The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
CHEMISTRY

Thursday, January 26, 2012 — 1:15 to 4:15 p.m., only

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 the examination booklet.

The answers to *all* questions in this examination are to be written in your separate answer booklet. Be sure to fill in the heading on the front of your answer booklet.

All work 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 in your answer booklet.

When you have completed the examination, you must sign the statement printed on the first page of your answer booklet, 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 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.

The use of any communications device is strictly prohibited when taking this examination. If you use any communications device, no matter how briefly, your examination will be invalidated and no score will be calculated for you.

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, write in your answer booklet 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 *Reference Tables for Physical Setting/Chemistry*.

1 What is the number of electrons in a completely filled second shell of an atom?

(1) 32 (3) 18
(2) 2 (4) 8

2 What is the number of electrons in an atom that has 3 protons and 4 neutrons?

(1) 1 (3) 3
(2) 7 (4) 4

3 As a result of the gold foil experiment, it was concluded that an atom

(1) contains protons, neutrons, and electrons
(2) contains a small, dense nucleus
(3) has positrons and orbitals
(4) is a hard, indivisible sphere

4 Which statement describes the distribution of charge in an atom?

(1) A neutral nucleus is surrounded by one or more negatively charged electrons.
(2) A neutral nucleus is surrounded by one or more positively charged electrons.
(3) A positively charged nucleus is surrounded by one or more negatively charged electrons.
(4) A positively charged nucleus is surrounded by one or more positively charged electrons.

5 Which atom in the ground state has an outermost electron with the most energy?

(1) Cs (3) Li
(2) K (4) Na

6 Which particle has the *least* mass?

(1) alpha particle (3) neutron
(2) beta particle (4) proton

7 The elements in Group 2 are classified as

(1) metals (3) nonmetals
(2) metalloids (4) noble gases

8 Which list includes elements with the most similar chemical properties?

(1) Br, Ga, Hg (3) O, S, Se
(2) Cr, Pb, Xe (4) N, O, F

9 The notation for the nuclide $^{137}_{55}Cs$ gives information about

(1) mass number, only
(2) atomic number, only
(3) both mass number and atomic number
(4) neither mass number nor atomic number

10 Which pair represents two forms of an element in the same phase at STP but with different structures and different properties?

(1) $I_2(s)$ and $I_2(g)$ (3) $H_2(g)$ and $Hg(g)$
(2) $O_2(g)$ and $O_3(g)$ (4) $H_2O(s)$ and $H_2O(\ell)$

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

(1) atomic mass (3) molar mass
(2) atomic number (4) oxidation number

12 What is the IUPAC name for the compound ZnO?

(1) zinc oxide (3) zinc peroxide
(2) zinc oxalate (4) zinc hydroxide

13 Which atom attains a stable valence electron configuration by bonding with another atom?

(1) neon (3) helium
(2) radon (4) hydrogen

14 An ionic bond can be formed when one or more electrons are

(1) equally shared by two atoms
(2) unequally shared by two atoms
(3) transferred from the nucleus of one atom to the nucleus of another atom
(4) transferred from the valence shell of one atom to the valence shell of another atom

15 Which sample of CO_2 has a definite shape and a definite volume?

(1) CO_2(aq)
(2) CO_2(g)
(3) $CO_2(\ell)$
(4) CO_2(s)

16 What occurs in order to break the bond in a Cl_2 molecule?

(1) Energy is absorbed.
(2) Energy is released.
(3) The molecule creates energy.
(4) The molecule destroys energy.

17 A sealed, rigid 1.0-liter cylinder contains He gas at STP. An identical sealed cylinder contains Ne gas at STP. These two cylinders contain the same number of

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

18 Which statement describes a chemical change?

(1) Alcohol evaporates.
(2) Water vapor forms snowflakes.
(3) Table salt (NaCl) is crushed into powder.
(4) Glucose ($C_6H_{12}O_6$) and oxygen produce CO_2 and H_2O.

19 Which statement describes the particles of an ideal gas according to the kinetic molecular theory?

(1) The gas particles are arranged in a regular geometric pattern.
(2) The gas particles are in random, constant, straight-line motion.
(3) The gas particles are separated by very small distances, relative to their sizes.
(4) The gas particles are strongly attracted to each other.

20 Which sample of matter is classified as a substance?

(1) air
(2) ammonia
(3) milk
(4) seawater

21 Which element has the *lowest* electronegativity value?

(1) F
(2) Fr
(3) Cl
(4) Cr

22 At standard pressure, CH_4 boils at 112 K and H_2O boils at 373 K. What accounts for the higher boiling point of H_2O at standard pressure?

