The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
CHEMISTRY

Tuesday, August 20, 2024 — 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 Which two particles each have a mass approximately equal to one atomic mass unit?

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

2 As the electron in a hydrogen atom gains energy and moves from the first shell to the third shell, the hydrogen atom becomes an

(1) atom in an excited state
(2) atom in the ground state
(3) ion in an excited state
(4) ion in the ground state

3 Which phrase describes the protons and neutrons in atoms of two different isotopes of the same element?

(1) the same number of protons and the same number of neutrons
(2) the same number of protons and a different number of neutrons
(3) a different number of protons and the same number of neutrons
(4) a different number of protons and a different number of neutrons

4 Which phrase compares the properties and molecular structure of oxygen, $O_2(g)$, and ozone, $O_3(g)$?

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

5 Which phrase describes the composition of a compound?

(1) different elements physically combined
(2) different elements chemically combined
(3) the same element physically combined
(4) the same element chemically combined

6 Which quantity is conserved during all chemical reactions?

(1) density
(2) molecules
(3) charge
(4) temperature

7 At STP, a 5.0-gram sample of which substance contains metallic bonds?

(1) CO
(2) Fe
(3) KI
(4) Ne

8 When a cesium atom becomes a positive ion, there is a change in electron configuration and radius. Which statement describes this change?

(1) The atom gains an electron, and the radius increases.
(2) The atom gains an electron, and the radius decreases.
(3) The atom loses an electron, and the radius increases.
(4) The atom loses an electron, and the radius decreases.

9 Given the equation representing a reaction:

$$F + F \rightarrow F_2$$

Which statement describes the changes that occur during this reaction?

(1) A bond is formed as energy is absorbed.
(2) A bond is formed as energy is released.
(3) A bond is broken as energy is absorbed.
(4) A bond is broken as energy is released.

10 Which atom, in the ground state, has a stable valence electron configuration?

(1) Bi
(2) Cs
(3) Pb
(4) Rn

11 Which term represents the strength of attraction that an atom has for the electrons in a chemical bond?

(1) entropy
(2) electronegativity
(3) first ionization energy
(4) heat of reaction

12 Which phrase describes a sample of NaCl(s)?

(1) a mixture that has constant composition and properties throughout
(2) a mixture that varies in both composition and properties
(3) a substance that has constant composition and properties throughout
(4) a substance that varies in both composition and properties

13 Which substance contains only atoms with the same atomic number?

(1) ammonia
(2) selenium
(3) methane
(4) water

14 Differences in which property allow the separation of a mixture of 2-propanol and water by distillation at 1.0 atm?

(1) boiling point
(2) freezing point
(3) solubility
(4) electronegativity

15 At standard pressure, how do the freezing point and the boiling point of $H_2O(\ell)$ compare to the freezing point and the boiling point of 1.0 M KCl(aq)?

(1) Both the freezing point and boiling point of $H_2O(\ell)$ are lower.
(2) Both the freezing point and boiling point of $H_2O(\ell)$ are higher.
(3) The freezing point of $H_2O(\ell)$ is lower, and the boiling point of $H_2O(\ell)$ is higher.
(4) The freezing point of $H_2O(\ell)$ is higher, and the boiling point of $H_2O(\ell)$ is lower.

16 Which term represents a form of energy?

(1) molarity
(2) temperature
(3) thermal
(4) volume

17 Which sample of zinc has atoms with the highest average kinetic energy?

(1) 5.0 g of Zn at 40.°C
(2) 10. g of Zn at 30.°C
(3) 15 g of Zn at 20.°C
(4) 20. g of Zn at 10.°C

18 Under which conditions will a real gas behave more like an ideal gas?

(1) high pressure and high temperature
(2) high pressure and low temperature
(3) low pressure and high temperature
(4) low pressure and low temperature

19 According to the kinetic molecular theory, the particles of an ideal gas

(1) constantly move in circular paths
(2) have no attractive forces between them
(3) do not transfer energy when the particles collide
(4) are separated by small distances relative to their sizes

20 A reaction between two different gases is most likely to occur when the colliding molecules have the proper orientation and sufficient

(1) charge
(2) energy
(3) mass
(4) volume

21 Which statement describes a chemical reaction that has reached equilibrium?

(1) The reactants have been completely consumed.
(2) The reverse reaction has stopped.
(3) The concentrations of the products and reactants remain constant.
(4) The rate of the forward reaction is greater than the rate of the reverse reaction.

22 An enzyme acts as a catalyst to speed up a reaction by providing an alternate reaction pathway that has a

(1) higher activation energy
(2) lower activation energy
(3) higher heat of reaction
(4) lower heat of reaction

23 Which element has atoms that can bond together to form chains, rings, or networks?

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

24 A molecule of which compound contains an atom of nitrogen?

(1) 2-chloropropane
(2) 1-propanol
(3) 2-pentanone
(4) 1-propanamine

25 How many electrons are shared between the carbon atoms in a molecule of ethyne?

(1) 6
(2) 2
(3) 3
(4) 4

26 Which change takes place in the process of reduction?

(1) A neutron is lost.
(2) A neutron is gained.
(3) An electron is lost.
(4) An electron is gained.

