The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
CHEMISTRY

Wednesday, January 25, 2017 — 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 statement describes the location of two types of subatomic particles in a helium atom?

(1) Protons and neutrons are located in the nucleus.
(2) Protons and neutrons are located outside the nucleus.
(3) Protons and electrons are located in the nucleus.
(4) Protons and electrons are located outside the nucleus.

2 An atom that contains six protons, six neutrons, and six electrons has a mass of approximately

(1) 12 u
(2) 12 g
(3) 18 u
(4) 18 g

3 Which term identifies the most probable location of an electron in the wave-mechanical model of the atom?

(1) anode
(2) orbital
(3) nucleus
(4) cathode

4 Which element has atoms in the ground state with the greatest number of valence electrons?

(1) tin
(2) sulfur
(3) arsenic
(4) fluorine

5 Which group on the Periodic Table has two elements that exist as gases at STP?

(1) Group 1
(2) Group 2
(3) Group 16
(4) Group 17

6 Which list of elements contains a metal, a metalloid, and a nonmetal?

(1) Ag, Si, I_2
(2) Ge, As, Ne
(3) K, Cu, Br_2
(4) S, Cl_2, Ar

7 What is the charge of the nucleus of a copper atom?

(1) +1
(2) +2
(3) +29
(4) +64

8 At STP, $O_2(g)$ and $O_3(g)$ have different properties because $O_3(g)$ has

(1) more dense nuclei than in $O_2(g)$
(2) more protons per atom than in $O_2(g)$
(3) molecules with a different structure than in $O_2(g)$
(4) molecules with fewer covalent bonds than in $O_2(g)$

9 A compound is a substance composed of two or more elements that are

(1) physically mixed in a fixed proportion
(2) physically mixed in a variable proportion
(3) chemically combined in a fixed proportion
(4) chemically combined in a variable proportion

10 Which element has the highest boiling point at standard pressure?

(1) Mg
(2) Na
(3) Rb
(4) Sr

11 How many pairs of electrons are shared between the nitrogen atoms in a molecule of N_2?

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

12 A molecule must be nonpolar if the molecule

(1) is linear
(2) is neutral
(3) has ionic and covalent bonding
(4) has a symmetrical charge distribution

13 Which property is used to determine the degree of polarity between two bonded atoms?

(1) density
(2) electronegativity
(3) pressure
(4) temperature

14 In a chemical reaction, a catalyst provides an alternate reaction pathway that

(1) decreases the concentration of the products
(2) increases the concentration of the reactants
(3) has a lower activation energy
(4) has a higher activation energy

15 Which substance can be decomposed by chemical means?

(1) cobalt
(2) krypton
(3) methane
(4) zirconium

16 Which sample of matter represents a mixture?

(1) aqueous ammonia
(2) gaseous ethane
(3) liquid mercury
(4) solid iodine

17 Differences in which property allow the separation of a sample of sand and seawater by filtration?

(1) concentration of ions
(2) volume of sample
(3) mass of sample
(4) particle size

18 Which process is a chemical change?

(1) evaporating an alcohol
(2) subliming of iodine
(3) melting an ice cube
(4) rusting of iron

19 Which term represents an intermolecular force in a sample of water?

(1) hydrogen bonding
(2) covalent bonding
(3) metallic bonding
(4) ionic bonding

20 Which sample of matter has particles arranged in a crystalline structure?

(1) Ne(g)
(2) $Br_2(\ell)$
(3) NaCl(aq)
(4) $CuSO_4(s)$

21 Which term is defined as a measure of the randomness of a system?

(1) heat
(2) entropy
(3) pressure
(4) temperature

22 Which formula represents an alkane?

(1) C_2H_2
(2) C_2H_4
(3) C_3H_4
(4) C_3H_8

23 Which term represents a chemical reaction?

(1) deposition
(2) combustion
(3) sublimation
(4) vaporization

24 Which type of reaction includes esterification and polymerization?

(1) decomposition
(2) neutralization
(3) organic
(4) nuclear

25 In a redox reaction, the total number of electrons lost is

(1) less than the total number of electrons gained
(2) greater than the total number of electrons gained
(3) equal to the total number of electrons gained
(4) unrelated to the total number of electrons gained

26 Which type of equation can represent the oxidation occurring in a reaction?

(1) a double-replacement reaction equation
(2) a half-reaction equation
(3) a neutralization reaction equation
(4) a transmutation reaction equation

