The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
CHEMISTRY

Tuesday, August 13, 2019 — 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 statement describes the earliest model of the atom?

(1) An atom is an indivisible hard sphere.
(2) An atom has a small, dense nucleus.
(3) Electrons are negative particles in an atom.
(4) Electrons in an atom have wave-like properties.

2 In all atoms of bismuth, the number of electrons must equal the

(1) number of protons
(2) number of neutrons
(3) sum of the number of neutrons and protons
(4) difference between the number of neutrons and protons

3 Which symbol represents a particle that has a mass approximately equal to the mass of a neutron?

(1) α (3) β^-
(2) β^+ (4) p

4 An orbital is a region in an atom where there is a high probability of finding

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

5 Which electron shell in an atom of calcium in the ground state has an electron with the greatest amount of energy?

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

6 As the elements in Period 2 are considered in order from lithium to fluorine, there is an increase in the

(1) atomic radius
(2) electronegativity
(3) number of electron shells
(4) number of electrons in the first shell

7 Which element is classified as a metalloid?

(1) boron (3) sulfur
(2) potassium (4) xenon

8 Strontium and barium have similar chemical properties because atoms of these elements have the same number of

(1) protons (3) electron shells
(2) neutrons (4) valence electrons

9 Which term represents the fixed proportion of elements in a compound?

(1) atomic mass (3) chemical formula
(2) molar mass (4) density formula

10 Which two terms represent types of chemical formulas?

(1) mechanical and structural
(2) mechanical and thermal
(3) molecular and structural
(4) molecular and thermal

11 Which element has metallic bonds at room temperature?

(1) bromine (3) krypton
(2) cesium (4) sulfur

12 What is the number of electrons shared between the atoms in a molecule of nitrogen, N_2?

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

13 Given the equation representing a reaction:

$$H + H \rightarrow H_2$$

What occurs during this reaction?

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

14 An atom of which element has the strongest attraction for electrons in a chemical bond?

(1) chlorine
(2) carbon
(3) phosphorus
(4) sulfur

15 At STP, a 50.-gram sample of $H_2O(\ell)$ and a 100.-gram sample of $H_2O(\ell)$ have

(1) the same chemical properties
(2) the same volume
(3) different temperatures
(4) different empirical formulas

16 Which statement describes a mixture of sand and water at room temperature?

(1) It is heterogeneous, and its components are in the same phase.
(2) It is heterogeneous, and its components are in different phases.
(3) It is homogeneous, and its components are in the same phase.
(4) It is homogeneous, and its components are in different phases.

17 Distillation is a process used to separate a mixture of liquids based on different

(1) boiling points
(2) densities
(3) freezing points
(4) solubilities

18 According to the kinetic molecular theory, which statement describes the particles in a sample of an ideal gas?

(1) The particles are constantly moving in circular paths.
(2) The particles collide, decreasing the total energy of the system.
(3) The particles have attractive forces between them.
(4) The particles are considered to have negligible volume.

19 Which sample of matter has the greatest distance between molecules at STP?

(1) $N_2(g)$
(2) $NH_3(aq)$
(3) $C_6H_{14}(\ell)$
(4) $C_6H_{12}O_6(s)$

20 For a chemical system at equilibrium, the concentrations of both the reactants and the products must

(1) decrease
(2) increase
(3) be constant
(4) be equal

21 In terms of disorder and energy, systems in nature have a tendency to undergo changes toward

(1) less disorder and lower energy
(2) less disorder and higher energy
(3) greater disorder and lower energy
(4) greater disorder and higher energy

22 The only two elements in alkenes and alkynes are

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

23 Which functional group contains a nitrogen atom and an oxygen atom?

(1) ester
(2) ether
(3) amide
(4) amine

24 When a sample of Mg(s) reacts completely with $O_2(g)$, the Mg(s) loses 5.0 moles of electrons. How many moles of electrons are gained by the $O_2(g)$?

(1) 1.0 mol
(2) 2.5 mol
(3) 5.0 mol
(4) 10.0 mol

25 Which statement describes the reactions in an electrochemical cell?

(1) Oxidation occurs at the anode, and reduction occurs at the cathode.
(2) Oxidation occurs at the cathode, and reduction occurs at the anode.
(3) Oxidation and reduction both occur at the cathode.
(4) Oxidation and reduction both occur at the anode.

