The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
CHEMISTRY

Wednesday, August 17, 2016 — 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 change occurs when an atom in an excited state returns to the ground state?

(1) Energy is emitted.
(2) Energy is absorbed.
(3) The number of electrons decreases.
(4) The number of electrons increases.

2 The valence electrons in an atom of phosphorus in the ground state are all found in

(1) the first shell
(2) the second shell
(3) the third shell
(4) the fourth shell

3 Which two elements have the most similar chemical properties?

(1) beryllium and magnesium
(2) hydrogen and helium
(3) phosphorus and sulfur
(4) potassium and strontium

4 Which phrase describes a compound that consists of two elements?

(1) a mixture in which the elements are in a variable proportion
(2) a mixture in which the elements are in a fixed proportion
(3) a substance in which the elements are chemically combined in a variable proportion
(4) a substance in which the elements are chemically combined in a fixed proportion

5 The formula mass of a compound is the

(1) sum of the atomic masses of its atoms
(2) sum of the atomic numbers of its atoms
(3) product of the atomic masses of its atoms
(4) product of the atomic numbers of its atoms

6 The arrangement of the elements from left to right in Period 4 on the Periodic Table is based on

(1) atomic mass
(2) atomic number
(3) the number of electron shells
(4) the number of oxidation states

7 Which diatomic molecule is formed when the two atoms share six electrons?

(1) H_2
(2) N_2
(3) O_2
(4) F_2

8 Which formula represents a polar molecule?

(1) O_2
(2) CO_2
(3) NH_3
(4) CH_4

9 Which element is *least* likely to undergo a chemical reaction?

(1) lithium
(2) carbon
(3) fluorine
(4) neon

10 Which element has a melting point higher than the melting point of rhenium?

(1) iridium
(2) osmium
(3) tantalum
(4) tungsten

11 Which property can be defined as the ability of a substance to be hammered into thin sheets?

(1) conductivity
(2) malleability
(3) melting point
(4) solubility

12 Which list of elements consists of a metal, a metalloid, and a noble gas?

(1) aluminum, sulfur, argon
(2) magnesium, sodium, sulfur
(3) sodium, silicon, argon
(4) silicon, phosphorus, chlorine

13 Which sample of matter has a crystal structure?

(1) $Hg(\ell)$
(2) $H_2O(\ell)$
(3) $NaCl(s)$
(4) $CH_4(g)$

14 One mole of liquid water and one mole of solid water have *different*

(1) masses
(2) properties
(3) empirical formulas
(4) gram-formula masses

15 Which substance can *not* be broken down by a chemical change?

(1) butanal
(2) propene
(3) gold
(4) water

16 Which statement describes particles of an ideal gas, based on the kinetic molecular theory?

(1) Gas particles are separated by distances smaller than the size of the gas particles.
(2) Gas particles do not transfer energy to each other when they collide.
(3) Gas particles have no attractive forces between them.
(4) Gas particles move in predictable, circular motion.

17 Which expression could represent the concentration of a solution?

(1) 3.5 g
(2) 3.5 M
(3) 3.5 mL
(4) 3.5 mol

18 Which form of energy is associated with the random motion of the particles in a sample of water?

(1) chemical energy
(2) electrical energy
(3) nuclear energy
(4) thermal energy

19 Which change is most likely to occur when a molecule of H_2 and a molecule of I_2 collide with proper orientation and sufficient energy?

(1) a chemical change, because a compound is formed
(2) a chemical change, because an element is formed
(3) a physical change, because a compound is formed
(4) a physical change, because an element is formed

20 Which changes can reach dynamic equilibrium?

(1) nuclear changes, only
(2) chemical changes, only
(3) nuclear and physical changes
(4) chemical and physical changes

21 What occurs when a reaction reaches equilibrium?

(1) The concentration of the reactants increases.
(2) The concentration of the products increases.
(3) The rate of the forward reaction is equal to the rate of the reverse reaction.
(4) The rate of the forward reaction is slower than the rate of the reverse reaction.

