a reaction between two molecules, X_2 and Z_2. These molecules form an "activated complex," which then forms molecules of the product.



Which diagram represents the most likely orientation of X_2 and Z_2 when the molecules collide with proper energy, producing an activated complex?



44 What is the chemical name for the compound $CH_3CH_2CH_2CH_3$?

(1) butane
(2) butene
(3) decane
(4) decene

45 In a laboratory activity, the density of a sample of vanadium is determined to be 6.9 g/cm^3 at room temperature. What is the percent error for the determined value?

(1) 0.15%
(2) 0.87%
(3) 13%
(4) 15%

46 Given the equation representing a reaction:

$$Cd + NiO_2 + 2H_2O \rightarrow Cd(OH)_2 + Ni(OH)_2$$

Which half-reaction equation represents the oxidation in the reaction?

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

47 Which metal reacts spontaneously with $NiCl_2(aq)$?

(1) Au(s)
(2) Cu(s)
(3) Sn(s)
(4) Zn(s)

48 Which solution is the best conductor of an electric current?

(1) 0.001 mole of NaCl dissolved in 1000. mL of water
(2) 0.005 mole of NaCl dissolved in 1000. mL of water
(3) 0.1 mole of NaCl dissolved in 1000. mL of water
(4) 0.05 mole of NaCl dissolved in 1000. mL of water

49 Compared to a 1.0-liter aqueous solution with a pH of 7.0, a 1.0-liter aqueous solution with a pH of 5.0 contains

(1) 10 times more hydronium ions
(2) 100 times more hydronium ions
(3) 10 times more hydroxide ions
(4) 100 times more hydroxide ions

50 Given the equation representing a reaction:

$$^{208}_{82}Pb + ^{70}_{30}Zn \rightarrow ^{277}_{112}Cn + ^{1}_{0}n$$

Which type of reaction is represented by this equation?

(1) neutralization
(2) polymerization
(3) substitution
(4) transmutation

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 *2011 Edition Reference Tables for Physical Setting/Chemistry.*

51 Show a numerical setup for calculating the percent composition by mass of oxygen in Al_2O_3 (gram-formula mass = 102 g/mol). [1]

52 Identify a laboratory process that can be used to separate a liquid mixture of methanol and water, based on the differences in their boiling points. [1]

Base your answers to questions 53 through 55 on the information below and on your knowledge of chemistry.

The table below shows data for three isotopes of the same element.

Data for Three Isotopes of an Element

Isotopes	Number of Protons	Number of Neutrons	Atomic Mass (u)	Natural Abundance (%)
Atom D	12	12	23.99	78.99
Atom E	12	13	24.99	10.00
Atom G	12	14	25.98	11.01

53 Explain, in terms of subatomic particles, why these three isotopes represent the same element. [1]

54 State the number of valence electrons in an atom of isotope *D* in the ground state. [1]

55 Compare the energy of an electron in the first electron shell to the energy of an electron in the second electron shell in an atom of isotope *E*. [1]

Base your answers to questions 56 through 58 on the information below and on your knowledge of chemistry.

The elements in Group 2 on the Periodic Table can be compared in terms of first ionization energy, electronegativity, and other general properties.

56 Describe the general trend in electronegativity as the metals in Group 2 on the Periodic Table are considered in order of increasing atomic number. [1]

57 Explain, in terms of electron configuration, why the elements in Group 2 have similar chemical properties. [1]

58 Explain, in terms of atomic structure, why barium has a lower first ionization energy than magnesium. [1]

Base your answers to questions 59 through 61 on the information below and on your knowledge of chemistry.

A saturated solution of sulfur dioxide is prepared by dissolving $SO_2(g)$ in 100. g of water at 10.°C and standard pressure.

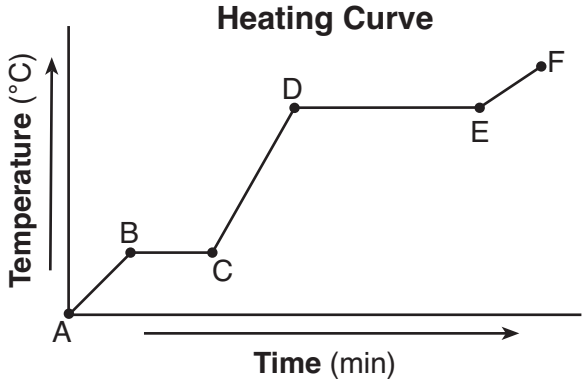
59 Determine the mass of SO_2 in this solution. [1]

60 Based on Table *G*, state the general relationship between solubility and temperature of an aqueous SO_2 solution at standard pressure. [1]

61 Describe what happens to the solubility of $SO_2(g)$ when the pressure is increased at constant temperature. [1]

Base your answers to questions 62 through 65 on the information below and on your knowledge of chemistry.