26 A 0.050 M aqueous solution of which compound is the best conductor of electric current?

(1) C_3H_7OH
(2) $C_6H_{12}O_6$
(3) $MgSO_4$
(4) K_2SO_4

27 What is the color of bromcresol green indicator in a solution with a pH value of 2.0?

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

28 Which formula can represent hydrogen ions in an aqueous solution?

(1) $OH^-(aq)$
(2) $Hg_2^{2+}(aq)$
(3) $H_3O^+(aq)$
(4) $NH_4^+(aq)$

29 In which reaction is an atom of one element converted into an atom of another element?

(1) combustion
(2) fermentation
(3) oxidation-reduction
(4) transmutation

30 In which type of nuclear reaction do nuclei combine to form a nucleus with a greater mass?

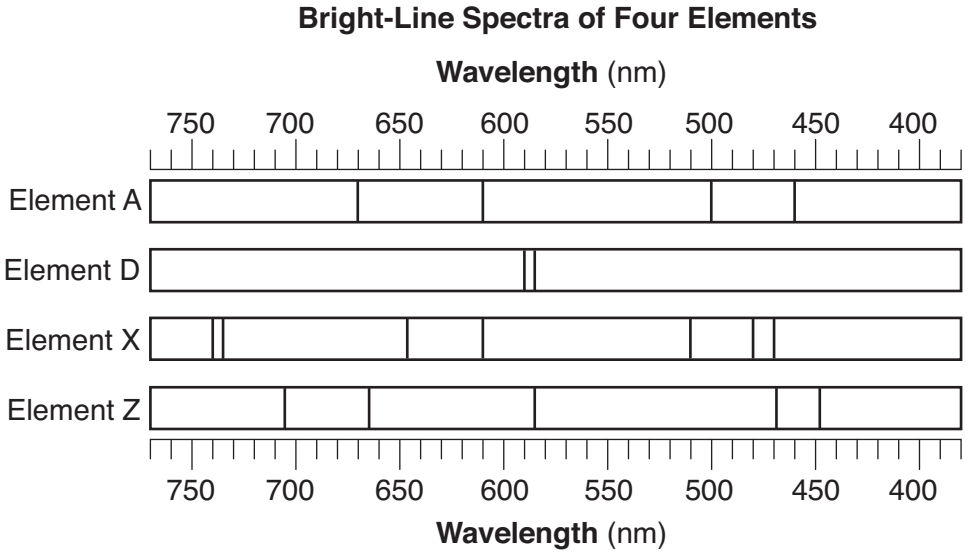
(1) alpha decay
(2) beta decay
(3) fusion
(4) fission

Part B–1

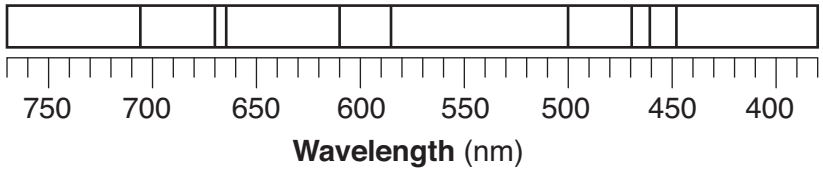
Answer all questions in this part.

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 The bright-line spectra produced by four elements are represented in the diagram below.



Given the bright-line spectrum of a mixture formed from two of these elements:



Which elements are present in this mixture?

(1) *A* and *X*
(2) *A* and *Z*
(3) *D* and *X*
(4) *D* and *Z*

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

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

33 Which notations represent atoms that have the same number of protons but a different number of neutrons?

(1) H-3 and He-3
(2) S-32 and S-32
(3) Cl-35 and Cl-37
(4) Ga-70 and Ge-73

34 What is the chemical name of the compound NH_4SCN?

(1) ammonium thiocyanate
(2) ammonium cyanide
(3) nitrogen hydrogen cyanide
(4) nitrogen hydrogen sulfate

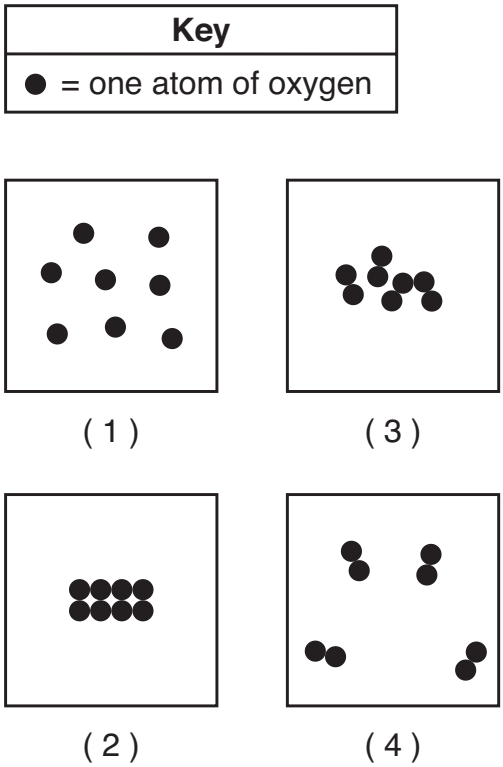
35 Which equation represents a conservation of atoms?