22 In terms of potential energy, *PE*, which expression defines the heat of reaction for a chemical change?

(1) $PE_{products} - PE_{reactants}$

(2) $PE_{reactants} - PE_{products}$

(3) $\frac{PE_{products}}{PE_{reactants}}$

(4) $\frac{PE_{reactants}}{PE_{products}}$

23 Systems in nature tend to undergo changes that result in

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

24 What occurs when Cr^{3+} ions are reduced to Cr^{2+} ions?

(1) Electrons are lost and the oxidation number of chromium increases.
(2) Electrons are lost and the oxidation number of chromium decreases.
(3) Electrons are gained and the oxidation number of chromium increases.
(4) Electrons are gained and the oxidation number of chromium decreases.

25 Where do reduction and oxidation occur in an electrolytic cell?

(1) Both occur at the anode.
(2) Both occur at the cathode.
(3) Reduction occurs at the anode, and oxidation occurs at the cathode.
(4) Reduction occurs at the cathode, and oxidation occurs at the anode.

26 Which compound is an electrolyte?

(1) H_2O
(2) C_2H_6
(3) H_3PO_4
(4) CH_3OH

27 When the hydronium ion concentration of an aqueous solution is increased by a factor of 10, the pH value of the solution

(1) decreases by 1
(2) increases by 1
(3) decreases by 10
(4) increases by 10

28 The stability of isotopes is related to the ratio of which particles in the atoms?

(1) electrons and protons
(2) electrons and positrons
(3) neutrons and protons
(4) neutrons and positrons

29 Which radioisotope has the fastest rate of decay?

(1) ^{14}C
(2) ^{37}Ca
(3) ^{53}Fe
(4) ^{42}K

30 The atomic mass of an element is the weighted average of the atomic masses of

(1) the least abundant isotopes of the element
(2) the naturally occurring isotopes of the element
(3) the artificially produced isotopes of the element
(4) the natural and artificial isotopes of the element

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 list of elements is arranged in order of increasing electronegativity?

(1) Be, Mg, Ca
(2) F, Cl, Br
(3) K, Ca, Sc
(4) Li, Na, K

32 The table below gives the masses of two different subatomic particles found in an atom.

Subatomic Particles and Their Masses

Subatomic Particle	Mass (g)
X	1.67×10^{-24}
Z	9.11×10^{-28}

Which of the subatomic particles are each paired with their corresponding name?

(1) *X*, proton and Z, electron
(2) *X*, proton and Z, neutron
(3) *X*, neutron and Z, proton
(4) *X*, electron and Z, proton

33 Which electron configuration represents an excited state for an atom of calcium?

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

34 At STP, graphite and diamond are two solid forms of carbon. Which statement explains why these two forms of carbon differ in hardness?

(1) Graphite and diamond have different ionic radii.
(2) Graphite and diamond have different molecular structures.
(3) Graphite is a metal, but diamond is a nonmetal.
(4) Graphite is a good conductor of electricity, but diamond is a poor conductor of electricity.

35 Which equation shows conservation of charge?

(1) $Cu + Ag^{+} \rightarrow Cu^{2+} + Ag$
(2) $Mg + Zn^{2+} \rightarrow 2Mg^{2+} + Zn$
(3) $2F_2 + Br^{-} \rightarrow 2F^{-} + Br_2$
(4) $2I^{-} + Cl_2 \rightarrow I_2 + 2Cl^{-}$

36 What occurs when potassium reacts with chlorine to form potassium chloride?

(1) Electrons are shared and the bonding is ionic.
(2) Electrons are shared and the bonding is covalent.
(3) Electrons are transferred and the bonding is ionic.
(4) Electrons are transferred and the bonding is covalent.

37 Given the balanced equation representing a reaction:

$$H_2 + \text{energy} \rightarrow H + H$$

What occurs as bonds are broken in one mole of H_2 molecules during this reaction?