27 The indicator methyl orange is red in an aqueous solution that has a pH value of

(1) 9.2
(2) 7.0
(3) 4.5
(4) 2.7

28 Which radioactive emissions are listed in order from greatest penetrating power to least penetrating power?

(1) alpha particle, beta particle, gamma radiation
(2) beta particle, gamma radiation, alpha particle
(3) gamma radiation, beta particle, alpha particle
(4) gamma radiation, alpha particle, beta particle

29 What is one benefit of a nuclear fission reaction?

(1) Fission reactants are hydrogen isotopes.
(2) Fission products must be stored indefinitely.
(3) Electrical energy can be produced using fission reactions.
(4) Workers in nuclear power plants can be exposed to radiation from fission reactions.

30 Which statement compares the relative amounts of energy released during a chemical reaction and a nuclear reaction when both reactions consume 1.0 mole of reactant?

(1) The chemical and nuclear reactions release equal amounts of energy.
(2) The nuclear reaction releases one half the amount of energy of the chemical reaction.
(3) The chemical reaction releases much more energy than the nuclear reaction.
(4) The nuclear reaction releases much more energy than the chemical reaction.

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 A student calculates the density of a sample of Fe to be 7.57 grams per cubic centimeter. Based on Table *S*, what is the percent error for the student's calculated density of Fe?

(1) −0.038%
(2) −0.040%
(3) −3.8%
(4) −4.0%

32 Based on Table *S*, which general trend is observed as the elements in Group 17 are considered in order of increasing atomic number from fluorine to iodine?

(1) increase in first ionization energy
(2) increase in boiling point
(3) decrease in melting point
(4) decrease in density

33 Given the equation representing a reaction:

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

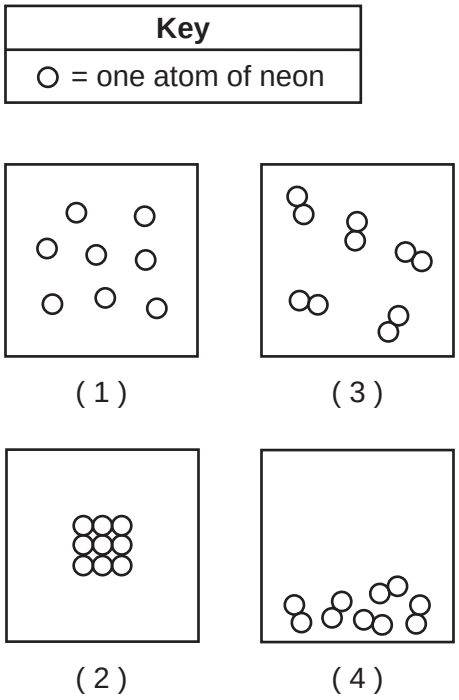
Which type of chemical reaction is represented by this equation?

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

34 At STP, which property can be used to differentiate a 2.0-gram sample of NaCl(s) from a 2.0-gram sample of AgCl(s)?

(1) mass
(2) solubility
(3) phase
(4) temperature

35 Which particle model diagram represents a sample of neon at 35 K and 1.0 atmosphere?



36 Which formula represents a molecule with the most polar bond?

(1) F_2
(2) H_2
(3) HCl
(4) HBr

37 What is the amount of heat that must be absorbed to increase the temperature of a 130.-gram sample of water from 20.0°C to 50.0°C?

(1) 3.90×10^3 J
(2) 1.63×10^4 J
(3) 4.34×10^4 J
(4) 2.94×10^5 J

38 A sealed, rigid cylinder contains 50. milliliters of argon gas, Ar(g), at 1.0 atmosphere and 273 K. A second sealed, rigid cylinder contains helium gas, He(g). Which conditions of volume, pressure, and temperature in the second cylinder would result in the number of helium atoms being equal to the number of argon atoms in the first cylinder?

(1) 50. mL, 0.5 atm, 546 K
(2) 50. mL, 1.0 atm, 273 K
(3) 100. mL, 0.5 atm, 546 K
(4) 100. mL, 1.0 atm, 273 K

39 Which equation represents a physical equilibrium?

(1) $CO_2(g) \rightleftharpoons CO_2(s)$
(2) $C(s) + O_2(g) \rightarrow CO_2(g)$
(3) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
(4) $N_2(g) + O_2(g) \rightarrow 2NO(g)$

40 Given an equation representing a system at equilibrium:

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) + \text{energy}$$

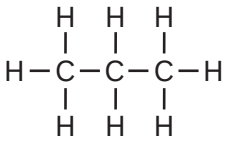
Which change occurs when the temperature is increased?

(1) The equilibrium shifts to the left and the concentration of $SO_3(g)$ decreases.
(2) The equilibrium shifts to the left and the concentration of $SO_3(g)$ increases.
(3) The equilibrium shifts to the right and the concentration of $SO_3(g)$ decreases.
(4) The equilibrium shifts to the right and the concentration of $SO_3(g)$ increases.

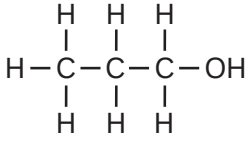
41 Which phase change results in an increase in disorder?