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

23 A mixture of sand and table salt can be separated by filtration because the substances in the mixture differ in

(1) boiling point
(2) density at STP
(3) freezing point
(4) solubility in water

24 Systems in nature tend to undergo changes toward

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

25 In the wave-mechanical model of the atom, an orbital is the most probable location of

(1) a proton
(2) a positron
(3) a neutron
(4) an electron

26 Functional groups are used to classify

(1) organic compounds
(2) inorganic compounds
(3) heterogeneous mixtures
(4) homogeneous mixtures

27 Which class of compounds contains *at least one* element from Group 17 of the Periodic Table?

(1) aldehyde
(2) amine
(3) ester
(4) halide

28 In a propanal molecule, an oxygen atom is bonded with a carbon atom. What is the total number of pairs of electrons shared between these atoms?

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

29 When a voltaic cell operates, ions move through the

(1) anode
(2) cathode
(3) salt bridge
(4) external circuit

30 When dissolved in water, an Arrhenius base yields

(1) hydrogen ions
(2) hydronium ions
(3) hydroxide ions
(4) oxide ions

Part B–1

Answer all questions in this part.

Directions (31–50): For *each* statement or question, write in your answer booklet 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 *Reference Tables for Physical Setting/Chemistry*.

31 What is the total number of valence electrons in a germanium atom in the ground state?

(1) 22
(2) 2
(3) 32
(4) 4

32 Which element is paired with an excited-state electron configuration for an atom of the element?

(1) Ca: 2-8-8-2
(2) Na: 2-8-2
(3) K: 2-6-8-3
(4) F: 2-8

33 Given the balanced equations representing two chemical reactions:

$$Cl_2 + 2NaBr \rightarrow 2NaCl + Br_2$$

$$2NaCl \rightarrow 2Na + Cl_2$$

Which types of chemical reactions are represented by these equations?

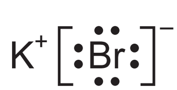
(1) single replacement and decomposition
(2) single replacement and double replacement
(3) synthesis and decomposition
(4) synthesis and double replacement

34 An ion that consists of 7 protons, 6 neutrons, and 10 electrons has a net charge of

(1) 4–
(2) 3–
(3) 3+
(4) 4+

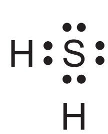
35 Which Lewis electron-dot diagram represents a molecule having a nonpolar covalent bond?

(1)



(3)

(2)



(4)

36 Which quantity is equal to 50 kilojoules?

(1) 0.05 J
(2) 500 J
(3) 5×10^3 J
(4) 5×10^4 J

37 Which compound is formed from its elements by an exothermic reaction at 298 K and 101.3 kPa?

(1) $C_2H_4(g)$
(2) $HI(g)$
(3) $H_2O(g)$
(4) $NO_2(g)$

38 At which temperature is the vapor pressure of ethanol equal to 80. kPa?

(1) 48°C
(2) 73°C
(3) 80.°C
(4) 101°C

39 At 25°C, gas in a rigid cylinder with a movable piston has a volume of 145 mL and a pressure of 125 kPa. Then the gas is compressed to a volume of 80. mL. What is the new pressure of the gas if the temperature is held at 25°C?

(1) 69 kPa
(2) 93 kPa
(3) 160 kPa
(4) 230 kPa

40 A 2400.-gram sample of an aqueous solution contains 0.012 gram of NH_3. What is the concentration of NH_3 in the solution, expressed as parts per million?

(1) 5.0 ppm
(2) 15 ppm
(3) 20. ppm
(4) 50. ppm

41 Which equation represents a change that results in an increase in disorder?

(1) $I_2(s) \rightarrow I_2(g)$
(2) $CO_2(g) \rightarrow CO_2(s)$
(3) $2Na(s) + Cl_2(g) \rightarrow 2NaCl(s)$
(4) $2H_2(g) + O_2(g) \rightarrow 2H_2O(\ell)$

42 A solution consists of 0.50 mole of $CaCl_2$ dissolved in 100. grams of H_2O at 25°C. Compared to the boiling point and freezing point of 100. grams of H_2O at standard pressure, the solution at standard pressure has

(1) a lower boiling point and a lower freezing point
(2) a lower boiling point and a higher freezing point
(3) a higher boiling point and a lower freezing point
(4) a higher boiling point and a higher freezing point