(1) Energy is absorbed and one mole of unbonded hydrogen atoms is produced.
(2) Energy is absorbed and two moles of unbonded hydrogen atoms are produced.
(3) Energy is released and one mole of unbonded hydrogen atoms is produced.
(4) Energy is released and two moles of unbonded hydrogen atoms are produced.

38 Which pair of atoms has the most polar bond?

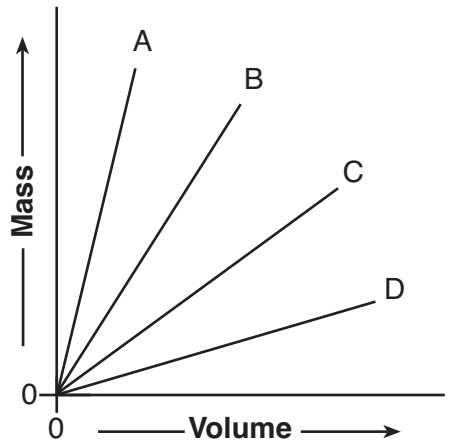
(1) H–Br
(2) H–Cl
(3) I–Br
(4) I–Cl

39 Which two notations represent isotopes of the same element?

(1) $^{14}_{7}N$ and $^{18}_{7}N$ (3) $^{14}_{7}N$ and $^{17}_{10}Ne$

(2) $^{20}_{7}N$ and $^{20}_{10}Ne$ (4) $^{19}_{7}N$ and $^{16}_{10}Ne$

40 The graph below shows the volume and the mass of four different substances at STP.



Which of the four substances has the *lowest* density?

(1) *A* (3) *C*

(2) *B* (4) *D*

41 What is the total amount of heat required to completely melt 347 grams of ice at its melting point?

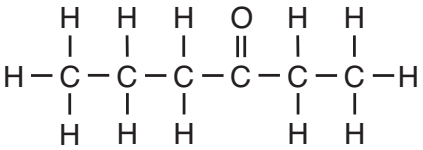
(1) 334 J (3) 116 000 J

(2) 1450 J (4) 784 000 J

42 As the temperature of a reaction increases, it is expected that the reacting particles collide

(1) more often and with greater force
(2) more often and with less force
(3) less often and with greater force
(4) less often and with less force

43 Given the formula representing a compound:



What is an IUPAC name for this compound?

(1) ethyl propanoate (3) 3-hexanone

(2) propyl ethanoate (4) 4-hexanone

44 A voltaic cell converts chemical energy to

(1) electrical energy with an external power source
(2) nuclear energy with an external power source
(3) electrical energy without an external power source
(4) nuclear energy without an external power source

45 Which acid and base react to form water and sodium sulfate?

(1) sulfuric acid and sodium hydroxide
(2) sulfuric acid and potassium hydroxide
(3) sulfurous acid and sodium hydroxide
(4) sulfurous acid and potassium hydroxide

46 Given the equation representing a reaction:

$$H_2CO_3 + NH_3 \rightarrow NH_4^+ + HCO_3^-$$

According to one acid-base theory, the compound NH_3 acts as a base because it

(1) accepts a hydrogen ion
(2) donates a hydrogen ion
(3) accepts a hydroxide ion
(4) donates a hydroxide ion

47 Which statement describes characteristics of a 0.01 M KOH(aq) solution?

(1) The solution is acidic with a pH less than 7.
(2) The solution is acidic with a pH greater than 7.
(3) The solution is basic with a pH less than 7.
(4) The solution is basic with a pH greater than 7.

48 Four statements about the development of the atomic model are shown below.

A: Electrons have wavelike properties.
B: Atoms have small, negatively charged particles.
C: The center of an atom is a small, dense nucleus.
D: Atoms are hard, indivisible spheres.

Which order of statements represents the historical development of the atomic model?