(1) $I_2(g) \rightarrow I_2(s)$
(2) $Cl_2(\ell) \rightarrow Cl_2(g)$
(3) $N_2O_4(g) \rightarrow N_2O_4(\ell)$
(4) $H_2O(\ell) \rightarrow H_2O(s)$

42 Which formula represents an unsaturated hydrocarbon?



(1)



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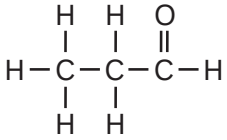

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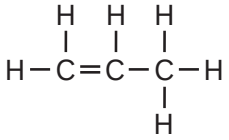


(4)

43 Given the incomplete equation for a fermentation reaction:

$$X \rightarrow 2CH_3CH_2OH + 2CO_2$$

Which formula represents the missing reactant, *X*, in this equation?

(1) $C_5H_6O_5$
(2) $C_5H_{12}O_5$
(3) $C_6H_6O_6$
(4) $C_6H_{12}O_6$

44 Which equation represents a combustion reaction?

(1) $Cl_2 + 2NaBr \rightarrow 2NaCl + Br_2$
(2) $2CH_3OH + 3O_2 \rightarrow 2CO_2 + 4H_2O$
(3) $2K + 2H_2O \rightarrow 2KOH + H_2$
(4) $BaS + 2H_2O \rightarrow Ba(OH)_2 + H_2S$

45 Given the equation representing a reaction:

$$Cl_2(g) + 2I^-(aq) \rightarrow 2Cl^-(aq) + I_2(s)$$

What is the number of moles of electrons gained by $Cl_2(g)$ when 2.0 moles of electrons are lost by $I^-(aq)$?

(1) 1.0 mol
(2) 2.0 mol
(3) 3.0 mol
(4) 4.0 mol

46 Which statement describes a 0.1 M NaOH(aq) solution?

(1) The solution contains an Arrhenius acid and conducts electricity.
(2) The solution contains an Arrhenius acid and does not conduct electricity.
(3) The solution contains an Arrhenius base and conducts electricity.
(4) The solution contains an Arrhenius base and does not conduct electricity.

47 A sample of LiOH(aq) has a concentration of 0.020 M. How many significant figures are used to express the concentration of this solution?

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

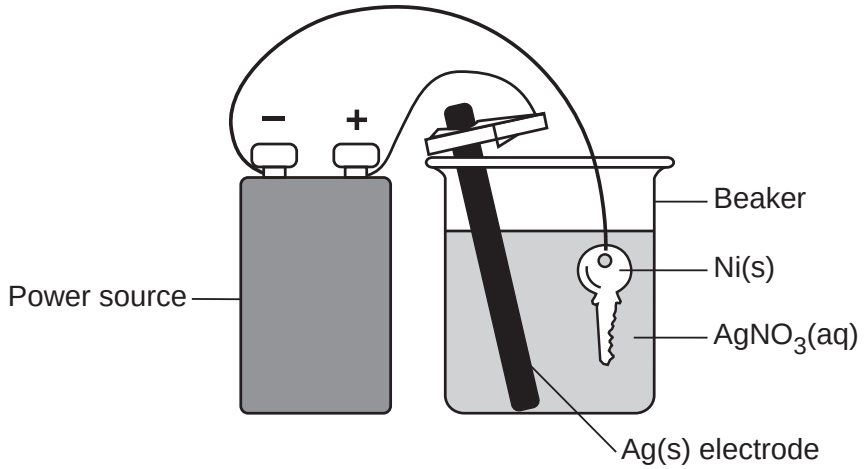
48 Given the balanced equation representing a reaction:

$$C_2H_5OH(\ell) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(\ell) + \text{energy}$$

The mole ratio of oxygen molecules to carbon dioxide molecules is

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

49 The diagram below represents an operating cell that is used to plate silver onto a nickel key.



Which statement describes the reaction that occurs inside the beaker?

(1) A spontaneous reaction converts electrical energy to chemical energy.
(2) A spontaneous reaction converts chemical energy to electrical energy.
(3) A nonspontaneous reaction uses electrical energy to produce a chemical change.
(4) A nonspontaneous reaction uses chemical change to produce electrical energy.

50 Given the equation representing an equilibrium:

$$HSO_4^- + H_2O \rightleftharpoons H_3O^+ + SO_4^{2-}$$

Which two formulas represent the H^+ acceptors in this equilibrium?

(1) HSO_4^- and H_3O^+
(2) H_2O and SO_4^{2-}
(3) H_2O and H_3O^+
(4) HSO_4^- and SO_4^{2-}

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 Draw a Lewis electron-dot diagram for a molecule of ammonia. [1]

Base your answers to questions 52 and 53 on the information below and on your knowledge of chemistry.

The table below gives the atomic mass and the natural abundance of the two naturally occurring isotopes of copper.

Naturally Occurring Isotopes of Copper

Isotope	Atomic Mass (u)	Natural Abundance (%)
Cu-63	62.93	69.15
Cu-65	64.93	30.85

52 Compare the energy of an electron in the first shell of a copper atom in the ground state to the energy of an electron in the second shell of the same atom in the ground state. [1]

53 Show a numerical setup for calculating the atomic mass of copper. [1]

Base your answers to questions 54 through 56 on the information below and on your knowledge of chemistry.