27 The electrical conductivity of an aqueous solution depends on the concentration of which particles in the solution?

(1) molecules
(2) electrons
(3) atoms
(4) ions

28 An electrolytic cell differs from a voltaic cell because an electrolytic cell

(1) generates its own energy from a spontaneous physical reaction
(2) generates its own energy from a nonspontaneous physical reaction
(3) requires an outside energy source for a spontaneous chemical reaction to occur
(4) requires an outside energy source for a nonspontaneous chemical reaction to occur

29 A sample of which radioisotope emits particles having the greatest mass?

(1) ^{137}Cs
(2) ^{53}Fe
(3) ^{220}Fr
(4) ^{3}H

30 Which term represents a nuclear reaction?

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

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 the distribution of electrons in a potassium atom in the ground state?

(1) 2-8-8-1
(2) 2-8-7-2
(3) 2-8-5
(4) 2-7-6

32 At STP, which element is malleable and a good conductor of electricity?

(1) xenon
(2) silicon
(3) platinum
(4) hydrogen

33 Which general trends in atomic radius and electronegativity are observed as the elements in Period 3 are considered in order of increasing atomic number?

(1) Atomic radius decreases and electronegativity increases.
(2) Atomic radius increases and electronegativity decreases.
(3) Both atomic radius and electronegativity increase.
(4) Both atomic radius and electronegativity decrease.

34 What is the chemical name for Na_2SO_3?

(1) sodium sulfite
(2) sodium sulfate
(3) sodium sulfide
(4) sodium thiosulfate

35 Which molecular formula is also an empirical formula?

(1) C_6H_6
(2) H_2O_2
(3) N_2H_4
(4) N_2O_5

36 Given the balanced equation representing a reaction:

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

Which mass of oxygen completely reacts with 4.0 grams of hydrogen to produce 36.0 grams of water?

(1) 8.0 g
(2) 16.0 g
(3) 32.0 g
(4) 40.0 g

37 What is the gram-formula mass of $Ca(OH)_2$?

(1) 29 g/mol
(2) 54 g/mol
(3) 57 g/mol
(4) 74 g/mol

38 Given the equation representing a reaction:

$$H_2(g) + I_2(g) \rightarrow 2HI(g)$$

Which statement describes the energy changes that occur in this reaction?

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

39 Based on Table *F*, which compound is *least* soluble in water?

(1) $AlPO_4$
(2) Li_2SO_4
(3) $Ca(OH)_2$
(4) $AgC_2H_3O_2$

40 How many joules of heat are absorbed to raise the temperature of 435 grams of water at 1 atm from 25°C to its boiling point, 100.°C?

(1) 4.5×10^4 J
(2) 1.4×10^5 J
(3) 2.5×10^7 J
(4) 7.4×10^7 J

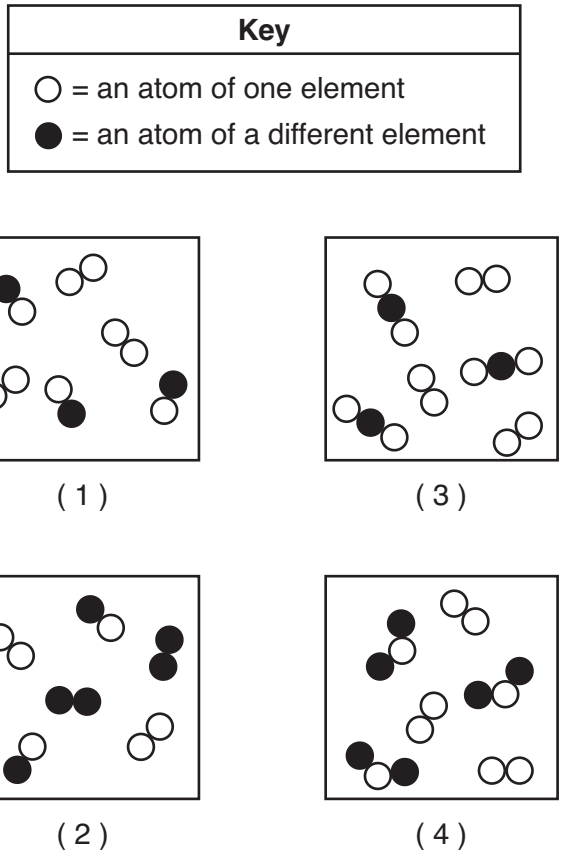
41 Which temperature represents the highest average kinetic energy of the particles in a sample of matter?