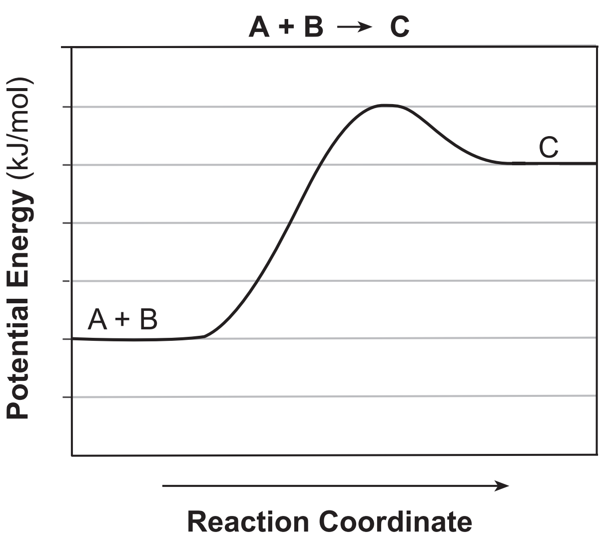
43 Given the balanced ionic equation representing a reaction:

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

Which half-reaction represents the reduction that occurs?

(1) $Al \rightarrow Al^{3+} + 3e$
(2) $Al^{3+} + 3e \rightarrow Al$
(3) $Cu \rightarrow Cu^{2+} + 2e$
(4) $Cu^{2+} + 2e \rightarrow Cu$

44 Given the equation and potential energy diagram representing a reaction:



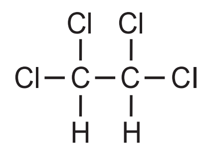
If each interval on the axis labeled "Potential Energy (kJ/mol)" represents 10. kJ/mol, what is the heat of reaction?

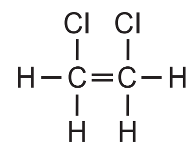
(1) +60. kJ/mol
(2) +20. kJ/mol
(3) +30. kJ/mol
(4) +40. kJ/mol

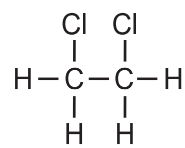
45 Some solid KNO_3 remains at the bottom of a stoppered flask containing a saturated KNO_3(aq) solution at 22°C. Which statement explains why the contents of the flask are at equilibrium?

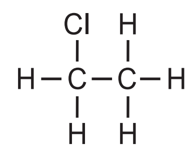
(1) The rate of dissolving is equal to the rate of crystallization.
(2) The rate of dissolving is greater than the rate of crystallization.
(3) The concentration of the solid is equal to the concentration of the solution.
(4) The concentration of the solid is greater than the concentration of the solution.

46 Which formula represents the product of the addition reaction between ethene and chlorine, Cl_2?


(1)


(3)


(2)


(4)

47 Based on Reference Table *J*, which two reactants react spontaneously?

(1) $Mg(s) + ZnCl_2(aq)$
(2) $Cu(s) + FeSO_4(aq)$
(3) $Pb(s) + ZnCl_2(aq)$
(4) $Co(s) + NaCl(aq)$

48 When the pH value of a solution is changed from 2 to 1, the concentration of hydronium ions

(1) decreases by a factor of 2
(2) increases by a factor of 2
(3) decreases by a factor of 10
(4) increases by a factor of 10

49 Given the balanced equation representing a nuclear reaction:

$$^{2}_{1}H + ^{3}_{1}H \rightarrow ^{4}_{2}He + ^{1}_{0}n$$

Which phrase identifies and describes this reaction?

(1) fission, mass converted to energy
(2) fission, energy converted to mass
(3) fusion, mass converted to energy
(4) fusion, energy converted to mass

50 Given the equation representing a reversible reaction:

$$NH_3(g) + H_2O(\ell) \rightleftharpoons NH_4^+(aq) + OH\ (aq)$$

According to one acid-base theory, the reactant that donates an H^+ ion in the forward reaction is

(1) $NH_3(g)$
(2) $H_2O(\ell)$
(3) $NH_4^+(aq)$
(4) $OH\ (aq)$

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 *Reference Tables for Physical Setting/Chemistry.*

Base your answers to questions 51 through 54 on the information below.

The atomic radius and the ionic radius for some Group 1 and some Group 17 elements are given in the tables below.

Atomic and Ionic Radii of Some Elements

Group 1

Particle	Radius (pm)
Li atom Li^{+} ion	130. 78
Na atom Na^{+} ion	160. 98
K atom K^{+} ion	200. 133
Rb atom Rb^{+} ion	215 148

Group 17

Particle	Radius (pm)
F atom F^{-} ion	60. 133
Cl atom Cl^{-} ion	100. 181
Br atom Br^{-} ion	117 ?
I atom I^{-} ion	136 220.