(1) $2Fe + 2O_2 \rightarrow Fe_2O_3$
(2) $2Fe + 3O_2 \rightarrow Fe_2O_3$
(3) $4Fe + 2O_2 \rightarrow 2Fe_2O_3$
(4) $4Fe + 3O_2 \rightarrow 2Fe_2O_3$

36 Which compound has covalent bonds?

(1) H_2O
(2) Li_2O
(3) Na_2O
(4) K_2O

37 Which particle diagram represents a sample of oxygen gas at STP?



38 At which temperature and pressure will a sample of neon gas behave most like an ideal gas?

(1) 300. K and 2.0 atm
(2) 300. K and 4.0 atm
(3) 500. K and 2.0 atm
(4) 500. K and 4.0 atm

39 What is the molarity of 2.0 liters of an aqueous solution that contains 0.50 mole of potassium iodide, KI?

(1) 1.0 M
(2) 2.0 M
(3) 0.25 M
(4) 0.50 M

40 The volumes of four samples of gaseous compounds at 298 K and 101.3 kPa are shown in the table below.

Sample	Compounds	Volume (L)
1	$NH_3(g)$	44.0
2	$CO_2(g)$	33.0
3	$HF(g)$	44.0
4	$CH_4(g)$	22.0

Which two samples contain the same number of molecules?

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

41 Hydrochloric acid reacts faster with powdered zinc than with an equal mass of zinc strips because the greater surface area of the powdered zinc

(1) decreases the frequency of particle collisions
(2) decreases the activation energy of the reaction
(3) increases the frequency of particle collisions
(4) increases the activation energy of the reaction

42 Given the equation representing a system at equilibrium in a sealed, rigid container:

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

Increasing the temperature of the system causes the concentration of

(1) HI to increase
(2) H_2 to increase
(3) HI to remain constant
(4) H_2 to remain constant

43 Based on Table *I*, which equation represents a reaction with the greatest difference between the potential energy of the products and the potential energy of the reactants?

(1) $4Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$

(2) $2H_2(g) + O_2(g) \rightarrow 2H_2O(\ell)$

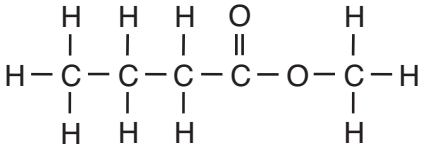
(3) $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(\ell)$

(4) $C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(\ell)$

44 Which phase change results in an increase in entropy?

(1) $I_2(g) \rightarrow I_2(s)$
(2) $CH_4(g) \rightarrow CH_4(\ell)$
(3) $Br_2(\ell) \rightarrow Br_2(g)$
(4) $H_2O(\ell) \rightarrow H_2O(s)$

45 Given the formula for a compound:



What is the name of this compound?

(1) methyl butanoate
(2) methyl butyl ether
(3) pentanone
(4) pentanoic acid

46 Given the equation representing a reaction:

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

During this reaction, each element changes in

(1) atomic number
(2) oxidation number
(3) number of protons per atom
(4) number of neutrons per atom

47 Which equation represents a spontaneous reaction?

(1) $Ca + Ba^{2+} \rightarrow Ca^{2+} + Ba$
(2) $Co + Zn^{2+} \rightarrow Co^{2+} + Zn$
(3) $Fe + Mg^{2+} \rightarrow Fe^{2+} + Mg$
(4) $Mn + Ni^{2+} \rightarrow Mn^{2+} + Ni$

48 Which equation represents a neutralization reaction?

(1) $6HClO \rightarrow 4HCl + 2HClO_3$

(2) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

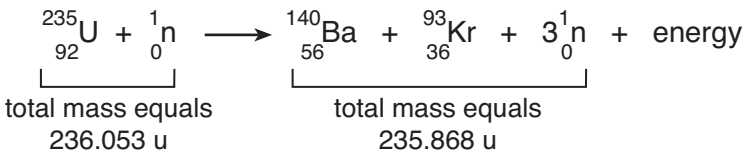
(3) $Ca(OH)_2 + H_2SO_4 \rightarrow CaSO_4 + 2H_2O$

(4) $Ba(OH)_2 + Cu(NO_3)_2 \rightarrow Ba(NO_3)_2 + Cu(OH)_2$

49 Which radioisotope requires long-term storage as the method of disposal, to protect living things from radiation exposure over time?

(1) Pu-239
(2) Fr-220
(3) Fe-53
(4) P-32

50 Given the equation representing a reaction:



Which statement explains the energy term in this reaction?