(1) 298 K
(2) 267 K
(3) 27°C
(4) 12°C

42 Which change in the H^+ ion concentration of an aqueous solution represents a *decrease* of one unit on the pH scale?

(1) a tenfold increase
(2) a tenfold decrease
(3) a hundredfold increase
(4) a hundredfold decrease

43 Which particle diagram represents a mixture of three substances?



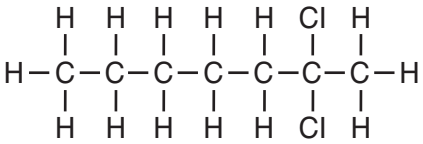
44 Given the equation representing a system at equilibrium:

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

Which statement describes this system?

(1) The concentration of $PCl_5(g)$ is increasing.
(2) The concentration of $PCl_5(g)$ is decreasing.
(3) The concentrations of $PCl_5(g)$ and $PCl_3(g)$ are equal.
(4) The concentrations of $PCl_5(g)$ and $PCl_3(g)$ are constant.

45 Given the formula representing a compound:



What is the IUPAC name of this compound?

(1) 2-chloroheptane
(2) 6-chloroheptane
(3) 2,2-dichloroheptane
(4) 6,6-dichloroheptane

46 Given the equation representing a reaction:

$$Sn^{4+}(aq) + 2e^- \rightarrow Sn^{2+}(aq)$$

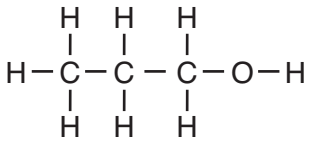
Which term best describes this reaction?

(1) ionization
(2) neutralization
(3) oxidation
(4) reduction

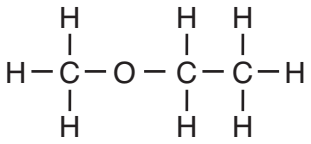
47 Which ionic equation represents a spontaneous reaction that can occur in a voltaic cell?

(1) $Cu(s) + Zn(s) \rightarrow Cu^{2+}(aq) + Zn^{2+}(aq)$
(2) $Cu(s) + Zn^{2+}(aq) \rightarrow Cu^{2+}(aq) + Zn(s)$
(3) $Cu^{2+}(aq) + Zn(s) \rightarrow Cu(s) + Zn^{2+}(aq)$
(4) $Cu^{2+}(aq) + Zn^{2+}(aq) \rightarrow Cu(s) + Zn(s)$

48 Given the formulas representing two compounds at standard pressure:



1 – propanol



methyl ethyl ether

The compounds can be differentiated by their

(1) boiling points
(2) gram-formula masses
(3) numbers of hydrogen atoms
(4) percent compositions by mass of carbon

49 The table below shows the atomic mass and natural abundance of the two naturally occurring isotopes of lithium.

Naturally Occurring Isotopes of Lithium

Isotope	Atomic Mass (u)	Natural Abundance (%)
Li-6	6.015	7.6
Li-7	7.016	92.4

Which numerical setup can be used to determine the atomic mass of naturally occurring lithium?

(1) $(7.6)(6.015\ \text{u}) + (92.4)(7.016\ \text{u})$

(2) $(0.076)(6.015\ \text{u}) + (0.924)(7.016\ \text{u})$

(3) $\dfrac{(7.6)(6.015\ \text{u}) + (92.4)(7.016\ \text{u})}{2}$

(4) $\dfrac{(0.076)(6.015\ \text{u}) + (0.924)(7.016\ \text{u})}{2}$

50 Given the equation representing a reaction at equilibrium:

$$H_2S(aq) + CH_3NH_2(aq) \rightleftharpoons HS^-(aq) + CH_3NH_3^+(aq)$$

According to one acid-base theory, the forward reaction is classified as an acid-base reaction because

(1) H_2S is a H^+ donor and CH_3NH_2 is a H^+ acceptor
(2) CH_3NH_2 is a H^+ donor and H_2S is a H^+ acceptor
(3) HS^- and $CH_3NH_3^+$ are both H^+ donors
(4) $CH_3NH_3^+$ and HS^- are both H^+ acceptors

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 Explain, in terms of electron configuration, why arsenic and antimony are chemically similar. [1]

52 Identify the element in Period 3 that is an unreactive gas at STP. [1]

53 Compare the energy of an electron in the first shell of a cadmium atom to the energy of an electron in the third shell of the same atom. [1]

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

The densities for two forms of carbon at room temperature are listed in the table below.

