The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
CHEMISTRY

Wednesday, January 27, 2016 — 9:15 a.m. to 12:15 p.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 phrase describes the charge and mass of a neutron?

(1) a charge of +1 and no mass
(2) a charge of +1 and an approximate mass of 1 u
(3) no charge and no mass
(4) no charge and an approximate mass of 1 u

2 What is the number of electrons in a potassium atom?

(1) 18
(2) 19
(3) 20
(4) 39

3 The number of valence electrons in each atom of an element affects the element's

(1) chemical properties
(2) number of isotopes
(3) decay mode
(4) half-life

4 The nuclides I-131 and I-133 are classified as

(1) isomers of the same element
(2) isomers of Xe-131 and Cs-133
(3) isotopes of the same element
(4) isotopes of Xe-131 and Cs-133

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

(1) mass number
(2) atomic number
(3) number of isotopes
(4) number of valence electrons

6 Compared to a 1.0-gram sample of chlorine gas at standard pressure, a 1.0-gram sample of solid aluminum at standard pressure has

(1) a lower melting point
(2) a higher boiling point
(3) a lower density
(4) a greater volume

7 Which processes represent one chemical change and one physical change?

(1) freezing and melting
(2) freezing and vaporization
(3) decomposition and melting
(4) decomposition and combustion

8 In the ground state, an atom of each of the elements in Group 2 has a different

(1) oxidation state
(2) first ionization energy
(3) number of valence electrons
(4) number of electrons in the first shell

9 Which statement explains why water is classified as a compound?

(1) Water can be broken down by chemical means.
(2) Water is a liquid at room temperature.
(3) Water has a heat of fusion of 334 J/g.
(4) Water is a poor conductor of electricity.

10 Which formula is an empirical formula?

(1) CH_4
(2) C_2H_6
(3) C_3H_6
(4) C_4H_{10}

11 Which compound contains both ionic and covalent bonds?

(1) KI
(2) $CaCl_2$
(3) CH_2Br_2
(4) NaCN

12 Given the balanced equation representing a reaction:

$$H_2 \rightarrow H + H$$

What occurs during this reaction?

(1) Energy is absorbed as bonds are formed.
(2) Energy is absorbed as bonds are broken.
(3) Energy is released as bonds are formed.
(4) Energy is released as bonds are broken.

13 Parts per million is used to express the
(1) atomic mass of an element
(2) concentration of a solution
(3) volume of a substance
(4) rate of heat transfer

14 According to Table *F*, which ions combine with chloride ions to form an insoluble compound?
(1) Fe^{2+} ions
(2) Ca^{2+} ions
(3) Li^{+} ions
(4) Ag^{+} ions

15 At 1 atm, equal masses of $H_2O(s)$, $H_2O(\ell)$, and $H_2O(g)$ have
(1) the same density
(2) the same distance between molecules
(3) different volumes
(4) different percent compositions

16 Which list includes three forms of energy?
(1) chemical, mechanical, electromagnetic
(2) chemical, mechanical, temperature
(3) thermal, pressure, electromagnetic
(4) thermal, pressure, temperature

17 At STP, a 1-liter sample of Ne(g) and a 1-liter sample of Kr(g) have the same
(1) mass
(2) density
(3) number of atoms
(4) number of electrons

18 A reaction will most likely occur if the colliding particles have the proper
(1) mass, only
(2) mass and volume
(3) orientation, only
(4) orientation and energy

19 Which factors have the greatest effect on the rate of a chemical reaction between $AgNO_3(aq)$ and Cu(s)?
(1) solution concentration and temperature
(2) solution concentration and pressure
(3) molar mass and temperature
(4) molar mass and pressure

20 Which expression represents the heat of reaction for a chemical change in terms of potential energy, *PE*?
(1) $(PE_{products}) + (PE_{reactants})$
(2) $(PE_{products}) - (PE_{reactants})$
(3) $(PE_{products}) \times (PE_{reactants})$
(4) $(PE_{products}) \div (PE_{reactants})$

21 When a chemical reaction is at equilibrium, the concentration of each reactant and the concentration of each product must be
(1) constant
(2) variable
(3) equal
(4) zero