Starting as a solid, a sample of a molecular substance is heated, until the entire sample of the substance is a gas. The graph below represents the relationship between the temperature of the sample and the elapsed time.



62 Using the key *in your answer booklet*, draw a particle diagram to represent the sample during interval *AB*. Your response must include *at least six* molecules. [1]

63 Compare the average kinetic energy of the molecules of the sample during interval *BC* to the average kinetic energy of the molecules of the sample during interval *DE*. [1]

64 On the graph *in your answer booklet*, mark an **X** on the axis labeled "Temperature (°C)" to indicate the boiling point of the substance. [1]

65 State evidence that indicates the sample undergoes only physical changes during this heating. [1]

Part C

Answer all questions in this part.

Directions (66–85): Record your answers in the spaces provided in your answer booklet. Some questions may require the use of the *2011 Edition Reference Tables for Physical Setting/Chemistry*.

Base your anwers to questions 66 through 68 on the information below and on your knowledge of chemistry.

"Water gas," a mixture of hydrogen and carbon monoxide, is an industrial fuel and source of commercial hydrogen. Water gas is produced by passing steam over hot carbon obtained from coal. The equation below represents this system at equilibrium:

$$C(s) + H_2O(g) + \text{heat} \rightleftharpoons CO(g) + H_2(g)$$

66 State, in terms of the rates of the forward and reverse reactions, what occurs when dynamic equilibrium is reached in this system. [1]

67 In the space *in your answer booklet*, draw a Lewis electron-dot diagram for a molecule of H_2O. [1]

68 Explain, in terms of collisions, why increasing the surface area of the hot carbon increases the rate of the forward reaction. [1]

Base your answers to questions 69 through 71 on the information below and on your knowledge of chemistry.

In a laboratory activity, each of four different masses of $KNO_3(s)$ is placed in a separate test tube that contains 10.0 grams of H_2O at 25°C.

When each sample is first placed in the water, the temperature of the mixture decreases. The mixture in each test tube is then stirred while it is heated in a hot water bath until all of the $KNO_3(s)$ is dissolved. The contents of each test tube are then cooled to the temperature at which KNO_3 crystals first reappear. The procedure is repeated until the recrystallization temperatures for each mixture are consistent, as shown in the table below.

Data Table for the Laboratory Activity

Mixture	Mass of KNO_3 (g)	Mass of H_2O (g)	Temperature of Recrystallization (°C)
1	4.0	10.0	24
2	5.0	10.0	32
3	7.5	10.0	45
4	10.0	10.0	58

69 Based on Table *I*, explain why there is a *decrease* in temperature when the $KNO_3(s)$ was first dissolved in the water. [1]

70 Determine the percent by mass concentration of KNO_3 in mixture 2 after heating. [1]

71 Compare the freezing point of mixture 4 at 1.0 atm to the freezing point of water at 1.0 atm. [1]

Base your answers to questions 72 through 74 on the information below and on your knowledge of chemistry.

The balanced equation below represents the reaction between carbon monoxide and oxygen to produce carbon dioxide.

$$2CO(g) + O_2(g) \rightarrow 2CO_2(g) + \text{energy}$$

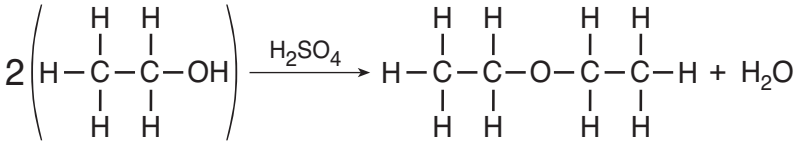
72 On the potential energy diagram *in your answer booklet*, draw a double-headed arrow (↕) to indicate the interval that represents the heat of reaction. [1]

73 Determine the number of moles of $O_2(g)$ needed to completely react with 8.0 moles of $CO(g)$. [1]

74 On the potential energy diagram *in your answer booklet*, draw a dashed line to show how the potential energy diagram changes when the reaction is catalyzed. [1]

Base your answers to questions 75 through 77 on the information below and on your knowledge of chemistry.

The equation below represents an industrial preparation of diethyl ether.