Densities of Two Forms of Carbon

Element Form	Density (g/cm^3)
carbon (graphite)	2.2
carbon (diamond)	3.513

54 Compare the number of carbon atoms in a 0.30-cm^3 sample of graphite and a 0.30-cm^3 sample of diamond. [1]

55 A student calculated the density of a sample of graphite to be 2.3 g/cm^3. Show a numerical setup for calculating the student's percent error for the density of graphite. [1]

Base your answers to questions 56 and 57 on the information below and on your knowledge of chemistry.

A sample of calcium carbonate, $CaCO_3$, has a mass of 42.2 grams. Calcium carbonate has a gram-formula mass of 100. g/mol.

56 Show a numerical setup for calculating the number of moles in the sample of $CaCO_3$. [1]

57 Determine the percent composition by mass of oxygen in the $CaCO_3$. [1]

Base your answers to questions 58 and 59 on the information below and on your knowledge of chemistry.

Carbon monoxide, CO(g), is a toxic gas found in automobile exhaust. The concentration of CO(g) can be decreased by using a catalyst in the reaction between CO(g) and O_2(g). This reaction is represented by the balanced equation below.

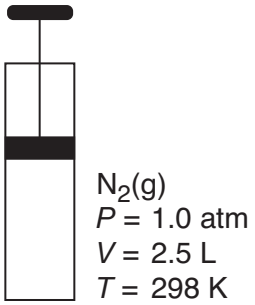
$$2CO(g) + O_2(g) \xrightarrow{\text{catalyst}} 2CO_2(g) + \text{energy}$$

58 Explain, in terms of collision theory, why an increase in temperature increases the rate of the reaction. [1]

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

Base your answers to questions 60 and 61 on the information below and on your knowledge of chemistry.

The diagram and data below represent a gas and the conditions of pressure, volume, and temperature of the gas in a rigid cylinder with a moveable piston.



60 Determine the volume of the gas in the cylinder at STP. [1]

61 State *one* change in temperature and *one* change in pressure that will cause the gas in the cylinder to behave more like an ideal gas. [1]

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

During a titration, 10.00 mL of acetic acid, $HC_2H_3O_2(aq)$, is completely neutralized by adding 12.50 mL of 0.64 M sodium hydroxide, NaOH(aq).

62 Identify the only positive ion in the $HC_2H_3O_2(aq)$. [1]

63 State the number of significant figures used to express the volume of the acetic acid. [1]

64 Determine the molarity of the acetic acid. [1]

65 Explain why it is better to use data from multiple trials to determine the molarity of acetic acid, rather than data from a single trial. [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.

Carbon dioxide, CO_2, changes from the solid phase to the gas phase at 1 atm and 194.5 K. In the solid phase, CO_2 is often called dry ice. When dry ice sublimes in air at 298 K, the water vapor in the air can condense, forming a fog of small water droplets. This fog is often used for special effects at concerts and in movie-making.

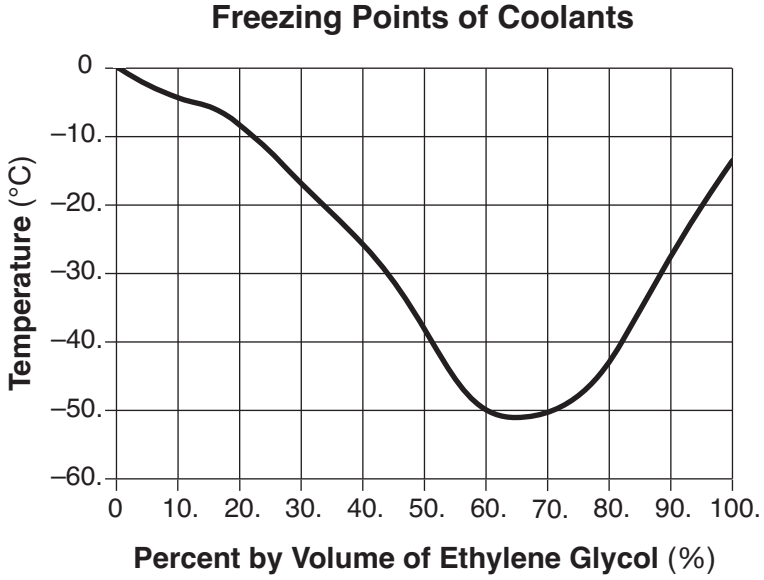
66 State the direction of heat flow between the dry ice and the water vapor in the air. [1]