(1) $C \rightarrow D \rightarrow A \rightarrow B$
(2) $C \rightarrow D \rightarrow B \rightarrow A$
(3) $D \rightarrow B \rightarrow A \rightarrow C$
(4) $D \rightarrow B \rightarrow C \rightarrow A$

49 Five cubes of iron are tested in a laboratory. The tests and the results are shown in the table below.

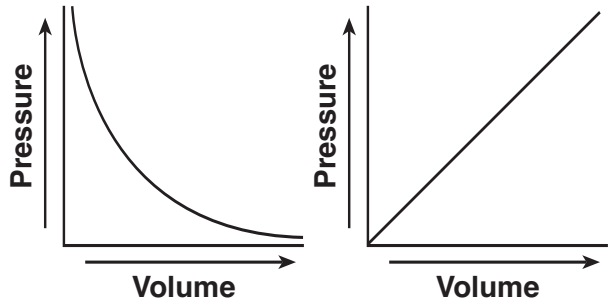
Iron Tests and the Results

Test	Procedure	Result
1	A cube of Fe is hit with a hammer.	The cube is flattened.
2	A cube of Fe is placed in 3 M HCl(aq).	Bubbles of gas form.
3	A cube of Fe is heated to 1811 K.	The cube melts.
4	A cube of Fe is left in damp air.	The cube rusts.
5	A cube of Fe is placed in water.	The cube sinks.

Which tests demonstrate chemical properties?

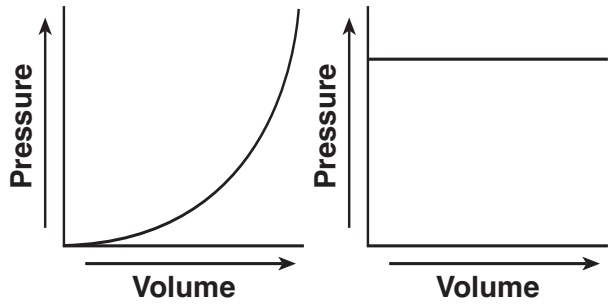
(1) 1, 3, and 4
(2) 1, 3, and 5
(3) 2 and 4
(4) 2 and 5

50 A rigid cylinder with a movable piston contains a sample of helium gas. The temperature of the gas is held constant as the piston is pulled outward. Which graph represents the relationship between the volume of the gas and the pressure of the gas?



(1)

(3)



(2)

(4)

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.*

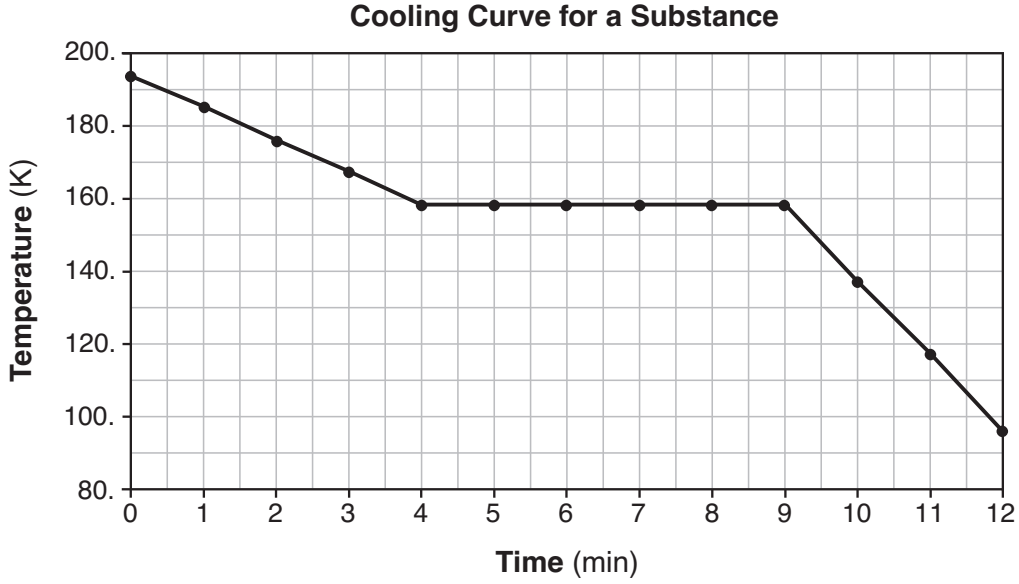
51 What is the empirical formula for C_6H_{12}? [1]