Compound A **Compound B**

75 Write the name of the class of organic compounds to which compound *A* belongs. [1]

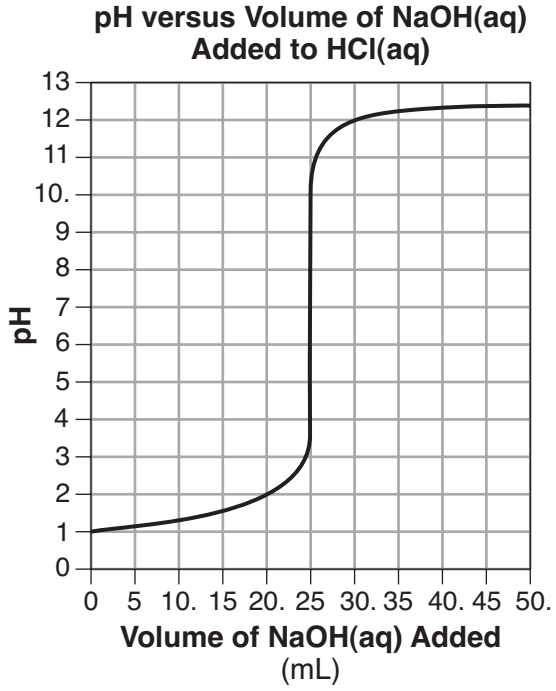
76 Identify the element in compound *B* that makes it an organic compound. [1]

77 Explain, in terms of elements, why compound *B* is *not* a hydrocarbon. [1]

Base your answers to questions 78 through 81 on the information below and on your knowledge of chemistry.

A student is to determine the concentration of an NaOH(aq) solution by performing two different titrations. In a first titration, the student titrates 25.0 mL of 0.100 M H_2SO_4(aq) with NaOH(aq) of unknown concentration.

In a second titration, the student titrates 25.0 mL of 0.100 M HCl(aq) with a sample of the NaOH(aq). During this second titration, the volume of the NaOH(aq) added and the corresponding pH value of the reaction mixture is measured. The graph below represents the relationship between pH and the volume of the NaOH(aq) added for this second titration.



78 Identify the positive ion present in the H_2SO_4(aq) solution before the titration. [1]

79 Complete the equation *in your answer booklet* for the neutralization that occurs in the first titration by writing a formula of the missing product. [1]

80 Based on the graph, determine the volume of NaOH(aq) used to exactly neutralize the HCl(aq). [1]

81 State the color of phenolphthalein indicator if it were added after the HCl(aq) was titrated with 50. mL of NaOH(aq). [1]

Base your answers to questions 82 through 85 on the information below and on your knowledge of chemistry.

When uranium-235 nuclei are bombarded with neutrons, many different combinations of smaller nuclei can be produced. The production of neodymium-150 and germanium-81 in one of these reactions is represented by the equation below.

$$^{1}_{0}\text{n} + {}^{235}_{92}\text{U} \rightarrow {}^{150}_{60}\text{Nd} + {}^{81}_{32}\text{Ge} + 5\,{}^{1}_{0}\text{n}$$

Germanium-81 and uranium-235 have different decay modes. Ge-81 emits beta particles and has a half-life of 7.6 seconds.

82 Explain, in terms of nuclides, why the reaction represented by the nuclear equation is a fission reaction. [1]

83 State the number of protons and number of neutrons in a neodymium-150 atom. [1]

84 Complete the equation *in your answer booklet* for the decay of Ge-81 by writing a notation for the missing nuclide. [1]

85 Determine the time required for a 16.00-gram sample of Ge-81 to decay until only 1.00 gram of the sample remains unchanged. [1]

Printed on Recycled Paper

P.S./CHEMISTRY

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
CHEMISTRY

Thursday, August 16, 2018 — 8:30 to 11:30 a.m., only

ANSWER BOOKLET

Student . . . . . .

Teacher . . . . . .

School . . . . . Grade . . . . .

Record your answers for Part B–2 and Part C in this booklet.