67 At 1 atm and 298 K, compare the potential energies of the water molecules before and after the water vapor condenses. [1]

68 At 1 atm and 190. K, compare the amount of thermal energy in a 1.0-kilogram block of dry ice to the amount of thermal energy in a 2.0-kilogram block of dry ice. [1]

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

A solution of ethylene glycol and water can be used as the coolant in an engine-cooling system. The ethylene glycol concentration in a coolant solution is often given as percent by volume. For example, 100. mL of a coolant solution that is 40.% ethylene glycol by volume contains 40. mL of ethylene glycol diluted with enough water to produce a total volume of 100. mL. The graph below shows the freezing point of coolants that have different ethylene glycol concentrations.



69 Explain, in terms of particle distribution, why a coolant solution is a homogeneous mixture. [1]

70 Explain, in terms of the molecular polarity, why ethylene glycol dissolves in water to form a solution. [1]

71 Identify the percent by volume of ethylene glycol in a solution that freezes at −10.°C. [1]

72 One engine-cooling system has a volume of 6400 mL. Determine the volume of ethylene glycol in the completely filled engine-cooling system when the concentration of ethylene glycol is 50.% by volume. [1]

Base your answers to questions 73 through 77 on the information below and on your knowledge of chemistry.

Molecules containing two carbon atoms and a functional group have many home and industrial uses. These compounds can be produced by a variety of reactions, as shown by the equations below.

Equation 1: $C_2H_4 + H_2O \rightarrow CH_3CH_2OH$

Equation 2: $2CH_3CH_2OH + O_2 \rightarrow 2CH_3CHO + 2H_2O$

Equation 3: $2CH_3CHO + O_2 \rightarrow 2CH_3COOH$

73 Explain, in terms of bonding, why the hydrocarbon reactant in equation 1 is unsaturated. [1]

74 Draw a structural formula of the ethanal molecule in equation 2. [1]

75 Explain, in terms of atoms, why CH_3CH_2OH and CH_3CHO are *not* isomers of each other. [1]

76 Identify the class of organic compounds to which the product in equation 3 belongs. [1]

77 Determine the number of moles of oxygen required to completely react with six moles of CH_3CHO in equation 3. [1]

Base your answers to questions 78 and 79 on the information below and on your knowledge of chemistry.

The hydrangea is a flowering plant. The color of the flowers it produces can change depending on the pH value of the soil in which the plant grows. Adding aluminum sulfate makes the soil more acidic and adding calcium hydroxide makes the soil more basic.

A student performed an experiment by varying soil pH and recording the color of the flowers. The following table summarizes the results of the experiment.

Hydrangea Soil pH and Flower Color

Soil pH	Flower Color
5.5 and below	blue
between 5.5 and 6.5	purple
6.5 and above	pink

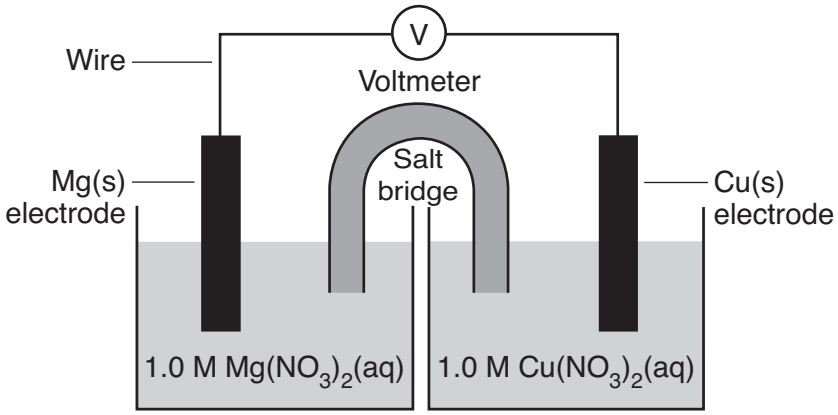
78 Identify the independent variable in this experiment. [1]

79 Hydrangea plants can be grown in soil that turns litmus red. What color are the flowers of the plants grown in this soil? [1]

Base your answers to questions 80 through 82 on the information below and on your knowledge of chemistry.

