**The University of the State of New York**

**REGENTS HIGH SCHOOL EXAMINATION**

# PHYSICAL SETTING
# CHEMISTRY

**Thursday,** January 25, 2018 — 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 protons and neutrons in an atom of helium?

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

2 Given a list of atomic model descriptions:

*A*: electron shells outside a central nucleus
*B*: hard, indivisible sphere
*C*: mostly empty space

Which list of atomic model descriptions represents the order of historical development from the earliest to most recent?

(1) *A*, *B*, *C*
(2) *A*, *C*, *B*
(3) *B*, *C*, *A*
(4) *B*, *A*, *C*

3 Which list represents the classification of the elements nitrogen, neon, magnesium, and silicon, respectively?

(1) metal, metalloid, nonmetal, noble gas
(2) nonmetal, noble gas, metal, metalloid
(3) nonmetal, metalloid, noble gas, metal
(4) noble gas, metal, metalloid, nonmetal

4 In the ground state, all atoms of Group 15 elements have the same number of

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

5 What is the chemical formula for ammonium sulfide?

(1) $(NH_4)_2S$
(2) $(NH_4)_2SO_3$
(3) $(NH_4)_2SO_4$
(4) $(NH_4)_2S_2O_3$

6 Which formula is an empirical formula?

(1) $N_2O_4$
(2) $NH_3$
(3) $C_3H_6$
(4) $P_4O_{10}$

7 Chemical properties can be used to

(1) determine the temperature of a substance
(2) determine the density of a substance
(3) differentiate between two compounds
(4) differentiate between two neutrons

8 Ice, $H_2O(s)$, is classified as

(1) an ionic compound
(2) a molecular compound
(3) a homogeneous mixture
(4) a heterogeneous mixture

9 Which phrase describes the molecular polarity and distribution of charge in a molecule of carbon dioxide, $CO_2$?

(1) polar and symmetrical
(2) polar and asymmetrical
(3) nonpolar and symmetrical
(4) nonpolar and asymmetrical

10 Which element tends *not* to react with other elements?

(1) helium
(2) hydrogen
(3) phosphorus
(4) potassium

11 Given the equation representing a reaction:

$$O + O \rightarrow O_2$$

Which statement describes the changes that occur as the oxygen molecule is produced?

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

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

(1) electrical conductivity
(2) electronegativity
(3) first ionization energy
(4) specific heat capacity

13 Compared to a 15-gram sample of Cu(s) at 25°C, a 25-gram sample of Cu(s) at 25°C has

(1) the same density and the same chemical properties
(2) the same density and different chemical properties
(3) a different density and the same chemical properties
(4) a different density and different chemical properties

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

(1) ammonia
(2) ethanol
(3) tungsten
(4) water

15 The kinetic molecular theory states that all particles of an ideal gas are

(1) colliding without transferring energy
(2) in random, constant, straight-line motion
(3) arranged in a regular geometric pattern
(4) separated by small distances relative to their size

16 Which sample of gas at STP has the same number of molecules as 6 liters of $Cl_2(g)$ at STP?

(1) 3 liters of $O_2(g)$
(2) 6 liters of $N_2(g)$
(3) 3 moles of $O_2(g)$
(4) 6 moles of $N_2(g)$

17 A chemical reaction is most likely to occur when the colliding particles have the proper

(1) energy and orientation
(2) solubility and density
(3) ionic radii and mass
(4) atomic radii and volume

18 The energy absorbed and the energy released during a chemical reaction are best represented by a

(1) cooling curve
(2) heating curve
(3) kinetic energy diagram
(4) potential energy diagram

19 A catalyst increases the rate of a chemical reaction by

(1) providing an alternate reaction pathway
(2) providing the required heat of reaction
(3) increasing the potential energy of the products
(4) increasing the activation energy of the reaction

20 Which formula represents an alkyne?

(1) $C_nH_n$
(2) $C_{2n}H_n$
(3) $C_nH_{2n+2}$
(4) $C_nH_{2n-2}$

21 Which process involves the transfer of electrons?

(1) double replacement
(2) neutralization
(3) oxidation-reduction
(4) sublimation

22 Which change occurs at the anode in an operating electrochemical cell?

(1) gain of protons
(2) gain of electrons
(3) loss of protons
(4) loss of electrons

23 Which device requires electrical energy to produce a chemical change?

(1) electrolytic cell
(2) salt bridge
(3) voltaic cell
(4) voltmeter

24 Which substance is an Arrhenius acid?

(1) HBr
(2) NaBr
(3) NaOH
(4) $NH_3$

25 Which laboratory process is used to determine the concentration of one solution by using a volume of another solution of known concentration?