Part B–2

51

52 _____

53

54

55

56

57

58

59 _____ **g**

60 _____

_____

_____

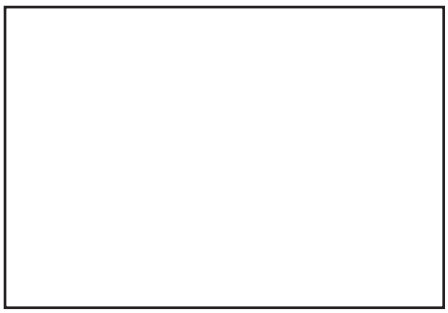
61 _____

_____

_____

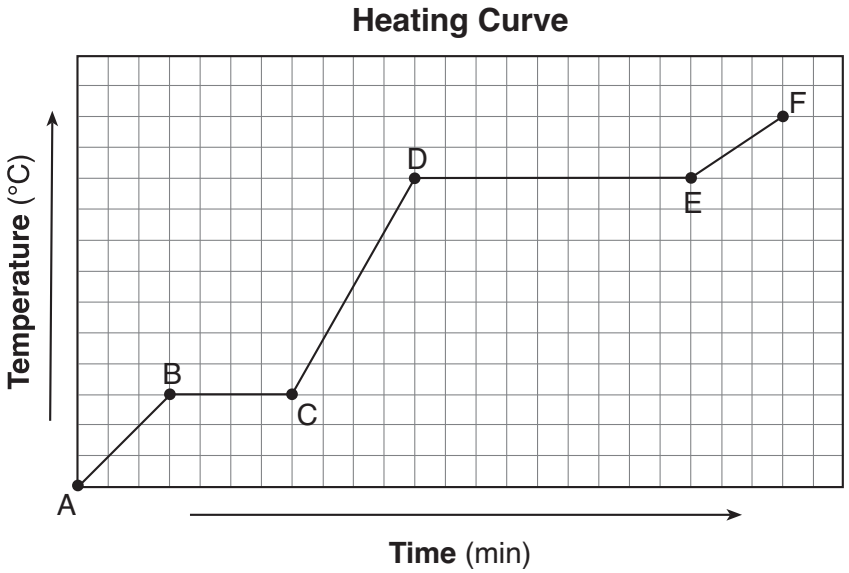
62

Key
◯ = a molecule of the substance



63

64



65

Part C

66

67

68

69 _____

_____

_____

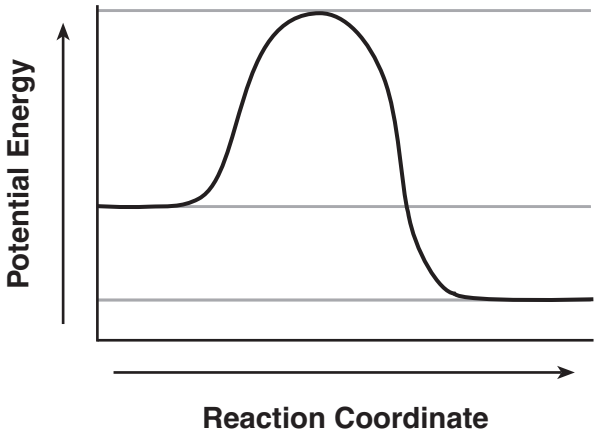
70 _____ **%**

71 _____

_____

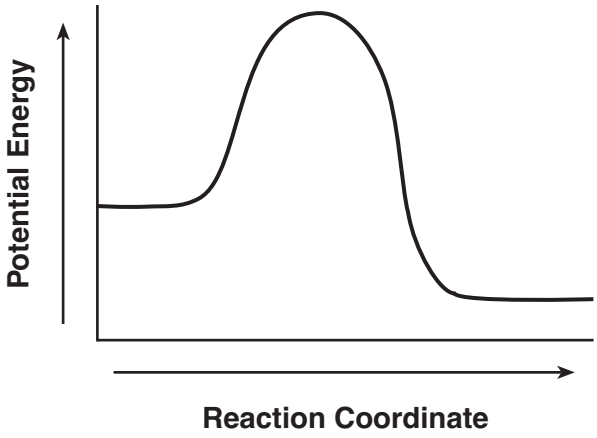
_____

72


Potential Energy
Reaction Coordinate

73 _____ **mol**

74


Potential Energy
Reaction Coordinate

75 _____

76 _____

77 _____

_____

_____

78 _____

79 $2NaOH(aq) + H_2SO_4(aq) \rightarrow 2H_2O(\ell) +$ _____ (aq)

80 _____ **mL**

81 _____

82 _____

_____

_____

83 Protons: _____

Neutrons: _____

84 $^{81}_{32}Ge \rightarrow {}^{0}_{-1}e +$ _____

85 _____ **s**

P.S./CHEMISTRY

FOR TEACHERS ONLY

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

P.S.–CH PHYSICAL SETTING/CHEMISTRY

Thursday, August 16, 2018 — 8:30 to 11:30 a.m., only

SCORING KEY AND RATING GUIDE

Directions to the Teacher:

Refer to the directions on page 2 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 at: http://www.p12.nysed.gov/assessment/ and select the link "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

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

Part B–1

31 . . . . . **1**	36 . . . . . **4**	41 . . . . . **3**	46 . . . . . **3** . . . . .
32 . . . . . **3**	37 . . . . . **4**	42 . . . . . **2**	47 . . . . . **4** . . . . .
33 . . . . . **2**	38 . . . . . **2**	43 . . . . . **2**	48 . . . . . **3** . . . . .
34 . . . . . **1**	39 . . . . . **1**	44 . . . . . **1**	49 . . . . . **2** . . . . .
35 . . . . . **1**	40 . . . . . **2**	45 . . . . . **4**	50 . . . . . **4** . . . . .

Directions to the Teacher

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

Do not attempt to correct the student's work by making insertions or changes of any kind. If the student's responses for the multiple-choice questions are being hand scored prior to being scanned, the scorer must be careful not to make any marks on the answer sheet except to record the scores in the designated score boxes. Marks elsewhere on the answer sheet will interfere with the accuracy of the scanning.

Allow 1 credit for each correct response.

At least two science teachers must participate in the scoring of the Part B–2 and Part C open-ended questions on a student's paper. 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 more than approximately one-half of the open-ended questions on a student's answer paper. Teachers may not score their own students' answer papers.

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. On the student's separate answer sheet, for each question, record the number of credits earned and the teacher's assigned rater/scorer letter.

Fractional credit is *not* allowed. Only whole-number credit may be given for a response. If the student gives more than one answer to a question, only the first answer should be rated. Units need not be given when the wording of the questions allows such omissions.

For hand scoring, raters should enter the scores earned in the appropriate boxes printed on the separate answer sheet. Next, the rater should add these scores and enter the total in the box labeled "Total Raw Score." Then the student's raw score should be converted to a scale score by using the conversion chart that will be posted on the Department's web site at: http://www.p12.nysed.gov/assessment/ on Thursday, August 16, 2018. The student's scale score should be entered in the box labeled "Scale Score" on the student's answer sheet. The scale score is the student's final examination score.

Schools are not permitted to rescore any of the open-ended questions on this exam after each question has been rated once, regardless of the final exam score. Schools are required to ensure that the raw scores have been added correctly and that the resulting scale score has been determined accurately.

Because scale scores corresponding to raw scores in the conversion chart may change from one administration 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:

$$\frac{3(16\text{ g/mol})}{102\text{ g/mol}} \times 100$$

$$\frac{(15.9994 \times 3)(100)}{102}$$

$$\frac{48}{102} \times 100$$

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

distillation

distilling

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

Atoms of isotopes *D*, *E* and *G* have the same number of protons.

They each have 12 protons.

54 [1] Allow 1 credit for 2 *or* two.

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

An electron in the first shell of an atom of isotope *E* has less energy than an electron in the second shell.

In an atom of *E*, an electron in the 2nd energy level has more energy than an electron in the 1st energy level.

Electrons in shell 2 have higher energies than shell 1 electrons.

lower in shell 1

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

Electronegativity generally decreases as the metals in Group 2 are considered in order of increasing atomic number.

Electronegativity decreases.

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

The atoms in Group 2 elements have the same number of valence electrons and, therefore, similar chemical properties.

Their atoms all have two valence electrons.

Group 2 elements have 2 outermost electrons in each atom.

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

An atom of Ba has three more electron shells than an atom of Mg, so less energy is required to remove one of the outermost electrons from an atom of Ba.

Barium atoms have more inner shell electrons, resulting in a greater shielding effect.

Magnesium's valence electrons are closer to the nucleus.

Barium has a larger atomic radius.

59 [1] Allow 1 credit for any value from 15 g to 18 g, inclusive.

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

The solubility at 1 atm increases as the temperature decreases.

As the temperature of the solution increases, the solubility of SO_2 decreases.

At lower temperatures, more SO_2 can dissolve.

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

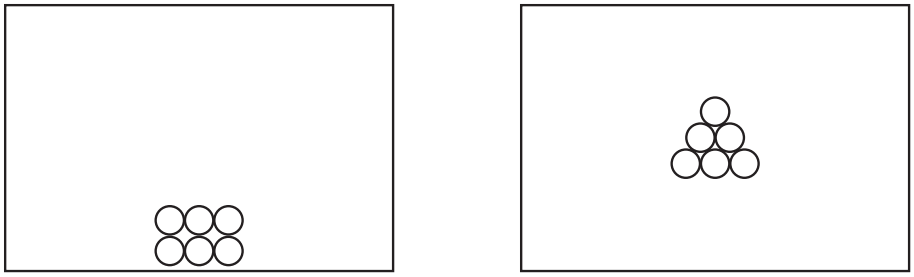
More $SO_2(g)$ can be dissolved in water when the pressure increases.