52 Using Table *G*, determine the minimum mass of NaCl that must be dissolved in 200. grams of water to produce a saturated solution at 90.°C. [1]

53 State the physical property that makes it possible to separate a solution by distillation. [1]

Base your answers to questions 54 and 55 on the information below and on your knowledge of chemistry.

A beaker contains a liquid sample of a molecular substance. Both the beaker and the liquid are at 194 K. The graph below represents the relationship between temperature and time as the beaker and its contents are cooled for 12 minutes in a refrigerated chamber.

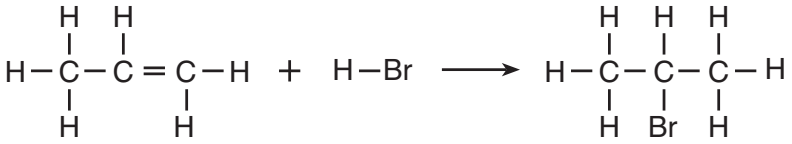


54 State what happens to the average kinetic energy of the molecules in the sample during the first 3 minutes. [1]

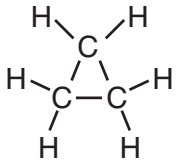
55 Identify the physical change occurring during the time interval, minute 4 to minute 9. [1]

Base your answers to questions 56 through 59 on the information below and on your knowledge of chemistry.

The equation below represents a reaction between propene and hydrogen bromide.



Cyclopropane, an isomer of propene, has a boiling point of –33°C at standard pressure and is represented by the formula below.



56 Explain why this reaction can be classified as a synthesis reaction. [1]

57 Identify the class of organic compounds to which the product of this reaction belongs. [1]

58 Explain, in terms of molecular formulas and structural formulas, why cyclopropane is an isomer of propene. [1]

59 Convert the boiling point of cyclopropane at standard pressure to kelvins. [1]

Base your answers to questions 60 through 63 on the information below and on your knowledge of chemistry.

The radius of a lithium atom is 130. picometers, and the radius of a fluorine atom is 60. picometers. The radius of a lithium ion, Li^+, is 59 picometers, and the radius of a fluoride ion, F^-, is 133 picometers.

60 Compare the radius of a fluoride ion to the radius of a fluorine atom. [1]

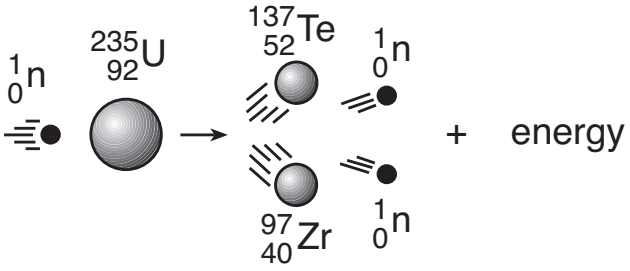
61 Explain, in terms of subatomic particles, why the radius of a lithium ion is smaller than the radius of a lithium atom. [1]

62 In the space *in your answer booklet*, draw a Lewis electron-dot diagram for a fluoride ion. [1]

63 Describe the general trend in atomic radius as each element in Period 2 is considered in order from left to right. [1]

Base your answers to questions 64 and 65 on the information below and on your knowledge of chemistry.

Nuclear fission reactions can produce different radioisotopes. One of these radioisotopes is Te-137, which has a half-life of 2.5 seconds. The diagram below represents one of the many nuclear fission reactions.