(1) Mass is gained due to the conversion of mass to energy.
(2) Mass is gained due to the conversion of energy to mass.
(3) Mass is lost due to the conversion of mass to energy.
(4) Mass is lost due to the conversion of energy to mass.

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*.

Base your answers to questions 51 through 53 on the information below and on your knowledge of chemistry.

The only naturally occurring isotopes of nitrogen are N-14 and N-15.

51 State the number of protons in an atom of N-15. [1]

52 State the number of electrons in each shell of a N-14 atom in the ground state. [1]

53 Based on the atomic mass of the element nitrogen on the Periodic Table, compare the relative abundances of the naturally occurring isotopes of nitrogen. [1]

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

The melting points and boiling points of five substances at standard pressure are listed on the table below.

Melting Points and Boiling Points of Five Substances

Substance	Melting Point (K)	Boiling Point (K)
HCl	159	188
NO	109	121
F_2	53	85
Br_2	266	332
I_2	387	457

54 Identify the substance in this table that is a liquid at STP. [1]

55 State, in terms of the strength of intermolecular forces, why I_2 has a higher boiling point than F_2. [1]

56 State what happens to the potential energy of a sample of NO(ℓ) at 121 K as it changes to NO(g) at constant temperature and standard pressure. [1]

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

A 100.-gram sample of liquid water is heated from 20.0°C to 50.0°C. Enough $KClO_3(s)$ is dissolved in the sample of water at 50.0°C to form a saturated solution.

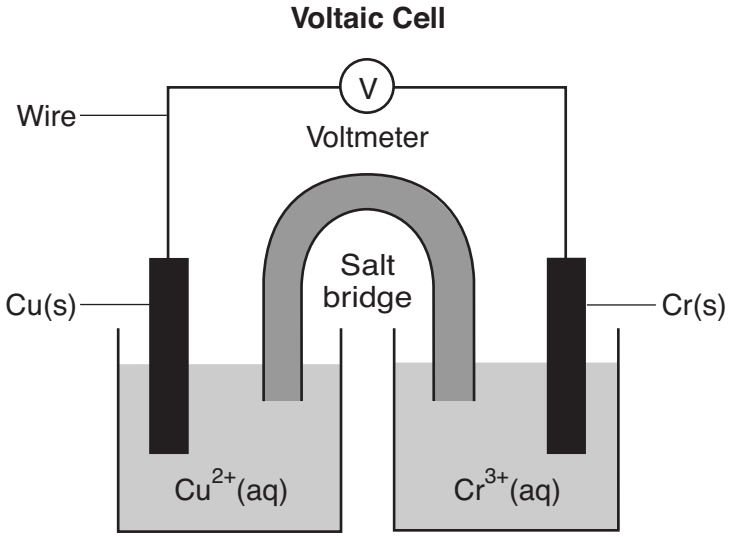
57 Using the information on Table *B*, determine the amount of heat absorbed by the water when the water is heated from 20.0°C to 50.0°C. [1]

58 Based on Table *H*, determine the vapor pressure of the water sample at its final temperature. [1]

59 Based on Table *G*, determine the mass of $KClO_3(s)$ that must dissolve to make a saturated solution in 100. g of H_2O at 50.0°C. [1]

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

The diagram and ionic equation below represent an operating voltaic cell.



$$3Cu^{2+}(aq) + 2Cr(s) \longrightarrow 3Cu(s) + 2Cr^{3+}(aq)$$

60 Identify the subatomic particles that flow through the wires as the cell operates. [1]

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

62 Write a balanced equation for the half-reaction that occurs in the copper half-cell when the cell operates. [1]

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

A NaOH(aq) solution with a pH value of 13 is used to determine the molarity of a HCl(aq) solution. A 10.0-mL sample of the HCl(aq) is exactly neutralized by 16.0 mL of 0.100 M NaOH(aq). During this laboratory activity, appropriate safety equipment was used and safety procedures were followed.

63 Determine the molarity of the HCl(aq) sample, using the titration data. [1]

64 Compare the hydronium ion concentration to the hydroxide ion concentration when the HCl(aq) solution is exactly neutralized by the NaOH(aq) solution. [1]

65 Determine the pH value of a solution that has a $H^+(aq)$ ion concentration 10 times greater than the original NaOH(aq) solution. [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 68 on the information below and on your knowledge of chemistry.

A hydrate is a compound that has water molecules within its crystal structure. Magnesium sulfate heptahydrate, $MgSO_4 \bullet 7H_2O$, is a hydrated form of magnesium sulfate. The hydrated compound has 7 moles of H_2O for each mole of $MgSO_4$. When 5.06 grams of $MgSO_4 \bullet 7H_2O$ are heated to at least 300.°C in a crucible by using a laboratory burner, the water molecules are released. The sample was heated repeatedly, until the remaining $MgSO_4$ had a constant mass of 2.47 grams. During this laboratory activity, appropriate safety equipment was used and safety procedures were followed.