22 Which element is present in all organic compounds?
(1) nitrogen
(2) oxygen
(3) carbon
(4) sulfur

23 Two types of organic reactions are
(1) deposition and saponification
(2) deposition and transmutation
(3) polymerization and saponification
(4) polymerization and transmutation

24 Given the balanced equation representing a reaction:

$$2Al(s) + 3Cu^{2+}(aq) \rightarrow 2Al^{3+}(aq) + 3Cu(s)$$

Which particles are transferred in this reaction?
(1) electrons
(2) neutrons
(3) positrons
(4) protons

25 In an operating voltaic cell, reduction occurs
(1) at the anode
(2) at the cathode
(3) in the salt bridge
(4) in the wire

26 Which type of substance yields hydrogen ions, H^{+}, in an aqueous solution?
(1) an Arrhenius acid
(2) an Arrhenius base
(3) a saturated hydrocarbon
(4) an unsaturated hydrocarbon

27 Phenolphthalein is pink in an aqueous solution having a pH of

(1) 5 (3) 7
(2) 2 (4) 12

28 According to one acid-base theory, NH_3 acts as a base when an NH_3 molecule

(1) accepts an H^+ ion
(2) donates an H^+ ion
(3) accepts an OH^- ion
(4) donates an OH^- ion

29 Which reaction releases the greatest amount of energy per mole of reactant?

(1) decomposition (3) fermentation
(2) esterification (4) fission

30 Which nuclear emission is negatively charged?

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

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 Which electron configuration represents an atom of chlorine in an excited state?

(1) 2-7-7
(2) 2-7-8
(3) 2-8-7
(4) 2-8-8

32 Given the balanced equation representing a reaction occurring at 101.3 kilopascals and 298 K:

$$2H_2(g) + O_2(g) \rightarrow 2H_2O(\ell) + \text{energy}$$

What is the net amount of energy released when *one* mole of $H_2O(\ell)$ is produced?

(1) 241.8 kJ
(2) 285.8 kJ
(3) 483.6 kJ
(4) 571.6 kJ

33 Element *X* reacts with copper to form the compounds Cu*X* and CuX_2. In which group on the Periodic Table is element *X* found?

(1) Group 1
(2) Group 2
(3) Group 13
(4) Group 17

34 What is the mass of 1.5 moles of CO_2?

(1) 66 g
(2) 44 g
(3) 33 g
(4) 29 g

35 Given the balanced equation representing a reaction:

$$K_2CO_3(aq) + BaCl_2(aq) \rightarrow 2KCl(aq) + BaCO_3(s)$$

Which type of reaction is represented by this equation?

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

36 Which sample, when dissolved in 1.0 liter of water, produces a solution with the highest boiling point?

(1) 0.1 mole KI
(2) 0.2 mole KI
(3) 0.1 mole $MgCl_2$
(4) 0.2 mole $MgCl_2$

37 Given the balanced equation representing a reaction:

$$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$$

What is the number of moles of $H_2O(g)$ formed when 2.0 moles of $NH_3(g)$ react completely?

(1) 6.0 mol
(2) 2.0 mol
(3) 3.0 mol
(4) 4.0 mol

38 A rigid cylinder with a movable piston contains a sample of gas. At 300. K, this sample has a pressure of 240. kilopascals and a volume of 70.0 milliliters. What is the volume of this sample when the temperature is changed to 150. K and the pressure is changed to 160. kilopascals?

(1) 35.0 mL
(2) 52.5 mL
(3) 70.0 mL
(4) 105 mL

39 A 100.-gram sample of $H_2O(\ell)$ at 22.0°C absorbs 8360 joules of heat. What will be the final temperature of the water?

(1) 18.3°C
(2) 20.0°C
(3) 25.7°C
(4) 42.0°C

40 Which compound has the strongest hydrogen bonding at STP?

(1) H_2O
(2) H_2S
(3) H_2Se
(4) H_2Te

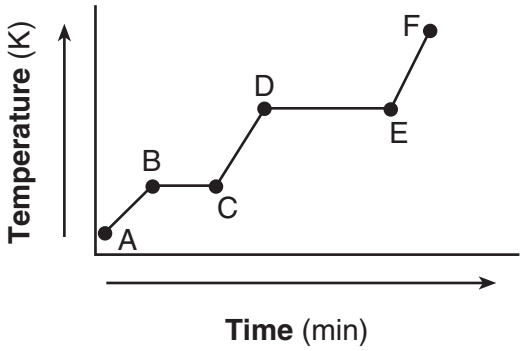
41 Which formula represents an unsaturated hydrocarbon?