64 State evidence that this nuclear reaction represents transmutation. [1]

65 Complete the nuclear equation *in your answer booklet* for the beta decay of Zr-97, by writing an isotopic notation for the missing product. [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.

Stamping an identification number into the steel frame of a bicycle compresses the crystal structure of the metal. If the number is filed off, there are scientific ways to reveal the number.

One method is to apply aqueous copper(II) chloride to the number area. The Cu^{2+} ions react with some iron atoms in the steel frame, producing copper atoms that show the pattern of the number. The ionic equation below represents this reaction.

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

Another method is to apply hydrochloric acid to the number area. The acid reacts with the iron, producing bubbles of hydrogen gas. The bubbles form faster where the metal was compressed, so the number becomes visible. The equation below represents this reaction.

$$2HCl(aq) + Fe(s) \rightarrow FeCl_2(aq) + H_2(g)$$

66 Explain why the Fe atoms in the bicycle frame react with the Cu^{2+} ions. [1]

67 Determine the number of moles of hydrogen gas produced when 0.001 mole of HCl(aq) reacts completely with the iron metal. [1]

68 Write a balanced half-reaction equation for the reduction of the hydrogen ions to hydrogen gas. [1]

69 Describe *one* change in the HCl(aq) that will increase the rate at which hydrogen bubbles are produced when the acid is applied to the steel frame. [1]

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

In an investigation, aqueous solutions are prepared by completely dissolving a different amount of NaCl(s) in each of four beakers containing 100.00 grams of $H_2O(\ell)$ at room temperature. Each solution is heated and the temperature at which boiling occurred is measured. The data are recorded in the table below.

Boiling Point Data for Four NaCl(aq) Solutions

Beaker Number	Mass of $H_2O(\ell)$ (g)	Mass of NaCl(s) Dissolved (g)	Boiling Point of Solution (°C)
1	100.00	8.76	101.5
2	100.00	17.52	103.1
3	100.00	26.28	104.6
4	100.00	35.04	106.1

70 Identify the solute and the solvent used in this investigation. [1]

71 Show a numerical setup for calculating the percent by mass of NaCl in the solution in beaker 4. [1]

72 Explain, in terms of ions, why the ability to conduct an electric current is greater for the solution in beaker 4 than for the solution in beaker 1. [1]

73 State the relationship between the concentration of ions and the boiling point for these solutions. [1]

Base your answers to questions 74 through 76 on the information below and on your knowledge of chemistry.

One type of voltaic cell, called a mercury battery, uses zinc and mercury(II) oxide to generate an electric current. Mercury batteries were used because of their miniature size, even though mercury is toxic. The overall reaction for a mercury battery is given in the equation below.

$$Zn(s) + HgO(s) \rightarrow ZnO(s) + Hg(\ell)$$

74 Determine the change in the oxidation number of zinc during the operation of the cell. [1]

75 Compare the number of moles of electrons lost to the number of moles of electrons gained during the reaction. [1]

76 Using information in the passage, state *one* risk and *one* benefit of using a mercury battery. [1]

Base your answers to questions 77 through 80 on the information below and on your knowledge of chemistry.

A company produces a colorless vinegar that is 5.0% $HC_2H_3O_2$ in water. Using thymol blue as an indicator, a student titrates a 15.0-milliliter sample of the vinegar with 43.1 milliliters of a 0.30 M NaOH(aq) solution until the acid is neutralized.

77 Based on Table *M*, what is the color of the indicator in the vinegar solution before any base is added? [1]

78 Identify the negative ion in the NaOH(aq) used in this titration. [1]

79 The concentration of the base used in this titration is expressed to what number of significant figures? [1]

80 Determine the molarity of the $HC_2H_3O_2$ in the vinegar sample, using the titration data. [1]

Base your answers to questions 81 through 85 on the information below and on your knowledge of chemistry.

In industry, ethanol is primarily produced by two different reactions. One process involves the reaction of glucose in the presence of an enzyme that acts as a catalyst. The equation below represents this reaction.