(1) crystallization
(2) distillation
(3) filtration
(4) titration

26 Which type of reaction occurs when $H^+(aq)$ reacts with $OH^-(aq)$?

(1) combustion
(2) decomposition
(3) fermentation
(4) neutralization

27 According to one acid-base theory, a molecule acts as an acid when the molecule

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

28 In which type of reaction can an atom of one element be converted to an atom of another element?

(1) addition
(2) reduction
(3) substitution
(4) transmutation

29 An unstable nucleus spontaneously releases a positron. This is an example of

(1) radioactive decay
(2) nuclear fusion
(3) chemical decomposition
(4) thermal conductivity

30 Which phrase describes a risk associated with producing energy in a nuclear power plant?

(1) depletion of atmospheric hydrogen ($H_2$)
(2) depletion of atmospheric carbon dioxide ($CO_2$)
(3) production of wastes needing long-term storage
(4) production of wastes that cool surrounding water supplies

## 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 An ion that consists of 7 protons, 9 neutrons, and 10 electrons has a net charge of

(1) 2−
(2) 2+
(3) 3+
(4) 3−

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

(1) 2–2
(2) 2–2–1
(3) 2–8
(4) 2–8–1

33 The table below gives the atomic mass and the abundance of the two naturally occurring isotopes of boron.

**Naturally Occurring Isotopes of Boron**

| Isotope | Atomic Mass (u) | Natural Abundance (%) |
|---|---|---|
| B–10 | 10.01 | 19.9 |
| B–11 | 11.01 | 80.1 |

Which numerical setup can be used to determine the atomic mass of the element boron?

(1) $\frac{(10.01\text{ u})(19.9) + (11.01\text{ u})(80.1)}{100}$

(2) $\frac{(10.01\text{ u})(0.199) + (11.01\text{ u})(0.801)}{100}$

(3) $\frac{10.01\text{ u} + 11.01\text{ u}}{2}$

(4) $\frac{19.9\% + 80.1\%}{2}$

34 In which group on the Periodic Table would a nonmetallic element belong if atoms of this element tend to gain two electrons to complete their valence shell?

(1) 14
(2) 15
(3) 16
(4) 17

35 Which trend is observed as the first four elements in Group 17 on the Periodic Table are considered in order of increasing atomic number?

(1) Electronegativity increases.
(2) First ionization energy decreases.
(3) The number of valence electrons increases.
(4) The number of electron shells decreases.

36 What is the number of moles of KF in a 29-gram sample of the compound?

(1) 1.0 mol
(2) 2.0 mol
(3) 0.50 mol
(4) 5.0 mol

37 Which bond is most polar?

(1) C–O
(2) H–O
(3) N–O
(4) S–O

38 Based on Table *F*, which equation represents a saturated solution having the *lowest* concentration of $Cl^-$ ions?

(1) $NaCl(s) \rightleftharpoons Na^+(aq) + Cl^-(aq)$
(2) $AgCl(s) \rightleftharpoons Ag^+(aq) + Cl^-(aq)$
(3) $NH_4Cl(s) \rightleftharpoons NH_4^+(aq) + Cl^-(aq)$
(4) $KCl(s) \rightleftharpoons K^+(aq) + Cl^-(aq)$

39 What is the molarity of a solution that contains 0.500 mole of $KNO_3$ dissolved in 0.500-liter of solution?

(1) 1.00 M
(2) 2.00 M
(3) 0.500 M
(4) 4.00 M

40 Given samples of water:

Sample 1: 100. grams of water at 10.°C
Sample 2: 100. grams of water at 20.°C

Compared to sample 1, sample 2 contains

(1) molecules with a lower average kinetic energy
(2) molecules with a lower average velocity
(3) less heat energy
(4) more heat energy

41 Given the key:

| Key |
| --- |
| ○ = an atom of element A |
| ● = an atom of element Z |

Which particle model diagram represents a chemical change?