66 Explain why the sample in the crucible was heated repeatedly until the sample had a constant mass. [1]

67 Using the lab data, show a numerical setup for calculating the percent composition by mass of water in the hydrated compound. [1]

68 Determine the gram-formula mass of the magnesium sulfate heptahydrate. [1]

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

Solid sodium chloride, also known as table salt, can be obtained by the solar evaporation of seawater and from underground mining. Liquid sodium chloride can be decomposed by electrolysis to produce liquid sodium and chlorine gas, as represented by the equation below.

$$2NaCl(\ell) \rightarrow 2Na(\ell) + Cl_2(g)$$

69 State, in terms of electrons, why the radius of a Na^+ ion in the table salt is smaller than the radius of a Na atom. [1]

70 Identify the noble gas that has atoms with the same number of electrons as a chloride ion in table salt. [1]

71 In the space *in your answer booklet*, draw a Lewis electron-dot diagram of a Cl_2 molecule. [1]

Base your answers to questions 72 through 75 on the information below and on your knowledge of chemistry.

The enclosed cabin of a submarine has a volume of 2.4×10^5 liters, a temperature of 312 K, and a pressure of 116 kPa. As people in the cabin breathe, carbon dioxide gas, $CO_2(g)$, can build up to unsafe levels. Air in the cabin becomes unsafe to breathe when the mass of $CO_2(g)$ in this cabin exceeds 2156 grams.

72 State what happens to the average kinetic energy of the gas molecules if the cabin temperature *decreases*. [1]

73 Show a numerical setup for calculating the pressure in the submarine cabin if the cabin temperature changes to 293 K. [1]

74 Determine the number of moles of $CO_2(g)$ in the submarine cabin at which the air becomes unsafe to breathe. The gram-formula mass of CO_2 is 44.0 g/mol. [1]

75 Convert the original air pressure in the cabin of the submarine to atmospheres. [1]

Base your answers to questions 76 through 78 on the information below and on your knowledge of chemistry.

Automobile catalytic converters use a platinum catalyst to reduce air pollution by changing emissions such as carbon monoxide, CO(g), into carbon dioxide, $CO_2(g)$. The uncatalyzed reaction is represented by the balanced equation below.

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

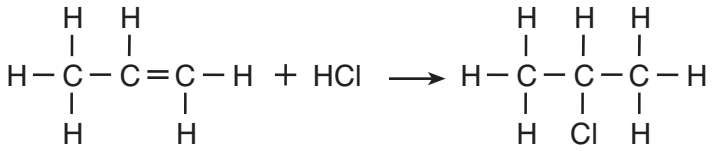
76 On the labeled axes *in your answer booklet*, draw a potential energy diagram for the reaction represented by this equation. [1]

77 Compare the activation energy of the catalyzed reaction to the activation energy of the uncatalyzed reaction. [1]

78 Determine the number of moles of $O_2(g)$ required to completely react with 28 moles of CO(g) during this reaction. [1]

Base your answers to questions 79 through 81 on the information below and on your knowledge of chemistry.

The solvent 2-chloropropane can be made when chemists react propene with hydrogen chloride, as shown in the equation below.



79 Identify the element in propene that is in all organic compounds. [1]

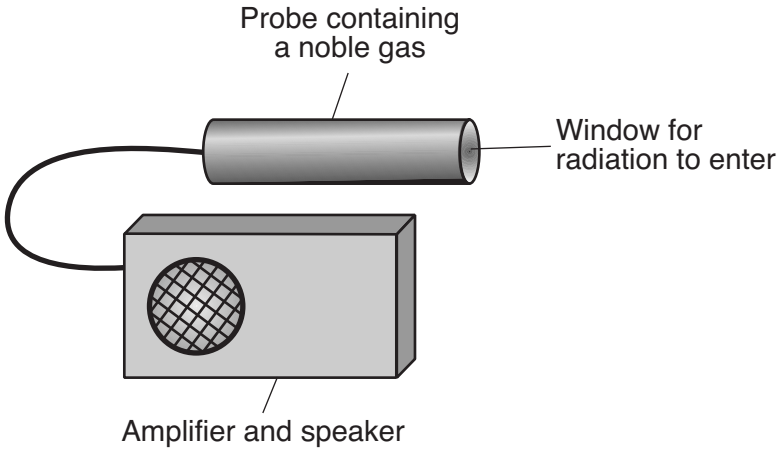
80 Explain, in terms of chemical bonds, why the hydrocarbon reactant is classified as unsaturated. [1]

81 Write the general formula for the homologous series to which propene belongs. [1]

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

Radioactive emissions can be detected by a Geiger counter. When radioactive emissions enter the Geiger counter probe, which contains a noble gas such as argon or helium, some of the atoms are ionized. The ionized gas allows for a brief electric current. The current causes the speaker to make a clicking sound. To make sure that the Geiger counter is measuring radiation properly, the device is tested using the radioisotope Cs-137.