At higher pressure, sulfur dioxide is more soluble.

Solubility increases.

62 [1] Allow 1 credit for a diagram with *at least six* molecules drawn to represent the solid phase of the sample.

Examples of 1-credit responses:



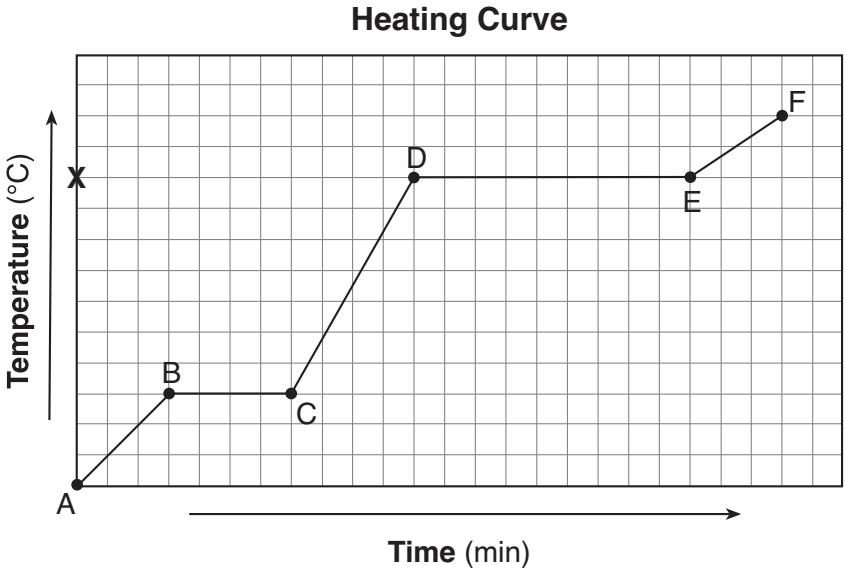
63 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

The average kinetic energy of the molecules during interval *BC is* less than the average kinetic energy of the molecules during interval *DE*.

During interval *DE*, the average kinetic energy is higher.

64 [1] Allow 1 credit for an **X** marked on the axis labeled "Temperature (°C)" in line with interval *DE*.

Example of a 1-credit response



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

No new substance is formed.

The phase changes do not change the chemical properties of the substance.

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:

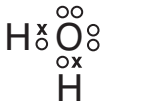
Dynamic equilibrium is reached when the rates of the forward and reverse reactions are equal.

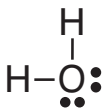
The rates in opposing directions are equal.

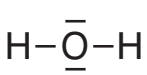
The rates are the same.

67 [1] Allow 1 credit.

Examples of 1-credit responses:







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

Increasing the surface area of the hot carbon increases the frequency of effective collisions, which increases the rate of the forward reaction.

More collisions between *C* atoms and H_2O molecules speed up the reaction.

More effective collisions occur.

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

The solution would decrease in temperature because the dissolving of $KNO_3(s)$ is endothermic.

The heat of solution is positive, which means the mixture would decrease in temperature.

The ΔH is + 34.89 kJ, so $KNO_3(s)$ requires energy to dissolve.

70 [1] Allow 1 credit for 33% *or* any value from 33% to 33.$\overline{3}$% inclusive.