The elements on the Periodic Table vary in their properties. The placement or locations of elements in Period 2 give an indication of the physical and chemical properties of these elements.

54 Identify the element in Period 2 that is classified as a metalloid. [1]

55 Identify the element in Period 2 that requires the *least* amount of energy to remove the most loosely held electrons from a mole of gaseous atoms of the element in the ground state. [1]

56 State the general trend in atomic radius as the elements in Period 2 are considered in order of increasing atomic number. [1]

Base your answers to questions 57 through 59 on the information below and on your knowledge of chemistry.

An aqueous solution of lead(II) nitrate reacts with an aqueous solution of potassium iodide in a test tube. The reaction produces a yellow solid that settles to the bottom of the test tube. The unbalanced equation for this reaction is shown below.

$$Pb(NO_3)_2(aq) + KI(aq) \rightarrow PbI_2(s) + KNO_3(aq)$$

57 Balance the equation *in your answer booklet* for this reaction, using the *smallest* whole-number coefficients. [1]

58 Write a chemical name for the aqueous product. [1]

59 Determine the gram-formula mass of the yellow solid compound produced by the reaction. [1]

Base your answers to questions 60 through 62 on the information below and on your knowledge of chemistry.

The vapor pressures of four liquids at various temperatures are given in Table *H*.

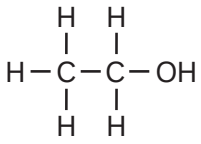
60 Identify the substance on Table *H* with the *weakest* intermolecular forces at 40.°C. [1]

61 Determine the vapor pressure of ethanoic acid at standard pressure and 50.°C. [1]

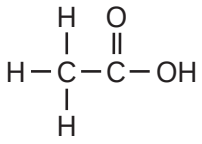
62 Explain, in terms of charge distribution, why water is a polar molecule. [1]

Base your answers to questions 63 through 65 on the information below and on your knowledge of chemistry.

Molecule *A* and molecule *B* are represented by the formulas below.



Molecule A



Molecule B

63 Identify the class of organic compound to which molecule *A* belongs. [1]

64 Draw a structural formula for dimethyl ether, the isomer of molecule *A*. [1]

65 Write a chemical name for the compound represented by molecule *B*. [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 answers to questions 66 through 69 on the information below and on your knowledge of chemistry.

During a laboratory activity, appropriate safety equipment was used and safety procedures were followed. A student investigated the relative chemical activity of four metals by placing one piece of each metal in aqueous nitrate solutions of each of the four metals. The observations from the investigation are shown in the table below.

Observations of Four Metals

Metal	Color of Metal	Compound in Aqueous Solution			
		$Cu(NO_3)_2(aq)$	$Mg(NO_3)_2(aq)$	$Zn(NO_3)_2(aq)$	$AgNO_3(aq)$
Cu	red	no reaction	no reaction	no reaction	black solid appears
Mg	silver-white	gray solid appears	no reaction	gray solid appears	black solid appears
Zn	blue-white	black solid appears	no reaction	no reaction	black solid appears
Ag	silver	no reaction	no reaction	no reaction	no reaction

The student wanted to use information from this investigation to make an operating voltaic cell using a zinc electrode and a $Zn(NO_3)_2(aq)$ solution in one of the half-cells.

66 Identify the most active metal and the least active metal used in this investigation. [1]

67 Determine the oxidation state of nitrogen in the $AgNO_3(aq)$ solution. [1]

68 Write a balanced half-reaction equation for the oxidation of the zinc during this investigation. [1]

69 Identify a metal, in this investigation, that could be used as the cathode in the other half-cell in the student's voltaic cell. [1]

Base your answers to questions 70 through 73 on the information below and on your knowledge of chemistry.

A student investigated the properties of solutions by dissolving 46.0 grams of $NH_4Cl(s)$ in 200. grams of water at 20.°C. The gram-formula mass of $NH_4Cl(s)$ is 53.5 grams per mole. The temperature of the solution decreased as the $NH_4Cl(s)$ dissolved. During this laboratory activity, appropriate safety equipment was used and safety procedures were followed.

70 State, in terms of temperature, why the dissolving of the $NH_4Cl(s)$ is classified as an endothermic process. [1]

71 Classify, in terms of saturation, the type of solution produced in this investigation. [1]

72 Based on Table *G*, identify the solute that has a solubility at 20.°C that is closest to the solubility of $NH_4Cl(s)$ at 20.°C. [1]

73 Determine the number of moles of $NH_4Cl(s)$ dissolved in the 200. grams of water in this investigation. [1]

Base your answers to questions 74 through 77 on the information below and on your knowledge of chemistry.

The process of evaporation affects the concentration of ions in a sample of seawater. The table below shows the name and concentration of four different ions in a seawater sample. The concentrations are expressed in grams per 1000. grams of seawater.

Concentration of Four Ions in a Seawater Sample

Ion	Concentration (g/1000. g of seawater)
bromide	0.067
chloride	19.33
potassium	0.394
sodium	10.53

74 Determine the concentration of potassium ions, in parts per million, in the sample of seawater. [1]

75 State what happens to the potential energy of the water molecules as they evaporate from a sample of the seawater. [1]

76 State how the concentration of ions in a sample of the seawater changes as some of the water evaporates from the seawater sample. [1]

77 Using the key *in your answer booklet*, draw *at least two* water molecules in the box, showing the orientation of each water molecule toward the bromide ion. [1]

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

During a laboratory activity, appropriate safety equipment was used and safety procedures were followed. A student performed three trials of a titration using 0.16 M KOH(aq) to determine the unknown concentration of a solution of hydrochloric acid, HCl(aq). The volumes of the solutions used are shown in the table below.