To detect gamma radiation, an aluminum shield can be placed over the probe window, to keep alpha and beta radiation from entering the probe. A diagram that represents the Geiger counter is shown below.



82 Compare the first ionization energy of argon to the first ionization energy of helium. [1]

83 State evidence from the passage that gamma radiation has greater penetrating power than alpha or beta radiation. [1]

84 Determine the time required for a sample of cesium-137 to decay until only $\frac{1}{8}$ of the original sample remains unchanged. [1]

85 Complete the nuclear equation *in your answer booklet* for the decay of Cs-137 by writing a notation for the missing product. [1]

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The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
CHEMISTRY

Tuesday, August 13, 2019 — 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 First shell: _____

Second shell: _____

53 _____

_____

_____

54 _____

55 _____

_____

_____

56 _____

_____

_____

57 _____ **J**

58 _____ **kPa**

59 _____ **g**

60 _____

61 _____

_____

_____

62 _____

63 _____ **M**

64 _____

_____

_____

65 _____

Part C

66 _____

_____

_____

67

68 _____ **g/mol**

69

70

71

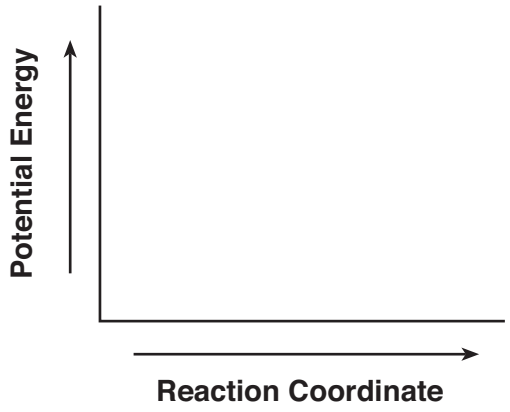
72

73

74 _____ **mol**

75 _____ **atm**

76



77 _____

_____

_____

78 _____ **mol**

79 _____

80 _____

_____

_____

81 _____

82 _____

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83 _____

_____

_____

84 _____ **y**

85 $^{137}_{55}\mathrm{Cs} \rightarrow {}^{0}_{-1}\mathrm{e} +$ _____

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

Regents Examination in Physical Setting/Chemistry – August 2019

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

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

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

Examination	Date	Question Number	Scoring Key	Question Type	Credit	Weight
Physical Setting/Chemistry	August '19	**51**	-	CR	1	1
Physical Setting/Chemistry	August '19	**52**	-	CR	1	1
Physical Setting/Chemistry	August '19	**53**	-	CR	1	1
Physical Setting/Chemistry	August '19	**54**	-	CR	1	1
Physical Setting/Chemistry	August '19	**55**	-	CR	1	1
Physical Setting/Chemistry	August '19	**56**	-	CR	1	1
Physical Setting/Chemistry	August '19	**57**	-	CR	1	1
Physical Setting/Chemistry	August '19	**58**	-	CR	1	1
Physical Setting/Chemistry	August '19	**59**	-	CR	1	1
Physical Setting/Chemistry	August '19	**60**	-	CR	1	1
Physical Setting/Chemistry	August '19	**61**	-	CR	1	1
Physical Setting/Chemistry	August '19	**62**	-	CR	1	1
Physical Setting/Chemistry	August '19	**63**	-	CR	1	1
Physical Setting/Chemistry	August '19	**64**	-	CR	1	1
Physical Setting/Chemistry	August '19	**65**	-	CR	1	1
Physical Setting/Chemistry	August '19	**66**	-	CR	1	1
Physical Setting/Chemistry	August '19	**67**	-	CR	1	1
Physical Setting/Chemistry	August '19	**68**	-	CR	1	1
Physical Setting/Chemistry	August '19	**69**	-	CR	1	1
Physical Setting/Chemistry	August '19	**70**	-	CR	1	1
Physical Setting/Chemistry	August '19	**71**	-	CR	1	1
Physical Setting/Chemistry	August '19	**72**	-	CR	1	1
Physical Setting/Chemistry	August '19	**73**	-	CR	1	1
Physical Setting/Chemistry	August '19	**74**	-	CR	1	1
Physical Setting/Chemistry	August '19	**75**	-	CR	1	1
Physical Setting/Chemistry	August '19	**76**	-	CR	1	1
Physical Setting/Chemistry	August '19	**77**	-	CR	1	1
Physical Setting/Chemistry	August '19	**78**	-	CR	1	1
Physical Setting/Chemistry	August '19	**79**	-	CR	1	1
Physical Setting/Chemistry	August '19	**80**	-	CR	1	1
Physical Setting/Chemistry	August '19	**81**	-	CR	1	1
Physical Setting/Chemistry	August '19	**82**	-	CR	1	1
Physical Setting/Chemistry	August '19	**83**	-	CR	1	1
Physical Setting/Chemistry	August '19	**84**	-	CR	1	1
Physical Setting/Chemistry	August '19	**85**	-	CR	1	1