51 Estimate the radius of a Br ion. [1]

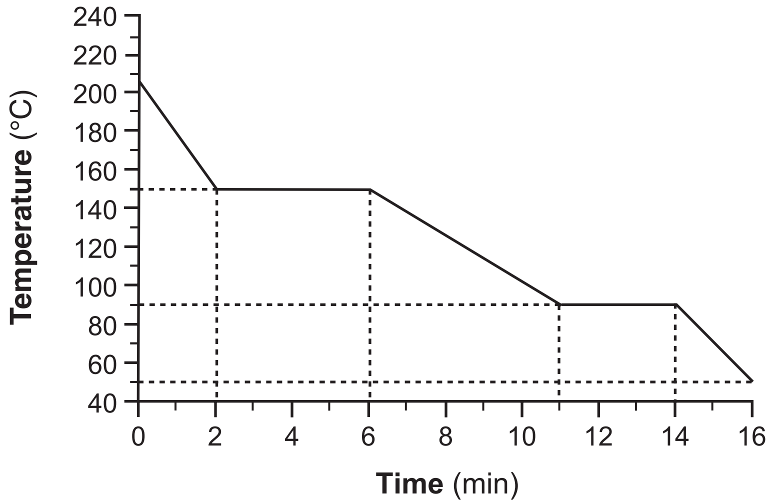
52 Explain, in terms of electron shells, why the radius of a K^{+} ion is greater than the radius of an Na^{+} ion. [1]

53 Write *both* the name and the charge of the particle that is gained by an F atom when the atom becomes an F ion. [1]

54 State the relationship between atomic number and first ionization energy as the elements in Group 1 are considered in order of increasing atomic number. [1]

Base your answers to questions 55 through 57 on the information below.

Starting as a gas at 206°C, a sample of a substance is allowed to cool for 16 minutes. This process is represented by the cooling curve below.



55 What is the melting point of this substance? [1]

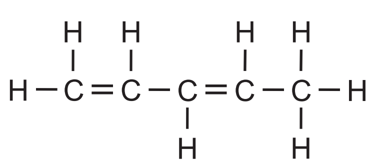
56 At what time do the particles of this sample have the *lowest* average kinetic energy? [1]

57 Using the key *in your answer booklet,* draw *two* particle diagrams to represent the *two* phases of the sample at minute 4. Your response must include *at least six* particles for *each* diagram. [1]

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

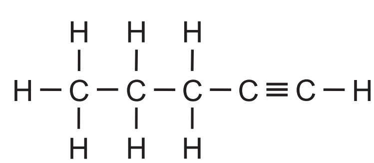
Two hydrocarbons that are isomers of each other are represented by the structural formulas and molecular formulas below.

Hydrocarbon 1



C_5H_8

Hydrocarbon 2



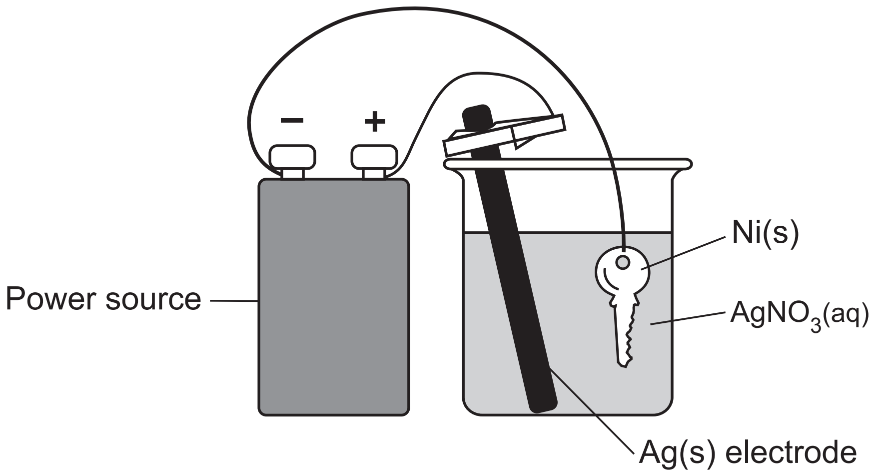
C_5H_8

58 Explain, in terms of bonds, why these hydrocarbons are unsaturated. [1]

59 Explain, in terms of structural formulas and molecular formulas, why these hydrocarbons are isomers of each other. [1]

Base your answers to questions 60 through 62 on the information below.