Titration Data

Trial	Volume of HCl(aq) (mL)	Volume of 0.16 M KOH(aq) (mL)
1	10.0	15.3
2	10.0	15.0
3	10.0	15.1

78 Identify the positive ion in the solution of hydrochloric acid. [1]

79 Complete the equation *in your answer booklet* for the reaction that occurs during this titration by writing a formula for *each* product. [1]

80 Show a numerical setup for calculating the molarity of the HCl(aq) solution using the titration data from trial 2. [1]

81 Explain, in terms of experimental design, why it is better to use data from multiple trials of a titration to determine the molarity of the acid than to use the data from only one trial of the titration. [1]

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

Scientists can produce useful radioisotopes of the lighter elements by bombarding atoms with neutrons. Tritium, ${}^{3}_{1}\mathrm{H}$, can be produced by bombarding a nuclide represented by *X* as shown by the incomplete equation below.

$$X + {}^{1}_{0}\mathrm{n} \rightarrow {}^{3}_{1}\mathrm{H} + {}^{4}_{2}\mathrm{He}$$

82 State the neutron to proton ratio in the ${}^{4}_{2}\mathrm{He}$ product of the reaction. [1]

83 Based on Table *N*, state the decay mode of tritium. [1]

84 Determine the time required for a 1.00-gram sample of the ${}^{3}_{1}\mathrm{H}$ produced to decay until 0.25 gram of the sample remains unchanged. [1]

85 Complete the nuclear equation *in your answer booklet* for this reaction by writing a notation for the missing reactant. [1]

P.S./CHEMISTRY

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
CHEMISTRY

Tuesday, August 20, 2024 — 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 _____ $Pb(NO_3)_2(aq)$ + _____ $KI(aq)$ → _____ $PbI_2(s)$ + _____ $KNO_3(aq)$

58 _____

59 _____ **g/mol**

60 _____

61 _____ **kPa**

62 _____

_____

_____

63 _____

64

65 _____

Part C

66 Most active metal: _____

Least active metal: _____

67 _____

68 _____

69 _____

70 _____

_____

_____

71 _____

72 _____

73 _____ **mol**

74 _____ **ppm**

75 _____

_____

_____

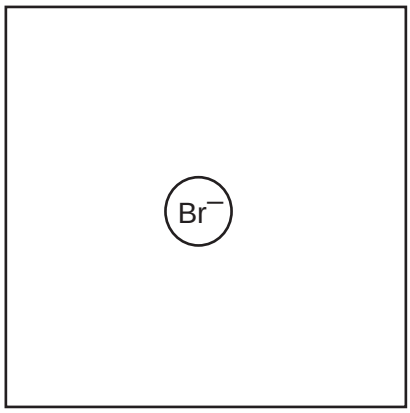
76 _____

_____

_____

77

Key
● = hydrogen atom
○ = oxygen atom
●○● = water molecule



78 _____

79 $HCl(aq) + KOH(aq) \rightarrow$ _____ + _____

80

81 _____

_____

_____

82 _____

83 _____

84 _____ **y**

85 _____ + $^{1}_{0}n \rightarrow {}^{3}_{1}H + {}^{4}_{2}He$

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P.S./CHEMISTRY

The State Education Department / The University of the State of New York

Regents Examination in Physical Setting/Chemistry – August 2024

Scoring Key: Parts A and B-1 (Multiple-Choice Questions)