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

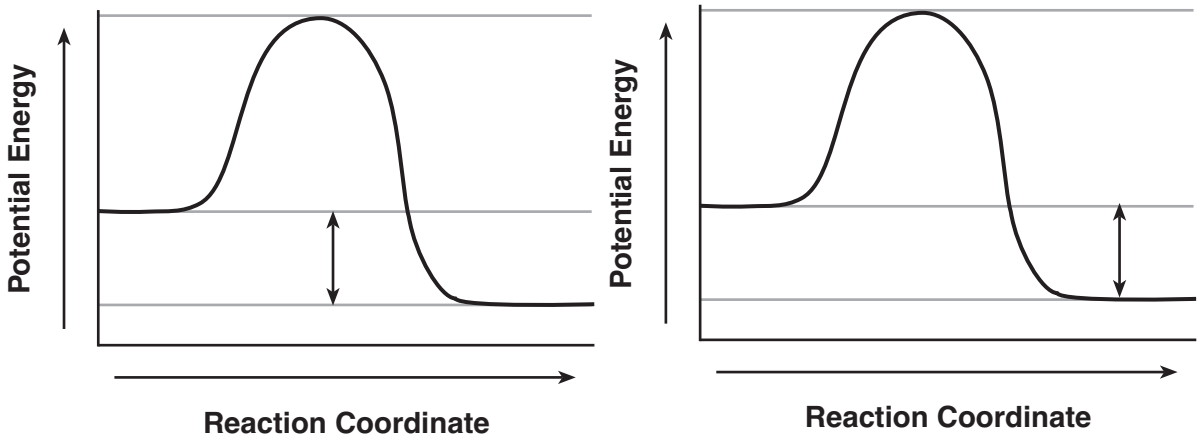
The freezing point of mixture 4 is lower than the freezing point of water.

Mixture 4 freezes below 0°C.

The FP of H_2O is higher.

72 [1] Allow 1 credit.

Examples of 1-credit responses:

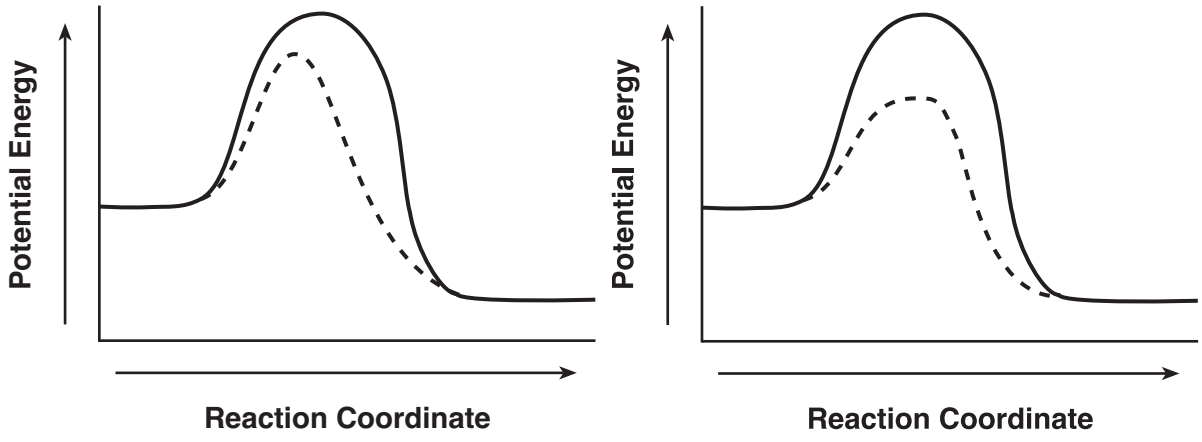


Note: Do *not* allow credit for a single-headed arrow (↑).

73 [1] Allow 1 credit for 4.0 mol *or* 4 mol.

74 [1] Allow 1 credit.

Examples of 1-credit responses:



Note: Do *not* allow credit if the potential energy of the reactants or products is changed.

75 [1] Allow 1 credit for alcohol *or* alcohols.

76 [1] Allow 1 credit for C *or* carbon.

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

Hydrocarbons contain only carbon and hydrogen, but compound *B* also contains oxygen.

Compound *B* contains carbon, hydrogen, and a different element.

This compound includes oxygen.

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

hydronium ion	H_3O^+
hydronium	H^+
hydrogen ion	$H_3O^+(aq)$
hydrogen	H^+ (aq)
proton	

79 [1] Allow 1 credit for Na_2SO_4.

80 [1] Allow 1 credit for any value from 24 mL to 26 mL, inclusive.

81 [1] Allow 1 credit for pink.

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

The $^{235}_{92}U$ nuclide splits into two different smaller nuclides.

the splitting of a large atom into two smaller ones

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

Protons: 60

Neutrons: 90

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

$^{81}_{33}As$

As-81

arsenic-81

^{81}As

85 [1] Allow 1 credit for 30.4 s. Significant figures do *not* need to be shown.

Regents Examination in Physical Setting/Chemistry

August 2018

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

The *Chart for Determining the Final Examination Score for the August 2018 Regents Examination in Physical Setting/Chemistry* will be posted on the Department's web site at: http://www.p12.nysed.gov/assessment/ on Thursday, August 16, 2018. 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 http://www.forms2.nysed.gov/emsc/osa/exameval/reexameval.cfm.
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.