(1) C_2H_4
(2) C_3H_8
(3) C_4H_{10}
(4) C_5H_{12}

42 Which radioisotope is used in dating geological formations?

(1) I-131
(2) U-238
(3) Ca-37
(4) Fr-220

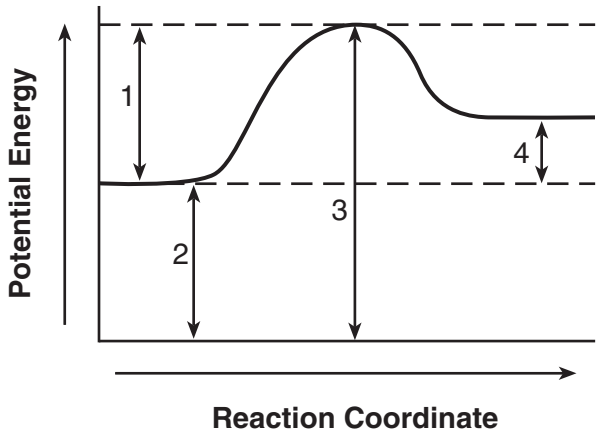
43 The heating curve below represents a sample of a substance starting as a solid below its melting point and being heated over a period of time.



Which statement describes the energy of the particles in this sample during interval *DE*?

(1) Both potential energy and average kinetic energy increase.
(2) Both potential energy and average kinetic energy decrease.
(3) Potential energy increases and average kinetic energy remains the same.
(4) Potential energy remains the same and average kinetic energy increases.

44 Given the potential energy diagram for a reaction:



Which intervals are affected by the addition of a catalyst?

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

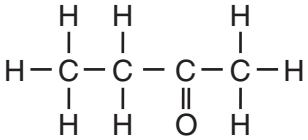
45 Which balanced equation represents a redox reaction?

(1) $Mg + Cl_2 \rightarrow MgCl_2$
(2) $CaO + H_2O \rightarrow Ca(OH)_2$
(3) $HNO_3 + NaOH \rightarrow NaNO_3 + H_2O$
(4) $NaCl + AgNO_3 \rightarrow AgCl + NaNO_3$

46 The pH of a solution is 7. When acid is added to the solution, the hydronium ion concentration becomes 100 times greater. What is the pH of the new solution?

(1) 1
(2) 5
(3) 9
(4) 14

47 Given the formula for a compound:



A chemical name for this compound is

(1) butanal
(2) butanol
(3) butanone
(4) butanoic acid

48 What occurs in both fusion and fission reactions?

(1) Small amounts of energy are converted into large amounts of matter.
(2) Small amounts of matter are converted into large amounts of energy.
(3) Heavy nuclei are split into lighter nuclei.
(4) Light nuclei are combined into heavier nuclei.

49 Given the reaction:

$$^{27}_{13}Al + {}^{4}_{2}He \rightarrow X + {}^{1}_{0}n$$

Which particle is represented by *X*?

(1) $^{28}_{12}Mg$
(2) $^{28}_{13}Al$
(3) $^{30}_{14}Si$
(4) $^{30}_{15}P$

50 A radioactive isotope has a half-life of 2.5 years. Which fraction of the original mass remains unchanged after 10. years?