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

The chart for determining students' final examination scores for the **August 2019 Regents Examination in Physical Setting/Chemistry** will be posted on the Department's web site at http://www.p12.nysed.gov/assessment/ 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 13, 2019 — 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: 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.

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: http://www.p12.nysed.gov/assessment/ on Tuesday, August 13, 2019. 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 for 7 *or* seven.

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

First shell: 2
Second shell: 5

First shell: $2e^-$
Second shell: $5e^-$

First shell: two
Second shell: five

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

Nitrogen-14 is more abundant than nitrogen-15.

There are fewer N-15 atoms.

54 [1] Allow 1 credit for Br_2 *or* bromine.

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

The I_2 has stronger intermolecular forces than F_2.

The F_2 has weaker IMF.

Note: Do *not* allow credit for a response that addresses bonding rather than intermolecular forces.

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

The potential energy of NO increases.

The NO(ℓ) gains PE as it becomes NO(g).

57 [1] Allow 1 credit for 12 500 J *or* any value from 12 500 J to 13 000 J, inclusive.

58 [1] Allow 1 credit for any value from 11 kPa to 13 kPa, inclusive.

59 [1] Allow 1 credit for any value from 20. g to 23 g, inclusive.

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

electrons

e^-

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

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

The salt bridge allows the migration of ions between the half-cells.

The salt bridge prevents polarization of the half-cells.

Electrical neutrality of the solutions is maintained.

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

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

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

$3Cu^{2+} + 6e^- \rightarrow 3Cu$

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

63 [1] Allow 1 credit for 0.160 M *or* .16 M.

64 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

The hydronium ion concentration is equal to the hydroxide ion concentration.

The concentrations of H_3O^+ ions and OH^- ions are the same.

65 [1] Allow 1 credit for 12.0 *or* 12 *or* twelve.

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:

Repeated heatings ensure that all of the water in the sample has been removed.

It is necessary to drive out all of the water from the hydrate.

to make sure all the H_2O is gone

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

$$\frac{5.06\text{ g} - 2.47\text{ g}}{5.06\text{ g}} \times 100$$

$$\frac{2.59(100)}{5.06}$$

$$\frac{2.59}{5.06} = \frac{x}{100}$$

Note: Do *not* allow credit if the fraction is not multiplied by 100.

68 [1] Allow 1 credit for 246 g/mol, *or* any value from 245.989 g/mol to 247 g/mol, inclusive.

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

The Na atom is formed when the Na^+ ion gains an electron.

A Na^+ ion has 10 electrons and a Na atom has 11 electrons.

A sodium atom has one more electron shell than a sodium ion.

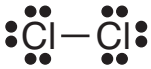
A Na^+ ion is formed when a Na atom loses an electron.

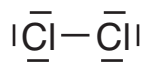
Note: Do *not* allow credit for a response indicating that the sodium ion lost an electron.

70 [1] Allow 1 credit for Ar *or* argon.

71 [1] Allow 1 credit.

Examples of 1-credit responses:





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

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

The average kinetic energy of the gas molecules in the cabin would decrease.

The average KE would be lower.

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

$$\frac{(116\,\text{kPa})(2.4 \times 10^5\,\text{L})}{312\ \text{K}} = \frac{P_2(2.4 \times 10^5\,\text{L})}{293\ \text{K}}$$

$$\frac{116\,\text{kPa}}{312\ \text{K}} = \frac{x}{293\ \text{K}}$$

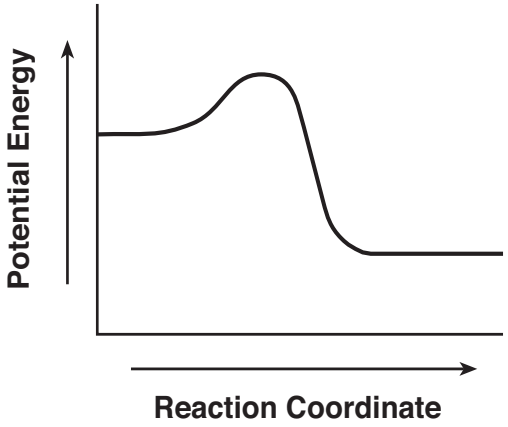
$$\frac{(116)(293)}{312}$$

74 [1] Allow 1 credit for 49.0 mol *or* any value from 49 mol to 50. mol, inclusive.