(1)


(2)


(3)


(4)


42 Based on Table *H*, what is the vapor pressure of $CH_3COOH$ at 90.°C?

(1) 40. kPa
(2) 48 kPa
(3) 114 kPa
(4) 150. kPa

43 The arrangement of particles is most ordered in a sample of

(1) NaCl(aq)
(2) NaCl(ℓ)
(3) NaCl(g)
(4) NaCl(s)

44 What is the net amount of heat released when two moles of $C_2H_6(g)$ are formed from its elements at 101.3 kPa and 298 K?

(1) 42.0 kJ
(2) 84.0 kJ
(3) 126.0 kJ
(4) 168.0 kJ

45 Which compounds are isomers of each other?

(1) methanol and methanal
(2) propanoic acid and pentanoic acid
(3) 1-propanol and 2-propanol
(4) 1-chloropropane and 2-bromopropane

46 A reaction between an alcohol and an organic acid is classified as

(1) esterification
(2) fermentation
(3) saponification
(4) substitution

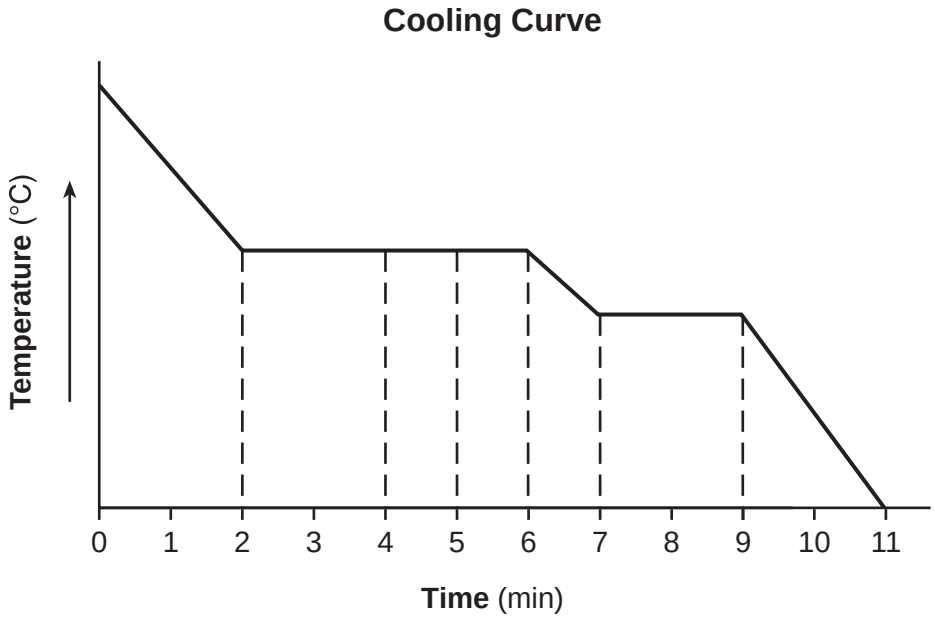
47 Why is potassium nitrate classified as an electrolyte?

(1) It is a molecular compound.
(2) It contains a metal.
(3) It can conduct electricity as a solid.
(4) It releases ions in an aqueous solution.

48 When the concentration of hydrogen ions in a solution is *decreased* by a factor of ten, the pH of the solution

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

49 The cooling curve below represents the uniform cooling of a substance, starting at a temperature above its boiling point.




During which time interval does the substance exist as both a liquid and a solid?

(1) min 2 to min 4
(2) min 4 to min 5
(3) min 5 to min 7
(4) min 7 to min 9

50 Given the balanced equation representing a reaction:

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g) + \text{energy}$$

Which change in reaction conditions will increase the frequency of effective collisions between reactant molecules?

