

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

**PHYSICAL SETTING
CHEMISTRY**

Friday, January 26, 2024 — 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 particles surround the nucleus of a neon atom?
- (1) electrons (3) positrons
(2) neutrons (4) protons
- 2 Which conclusion was proposed as a result of an experiment during which some alpha particles were deflected while passing through a thin sheet of gold foil?
- (1) Atoms are hard, indivisible spheres.
(2) Atoms have small, dense, positive nuclei.
(3) Atoms contain negatively charged particles.
(4) Atoms have electrons with wavelike properties.
- 3 The mass of each proton and each neutron is approximately equal to
- (1) 1 g (3) 1 u
(2) 1 mL (4) 1 mol
- 4 Which statement describes the relationship between two electrons in an atom of magnesium in the ground state?
- (1) An electron in the first shell has the same amount of energy as an electron in the second shell.
(2) An electron in the first shell has a greater amount of energy than an electron in the second shell.
(3) An electron in the second shell has the same amount of energy as an electron in the third shell.
(4) An electron in the third shell has a greater amount of energy than an electron in the second shell.
- 5 As an atom in the ground state changes to an atom in an excited state, the atom
- (1) absorbs energy
(2) releases energy
(3) increases in mass number
(4) decreases in mass number
- 6 Which statement describes a chemical property of copper?
- (1) Copper has a red-orange color.
(2) Copper can be flattened into sheets.
(3) Copper reacts with oxygen.
(4) Copper conducts an electric current.
- 7 At STP, two forms of solid carbon, diamond and graphite, have different properties because
- (1) diamond has a different percent composition than graphite
(2) diamond has more electrons per atom than graphite
(3) diamond has stronger hydrogen bonding than graphite
(4) diamond has a different crystal structure than graphite
- 8 Which element in Period 2 has the highest first ionization energy?
- (1) boron (3) neon
(2) lithium (4) nitrogen
- 9 Which phrase describes a specific compound?
- (1) can contain only one element
(2) can be physically separated into elements
(3) is composed of elements chemically combined in a definite ratio
(4) is composed of elements mixed in proportions that can vary

- 10 Which type of chemical formula shows the arrangement of the atoms in a molecule?
 (1) empirical formula (3) molecular formula
 (2) general formula (4) structural formula
- 11 A 2.5 L sample of $\text{SO}_2(\text{g})$ at STP and a 2.5 L sample of $\text{CO}_2(\text{g})$ at STP can be differentiated by comparing their
 (1) masses (3) temperatures
 (2) phases (4) volumes
- 12 Which terms identify the two different major categories of compounds?
 (1) covalent and molecular
 (2) covalent and thermal
 (3) ionic and molecular
 (4) ionic and thermal
- 13 Which molecule of an element contains a multiple covalent bond?
 (1) Br_2 (3) H_2
 (2) F_2 (4) O_2
- 14 Which molecule is symmetrical in *both* shape and distribution of charge?
 (1) HCl (3) NH_3
 (2) H_2O (4) CH_4
- 15 What occurs when two atoms of bromine react to form a molecule of bromine?
 (1) A bond is broken as energy is released.
 (2) A bond is broken as energy is absorbed.
 (3) A bond is formed as energy is released.
 (4) A bond is formed as energy is absorbed.
- 16 Atoms of which element have the strongest attraction for electrons in a chemical bond?
 (1) fluorine (3) phosphorus
 (2) nitrogen (4) potassium
- 17 Heat flows from an object at a temperature of $20.^\circ\text{C}$ to an object at a temperature of
 (1) 15°C (3) 35°C
 (2) 25°C (4) 45°C
- 18 According to the kinetic molecular theory, an ideal gas has particles with
 (1) large volume
 (2) large atomic radii
 (3) no attractive forces
 (4) no random motion
- 19 Which sample at STP contains the same number of atoms as 2.0 liters of $\text{He}(\text{g})$ at STP?
 (1) 1.0 liter of $\text{Ar}(\text{g})$
 (2) 2.0 liters of $\text{Ar}(\text{g})$
 (3) 3.0 liters of $\text{Ne}(\text{g})$
 (4) 4.0 liters of $\text{Ne}(\text{g})$
- 20 All chemical systems at equilibrium have equal
 (1) masses of reactants and products
 (2) concentrations of reactants and products
 (3) rates of forward and reverse reactions
 (4) activation energies of forward and reverse reactions
- 21 Which expression represents the heat of reaction for a chemical change?
 (1) $(\text{PE}_{\text{products}}) + (\text{PE}_{\text{reactants}})$
 (2) $(\text{PE}_{\text{products}}) - (\text{PE}_{\text{reactants}})$
 (3) $(\text{PE}_{\text{products}}) \div (\text{PE}_{\text{reactants}})$
 (4) $(\text{PE}_{\text{products}}) \times (\text{PE}_{\text{reactants}})$
- 22 Which phase change represents an increase in entropy?
 (1) liquid to gas (3) gas to solid
 (2) liquid to solid (4) gas to liquid
- 23 Systems in nature tend to change toward
 (1) lower energy and less disorder
 (2) lower energy and greater disorder
 (3) higher energy and less disorder
 (4) higher energy and greater disorder
- 24 Which name represents a hydrocarbon?
 (1) 1-hexene (3) 3-hexanone
 (2) 1-iodohexane (4) 3-hexanol