Examination	Date	Question Number	Scoring Key	Question Type	Credit	Weight
Physical Setting/Chemistry	August '24	**1**	4	MC	1	1
Physical Setting/Chemistry	August '24	**2**	1	MC	1	1
Physical Setting/Chemistry	August '24	**3**	2	MC	1	1
Physical Setting/Chemistry	August '24	**4**	4	MC	1	1
Physical Setting/Chemistry	August '24	**5**	2	MC	1	1
Physical Setting/Chemistry	August '24	**6**	3	MC	1	1
Physical Setting/Chemistry	August '24	**7**	2	MC	1	1
Physical Setting/Chemistry	August '24	**8**	4	MC	1	1
Physical Setting/Chemistry	August '24	**9**	2	MC	1	1
Physical Setting/Chemistry	August '24	**10**	4	MC	1	1
Physical Setting/Chemistry	August '24	**11**	2	MC	1	1
Physical Setting/Chemistry	August '24	**12**	3	MC	1	1
Physical Setting/Chemistry	August '24	**13**	2	MC	1	1
Physical Setting/Chemistry	August '24	**14**	1	MC	1	1
Physical Setting/Chemistry	August '24	**15**	4	MC	1	1
Physical Setting/Chemistry	August '24	**16**	3	MC	1	1
Physical Setting/Chemistry	August '24	**17**	1	MC	1	1
Physical Setting/Chemistry	August '24	**18**	3	MC	1	1
Physical Setting/Chemistry	August '24	**19**	2	MC	1	1
Physical Setting/Chemistry	August '24	**20**	2	MC	1	1
Physical Setting/Chemistry	August '24	**21**	3	MC	1	1
Physical Setting/Chemistry	August '24	**22**	2	MC	1	1
Physical Setting/Chemistry	August '24	**23**	1	MC	1	1
Physical Setting/Chemistry	August '24	**24**	4	MC	1	1
Physical Setting/Chemistry	August '24	**25**	1	MC	1	1
Physical Setting/Chemistry	August '24	**26**	4	MC	1	1
Physical Setting/Chemistry	August '24	**27**	4	MC	1	1
Physical Setting/Chemistry	August '24	**28**	3	MC	1	1
Physical Setting/Chemistry	August '24	**29**	3	MC	1	1
Physical Setting/Chemistry	August '24	**30**	4	MC	1	1
Physical Setting/Chemistry	August '24	**31**	3	MC	1	1
Physical Setting/Chemistry	August '24	**32**	2	MC	1	1
Physical Setting/Chemistry	August '24	**33**	3	MC	1	1
Physical Setting/Chemistry	August '24	**34**	2	MC	1	1
Physical Setting/Chemistry	August '24	**35**	1	MC	1	1
Physical Setting/Chemistry	August '24	**36**	3	MC	1	1
Physical Setting/Chemistry	August '24	**37**	2	MC	1	1
Physical Setting/Chemistry	August '24	**38**	2	MC	1	1
Physical Setting/Chemistry	August '24	**39**	1	MC	1	1
Physical Setting/Chemistry	August '24	**40**	1	MC	1	1
Physical Setting/Chemistry	August '24	**41**	2	MC	1	1
Physical Setting/Chemistry	August '24	**42**	4	MC	1	1
Physical Setting/Chemistry	August '24	**43**	4	MC	1	1
Physical Setting/Chemistry	August '24	**44**	2	MC	1	1
Physical Setting/Chemistry	August '24	**45**	2	MC	1	1
Physical Setting/Chemistry	August '24	**46**	3	MC	1	1
Physical Setting/Chemistry	August '24	**47**	2	MC	1	1
Physical Setting/Chemistry	August '24	**48**	3	MC	1	1
Physical Setting/Chemistry	August '24	**49**	3	MC	1	1
Physical Setting/Chemistry	August '24	**50**	2	MC	1	1

Regents Examination in Physical Setting/Chemistry – August 2024

Scoring Key: Parts B-2 and C (Constructed-Response Questions)

Examination	Date	Question Number	Scoring Key	Question Type	Credit	Weight
Physical Setting/Chemistry	August '24	**51**	-	CR	1	1
Physical Setting/Chemistry	August '24	**52**	-	CR	1	1
Physical Setting/Chemistry	August '24	**53**	-	CR	1	1
Physical Setting/Chemistry	August '24	**54**	-	CR	1	1
Physical Setting/Chemistry	August '24	**55**	-	CR	1	1
Physical Setting/Chemistry	August '24	**56**	-	CR	1	1
Physical Setting/Chemistry	August '24	**57**	-	CR	1	1
Physical Setting/Chemistry	August '24	**58**	-	CR	1	1
Physical Setting/Chemistry	August '24	**59**	-	CR	1	1
Physical Setting/Chemistry	August '24	**60**	-	CR	1	1
Physical Setting/Chemistry	August '24	**61**	-	CR	1	1
Physical Setting/Chemistry	August '24	**62**	-	CR	1	1
Physical Setting/Chemistry	August '24	**63**	-	CR	1	1
Physical Setting/Chemistry	August '24	**64**	-	CR	1	1
Physical Setting/Chemistry	August '24	**65**	-	CR	1	1
Physical Setting/Chemistry	August '24	**66**	-	CR	1	1
Physical Setting/Chemistry	August '24	**67**	-	CR	1	1
Physical Setting/Chemistry	August '24	**68**	-	CR	1	1
Physical Setting/Chemistry	August '24	**69**	-	CR	1	1
Physical Setting/Chemistry	August '24	**70**	-	CR	1	1
Physical Setting/Chemistry	August '24	**71**	-	CR	1	1
Physical Setting/Chemistry	August '24	**72**	-	CR	1	1
Physical Setting/Chemistry	August '24	**73**	-	CR	1	1
Physical Setting/Chemistry	August '24	**74**	-	CR	1	1
Physical Setting/Chemistry	August '24	**75**	-	CR	1	1
Physical Setting/Chemistry	August '24	**76**	-	CR	1	1
Physical Setting/Chemistry	August '24	**77**	-	CR	1	1
Physical Setting/Chemistry	August '24	**78**	-	CR	1	1
Physical Setting/Chemistry	August '24	**79**	-	CR	1	1
Physical Setting/Chemistry	August '24	**80**	-	CR	1	1
Physical Setting/Chemistry	August '24	**81**	-	CR	1	1
Physical Setting/Chemistry	August '24	**82**	-	CR	1	1
Physical Setting/Chemistry	August '24	**83**	-	CR	1	1
Physical Setting/Chemistry	August '24	**84**	-	CR	1	1
Physical Setting/Chemistry	August '24	**85**	-	CR	1	1

Key
MC = Multiple-choice question
CR = Constructed-response question

The chart for determining students' final examination scores for the **August 2024 Regents Examination in Physical Setting/Chemistry** will be posted on the Department's web site at https://www.nysedregents.org/Chemistry/ on the day of the examination. Conversion charts provided for the previous administrations of the Physical Setting/Chemistry examination must NOT be used to determine students' final scores for this administration.