(1) decreasing the pressure of the reactants
(2) decreasing the temperature of the reactants
(3) increasing the concentration of the reactants
(4) increasing the volume of the reactants

## 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 Convert the melting point of mercury to degrees Celsius. [1]

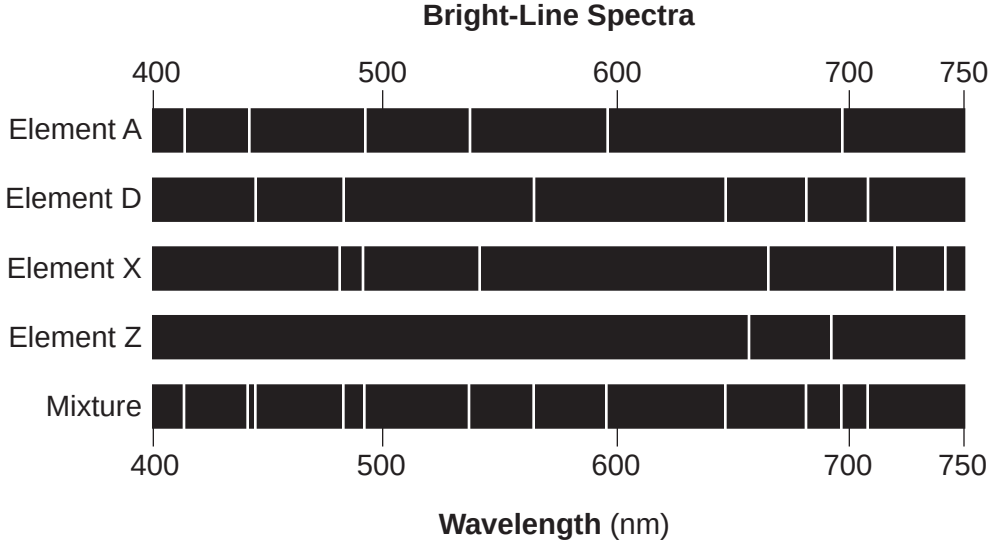
52 Draw a Lewis electron-dot diagram for a molecule of hydrogen fluoride, HF. [1]

53 Show a numerical setup for calculating the quantity of heat in joules required to completely vaporize 102.3 grams of $H_2O(\ell)$ at 100.°C and 1.0 atm. [1]

54 State the color of methyl orange indicator after the indicator is placed in a solution of 0.10 M $NH_3(aq)$. [1]

Base your answers to questions 55 and 56 on the information below and on your knowledge of chemistry.

The bright-line spectra for four elements and a mixture of elements are shown in the diagram below.




55 Write the letter of each element present in the mixture. [1]

56 Explain, in terms of electrons and energy states, how the light emitted by excited atoms is produced. [1]

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

Rubidium and iodine have different chemical and physical properties. Some of these properties are shown in the table below.

**Some Physical and Chemical Properties of Rubidium and Iodine**

| Rubidium | Iodine |
|---|---|
| silvery-white solid | bluish-black lustrous solid |
| forms ionic compounds with nonmetals | forms ionic bonds with active metals |
| reacts with oxygen in the air | sublimes at room temperature |
| specific heat = 0.363 J/g•K | specific heat = 0.214 J/g•K |

57 State the chemical property of iodine listed in this table. [1]

58 Compare the atomic radius of an atom of iodine to the atomic radius of an atom of rubidium when both atoms are in the ground state. [1]

59 Compare the electrical conductivity of these two elements at STP. [1]

---

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

Given the unbalanced equation showing the reactants and product of a reaction occurring at 298 K and 100. kPa:

$$P_4(s) + Cl_2(g) \rightarrow PCl_3(\ell) + \text{energy}$$

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

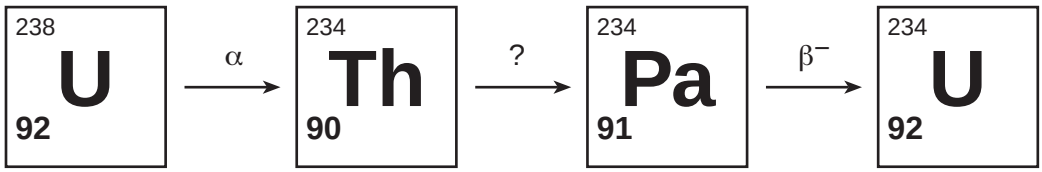
61 State why this reaction is a synthesis reaction. [1]

62 Show a numerical setup for calculating the percent composition by mass of chlorine in $PCl_3(\ell)$ (gram-formula mass = 137 g/mol). [1]

---

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

The diagram below shows the first three steps in the uranium-238 radioactive decay series.




The decay mode for the first and third steps is shown above the arrows. The decay mode for the second step is not shown in the diagram. Thorium-234 has a half-life of 24.10 days.