The diagram below represents an operating electrolytic cell used to plate silver onto a nickel key. As the cell operates, oxidation occurs at the silver electrode and the mass of the silver electrode decreases.



60 Identify the cathode in the cell. [1]

61 State the purpose of the power source in the cell. [1]

62 Explain, in terms of Ag atoms and $Ag^{+}(aq)$ ions, why the mass of the silver electrode *decreases* as the cell operates. [1]

Base your answers to questions 63 through 65 on the information below.

In a titration, a few drops of an indicator are added to a flask containing 35.0 milliliters of $HNO_3(aq)$ of unknown concentration. After 30.0 milliliters of 0.15 M NaOH(aq) solution is slowly added to the flask, the indicator changes color, showing the acid is neutralized.

63 The volume of the NaOH(aq) solution is expressed to what number of significant figures? [1]

64 Complete the equation *in your answer booklet* for this neutralization reaction by writing the formula of *each* product. [1]

65 In the space *in your answer booklet,* show a numerical setup for calculating the concentration of the $HNO_3(aq)$ solution. [1]

Part C

Answer all questions in this part.

Directions (66–85): Record your answers in the spaces provided in your answer booklet. Some questions may require the use of the *Reference Tables for Physical Setting/Chemistry*.

Base your answers to questions 66 through 69 on the information below.

During a fireworks display, salts are heated to very high temperatures. Ions in the salts absorb energy and become excited. Spectacular colors are produced as energy is emitted from the ions in the form of light.

The color of the emitted light is characteristic of the metal ion in each salt. For example, the lithium ion in lithium carbonate, Li_2CO_3, produces a deep-red color. The strontium ion in strontium carbonate, $SrCO_3$, produces a bright-red color. Similarly, calcium chloride is used for orange light, sodium chloride for yellow light, and barium chloride for green light.

66 Write the formula for the salt used to produce green light in a fireworks display. [1]

67 Identify the *two* types of chemical bonds found in the salt used to produce a deep-red color. [1]

68 Determine the oxidation state of carbon in the salt used to produce a bright-red color. [1]

69 Explain, in terms of subatomic particles and energy states, how the colors in a fireworks display are produced. [1]

Base your answers to questions 70 and 71 on the information below.

A scientist makes a solution that contains 44.0 grams of hydrogen chloride gas, HCl(g), in 200. grams of water, $H_2O(\ell)$, at 20.°C. This process is represented by the balanced equation below.

$$\mathrm{HCl(g)} \xrightarrow{H_2O} \mathrm{H^+(aq) + Cl\ (aq)}$$

70 Based on Reference Table *G*, identify, in terms of saturation, the type of solution made by the scientist. [1]

71 Explain, in terms of the distribution of particles, why the solution is a homogeneous mixture. [1]

Base your answers to questions 72 through 74 on the information below.

Iron has been used for thousands of years. In the air, iron corrodes. One reaction for the corrosion of iron is represented by the balanced equation below.

$$\text{Equation 1: } 4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$$

In the presence of water, iron corrodes more quickly. This corrosion is represented by the unbalanced equation below.

$$\text{Equation 2: } Fe(s) + O_2(g) + H_2O(\ell) \rightarrow Fe(OH)_2(s)$$

72 Identify *one* substance in the passage that can *not* be broken down by a chemical change. [1]

73 Using equation 1, describe *one* chemical property of iron. [1]

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

Base your answers to questions 75 through 78 on the information below.

Vitamin C, also known as ascorbic acid, is water soluble and cannot be produced by the human body. Each day, a person's diet should include a source of vitamin C, such as orange juice. Ascorbic acid has a molecular formula of $C_6H_8O_6$ and a gram-formula mass of 176 grams per mole.

75 What is the color of the indicator thymol blue after it is added to an aqueous solution of vitamin C? [1]

76 Determine the number of moles of vitamin C in an orange that contains 0.071 gram of vitamin C. [1]

77 In the space *in your answer booklet*, show a numerical setup for calculating the percent composition by mass of oxygen in ascorbic acid. [1]

78 Write the empirical formula for ascorbic acid. [1]

Base your answers to questions 79 through 81 on the information below.