- 25 Which process occurs at the anode in an electrolytic cell?
(1) addition (3) oxidation
(2) combustion (4) reduction
- 26 Which formula represents an electrolyte?
(1) H_2O (3) H_2SO_4
(2) CCl_4 (4) $\text{C}_6\text{H}_{12}\text{O}_6$
- 27 Which formula represents an Arrhenius acid?
(1) KCl (3) NH_3
(2) HCl (4) KOH
- 28 According to one acid-base theory, an acid is a substance that
(1) donates hydroxide ions
(2) donates hydrogen ions
(3) accepts hydroxide ions
(4) accepts hydrogen ions
- 29 Which nuclear emission has the greatest mass and ionizing power?
(1) alpha particle (3) gamma radiation
(2) beta particle (4) positron
- 30 Which statement describes a benefit of the nuclear reaction that occurs in a nuclear power plant?
(1) Large amounts of water are needed to cool the nuclear reactor.
(2) The power plant reaction can be used in dating geologic formations.
(3) Radioactive isotopes are stored for a very long time at the power plant site.
(4) A large amount of energy is produced from a small amount of a radioisotope.
-

33 A student determines the density of a copper sample at room temperature to be 9.46 g/cm^3 . Based on Table S, what is the student's percent error in determining the density of copper?

- (1) 0.50% (3) 5.3%
 (2) 5.0% (4) 5.6%

34 What is the gram-formula mass of $\text{Mg}(\text{NO}_3)_2$?

- (1) 86 g/mol (3) 148 g/mol
 (2) 134 g/mol (4) 172 g/mol

35 Compared to a rubidium atom, a Rb^+ ion has

- (1) one more electron and a larger radius
 (2) one more electron and a smaller radius
 (3) one fewer electron and a larger radius
 (4) one fewer electron and a smaller radius

36 Which ion in the ground state has the same electron configuration as an atom of neon in the ground state?

- (1) K^+ (3) F^-
 (2) Li^+ (4) Cl^-

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

- (1) barium (3) methane
 (2) butanal (4) methanol

38 The difference in which property allows the separation of a sample of water and sand by using filter paper and a funnel?

- (1) boiling point (3) particle size
 (2) melting point (4) sample volume

39 According to Table F, which compound has a very low solubility in water?

- (1) sodium carbonate (3) calcium hydroxide
 (2) sodium sulfide (4) calcium phosphate

40 What is the molarity of a NaOH solution containing 0.125 mole of NaOH in 0.200 L of water?

- (1) 0.025 M (3) 0.625 M
 (2) 0.250 M (4) 1.60 M

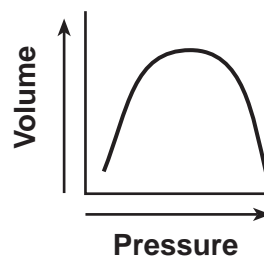
41 Compared to a 0.10 M aqueous NaNO_3 solution at 1 atmosphere, a 1.0 M aqueous NaNO_3 solution at 1 atmosphere has a

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

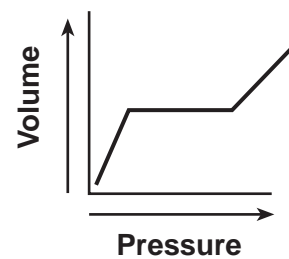
42 What is the temperature, in degrees Celsius, of a sample of matter at 35 K?