(1) 1/2
(2) 1/4
(3) 1/8
(4) 1/16

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.*

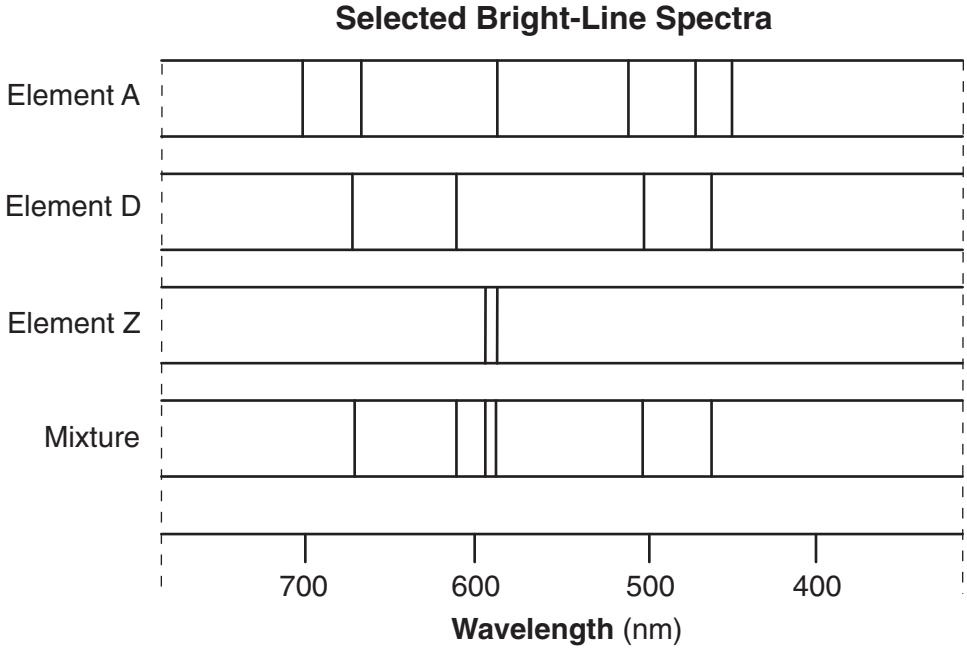
51 Based on Table *H*, state the vapor pressure of ethanol at 75°C. [1]

52 Show a numerical setup for calculating the percent composition by mass of silicon in SiO_2. [1]

53 Explain, in terms of element classification, why K_2O is an ionic compound. [1]

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

The bright-line spectra observed in a spectroscope for three elements and a mixture of two of these elements are represented in the diagram below.



54 State evidence from the bright-line spectra that indicates element *A* is *not* present in the mixture. [1]

55 Explain why the spectrum produced by a 1-gram sample of element Z would have the same spectral lines at the same wavelengths as the spectrum produced by a 2-gram sample of element Z. [1]

56 Describe, in terms of *both* electrons and energy states, how the light represented by the spectral lines is produced. [1]

Base your answers to questions 57 through 61 on the information below and on your knowledge of chemistry.

The Lewis electron-dot diagrams for three substances are shown below.

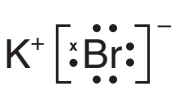


Diagram 1

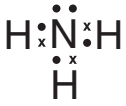


Diagram 2

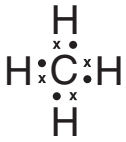


Diagram 3

57 Describe, in terms of valence electrons, how the chemical bonds form in the substance represented in diagram 1. [1]

58 Determine the total number of electrons in the bonds between the nitrogen atom and the three hydrogen atoms represented in diagram 2. [1]

59 Explain, in terms of distribution of charge, why a molecule of the substance represented in diagram 3 is nonpolar. [1]

60 Draw a Lewis electron-dot diagram for a molecule of Br_2. [1]

61 Identify the noble gas that has atoms with the same electron configuration as the positive ion represented in diagram 1, when both the atoms and the ion are in the ground state. [1]

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

A NaOH(aq) solution and an acid-base indicator are used to determine the molarity of an HCl(aq) solution. A 25.0-milliliter sample of the HCl(aq) is exactly neutralized by 15.0 milliliters of 0.20 M NaOH(aq).