Several steps are involved in the industrial production of sulfuric acid. One step involves the oxidation of sulfur dioxide gas to form sulfur trioxide gas. A catalyst is used to increase the rate of production of sulfur trioxide gas. In a rigid cylinder with a movable piston, this reaction reaches equilibrium, as represented by the equation below.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) + 392 \text{ kJ}$$

79 Explain, in terms of collision theory, why increasing the pressure of the gases in the cylinder increases the rate of the forward reaction. [1]

80 Determine the amount of heat released by the production of 1.0 mole of $SO_3(g)$. [1]

81 State, in terms of the concentration of $SO_3(g)$, what occurs when more $O_2(g)$ is added to the reaction at equilibrium. [1]

Base your answers to questions 82 through 85 on the information below.

Nuclear radiation is harmful to living cells, particularly to fast-growing cells, such as cancer cells and blood cells. An external beam of the radiation emitted from a radioisotope can be directed on a small area of a person to destroy cancer cells within the body.

Cobalt-60 is an artificially produced radioisotope that emits gamma rays and beta particles. One hospital keeps a 100.0-gram sample of cobalt-60 in an appropriate, secure storage container for future cancer treatment.

82 State *one* risk to human tissue associated with the use of radioisotopes to treat cancer. [1]

83 Compare the penetrating power of the two emissions from the Co-60. [1]

84 Complete the nuclear equation *in your answer booklet* for the beta decay of the Co-60 by writing an isotopic notation for the missing product. [1]

85 Determine the total time that will have elapsed when 12.5 grams of the original Co-60 sample at the hospital remains unchanged. [1]

P.S./CHEMISTRY

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING CHEMISTRY

Thursday, January 26, 2012 — 1:15 to 4:15 p.m., only

ANSWER BOOKLET

Student . . . . Sex: ☐ Male ☐ Female

Teacher. . . . .

School . . . . Grade . . . .

Answer all questions in this examination. Record your answers in this booklet.

Part	Maximum Score	Student's Score
A	30	
B–1	20	
B–2	15	
C	20	

Total Written Test Score (Maximum Raw Score: 85) ☐

Final Score (from conversion chart) ☐

Raters' Initials:

Rater 1 . . . . **Rater 2** . . . .

Part A

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

Part A Score ☐

Part B–1

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

Part B–1 Score ☐

The declaration below must be signed when you have completed the examination.

I do hereby affirm, at the close of this examination, that I had no unlawful knowledge of the questions or answers prior to the examination and that I have neither given nor received assistance in answering any of the questions during the examination.

____

Signature

Part B–2

51 ____________________ **pm**

52 ____

____

____

53 Particle: ____________________________

Charge of particle: ____________________________

54 ____

____

55 ____________________ **°C**

56 ____

57

Key
○ = particle of the substance

One phase of the sample at minute 4

A different phase of the sample at minute 4

For Raters Only

51

52

53

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57

For Raters Only

58 ______________________________ 58

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59 ______________________________ 59

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60 ______________________________ 60

61 ______________________________ 61

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62 ______________________________ 62

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63 ____________________

64 $HNO_3(aq) + NaOH(aq) \rightarrow$ ____________________ + ____________________

65

For Raters Only	
63	
64	
65	

Total Score for Part B–2

Part C

For Raters Only

66 ____________ 66

67 ____________ and ____________ 67

68 ____________ 68

69 ____________

____________ 69

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70 ____________ 70

71 ____________

____________ 71

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72 ____________ 72

73 ____________

____________ 73

74 ______ $Fe(s)$ + ______ $O_2(g)$ + ______ $H_2O(\ell) \rightarrow$ ______ $Fe(OH)_2(s)$ 74

For Raters Only

75 ____________________ 75

76 ____________________ mol 76

77

77

78 ____________________ 78

79 ____________________

____________________ 79

____

80 ____________________ kJ 80

81 ____________________

____________________ 81

For Raters Only

82 ______________________________

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83 ______________________________

____

84 $^{60}_{27}Co \rightarrow ^{0}_{-1}\beta$ + ____________

85 ____________ y

82	
83	
84	
85	

Total Score for Part C

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 26, 2012 — 1:15 to 4:15 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/apda/ 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						Part B–1			
1	**4**	11	**2**	21	**2**	31	**4**	41	**1**
2	**3**	12	**1**	22	**3**	32	**3**	42	**3**
3	**2**	13	**4**	23	**4**	33	**1**	43	**4**
4	**3**	14	**4**	24	**2**	34	**2**	44	**3**
5	**1**	15	**4**	25	**4**	35	**1**	45	**1**
6	**2**	16	**1**	26	**1**	36	**4**	46	**2**
7	**1**	17	**1**	27	**4**	37	**3**	47	**1**
8	**3**	18	**4**	28	**2**	38	**2**	48	**4**
9	**3**	19	**2**	29	**3**	39	**4**	49	**3**
10	**2**	20	**2**	30	**3**	40	**1**	50	**2**

Directions to the Teacher

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

Use only *red* ink or *red* pencil in rating Regents papers. Do *not* correct the student's work by making insertions or changes of any kind.