- (1) -238°C (3) 35°C
 (2) -308°C (4) 308°C

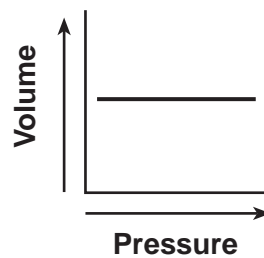
43 Which graph represents the relationship between pressure and volume for an ideal gas at constant temperature?



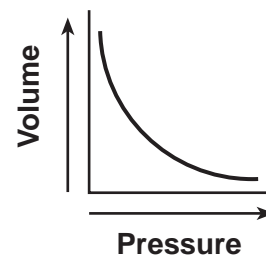
(1)



(3)



(2)



(4)

44 Which equation represents a physical change?

- (1) $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightarrow 2\text{HI}(\text{g})$
 (2) $\text{N}_2(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow 2\text{NO}_2(\text{g})$
 (3) $\text{I}_2(\text{s}) \rightarrow \text{I}_2(\text{g})$
 (4) $3\text{O}_2(\text{g}) \rightarrow 2\text{O}_3(\text{g})$

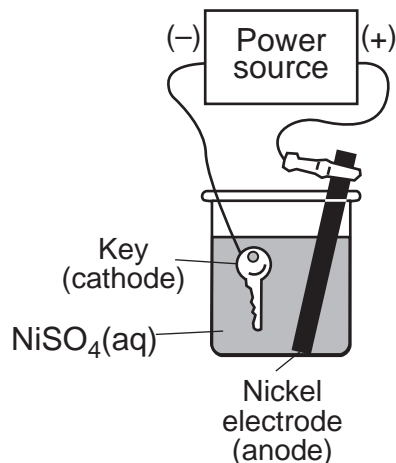
- 45 Which combination of reactants would result in the fastest reaction rate?
- (1) a 1.0 g strip of zinc with 10 mL of 0.20 M HCl(aq)
 - (2) a 1.0 g strip of zinc with 10 mL of 2.0 M HCl(aq)
 - (3) 1.0 g of powdered zinc with 10 mL of 0.20 M HCl(aq)
 - (4) 1.0 g of powdered zinc with 10 mL of 2.0 M HCl(aq)

- 46 Which equation represents a redox reaction?
- (1) $\text{H}_3\text{O}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow 2\text{H}_2\text{O}(\ell)$
 - (2) $\text{NaCl}(\text{aq}) + \text{AgNO}_3(\text{aq}) \rightarrow \text{NaNO}_3(\text{aq}) + \text{AgCl}(\text{s})$
 - (3) $4\text{Fe}(\text{s}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{Fe}_2\text{O}_3(\text{s})$
 - (4) $\text{NaOH}(\text{aq}) + \text{HBr}(\text{aq}) \rightarrow \text{H}_2\text{O}(\ell) + \text{NaBr}(\text{aq})$

- 47 Which equation represents a reduction half-reaction?
- (1) $\text{Na} \rightarrow \text{Na}^+ + \text{e}^-$
 - (2) $\text{Na} + \text{e}^- \rightarrow \text{Na}^+$
 - (3) $\text{Na}^+ \rightarrow \text{Na} + \text{e}^-$
 - (4) $\text{Na}^+ + \text{e}^- \rightarrow \text{Na}$

- 48 The pH value of a solution is changed from 6.0 to 4.0. Which phrase describes the change in the hydronium ion concentration of the solution?
- (1) decreased by a factor of 2
 - (2) increased by a factor of 2
 - (3) decreased by a factor of 100
 - (4) increased by a factor of 100

- 49 A key is plated with nickel as shown in the diagram below.



Which type of cell is represented by the diagram and what change occurs?