63 Explain, in terms of neutrons and protons, why U-238 and U-234 are different isotopes of uranium. [1]

64 Identify the decay mode particle emitted from the Th-234. [1]

65 Determine the total time that must elapse until only $\frac{1}{16}$ of an original sample of Th-234 remains unchanged. [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 answer to question 66 on the information below and on your knowledge of chemistry.

Tetrachloroethene, $C_2Cl_4$, is a solvent used in many dry cleaning processes.

66 Write the empirical formula for tetrachloroethene. [1]

---

Base your answers to questions 67 through 69 on the information below and on your knowledge of chemistry.

Thermal energy is absorbed as chemical reactions occur during the process of baking muffins. The batter for muffins often contains baking soda, $NaHCO_3(s)$, which decomposes as the muffins are baked in an oven at 200.°C. The balanced equation below represents this reaction, which releases $CO_2(g)$ and causes the muffins to rise as they bake. The $H_2O(\ell)$ is released into the air of the oven as it becomes a vapor.

$$2NaHCO_3(s) + \text{heat} \rightarrow Na_2CO_3(s) + H_2O(\ell) + CO_2(g)$$

67 Based on Table *E*, identify the polyatomic ion in the solid product of the reaction. [1]

68 State the direction of heat flow between the air in the oven and the muffin batter when the muffin batter is first placed in the preheated oven at 200.°C. [1]

69 Compare the potential energy of the liquid water molecules to the potential energy of the water vapor molecules. [1]

---

Base your answers to questions 70 through 72 on the information below and on your knowledge of chemistry.

A bubble of air at the bottom of a lake rises to the surface of the lake. Data for the air inside the bubble at the bottom of the lake and at the surface of the lake are listed in the table below.

**Data for the Air Inside the Bubble**

| Location in Lake | Temperature (K) | Pressure (kPa) | Volume (mL) | Density (g/mL) |
|---|---|---|---|---|
| surface | 293 | 104.0 | 2.5 | 0.0012 |
| bottom | 282 | 618.3 | ? | ——— |

70 State the number of significant figures used to express the pressure at the surface of the lake. [1]

71 Show a numerical setup for calculating the volume of the bubble at the bottom of the lake. [1]

72 Determine the mass of the air in the bubble at the surface of the lake. [1]

---

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

Nitrogen dioxide, $NO_2$, is a dark brown gas that is used to make nitric acid and to bleach flour. Nitrogen dioxide has a boiling point of 294 K at 101.3 kPa. In a rigid cylinder with a movable piston, nitrogen dioxide can be in equilibrium with colorless dinitrogen tetroxide, $N_2O_4$. This equilibrium is represented by the equation below.

$$2NO_2(g) \rightleftharpoons N_2O_4(g) + 58\ kJ$$

73 State evidence from the equation that the forward reaction is exothermic. [1]

74 Compare the rate of the forward reaction to the rate of the reverse reaction when the system has reached equilibrium. [1]

75 State one stress, other than adding or removing $NO_2(g)$ or $N_2O_4(g)$, that would increase the amount of the dark brown gas. [1]

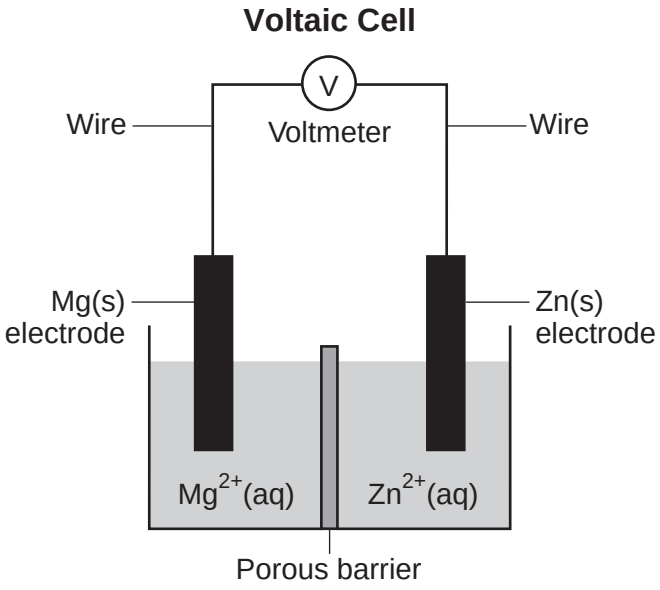
76 At standard pressure, compare the strength of intermolecular forces in $NO_2(g)$ to the strength of intermolecular forces in $N_2(g)$. [1]

77 Determine the oxidation state of nitrogen in nitrogen dioxide. [1]

---

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

A student sets up a voltaic cell using magnesium and zinc electrodes. The porous barrier in the cell has the same purpose as a salt bridge. The diagram and the ionic equation below represent this operating cell.