FOR TEACHERS ONLY

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

PHYSICAL SETTING/CHEMISTRY

Tuesday, August 20, 2024 — 8:30 to 11:30 a.m., only

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: https://www.nysed.gov/state-assessment/high-school-regents-examinations 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.

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*.

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 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. Do not attempt to correct the student's work by making insertions or changes of any kind. 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: https://www.nysed.gov/state-assessment/high-school-regents-examinations on Tuesday, August 20, 2024. 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.

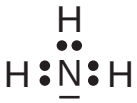
Because scale scores corresponding to raw scores in the conversion chart may change from one administration to another, it is crucial that, for each administration, the conversion chart provided for that administration be used to determine the student's final score.

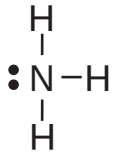
Part B–2

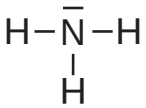
Allow a total of 15 credits for this part. The student must answer all questions in this part.

51 [1] Allow 1 credit.

Examples of 1-credit responses:







Note: Do *not* allow credit for •—• *or* •—• *or* —• for a bond, because each • represents one electron and each — represents two electrons.

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

The energy of an electron in the first shell is lower than the energy of the electron in the second shell.

The second shell electron has more energy.

An electron in the first shell has less.

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

$$(62.93\text{ u})(0.6915) + (64.93\text{ u})(0.3085)$$

$$\frac{(69.15)(62.93) + (30.85)(64.93)}{100}$$

$$(69.15\%)(62.93) + (30.85\%)(64.93)$$

Note: Do *not* allow credit for a numerical setup using mass numbers rather than isotopic masses.

54 [1] Allow 1 credit for B *or* boron.

55 [1] Allow 1 credit for Li *or* lithium.

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

As the atomic number of the elements in Period 2 increases, the atomic radius generally decreases.

The radius gets smaller.

decreases

57 [1] Allow 1 credit for ____ $Pb(NO_3)_2(aq)$ + __2__ $KI(aq) \rightarrow$ ____ $PbI_2(s)$ + __2__ $KNO_3(aq)$

Allow credit even if the coefficient "1" is written in front of $Pb(NO_3)_2(aq)$ and/or $PbI_2(s)$.

58 [1] Allow 1 credit for potassium nitrate.

59 [1] Allow 1 credit for 461.0 g/mol *or* any value from 460.8 g/mol to 461.2 g/mol, inclusive.

60 [1] Allow 1 credit for propanone.

61 [1] Allow 1 credit for 8 kPa *or* any value from 7 kPa to 9 kPa, inclusive.

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

A water molecule has an asymmetrical distribution of charge.

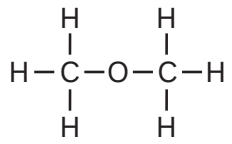
Charge distribution is uneven.

Center of positive and negative charges do not coincide.

63 [1] Allow 1 credit for alcohol *or* alcohols.

64 [1] Allow 1 credit.

Examples of 1-credit responses:



Note: Do *not* allow credit if only some of the H atoms bonded to C atoms are shown.

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

ethanoic acid

acetic acid

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:

Most active metal: Mg
Least active metal: Ag

Most active metal: magnesium
Least active metal: silver

67 [1] Allow 1 credit for +5 or 5+.

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

$Zn(s) \rightarrow Zn^{2+}(aq) + 2e^-$

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

Note: Do *not* allow credit for the e without the minus sign (−).

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

copper

silver

Ag

Cu

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

As the $NH_4Cl(s)$ dissolves in the water, the temperature of the mixture decreases.

The temperature of the solution decreases.

Temperature goes down.

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

unsaturated

not saturated

72 [1] Allow 1 credit for NaCl *or* sodium chloride.

73 [1] Allow 1 credit for 0.860 mol *or* any value from 0.85 mol to 0.87 mol, inclusive.

74 [1] Allow 1 credit for 394 ppm.

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

The potential energy of the water molecules increases as the water evaporates.

Evaporation of the H_2O makes the PE of the molecules greater.

The molecules gain potential energy.

increases

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

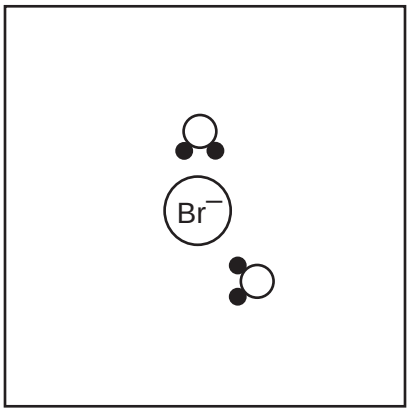
The concentration of the ions increases as the water evaporates.