Equation 1: $\underset{\text{glucose}}{C_6H_{12}O_6} \xrightarrow{\text{enzyme}} \underset{\text{ethanol}}{2CH_3CH_2OH} + 2CO_2$

In another reaction, ethanol is produced from ethene and water. The equation below represents this reaction in which H_2SO_4 is a catalyst.

Equation 2: $CH_2CH_2 + H_2O \xrightarrow{H_2SO_4} CH_3CH_2OH$

Industrial ethanol can be oxidized using a catalyst to produce ethanal. The equation representing this oxidation is shown below.

Equation 3: $CH_3CH_2OH \xrightarrow{\text{catalyst}} CH_3CHO + H_2$

81 Identify the element that causes the reactant in equation 1 to be classified as an organic compound. [1]

82 Identify the type of organic reaction represented by equation 1. [1]

83 Explain why the hydrocarbon in equation 2 is unsaturated. [1]

84 Explain, in terms of intermolecular forces, why ethanol has a much higher boiling point than ethene, at standard pressure. [1]

85 Draw a structural formula for the organic product in equation 3. [1]

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The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
CHEMISTRY

Wednesday, August 17, 2016 — 8:30 to 11:30 a.m., only

ANSWER BOOKLET

☐ Male

Student . . . . . Sex: ☐ Female

Teacher . . . . . .

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

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

Part B–2

51 _____

52 _____ **g**

53 _____

54 _____

_____

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55 _____

56 _____

_____

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57 _____

58 _____

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_____

59 _____ **K**

60 _____

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61 _____

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62

63 _____

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_____

64 _____

_____

_____

65 $^{97}_{40}\mathrm{Zr} \rightarrow {}^{0}_{-1}\mathrm{e} +$ _____

Part C

66 _____

_____

_____

67 _____ **mol**

68 _____

69 _____

_____

_____

70 Solute: _____

Solvent: _____

71

72 _____

_____

_____

73 _____

_____

_____

74 From _____ to _____

75 _____

_____

_____

76 Risk: _____

Benefit: _____

77 _____

78 _____

79 _____

80 _____ **M**

81 _____

82 _____

83 _____

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84 _____

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85

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FOR TEACHERS ONLY

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

P.S.–CH PHYSICAL SETTING/CHEMISTRY

Wednesday, August 17, 2016 — 8:30 to 11:30 a.m., only

SCORING KEY AND RATING GUIDE

Directions to the Teacher:

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

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

Part A and Part B–1

Allow 1 credit for each correct response.

Part A

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

Part B–1

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

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, August 17, 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 CH_2. The order of the elements can vary.

52 [1] Allow 1 credit for any value from 78 g to 82 g inclusive.

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

boiling point

boiling temperature

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

The average kinetic energy decreases.

The average KE goes down.

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

freezing

solidification

liquid to solid

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

Two substances react to produce one substance.

This product is formed by chemically combining two substances.

Two molecules produce a more complex molecule.

One compound is formed from two compounds.

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

halide

halocarbon

alkyl halide

halogenalkane

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

The molecular formulas for the two compounds are the same, but the structural formulas are different.

Both molecules have the same number of *C* atoms and the same number of *H* atoms, but have a different arrangement of atoms.

Both compounds are C_3H_6, but have different structures.

Both compounds are C_3H_6, but one has a ring and one has a double bond.

59 [1] Allow 1 credit for 240. K. Significant figures need *not* be shown.

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

The radius of a fluoride ion is larger than the radius of a fluorine atom.

The radius of F^- is 73 pm greater than the radius of an F atom.

The F atom is 60 pm, the F^- is 133 pm.

The F atom is smaller.

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

A lithium atom loses its second-shell electron, so the lithium ion has only one shell of electrons.

A lithium ion has one fewer electron.

The Li atom has 3 electrons and the Li^+ ion has 2 electrons.

A Li^+ ion has one less electron.