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

78 Determine the number of moles of $Mg^{2+}(aq)$ ions produced when 2.5 moles of $Zn^{2+}(aq)$ react completely in this cell. [1]

79 State, in terms of ions, how the porous barrier functions as a salt bridge in this cell. [1]

80 State, in terms of the relative activity of metals, why the reaction in this cell occurs. [1]

81 Write a balanced half-reaction equation for the oxidation that occurs in this operating cell. [1]

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

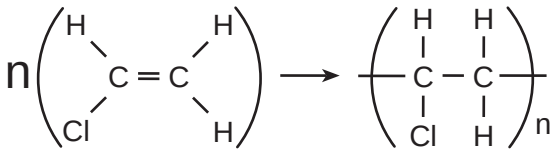
Polyvinyl chloride (PVC) is a polymer used to make drain pipes, flooring, electric wire insulation, and some plastic bottles. Making PVC requires several reactions. The first step is represented by the equation below.

Equation 1: $C_2H_4 + Cl_2 \rightarrow C_2H_4Cl_2$

ethene chlorine 1,2-dichloroethane

The 1,2-dichloroethane is converted to vinyl chloride. To produce PVC, the vinyl chloride monomer is polymerized, as represented by the equation below.

Equation 2:




Vinyl chloride (monomer) PVC (polymer)

**Note:** n and n represent the same large number in the equation.

82 Explain, in terms of chemical bonds, why the hydrocarbon in equation 1 is unsaturated. [1]

83 Identify the class of organic compounds to which the product of equation 1 belongs. [1]

84 Draw a structural formula for the product of equation 1. [1]

85 State the number of electrons shared between the carbon atoms in a molecule of vinyl chloride. [1]

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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

**Thursday,** January 25, 2018 — 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 . . . . . **1** . . . . . | 25 . . . . . **4** . . . . . |
| 2 . . . . . **3** . . . . . | 10 . . . . . **1** . . . . . | 18 . . . . . **4** . . . . . | 26 . . . . . **4** . . . . . |
| 3 . . . . . **2** . . . . . | 11 . . . . . **4** . . . . . | 19 . . . . . **1** . . . . . | 27 . . . . . **3** . . . . . |
| 4 . . . . . **1** . . . . . | 12 . . . . . **2** . . . . . | 20 . . . . . **4** . . . . . | 28 . . . . . **4** . . . . . |
| 5 . . . . . **1** . . . . . | 13 . . . . . **1** . . . . . | 21 . . . . . **3** . . . . . | 29 . . . . . **1** . . . . . |
| 6 . . . . . **2** . . . . . | 14 . . . . . **3** . . . . . | 22 . . . . . **4** . . . . . | 30 . . . . . **3** . . . . . |
| 7 . . . . . **3** . . . . . | 15 . . . . . **2** . . . . . | 23 . . . . . **1** . . . . . | |
| 8 . . . . . **2** . . . . . | 16 . . . . . **2** . . . . .. | 24 . . . . . **1** . . . . . | |

**Part B–1**

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

## 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 Thursday, January 25, 2018. 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.

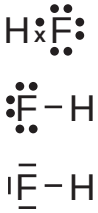
## Part B–2

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

**51** [1] Allow 1 credit for −39°C.

**52** [1] Allow 1 credit.

**Examples of 1-credit responses:**



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

$q = (102.3\ g)(2260\ J/g)$

$2260 \times 102.3$

**54** [1] Allow 1 credit for yellow.

**55** [1] Allow 1 credit for A and D.

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

Electrons in the excited atoms release energy as they move from higher energy states to lower energy states.

Electrons lose energy as they return to a lower energy state.

Excited electrons emit energy in the form of light as they return to lower electron shells.