The diagram and balanced ionic equation below represent two half-cells connected to produce an operating voltaic cell in a laboratory investigation. The half-cells are connected by a salt bridge.

Voltaic Cell



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

80 Determine the oxidation number of nitrogen in the negative ion in the aqueous solutions. [1]

81 State the purpose of the salt bridge in this voltaic cell. [1]

82 Explain, in terms of atoms and ions, why the mass of the Mg(s) electrode decreases as the cell operates. [1]

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

The radioisotope Mo-99 naturally decays to produce the metastable isotope Tc-99m, which is used in medical diagnosis. A doctor can obtain images of organs and bones by injecting a patient with a solution of Tc-99m. The half-life of the metastable Tc-99m is six hours.

83 Complete the nuclear equation *in your answer booklet* for the nuclear decay of Mo-99. [1]

84 State *both* the number of protons and the number of neutrons in a Tc-99 nuclide. [1]

85 Determine the fraction of an original sample of metastable Tc-99m that remains unchanged after 24 hours. [1]

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Wednesday, January 25, 2017 — 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 _____

_____

_____

52 _____

53 _____

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54 _____

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_____

55

56

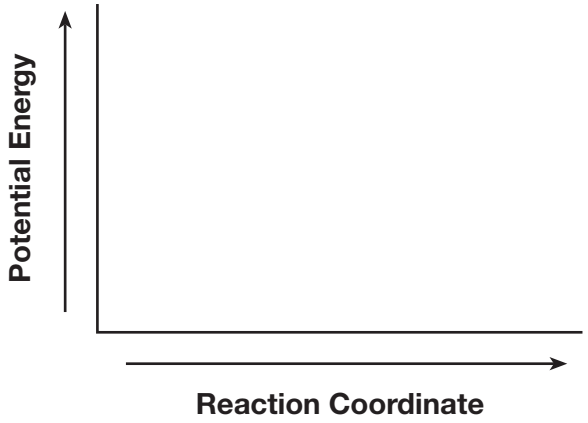
57 _____ **%**

58 _____

_____

_____

59



60 _____ **L**

61 Temperature: _____

Pressure: _____

62 _____

63 _____

64 _____ **M**

65 _____

_____

_____

Part C

66 From _____ to _____

67 _____

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68 _____

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69 _____

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70 _____

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71 _____ **%**

72 _____ **mL**

73 _____

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74

75 _____

_____

_____

76 _____

77 _____ **mol**

78 _____

79 _____

80 _____

81 _____

_____

_____

82 _____

_____

_____

83 $^{99}_{42}\text{Mo} \rightarrow$ _____ + $^{99\text{m}}_{43}\text{Tc}$

84 Protons: _____

Neutrons: _____

85 _____

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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 25, 2017 — 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 . . . . . **1**	9 . . . . . **3**	17 . . . . . **4**	25 . . . . . **3** . . . . .
2 . . . . . **1**	10 . . . . . **4**	18 . . . . . **4**	26 . . . . . **2** . . . . .
3 . . . . . **2**	11 . . . . . **3**	19 . . . . . **1**	27 . . . . . **4** . . . . .
4 . . . . . **4**	12 . . . . . **4**	20 . . . . . **4**	28 . . . . . **4** . . . . .
5 . . . . . **4**	13 . . . . . **2**	21 . . . . . **2**	29 . . . . . **3** . . . . .
6 . . . . . **1**	14 . . . . . **3**	22 . . . . . **4**	30 . . . . . **3** . . . . .
7 . . . . . **3**	15 . . . . . **3**	23 . . . . . **2**	
8 . . . . . **3**	16 . . . . . **1**	24 . . . . . **3**	

Part B–1

31 . . . . . **1**	36 . . . . . **3**	41 . . . . . **3**	46 . . . . . **4** . . . . .
32 . . . . . **3**	37 . . . . . **4**	42 . . . . . **1**	47 . . . . . **3** . . . . .
33 . . . . . **1**	38 . . . . . **4**	43 . . . . . **2**	48 . . . . . **1** . . . . .
34 . . . . . **1**	39 . . . . . **1**	44 . . . . . **4**	49 . . . . . **2** . . . . .
35 . . . . . **4**	40 . . . . . **2**	45 . . . . . **3**	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, January 25, 2017. The student's scale score should be entered in the box labeled "Scale Score" on the student's answer sheet. The scale score is the student's final examination score.