For Part A and Part B–1, indicate by means of a check mark each incorrect or omitted answer. In the box provided at the end of each part, record the number of questions the student answered correctly for that part.

At least two science teachers must participate in the scoring of each student's responses to the Part B–2 and Part C open-ended questions. 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.

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. Complete sentences are *not* required. Phrases, diagrams, and symbols may be used. In the student's answer booklet, record the number of credits earned for each answer in the box printed to the right of the answer lines or spaces for that question.

Fractional credit is *not* allowed. Only whole-number credit may be given to a response. Units need not be given when the wording of the questions allows such omissions.

Raters should enter the scores earned for Part A, Part B–1, Part B–2, and Part C on the appropriate lines in the box printed on the answer booklet and then should add these four scores and enter the total in the box labeled "Total Written Test 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/apda/ on Thursday, January 26, 2012. The student's scale score should be entered in the labeled box on the student's answer booklet. The scale score is the student's final examination score. On the front of the student's answer booklet, raters must enter their initials on the lines next to "Rater 1" or "Rater 2."

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 an ionic radius value greater than 181 pm and less than 220. pm.

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

A K^+ ion has three electron shells and an Na^+ ion has only two.

A sodium ion has fewer electron shells than a potassium ion.

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

Particle: electron

Charge of particle: −1

Particle: electron

Charge of particle: negative

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

As the elements in Group 1 are considered in order of increasing atomic number, first ionization energy decreases.

As atomic number increases, first ionization energy decreases.

55 [1] Allow 1 credit for 90°C ± 2°C.

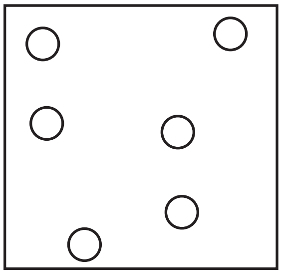
56 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

minute 16

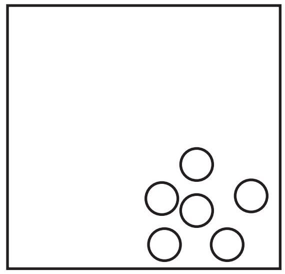
at 16 minutes

57 [1] Allow 1 credit. Particles of the gas must be drawn farther apart than particles of the liquid.

Example of a 1-credit response:



One phase of the sample at minute 4



A different phase of the sample at minute 4

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

A hydrocarbon 1 molecule has two carbon-carbon double bonds and a hydrocarbon 2 molecule has one carbon-carbon triple bond.

Both hydrocarbons have at least one multiple covalent bond between two carbon atoms.

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

The molecular formulas of the two hydrocarbons are the same, but the structural formulas are different.

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

Ni(s) key

key

nickel

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

The cell requires electrical energy for the nonspontaneous reaction to occur.

The power source causes some Ag(s) atoms to oxidize.

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

Silver atoms lose electrons and become silver ions in the solution.

Some of the Ag atoms become Ag^{+} ions.

Silver atoms are oxidized to silver ions.

63 [1] Allow 1 credit for 3 *or* three.

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

$NaNO_3(aq) + H_2O(\ell)$

$HOH + NaNO_3$

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

$M_A(35.0 \text{ mL}) = (0.15 \text{ M})(30.0 \text{ mL})$

$0.15 \times \frac{30}{35}$

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 $BaCl_2$.

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

ionic bonds and polar covalent bonds

covalent and ionic

68 [1] Allow 1 credit for +4.

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

When electrons in the ions move from higher energy states to lower energy states, lights of specific wavelengths are emitted.

Light is emitted when electrons return from higher electron shells to lower electron shells.

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

unsaturated solution

unsaturated

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

The H^+ ions and the Cl^- ions are distributed uniformly throughout the solution.

There is an even distribution of $H^+(aq)$ and $Cl^-(aq)$.

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

Fe

oxygen

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

Iron reacts with oxygen to form a compound.

An iron atom can lose three electrons.

The Fe atoms can form positive ions.

74 [1] Allow 1 credit for __2__ Fe(s) + ______ O_2(g) + __2__ $H_2O(\ell) \rightarrow$ __2__ $Fe(OH)_2$(s).