62 Identify the laboratory process described in this passage. [1]

63 Complete the equation *in your answer booklet* for the neutralization reaction that occurs, by writing a formula for *each* product. [1]

64 Based on the data, the calculated molarity of the HCl(aq) solution should be expressed to what number of significant figures? [1]

65 Using the data, determine the concentration of the HCl(aq). [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.

Elements with an atomic number greater than 92 can be artificially produced in nuclear reactions by bombarding a naturally occurring nuclide with a different nuclide. One of these elements is roentgenium, Rg. The equation below represents a nuclear reaction that produces Rg-272.

$$^{209}_{83}\text{Bi} + ^{64}_{28}\text{Ni} \rightarrow ^{272}_{111}\text{Rg} + ^{1}_{0}\text{n}$$

66 State the location and the total charge of the protons in a Ni-64 atom. [1]

67 Determine the number of neutrons in an atom of Rg-272. [1]

68 Based on the Periodic Table, classify the element produced by this nuclear reaction as a metal, metalloid, nonmetal, or noble gas. [1]

Base your answers to questions 69 through 72 on the information below and on your knowledge of chemistry.

Hydrazine, N_2H_4, is a compound that is very soluble in water and has a boiling point of 113°C at standard pressure. Unlike water, hydrazine is very reactive and is sometimes used as a fuel for small rockets. One hydrazine reaction producing gaseous products is represented by the balanced equation below.

$$N_2H_4(\ell) \rightarrow N_2(g) + 2H_2(g) + \text{heat}$$

69 Compare the entropy of the products to the entropy of the reactant for this reaction. [1]

70 Based on Table *S*, determine the electronegativity difference for the N-H bond in hydrazine. [1]

71 Explain, in terms of molecular polarity, why N_2H_4 is very soluble in water. [1]

72 Explain, in terms of intermolecular forces, why the boiling point of hydrazine at standard pressure is higher than the boiling point of water at standard pressure. [1]

Base your answers to questions 73 through 75 on the information below and on your knowledge of chemistry.

A laboratory technician is given the table below and a sample of one of the three substances listed in the table. The technician makes an aqueous solution with a portion of the sample. When a conductivity tester is lowered into the solution, the lightbulb on the tester glows brightly. Another portion of the sample is placed in a heat-resistant container that is placed in an oven at 450.°C. The sample melts.

Some Properties of Three Substances

Property	Substance		
	Sodium nitrate	**Potassium chromate**	**Sulfur**
solubility in water at 20.°C	soluble	soluble	insoluble
electrical conductivity of aqueous solution	good	good	not applicable
melting point (°C)	307	974	115

73 Identify the substance given to the technician. [1]

74 State evidence that makes it necessary to use more than one property to identify the substance given to the technician. [1]

75 Explain, in terms of ions, why an aqueous solution of potassium chromate conducts an electric current. [1]

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

Natural gas and coal are two fuels burned to produce energy. Natural gas consists of approximately 80% methane, 10% ethane, 4% propane, 2% butane, and other components.

The burning of coal usually produces sulfur dioxide, $SO_2(g)$, and sulfur trioxide, $SO_3(g)$, which are major air pollutants. Both $SO_2(g)$ and $SO_3(g)$ react with water in the air to form acids.

76 Write the general formula for the homologous series that includes the components of the natural gas listed in this passage. [1]

77 Draw a structural formula for the hydrocarbon that is approximately 2% of natural gas. [1]

78 Complete the equation *in your answer booklet* representing the reaction of sulfur trioxide with water to produce sulfuric acid, by writing the formula of the missing reactant and the formula of the missing product. [1]

Base your answers to questions 79 through 82 on the information below and on your knowledge of chemistry.

A student prepares two 141-gram mixtures, *A* and *B*. Each mixture consists of NH_4Cl, sand, and H_2O at 15°C. Both mixtures are thoroughly stirred and allowed to stand. The mass of each component used to make the mixtures is listed in the data table below.

Mass of the Components in Each Mixture

Component	Mixture A (g)	Mixture B (g)
NH_4Cl	40.	10.
sand	1	31
H_2O	100.	100.

79 State evidence from the table indicating that the proportion of the components in a mixture can vary. [1]

80 Which type of mixture is mixture *B*? [1]

81 Determine the temperature at which all of the NH_4Cl in mixture *A* dissolves to form a saturated solution. [1]

82 Describe *one* property of sand that would enable the student to separate the sand from the other components in mixture *B*. [1]

Base your answers to questions 83 through 85 on the information below and on your knowledge of chemistry.

Fossil fuels produce air pollution and may eventually be depleted. Scientists are researching ways to use hydrogen as an alternate fuel.