75 [1] Allow 1 credit for 1.15 atm *or* any value from 1.14 atm to 1.16 atm, inclusive.

76 [1] Allow 1 credit for showing that the PE of the products is lower than the PE of the reactants.

Example of a 1-credit response:



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

The catalyzed reaction has a lower activation energy than the uncatalyzed reaction.

The activation energy is higher for the reaction with no catalyst.

78 [1] Allow 1 credit for 14 mol.

79 [1] Allow 1 credit for C *or* carbon.

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

The hydrocarbon has a carbon-carbon double bond.

The molecule has a C=C bond.

There is a multiple bond in each molecule.

More H atoms could be bonded with this hydrocarbon.

81 [1] Allow 1 credit for C_nH_{2n}.

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

Argon has a lower ionization energy than helium.

The Ar has a first ionization energy of 1521 kJ/mol and the He has a first ionization energy of 2372 kJ/mol.

Helium has a higher first ionization energy than argon.

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

The gamma radiation has much greater penetrating power because it can pass through the aluminum shield.

The alpha and beta particles cannot penetrate the aluminum shield.

The aluminum shield does not stop gamma radiation.

84 [1] Allow 1 credit for 90.6 y. Significant figures do *not* need to be shown.

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

$^{137}_{56}Ba$

^{137}Ba

Ba-137

barium-137

Regents Examination in Physical Setting/Chemistry

August 2019

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

The *Chart for Determining the Final Examination Score for the August 2019 Regents Examination in Physical Setting/Chemistry* will be posted on the Department's web site at: http://www.p12.nysed.gov/assessment/ on Tuesday, August 13, 2019. 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.

Map to Core Curriculum

August 2019 Physical Setting/Chemistry			
Question Numbers			
Key Ideas/Performance Indicators	Part A	Part B	Part C
Standard 1			
Math Key Idea 1		50, 58, 59, 65	67, 73, 75
Math Key Idea 2		38, 43, 50, 53, 62, 65	72, 81, 85
Math Key Idea 3		39, 46, 57, 63	68, 74, 78, 84
Science Inquiry Key Idea 1		41, 48, 51, 55, 56, 60, 61, 64	66, 69, 70, 72, 77, 79, 80, 82, 83
Science Inquiry Key Idea 2			
Science Inquiry Key Idea 3		31, 32, 34, 36, 40, 41, 44, 45, 46, 47, 48, 54, 56, 58, 59, 61, 62	66, 76, 79, 81, 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	71
Key Idea 3		65	
Key Idea 4		42	
Key Idea 5		59	76
Standard 7			
Key Idea 1		49	
Key Idea 2			
Standard 4 Process Skills			
Key Idea 3		31, 32, 33, 35, 37, 39, 41, 42, 44, 45, 47, 51, 52, 53, 54, 59, 60, 61, 62, 63	68, 71, 73, 74, 78, 80, 82, 85
Key Idea 4		56, 57	76, 84
Key idea 5		55	70, 71
Standard 4			
Key Idea 3	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28	31, 32, 33, 34, 35, 37, 38, 39, 40, 41, 42, 44, 45, 46, 47, 48, 51, 52, 53, 54, 59, 60, 61, 62, 63, 64, 65	66, 67, 68, 73, 74, 75, 77, 78, 79, 80, 82, 83
Key Idea 4	30	43, 49, 56, 57	72, 76, 84, 85
Key Idea 5	11, 12, 13, 14, 29	36, 50, 55, 58	69, 70, 71, 81
Reference Tables			
2011 Edition	2, 3, 5, 6, 7, 8, 11, 12, 14, 19, 22, 23, 27, 30	32, 34, 36, 38, 39, 42, 43, 45, 46, 47, 49, 51, 52, 53, 54, 57, 58, 59, 63	67, 68, 69, 70, 71, 73, 74, 75, 79, 81, 82, 84, 85

Regents Examination in Physical Setting/Chemistry – August 2019

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	**87**
75	**86**
74	**85**
73	**83**
72	**82**
71	**81**
70	**80**
69	**79**
68	**78**
67	**78**
66	**77**
65	**76**
64	**75**

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

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

Raw Score	Scale Score
19	**38**
18	**36**
17	**35**
16	**33**
15	**32**
14	**30**
13	**29**
12	**27**
11	**25**
10	**24**
9	**22**
8	**20**
7	**18**
6	**15**
5	**13**
4	**11**
3	**8**
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.