- (1) electrolytic cell; electrical energy produces a chemical change
 - (2) electrolytic cell; a chemical change produces electrical energy
 - (3) voltaic cell; electrical energy produces a chemical change
 - (4) voltaic cell; a chemical change produces electrical energy
- 50 Which equation represents a nuclear fusion reaction?
- (1) ${}_{37}^{87}\text{Rb} \rightarrow {}_{-1}^0\text{e} + {}_{38}^{87}\text{Sr}$
 - (2) ${}_{6}^{11}\text{C} \rightarrow {}_{+1}^0\text{e} + {}_{5}^{11}\text{B}$
 - (3) ${}_{1}^2\text{H} + {}_{1}^3\text{H} \rightarrow {}_{2}^4\text{He} + {}_{0}^1\text{n}$
 - (4) ${}_{92}^{235}\text{U} + {}_{0}^1\text{n} \rightarrow {}_{56}^{142}\text{Ba} + {}_{36}^{91}\text{Kr} + 3{}_{0}^1\text{n}$

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 Determine the molecular formula for a compound that has the empirical formula CH_2O and a molar mass of 180. grams per mole. [1]

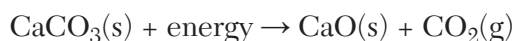
Base your answers to questions 52 through 54 on the information below and on your knowledge of chemistry.

Bromine, chlorine, fluorine, and iodine are four elements in Group 17 that can be differentiated by some of their properties.

- 52 State the trend in atomic radius for these four elements as they are considered in order of increasing atomic number. [1]
- 53 Determine the mass of a sample of iodine that has a volume of 2.5 cm^3 at room temperature and standard pressure. [1]
- 54 State, in terms of electrons, why these elements have similar chemical properties. [1]
-

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

When solid calcium carbonate is heated, solid calcium oxide and carbon dioxide gas are formed. The balanced equation below represents this reaction.



55 State the molecular polarity of a CO_2 molecule. [1]

56 Based on Table S, determine the electronegativity difference between oxygen and calcium in calcium oxide. [1]

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

During a laboratory activity, a student dissolves 20.0 grams of solid ammonium chloride, $\text{NH}_4\text{Cl}(\text{s})$, in 100.0 grams of water at 25°C . After thorough stirring, no undissolved $\text{NH}_4\text{Cl}(\text{s})$ remains. During this laboratory activity, appropriate safety equipment is used and safety procedures are followed.

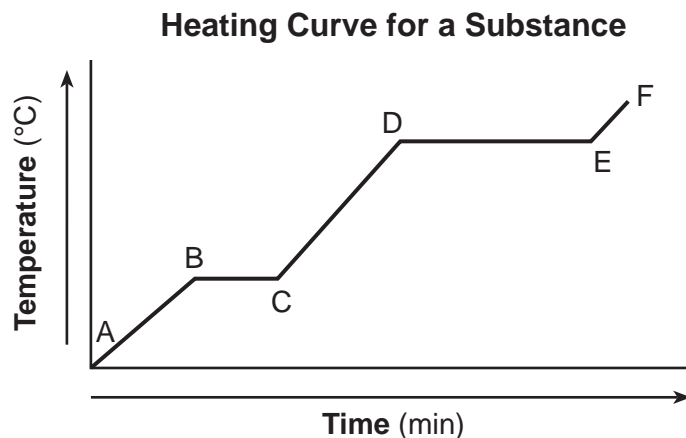
57 Classify, in terms of saturation, the type of solution produced. [1]

58 State evidence from Table I that indicates that this dissolving process is endothermic. [1]

59 State, in terms of particle distribution, why this solution is classified as a homogeneous mixture. [1]

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

Starting as a solid, a sample of a substance is heated uniformly at standard pressure, as shown by the heating curve below.



60 Identify the interval during which the average distance between the particles is the greatest. [1]

61 State what happens to the potential energy of the particles during the melting of the substance. [1]

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

A 30.0-milliliter sample of $\text{HCl}(\text{aq})$ was exactly neutralized by 18.0 milliliters of 0.10 M $\text{KOH}(\text{aq})$. During this laboratory activity, appropriate safety equipment was used and safety procedures were followed.

62 State the color of bromocresol green indicator if it were added to a sample of the 0.10 M $\text{KOH}(\text{aq})$. [1]

63 State the number of significant figures used to express the concentration of $\text{KOH}(\text{aq})$. [1]

64 Determine the concentration of the $\text{HCl}(\text{aq})$ sample, using the titration data. [1]

65 Compare the hydroxide ion concentration of the 0.10 M $\text{KOH}(\text{aq})$ with the hydroxide ion concentration of the resulting neutral 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 *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.

Some scientists study samples of ancient ice. A water molecule trapped in ancient ice typically has an oxygen-16 or an oxygen-18 in its structure. Water with oxygen-16 evaporates slightly faster from seawater than water with oxygen-18. The three naturally occurring isotopes of oxygen have mass numbers of 16, 17, or 18.