August 2018 Physical Setting/Chemistry			
Question Numbers			
Key Ideas/Performance Indicators	Part A	Part B	Part C
Standard 1			
Math Key Idea 1		51, 59, 62, 64	
Math Key Idea 2		34, 60, 61	80
Math Key Idea 3		31, 35, 36, 39, 40, 41, 42, 45, 46, 64	70, 73, 79, 83, 84, 85
Science Inquiry Key Idea 1		38, 43, 49, 52, 53, 54, 55, 56, 57, 58, 59, 61, 65	66, 68, 69, 71, 75, 76, 77, 78, 81, 82, 83
Science Inquiry Key Idea 2			
Science Inquiry Key Idea 3		32, 33, 34, 35, 36, 37, 38, 44, 46, 50, 53, 57, 60, 65	67, 69, 70, 72, 74, 78, 79, 80, 82, 83, 84
Engineering Design Key Idea 1			
Standard 2			
Key Idea 1			
Key Idea 2			
Key Idea 3			
Standard 6			
Key Idea 1			
Key Idea 2		43, 45	67, 72, 74
Key Idea 3		49, 62	
Key Idea 4			
Key Idea 5		60, 63, 64	
Standard 7			
Key Idea 1			
Key Idea 2			
Standard 4 Process Skills			
Key Idea 3		32, 37, 40, 42, 47, 48, 54, 56, 58, 59, 60, 62, 65	66, 68, 70, 73, 75, 77, 79, 80, 81, 83
Key Idea 4		41, 63	69, 72, 74, 84, 85
Key idea 5			67
Standard 4			
Key Idea 3	1, 2, 3, 4, 5, 6, 8, 9, 16, 18, 20, 21, 23, 24, 25, 26, 27, 28	31, 32, 33, 34, 35, 36, 37, 40, 42, 43, 44, 45, 46, 47, 48, 49, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 65	66, 68, 70, 71, 73, 74, 75, 76, 77, 78, 79, 80, 81, 83
Key Idea 4	14, 17, 30	41, 50, 63	69, 72, 82, 84, 85
Key Idea 5	7, 10, 11, 12, 13, 15, 19, 22, 29	38, 39, 64	67
Reference Tables			
2011 Edition	3, 5, 6, 13, 15, 21, 22, 27, 28	31, 32, 33, 34, 35, 38, 39, 40, 41, 42, 44, 45, 46, 47, 51, 53, 54, 56, 57, 58, 59, 60	67, 69, 70, 75, 76, 77, 78, 79, 81, 83, 84

Regents Examination in Physical Setting/Chemistry – August 2018

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

Raw Score	Scale Score
85	**100**
84	**98**
83	**96**
82	**95**
81	**93**
80	**91**
79	**90**
78	**89**
77	**87**
76	**86**
75	**85**
74	**84**
73	**83**
72	**82**
71	**81**
70	**80**
69	**79**
68	**78**
67	**77**
66	**76**
65	**75**
64	**75**

Raw Score	Scale Score
63	**74**
62	**73**
61	**72**
60	**72**
59	**71**
58	**70**
57	**69**
56	**69**
55	**68**
54	**67**
53	**67**
52	**66**
51	**66**
50	**65**
49	**64**
48	**63**
47	**63**
46	**62**
45	**61**
44	**61**
43	**60**
42	**59**

Raw Score	Scale Score
41	**59**
40	**58**
39	**57**
38	**57**
37	**56**
36	**55**
35	**54**
34	**53**
33	**53**
32	**52**
31	**51**
30	**50**
29	**49**
28	**48**
27	**47**
26	**46**
25	**45**
24	**44**
23	**43**
22	**42**
21	**41**
20	**40**

Raw Score	Scale Score
19	**38**
18	**37**
17	**36**
16	**34**
15	**33**
14	**31**
13	**30**
12	**28**
11	**26**
10	**24**
9	**22**
8	**20**
7	**18**
6	**16**
5	**14**
4	**11**
3	**9**
2	**6**
1	**3**
0	**0**

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 "Scale Score" on the student's answer sheet.

Schools are not permitted to rescore any of the open-ended questions on this exam after each question has been rated once, regardless of the final exam score. Schools are required to ensure that the raw scores have been added correctly and that the resulting scale score has been determined accurately.

Because scale scores corresponding to raw scores in the conversion chart change from one administration 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 Regents Examination in Physical Setting/Chemistry.