A device called an artificial leaf was invented to produce hydrogen and oxygen using sunlight and water. The artifical leaf is an electrochemical cell. Equations 1 and 2 below represent the reactions taking place in the leaf. Equation 3 represents a reaction of hydrogen when used as fuel.

Equation 1: $2H_2O + \text{energy from sunlight} \rightarrow O_2 + 4H^+ + 4e^-$

Equation 2: $4H^+ + 4e^- \rightarrow 2H_2$

Equation 3: $2H_2(g) + O_2(g) \rightarrow 2H_2O(g) + \text{energy}$

83 State *one* benefit of using the artificial leaf to produce hydrogen. [1]

84 Explain, in terms of energy, why the artificial leaf is an electrolytic cell. [1]

85 State the change in oxidation number of oxygen during the reaction represented in equation 3. [1]

P.S./CHEMISTRY

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
CHEMISTRY

Wednesday, January 27, 2016 — 9:15 a.m. to 12:15 p.m., only

ANSWER BOOKLET

Student . . . . . Sex: ☐ Male ☐ Female

Teacher . . . . . .

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

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

Part B–2

51 _____ **kPa**

52

53 _____

_____

_____

54

55

56

57

58

59

60

61 _____

62 _____

63 $HCl(aq) + NaOH(aq) \rightarrow$ _____ + _____

64 _____

65 _____ **M**

Part C

66 Location of protons: _____

Total charge of protons: _____

67 _____

68 _____

69 _____

_____

_____

70 _____

71 _____

_____

_____

72 _____

_____

_____

73 _____

74 _____

_____

_____

75 _____

_____

_____

76 _____

77

78 _____ (g) + $H_2O(\ell)$ → _____ (aq)

79 _____

_____

_____

80 _____

81 _____ **°C**

82 _____

_____

_____

83 _____

_____

_____

84 _____

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_____

85 From _____ to _____

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P.S./CHEMISTRY

FOR TEACHERS ONLY

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

P.S.–CH PHYSICAL SETTING/CHEMISTRY

Wednesday, January 27, 2016 — 9:15 a.m. to 12:15 p.m., only

SCORING KEY AND RATING GUIDE

Directions to the Teacher:

Refer to the directions on page 2 before rating student papers.

Updated information regarding the rating of this examination may be posted on the New York State Education Department's web site during the rating period. Check this web site at: http://www.p12.nysed.gov/assessment/ and select the link "Scoring Information" for any recently posted information regarding this examination. This site should be checked before the rating process for this examination begins and several times throughout the Regents Examination period.

Part A and Part B–1

Allow 1 credit for each correct response.

Part A

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

Part B–1

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

Directions to the Teacher

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

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

Allow 1 credit for each correct response.

At least two science teachers must participate in the scoring of the Part B–2 and Part C open-ended questions on a student's paper. Each of these teachers should be responsible for scoring a selected number of the open-ended questions on each answer paper. No one teacher is to score more than approximately one-half of the open-ended questions on a student's answer paper. Teachers may not score their own students' answer papers.

Students' responses must be scored strictly according to the Scoring Key and Rating Guide. For open-ended questions, credit may be allowed for responses other than those given in the rating guide if the response is a scientifically accurate answer to the question and demonstrates adequate knowledge, as indicated by the examples in the rating guide. On the student's separate answer sheet, for each question, record the number of credits earned and the teacher's assigned rater/scorer letter.

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

For hand scoring, raters should enter the scores earned in the appropriate boxes printed on the separate answer sheet. Next, the rater should add these scores and enter the total in the box labeled "Total Raw Score." Then the student's raw score should be converted to a scale score by using the conversion chart that will be posted on the Department's web site at: http://www.p12.nysed.gov/assessment/ on Wednesday, January 27, 2016. 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 any value from 84 kPa to 87 kPa, inclusive.

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

$$\frac{28.0855\ \text{g}}{28.0855\ \text{g} + 2(15.9994\ \text{g})} \times 100$$

$$\frac{28.1\ \text{u}}{60.1\ \text{u}} \times 100$$

$$\frac{28(100)}{60}$$

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

A metal reacts with a nonmetal to produce an ionic compound.

Potassium is a metal and oxygen is a nonmetal.