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

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

Part B–2

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

51 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

Arsenic atoms and antimony atoms each have 5 valence electrons.

An As atom and a Sb atom both have five outermost electrons.

same number of valence e^-

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

Ar

argon

element 18

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

An electron in the first shell has less energy than an electron in the third shell.

The third shell electron has higher energy.

3^{rd} shell $>$ 1^{st} shell

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

The 0.30-cm^3 sample of graphite has fewer carbon atoms than the 0.30-cm^3 sample of diamond.

The diamond sample has more atoms.

more C atoms in the diamond

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

$$\frac{2.3\ g/cm^3 - 2.2\ g/cm^3}{2.2\ g/cm^3} \times 100$$

$$\frac{2.3 - 2.2}{2.2} \times 100$$

$$\frac{0.1(100)}{2.2}$$

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

$$\frac{42.2\text{ g}}{100.\text{ g/mol}}$$

$$42.2\text{ g} \times \frac{1.00\text{ mol}}{100.\text{ g}}$$

$$\frac{x}{42.2} = \frac{1}{100}$$

57 [1] Allow 1 credit for 48.0% *or* for any value from 47.9% to 48%, inclusive.

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

The rate of the chemical reaction increases because the reactant molecules move faster and collide with more kinetic energy.

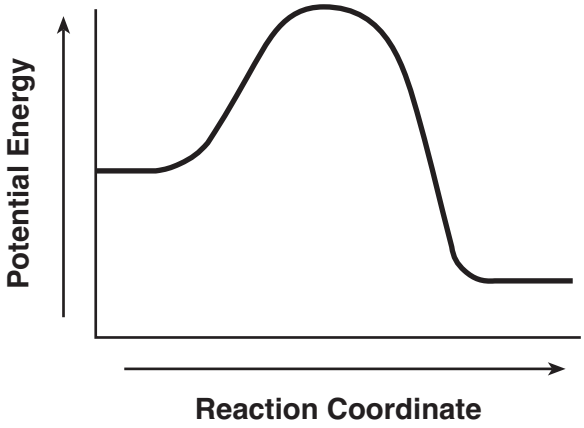
Increasing the temperature causes more frequent collisions.

As molecules acquire more kinetic energy, the probability of effective collisions increases.

More reactant molecules collide with sufficient energy.

59 [1] Allow 1 credit for showing that the potential energy of the products is lower than the potential energy of the reactants.

Example of a 1-credit response:



60 [1] Allow 1 credit for 2.3 L *or* for any value from 2.29 L to 2.3 L, inclusive.

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

Temperature: higher/increase

Pressure: lower/decrease

Temperature: above 298 K

Pressure: below 1.0 atm

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

$H^+(aq)$

H_3O^+

hydrogen ions

hydronium

63 [1] Allow 1 credit for 4 *or* four.

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

0.80 M

8.0×10^{-1} M

.8 M

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

Multiple trials may improve the precision of results.

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

Results can be shown to be reproducible.

Multiple trials help cancel random errors.

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:

from water vapor to the dry ice

from $H_2O(g)$ to $CO_2(s)$

from water to CO_2

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

The potential energy of the $H_2O(g)$ molecules is higher than the potential energy of the $H_2O(\ell)$ molecules.

The water vapor has greater PE.

There is less PE in the liquid water.

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

The block of dry ice with less mass contains less thermal energy.

There is more thermal energy in the 2.0-kg block.

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

The particles are distributed uniformly throughout the coolant mixture.

There is an even distribution of molecules in the solution.

The water and ethylene glycol molecules mix uniformly.

All particles are evenly dispersed.

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

Water molecules and ethylene glycol molecules are both polar.

Water and the glycol have similar polarities.

71 [1] Allow 1 credit for any value from 21% to 23%, inclusive.

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

3200 mL

3.2×10^3 mL

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

In ethene, there is a double bond between the two carbon atoms, which makes the compound unsaturated.

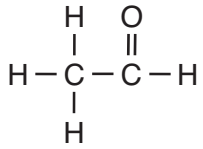
More H atoms can bond with C atoms.

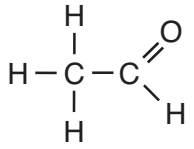
has C=C

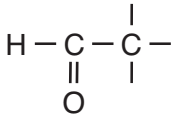
Two carbons share four electrons.