Concentration goes up.

increases

77 [1] Allow 1 credit. Acceptable responses must show at least two water molecules. One *or* both hydrogen atoms in each water molecule may touch the bromide ion. At least one of the hydrogen atoms in each water molecule must face the bromide ion.

Example of a 1-credit response:



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	$H^+(aq)$

Note: Do *not* allow credit for H *or* H_2.

79 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

$KCl(aq) + H_2O(\ell)$

HOH + KCl

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

$M_A(10.0\ mL) = (0.16\ M)(15.0\ mL)$

$$\frac{(0.16M)(15.0mL)}{10.0\ mL}$$

$$\frac{(0.16)(15)}{10}$$

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

Multiple trials may improve the precision of results.

Each trial may involve errors, either above or below the acceptable value. Therefore, an average value may be more accurate.

Results can be shown to be reproducible.

Multiple trials may help cancel random errors.

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

2:2

$\frac{2}{2}$

1 to 1

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

beta decay

β^-

$_{-1}^{0}e$

$_{-1}^{0}\beta$

beta

beta particle

84 [1] Allow 1 credit for 24.62 y. Significant figures do *not* need to be shown.

85 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

Li-6

$^{6}_{3}Li$

lithium-6

^{6}Li

Regents Examination in Physical Setting/Chemistry

August 2024

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

The *Chart for Determining the Final Examination Score for the August 2024 Regents Examination in Physical Setting/Chemistry* will be posted on the Department's web site at: https://www.nysed.gov/state-assessment/high-school-regents-examinations on Tuesday, August 20, 2024. 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 https://www.surveymonkey.com/r/8LNLLDW.
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

August 2024 Physical Setting/Chemistry			
Question Numbers			
Key Ideas/Performance Indicators	Part A	Part B	Part C
Standard 1			
Math Key Idea 1		31, 47, 53, 60, 61	80
Math Key Idea 2			82
Math Key Idea 3		36, 37, 48, 57, 59	67, 73, 74, 84
Science Inquiry Key Idea 1		33, 34, 38, 39, 40, 42, 43, 44, 45, 46, 49, 52, 54, 55, 56, 60, 62, 63, 64, 65	68, 70, 71, 72, 75, 76, 78, 81, 85
Science Inquiry Key Idea 2			
Science Inquiry Key Idea 3		31, 33, 34, 38, 39, 41, 42, 43, 44, 45, 46, 49, 50, 57, 58, 64, 65	66, 67, 68, 70, 71, 72, 77, 79, 82, 84, 85
Engineering Design Key Idea 1			
Standard 2			
Key Idea 1			
Key Idea 2			
Key Idea 3			
Standard 6			
Key Idea 1			
Key Idea 2		31, 51, 64	77
Key Idea 3			
Key Idea 4		40	
Key Idea 5			
Standard 7			
Key Idea 1			
Key Idea 2			
Standard 4 Process Skills			
Key Idea 3		32, 33, 35, 39, 40, 41, 42, 43, 44, 46, 48, 49, 54, 55, 56, 57, 59, 63	66, 68, 69, 71, 72, 73, 74, 79, 80, 83
Key Idea 4		37	70, 84, 85
Key idea 5		36, 51, 60	
Standard 4			
Key Idea 3	1, 2, 3, 5, 6, 12, 13, 14, 15, 18, 19, 20, 21, 22, 23, 24, 26, 27, 28	31, 32, 33, 34, 35, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 52, 53, 54, 55, 56, 57, 58, 59, 63, 64, 65	66, 67, 68, 69, 71, 72, 73, 74, 76, 78, 79, 80, 81, 82
Key Idea 4	16, 29	37	70, 75, 83, 84, 85
Key Idea 5	4, 7, 8, 9, 10, 11, 17, 25, 30	36, 51, 60, 61, 62	77
Reference Tables			
2011 Edition	1, 7, 8, 10, 13, 24, 25, 27	31, 32, 34, 35, 36, 37, 46, 51, 52, 54, 55, 56, 58, 59, 60, 61, 62, 63, 64, 65	66, 67, 68, 69, 70, 71, 72, 73, 74, 78, 80, 83, 84, 85

Regents Examination in Physical Setting/Chemistry – August 2024

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	**92**
79	**90**
78	**89**
77	**88**
76	**86**
75	**85**
74	**84**
73	**83**
72	**82**
71	**81**
70	**80**
69	**79**
68	**78**
67	**77**
66	**76**
65	**76**
64	**75**

Raw Score	Scale Score
63	**74**
62	**73**
61	**72**
60	**72**
59	**71**
58	**70**
57	**70**
56	**69**
55	**68**
54	**67**
53	**67**
52	**66**
51	**66**
50	**65**
49	**64**
48	**63**
47	**63**
46	**62**
45	**62**
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	**54**
33	**53**
32	**52**
31	**51**
30	**50**
29	**49**
28	**48**
27	**48**
26	**47**
25	**46**
24	**45**
23	**43**
22	**42**
21	**41**
20	**40**

Raw Score	Scale Score
19	**39**
18	**37**
17	**36**
16	**35**
15	**33**
14	**32**
13	**30**
12	**29**
11	**27**
10	**25**
9	**23**
8	**21**
7	**19**
6	**17**
5	**14**
4	**12**
3	**9**
2	**6**
1	**4**
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.