54 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

Not all of the wavelengths of element *A* are shown in the wavelengths of the mixture.

The mixture has no spectral line at 700 nm.

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

The wavelengths of the spectral lines for element Z are independent of the mass of the sample.

All atoms of element Z have the same electron configuration in the ground state.

The intensive properties of an element remain constant.

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

Different colors of light are produced when electrons return from higher energy states to lower energy states.

Light energy can be emitted when electrons in excited atoms return to lower shells.

Electrons release energy as they move toward the ground state.

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

Valence electrons are lost by potassium and gained by bromine.

The ions form as a result of a transfer of electrons between the atoms.

58 [1] Allow 1 credit for 6 *or* six.

59 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

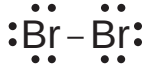
Charge is symmetrically distributed.

The molecule has uniform charge distribution.

The centers of positive charge and negative charge coincide.

60 [1] Allow 1 credit. The positions of the electrons can vary.

Examples of 1-credit responses:



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

argon

Ar

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

titration

volumetric analysis

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

$HCl(aq) + NaOH(aq) \rightarrow \underline{H_2O(\ell)} + \underline{NaCl(aq)}$

$HCl(aq) + NaOH(aq) \rightarrow \underline{NaCl} + \underline{HOH}$

64 [1] Allow 1 credit for 2 *or* two.

65 [1] Allow 1 credit for 0.12 M. Significant figures do *not* need to be shown.

Part C

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

66 [1] Allow 1 credit for a correct combination of the location and the total charge of the protons. Acceptable responses include, but are not limited to:

Location of protons:

in the nucleus

the small, dense center of an atom

center of an atom

Total charge of protons:

+28

28+

28

67 [1] Allow 1 credit for 161.

68 [1] Allow 1 credit for metal *or* transition metal.

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

The gaseous products have greater entropy than the liquid reactant.

The products are more disordered.

70 [1] Allow 1 credit for 0.8 *or* .8.

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

Hydrazine is very soluble in water because the molecular polarity of hydrazine is similar to the molecular polarity of water.

Water and hydrazine are both polar.

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

The intermolecular forces in hydrazine must be greater than the intermolecular forces in water.

The intermolecular forces in H_2O are weaker.

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

sodium nitrate

$NaNO_3$

74 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

Sodium nitrate and potassium chromate are both soluble in water and are good conductors in solution. Therefore, the melting points are needed to identify the substance.

Solubility alone cannot be used because two of the substances are soluble in water.

Two of the substances melt below 450.°C.

Electrical conductivity is not sufficient to differentiate the two salts.

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

An aqueous solution of potassium chromate has mobile ions that conduct electricity.

The K_2CrO_4 dissociated into mobile ions.

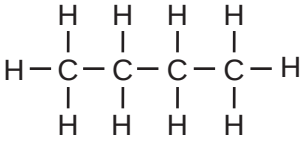
Aqueous potassium chromate has charged particles that can move.

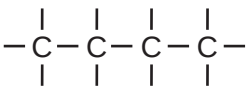
The $K^+(aq)$ and $CrO_4^{2-}(aq)$ move freely.

76 [1] Allow 1 credit for C_nH_{2n+2}.

77 [1] Allow 1 credit.

Examples of 1-credit responses:





78 [1] Allow 1 credit. The order of the elements in each compound may vary.

$\underline{SO_3}(g) + H_2O(\ell) \rightarrow \underline{H_2SO_4}(aq)$

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

The ratio by mass of NH_4Cl to H_2O in mixture *A* is 40. g/100. g, and the ratio in mixture *B* is 10. g/100. g.

Both mixtures have the same total mass, but have different amounts of sand.

Mixture *B* has more sand.

The mixtures have different proportions of NH_4Cl.

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

heterogeneous

nonuniform mixture

81 [1] Allow 1 credit for any value from 23°C to 26°C, inclusive.

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

Sand is insoluble in water.

Sand particles are too large to pass through filter paper.

Sand is more dense than $NH_4Cl(aq)$.

Sand remains a solid in the mixture.

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

The hydrogen could replace the use of fossil fuel.

The use of hydrogen as a car fuel could reduce air pollution.

The H_2 fuel is renewable.