62 [1] Allow 1 credit. The positions of the dots may vary.

Examples of 1-credit responses:

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

As the elements in Period 2 are considered from left to right, the atomic radius generally decreases.

The atomic radius goes down except for Neon.

The atomic radius gets smaller.

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

In this reaction, uranium is changing to other elements.

Different elements are formed.

One element becomes two new elements.

Two atoms are formed with different atomic numbers from the U-235.

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

$^{97}_{41}Nb$

^{97}Nb

Nb–97

niobium–97

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:

Fe oxidizes in the presence of Cu^{2+} ions.

Iron is a more active metal than copper.

Cu^2 ions act as an oxidizing agent.

Fe is above Cu on Table *J*.

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

5×10^{-4} mol

0.0005 mol

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

$2H^+(aq) + 2e^- \rightarrow H_2(g)$

$2H^+ + 2e^- \rightarrow H_2$

$2e^- + 2H^{+1} \rightarrow H_2$

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

Increase the concentration of the HCl(aq).

Increase the temperature.

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

Solute: NaCl
Solvent: H_2O

Solute: sodium chloride
Solvent: water

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

$$\frac{35.04\ \text{g}}{100.00\ \text{g} + 35.04\ \text{g}} \times 100$$

$$\frac{35}{135} \times 100$$

$$\frac{35\ \text{g}\ (100)}{35\ \text{g} + 100\ \text{g}}$$

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

The solution in beaker 4 has a greater ability to conduct an electric current because it has a greater concentration of aqueous ions than the solution in beaker 1.

There are fewer charged particles free to move in beaker 1.

There are more ions in beaker 4.

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

The greater the concentration of ions, the higher the boiling point of the solution.

The boiling point is lower with fewer dissolved particles.

The boiling point goes up with more aqueous ions.

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

From 0 to +2

From 0 to 2+

From zero to two

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

The number of moles of electrons lost is equal to the number of moles of electrons gained.

The number of moles is the same.

e^- lost = e^- gained.

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

Risk: Mercury is toxic.
Benefit: Mercury batteries are miniature.

Risk: harmful to humans
Benefit: producing electricity

77 [1] Allow 1 credit for yellow.

78 [1] Allow 1 credit for OH^- *or* hydroxide.

79 [1] Allow 1 credit for 2 *or* two.

80 [1] Allow 1 credit for 0.86 M *or* 0.862 M.

81 [1] Allow 1 credit for carbon *or* C.

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

fermentation

fermenting

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

There is a double carbon-carbon bond in an ethene molecule.

Molecules of the compound contain a multiple C to C bond.

More H atoms can be added to the molecule.

Each molecule has C = C.

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

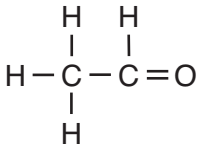
The alcohol functional group, −OH, allows for hydrogen bonding between ethanol molecules, so ethanol has a higher boiling point than ethene.

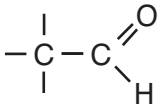
The boiling point of ethene is lower because its intermolecular forces are weaker than the intermolecular forces in the alcohol.

IMF for ethanol is stronger.

85 [1] Allow 1 credit.

Examples of 1-credit responses:





Regents Examination in Physical Setting/Chemistry

August 2016

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

The *Chart for Determining the Final Examination Score for the August 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, August 17, 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

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

Regents Examination in Physical Setting/Chemistry – August 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	**90**
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	**64**
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	**49**
29	**49**
28	**48**
27	**46**
26	**45**
25	**44**
24	**43**
23	**42**
22	**41**
21	**40**
20	**38**
19	**37**
18	**35**
17	**34**

Raw Score	Scale Score
16	**33**
15	**31**
14	**29**
13	**28**
12	**26**
11	**24**
10	**22**
9	**20**
8	**18**
7	**16**
6	**14**
5	**12**
4	**10**
3	**8**
2	**5**
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.