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

forms ionic bonds with active metals

forms ionic bonds

reacts with metals

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

In the ground state, the atomic radius of an iodine atom is smaller than the atomic radius of a rubidium atom.

The Rb atom is larger than the I atom.

The Rb atomic radius is 215 pm, but the I atomic radius is only 136 pm.

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

Rubidium is a better electrical conductor than iodine at STP.

$I_2(s)$ is a poor conductor; Rb(s) is a good conductor.

**60** [1] Allow 1 credit for _____ $P_4(s)$ + ___6___ $Cl_2(g) \rightarrow$ ___4___ $PCl_3(\ell)$ + energy

Allow credit even if the coefficient "1" is written in front of $P_4(s)$.

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

Two elements are chemically combined to form a compound.

Two reactants form only one product.

Two substances react to form one substance.

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

$$\frac{3(35.5\ \text{g/mol})}{137\ \text{g/mol}} \times 100$$

$$\frac{3(35.453)}{137} \times 100$$

$$\frac{106 \times 100}{137}$$

$$\frac{3(35)}{136} \times 100$$

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

An atom of U-238 has 92 protons and 146 neutrons. An atom of U-234 also has 92 protons but has 142 neutrons.

These two atoms have the same number of protons but a different number of neutrons.

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

| | |
|---|---|
| beta particle | beta |
| $\beta^-$ | $^{0}_{-1}\beta$ |
| $^{0}_{-1}e$ | electron |

**65** [1] Allow 1 credit for 96.40 d. 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 $CCl_2$. The order of the elements may vary.

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

carbonate ion

carbonate

$CO_3^{2-}$

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

from oven air to muffin batter

from air to muffin

from air to batter

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

The potential energy of the liquid water molecules is less than the potential energy of the water vapor molecules.

There is greater PE in the $H_2O(g)$.

**70** [1] Allow 1 credit for 4 *or* four.

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

$$V = \frac{(104.0\text{ kPa})(2.5\text{ mL})(282\text{ K})}{(618.3\text{ kPa})(293\text{ K})}$$

$$\frac{(618.3\text{ kPa})V}{282\text{ K}} = \frac{(104.0\text{ kPa})(2.5\text{ mL})}{293\text{ K}}$$

$$\frac{(104)(2.5)(282)}{(293)(618.3)}$$

**72** [1] Allow 1 credit for 0.0030 g *or* $3 \times 10^{-3}$ g.

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

There are 58 kJ of energy produced by the forward reaction.

The heat term is on the right side of the equation.

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

The rate of the forward reaction is equal to the rate of the reverse reaction at equilibrium.

The rates are the same.

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

Increase the temperature.

Add heat.

Decrease the pressure.

Increase the volume.

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

The $NO_2$ has stronger intermolecular forces of attraction than $N_2$.

The attractions in $N_2(g)$ are weaker.

**77** [1] Allow 1 credit for +4 *or* 4+ *or* four.

**78** [1] Allow 1 credit for 2.5 mol.

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

The porous barrier allows for the migration of ions between the half-cells.

The barrier maintains electrical neutrality by allowing ions to flow.

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

Magnesium is more active than zinc.

The Zn is less active than Mg.

Mg is higher on Table *J*.

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

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

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

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

Ethene is classified as an unsaturated hydrocarbon because each molecule contains a double bond.

There is a C=C bond in each molecule.

Ethene molecules contain a multiple carbon-carbon bond.

Less than the maximum number of hydrogen atoms are bonded to the carbons.