Water is a nonpolluting product.

The leaf uses renewable resources.

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

Sunlight is used as an external power source for the cell.

Sunlight is required to cause a nonspontaneous chemical change.

Energy is required.

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

From 0 to −2

From 0 to 2−

From zero to negative two

Regents Examination in Physical Setting/Chemistry

January 2016

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

The *Chart for Determining the Final Examination Score for the January 2016 Regents Examination in Physical Setting/Chemistry* will be posted on the Department's web site at: http://www.p12.nysed.gov/assessment/ on Wednesday, January 27, 2016. 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

January 2016 Physical Setting/Chemistry			
Question Numbers			
Key Ideas/Performance Indicators	Part A	Part B	Part C
Standard 1			
Math Key Idea 1		52, 64	
Math Key Idea 2		33, 44, 50, 51	73
Math Key Idea 3		32, 34, 38, 39, 65	67, 70, 85
Science Inquiry Key Idea 1		53, 55, 56, 57, 59, 61, 62	66, 71, 72, 74, 75, 79, 80, 82, 84
Science Inquiry Key Idea 2			
Science Inquiry Key Idea 3		32, 36, 40, 45, 46, 47, 49, 51, 54, 58, 63	66, 69, 73, 74, 76, 78, 79, 80, 85
Engineering Design Key Idea 1			
Standard 2			
Key Idea 1			68
Key Idea 2			
Key Idea 3			
Standard 6			
Key Idea 1			
Key Idea 2			
Key Idea 3		46	
Key Idea 4			
Key Idea 5		43	81
Standard 7			
Key Idea 1			83
Key Idea 2			
Standard 4 Process Skills			
Key Idea 3		31, 33, 34, 35, 37, 38, 41, 45, 47, 52, 54, 63, 65	67, 68, 69, 71, 77, 78, 81, 84
Key Idea 4		39, 42, 43, 44, 48, 49, 50	
Key idea 5		57, 60, 61	72
Standard 4			
Key Idea 3	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 17, 18, 19, 21, 22, 23, 24, 25, 26, 27, 28, 30	31, 33, 34, 35, 36, 37, 38, 41, 44, 45, 46, 47, 52, 54, 55, 56, 62, 63, 64, 65	66, 67, 68, 69, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85
Key Idea 4	16, 20	32, 39, 42, 43, 49, 50	
Key Idea 5	11, 12, 29	40, 48, 51, 53, 57, 58, 59, 60, 61	70, 71, 72
Reference Tables			
2011 Edition	1, 2, 5, 6, 8, 11, 13, 14, 27, 30	31, 32, 33, 34, 38, 39, 41, 42, 45, 47, 49, 51, 52, 53, 60, 61, 63, 65	67, 68, 70, 76, 77, 78, 81, 85

Regents Examination in Physical Setting/Chemistry – January 2016

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

Raw Score	Scale Score
85	**100**
84	**98**
83	**97**
82	**95**
81	**94**
80	**92**
79	**91**
78	**89**
77	**88**
76	**87**
75	**86**
74	**85**
73	**84**
72	**83**
71	**82**
70	**81**
69	**80**
68	**79**
67	**78**
66	**77**
65	**76**
64	**75**
63	**74**

Raw Score	Scale Score
62	**74**
61	**73**
60	**72**
59	**71**
58	**71**
57	**70**
56	**69**
55	**68**
54	**68**
53	**67**
52	**66**
51	**66**
50	**65**
49	**64**
48	**63**
47	**63**
46	**62**
45	**61**
44	**61**
43	**60**
42	**59**
41	**59**
40	**58**

Raw Score	Scale Score
39	**57**
38	**56**
37	**56**
36	**55**
35	**54**
34	**53**
33	**52**
32	**51**
31	**50**
30	**50**
29	**49**
28	**48**
27	**47**
26	**46**
25	**45**
24	**43**
23	**42**
22	**41**
21	**40**
20	**39**
19	**37**
18	**36**
17	**34**

Raw Score	Scale Score
16	**33**
15	**32**
14	**30**
13	**28**
12	**27**
11	**25**
10	**23**
9	**21**
8	**19**
7	**17**
6	**15**
5	**13**
4	**10**
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.