74 [1] Allow 1 credit.

Examples of 1-credit responses:







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

The CH_3CH_2OH has 2 carbon atoms, 6 hydrogen atoms, and 1 oxygen atom, while the CH_3CHO has 2 carbon atoms, 4 hydrogen atoms, and 1 oxygen atom.

They don't have the same number of H atoms.

different molecular formulas

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

organic acid

carboxylic acid

acids

77 [1] Allow 1 credit for 3 mol *or* three mol.

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

pH value of the soil

soil pH

79 [1] Allow 1 credit for blue.

80 [1] Allow 1 credit for +5 *or* 5 *or* five.

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

The salt bridge allows ions to flow between the two half-cells.

It maintains the electrical neutrality of the solutions.

prevents polarization of the half-cells

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

Magnesium atoms lose electrons and become magnesium ions in the solution.

Some of the Mg atoms oxidize to Mg^{2+} ions, decreasing the electrode mass.

Atoms become aqueous Mg^{2+} ions.

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

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

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

β^{-}

84 [1] Allow 1 credit for 43 protons and 56 neutrons.

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

$\frac{1}{16}$

0.0625

6.25%

Regents Examination in Physical Setting/Chemistry

January 2017

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

The *Chart for Determining the Final Examination Score for the January 2017 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 25, 2017. 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 2017 Physical Setting/Chemistry			
Question Numbers			
Key Ideas/Performance Indicators	Part A	Part B	Part C
Standard 1			
Math Key Idea 1		49, 55, 56, 63	71, 78
Math Key Idea 2		54, 59	68, 72
Math Key Idea 3		25, 36, 37, 40, 41, 57, 60, 64	72, 77, 80, 84, 85
Science Inquiry Key Idea 1		32, 34, 48, 50, 51, 53, 54, 58, 61, 62, 63, 65	67, 69, 70, 73, 75, 76, 78, 81, 82
Science Inquiry Key Idea 2			
Science Inquiry Key Idea 3		33, 34, 38, 39, 43, 45, 46, 47, 50, 53, 59, 65	74, 75, 80, 82
Engineering Design Key Idea 1			
Standard 2			
Key Idea 1			
Key Idea 2			
Key Idea 3			
Standard 6			
Key Idea 1			66
Key Idea 2		55, 60	
Key Idea 3		42	
Key Idea 4			
Key Idea 5			71
Standard 7			
Key Idea 1			
Key Idea 2			
Standard 4 Process Skills			
Key Idea 3		31, 33, 35, 36, 37, 41, 43, 44, 47, 49, 52, 56, 58, 60, 64	70, 72, 74, 76, 77, 79, 81, 84
Key Idea 4		40, 59	67, 68, 83, 85
Key idea 5			
Standard 4			
Key Idea 3	1, 2, 3, 4, 5, 6, 7, 9, 10, 14, 15, 16, 17, 18, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29	31, 32, 33, 34, 35, 36, 37, 39, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 60, 61, 62, 63, 64, 65	69, 70, 71, 72, 74, 75, 76, 77, 78, 79, 80, 81, 82, 84
Key Idea 4	30	40, 41, 59	66, 67, 68, 83, 85
Key Idea 5	8, 11, 12, 13, 19	38	73
Reference Tables			
2011 Edition	2, 4, 5, 6, 7, 10, 11, 15, 22, 24, 29	31, 32, 33, 34, 37, 38, 39, 40, 41, 45, 47, 51, 52, 54, 55, 56, 57, 59, 60, 62, 64	73, 74, 76, 79, 80, 83, 84

Regents Examination in Physical Setting/Chemistry – January 2017

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	**93**
80	**92**
79	**91**
78	**89**
77	**88**
76	**87**
75	**86**
74	**85**
73	**83**
72	**82**
71	**81**
70	**80**
69	**79**
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	**62**
44	**61**
43	**60**
42	**60**
41	**59**
40	**58**

Raw Score	Scale Score
39	**57**
38	**57**
37	**56**
36	**55**
35	**54**
34	**53**
33	**53**
32	**52**
31	**51**
30	**50**
29	**49**
28	**48**
27	**47**
26	**46**
25	**45**
24	**44**
23	**43**
22	**42**
21	**40**
20	**39**
19	**38**
18	**36**
17	**35**

Raw Score	Scale Score
16	**34**
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.