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

halide

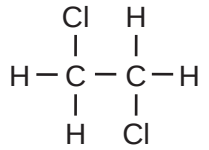
halocarbons

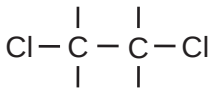
alkyl halide

halogenoalkane

**84** [1] Allow 1 credit.

**Examples of 1-credit responses:**





**85** [1] Allow 1 credit for 4 *or* four *or* 2 pairs.

**Regents Examination in Physical Setting/Chemistry**

**January 2018**

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

**The *Chart for Determining the Final Examination Score for the January 2018 Regents Examination in Physical Setting/Chemistry* will be posted on the Department's web site at: http://www.p12.nysed.gov/assessment/ on Thursday, January 25, 2018. 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 2018 Physical Setting/Chemistry | | | |
|---|---|---|---|
| Question Numbers | | | |
| Key Ideas/Performance Indicators | Part A | Part B | Part C |
| **Standard 1** | | | |
| Math Key Idea 1 | | 33, 39, 51, 53, 62 | 70, 71 |
| Math Key Idea 2 | | 42, 60 | 78, 81 |
| Math Key Idea 3 | | 31, 36, 37, 44, 65 | 66, 72, 77, 81 |
| Science Inquiry Key Idea 1 | | 37, 47, 54, 55, 56, 57, 58, 59, 61, 63 | 73, 74, 75, 82 |
| Science Inquiry Key Idea 2 | | | |
| Science Inquiry Key Idea 3 | | 34, 38, 44, 45, 50, 55, 56, 60, 64 | 66, 67, 73, 77, 79, 82, 85 |
| Engineering Design Key Idea 1 | | | |
| **Standard 2** | | | |
| Key Idea 1 | | | |
| Key Idea 2 | | | |
| Key Idea 3 | | | |
| **Standard 6** | | | |
| Key Idea 1 | | | 68 |
| Key Idea 2 | | 41, 52, 64 | 84 |
| Key Idea 3 | | 48 | |
| Key Idea 4 | | | 75 |
| Key Idea 5 | | 49 | |
| **Standard 7** | | | |
| Key Idea 1 | | | |
| Key Idea 2 | | | |
| **Standard 4 Process Skills** | | | |
| Key Idea 3 | | 32, 33, 35, 36, 39, 41, 43, 45, 46, 50, 54, 55, 57, 58, 60, 63 | 66, 71, 74, 75, 78, 79, 80, 81, 83, 84 |
| Key Idea 4 | | 40, 49, 53, 64, 65 | 69, 73 |
| Key idea 5 | | 52 | 76 |
| **Standard 4** | | | |
| Key Idea 3 | 1, 2, 3, 4, 5, 6, 7, 13, 14, 15, 16, 17, 19, 20, 21, 22, 23, 24, 25, 26, 27, 29 | 31, 32, 33, 34, 35, 36, 38, 39, 41, 43, 45, 46, 47, 48, 50, 51, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63 | 66, 67, 70, 71, 72, 74, 75, 77, 78, 79, 80, 81, 83, 84 |
| Key Idea 4 | 18, 30 | 40, 44, 49, 53, 64, 65 | 68, 69, 73 |
| Key Idea 5 | 8, 9, 10, 11, 12, 28 | 37, 42, 52 | 76, 82, 85 |
| **Reference Tables** | | | |
| 2011 Edition | 1, 3, 4, 5, 8, 10, 14, 20, 25, 29 | 31, 32, 35, 36, 37, 38, 39, 42, 44, 45, 51, 52, 53, 54, 58, 59, 62 | 67, 71, 72, 76, 77, 80, 82, 83, 84 |

# Regents Examination in Physical Setting/Chemistry – January 2018

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

| Raw Score | Scale Score |
|---|---|
| 85 | **100** |
| 84 | **98** |
| 83 | **96** |
| 82 | **95** |
| 81 | **93** |
| 80 | **92** |
| 79 | **90** |
| 78 | **89** |
| 77 | **88** |
| 76 | **86** |
| 75 | **85** |
| 74 | **84** |
| 73 | **83** |
| 72 | **82** |
| 71 | **81** |
| 70 | **80** |
| 69 | **79** |
| 68 | **78** |
| 67 | **77** |
| 66 | **77** |
| 65 | **76** |
| 64 | **75** |

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

| Raw Score | Scale Score |
|---|---|
| 41 | **59** |
| 40 | **58** |
| 39 | **58** |
| 38 | **57** |
| 37 | **56** |
| 36 | **56** |
| 35 | **55** |
| 34 | **54** |
| 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 | **41** |
| 20 | **39** |

| Raw Score | Scale Score |
|---|---|
| 19 | **38** |
| 18 | **37** |
| 17 | **35** |
| 16 | **34** |
| 15 | **32** |
| 14 | **31** |
| 13 | **29** |
| 12 | **27** |
| 11 | **26** |
| 10 | **24** |
| 9 | **22** |
| 8 | **20** |
| 7 | **18** |
| 6 | **16** |
| 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.