Allow credit even if the coefficient "1" is written in front of O_2(g).

75 [1] Allow 1 credit for yellow.

76 [1] Allow 1 credit. Significant figures do *not* need to be shown. Acceptable responses include, but are not limited to:

4.0×10^{-4} mol

0.000 40 mol

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

$$\frac{6(16\text{ g/mol})}{176\text{ g/mol}} \times 100$$

$$\frac{(96)(100)}{176}$$

78 [1] Allow 1 credit for $C_3H_4O_3$. The order of the elements can vary.

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

When the pressure in the cylinder is increased, the SO_2(g) molecules and O_2(g) molecules collide more frequently, producing more SO_3(g).

80 [1] Allow 1 credit for 196 kJ.

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

The concentration of SO_3(g) increases.

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

Nuclear radiation is harmful to all living cells.

Radioisotopes can cause gene mutations.

Treatments can cause stomach problems, such as nausea.

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

Gamma radiation has greater penetrating power.

Beta particles have weaker penetrating power.

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

$^{60}_{28}Ni$

^{60}Ni

nickel-60

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

15.813 y

15.8 y

Regents Examination in Physical Setting/Chemistry

January 2012

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

The *Chart for Determining the Final Examination Score for the January 2012 Regents Examination in Physical Setting/Chemistry* will be posted on the Department's web site at: http://www.p12.nysed.gov/apda/ on Thursday, January 26, 2012. 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 2012 Physical Setting/Chemistry			
Question Numbers			
Key Ideas/Performance Indicators	Part A	Part B	Part C
Standard 1			
Math Key Idea 1		36, 54, 56, 63	
Math Key Idea 2			
Math Key Idea 3		34, 51, 65	66, 68, 77, 80
Science Inquiry Key Idea 1		49, 52, 61, 62	67, 69, 71
Science Inquiry Key Idea 2			
Science Inquiry Key Idea 3		32, 41, 46, 50, 53, 59	78
Engineering Design Key Idea 1			
Standard 2			
Key Idea 1			72, 73
Key Idea 2			
Key Idea 3			
Standard 6			
Key Idea 1			
Key Idea 2			
Key Idea 3		48	
Key Idea 4			81
Key Idea 5		38	
Standard 7			
Key Idea 1			76, 82
Key Idea 2			
Standard 4 Process Skills			
Key Idea 3		31, 33, 39, 40, 42, 43, 45, 47, 54, 57, 58, 60, 64	74, 75, 79, 83
Key Idea 4		37, 44, 55	84, 85
Key idea 5		35	70
Standard 4			
Key Idea 3	1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 15, 17, 18, 19, 20, 23, 24, 25, 26, 27, 29, 30	31, 32, 33, 39, 40, 41, 42, 43, 45, 46, 47, 48, 50, 51, 52, 54, 57, 58, 59, 60, 61, 62, 63, 64, 65	66, 68, 69, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 83
Key Idea 4		36, 37, 44, 55, 56	82, 84, 85
Key Idea 5	10, 13, 14, 16, 21, 22, 28	34, 35, 38, 49, 53	67, 70
Reference Tables			
2011 Edition	1, 2, 5, 6, 7, 8, 9, 11, 12, 13, 21, 26, 27, 28, 30	31, 35, 38, 39, 40, 46, 47, 65	66, 67, 68, 70, 75, 76, 77, 84, 85

University of the State of New York
State Education Department

Regents Examination in Physical Setting/Chemistry
January 2012

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

Raw Score	Scale Score	Raw Score	Scale Score	Raw Score	Scale Score	Raw Score	Scale Score
85	100	63	74	41	59	19	38
84	98	62	73	40	58	18	36
83	96	61	72	39	57	17	35
82	95	60	72	38	57	16	33
81	93	59	71	37	56	15	32
80	91	58	70	36	55	14	30
79	90	57	70	35	54	13	29
78	89	56	69	34	53	12	27
77	87	55	68	33	53	11	25
76	86	54	67	32	52	10	23
75	85	53	67	31	51	9	21
74	84	52	66	30	50	8	19
73	83	51	66	29	49	7	17
72	82	50	65	28	48	6	15
71	81	49	64	27	47	5	13
70	80	48	63	26	46	4	11
69	79	47	63	25	45	3	8
68	78	46	62	24	44	2	6
67	77	45	61	23	43	1	3
66	76	44	61	22	42	0	0
65	75	43	60	21	40		
64	75	42	59	20	39		

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 "Final 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.