66 Compare the number of protons to the number of electrons in an atom of oxygen-18. [1]

67 In the space *in your answer booklet*, draw a Lewis electron-dot diagram for an atom of oxygen. [1]

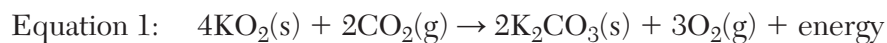
68 State, in terms of neutrons, why a water molecule containing an O-18 atom has a greater mass than a water molecule containing an O-16 atom. [1]

Base your answers to questions 69 through 71 on the information below and on your knowledge of chemistry.

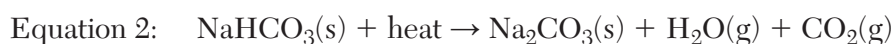
The table below shows two compounds and their uses.

Compound	Use
KO ₂	as a source of O ₂ (g) in space shuttles
NaHCO ₃	as a source of CO ₂ (g) in baking

Potassium superoxide, KO₂, removes carbon dioxide from the air and produces oxygen in space shuttles, as represented in balanced equation 1 below.



The heating of sodium hydrogen carbonate, NaHCO₃, causes baked goods to rise when it produces steam and carbon dioxide gas, as shown in unbalanced equation 2 below.

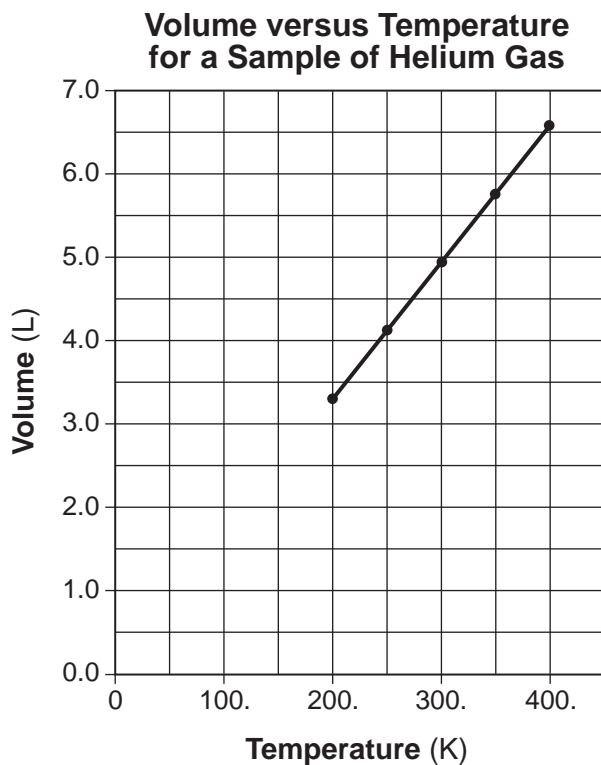


- 69 Show a numerical setup for calculating the percent composition by mass of oxygen in the sodium hydrogen carbonate (gram-formula mass = 84 g/mol). [1]
- 70 Determine the number of moles of K₂CO₃ produced when 3.50 moles of KO₂ completely reacts, as represented in equation 1. [1]
- 71 Balance equation 2 *in your answer booklet* for the heating of NaHCO₃(s), using smallest whole-number coefficients. [1]
-

Base your answers to questions 72 and 73 on the information below and on your knowledge of chemistry.

In 1787, Jacques Charles, a French scientist and pioneer balloonist, performed experiments on how the volume of a gas depends on temperature.

Using a rigid cylinder with a movable piston containing a sample of helium gas, a scientist obtained data for temperature and volume. The graph below represents the relationship between the temperature and volume of the sample of helium gas at 1.0 atmosphere.

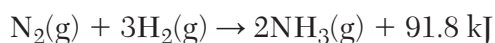


72 Determine the volume of this sample of helium gas at 350. K. [1]

73 Compare the average kinetic energy of the helium atoms in the sample at 200. K to the average kinetic energy of the helium atoms at 300. K. [1]

Base your answers to questions 74 through 77 on the information below and on your knowledge of chemistry.

In the early 1900s, scientists developed a process to produce ammonia from hydrogen and atmospheric nitrogen on an industrial scale. The balanced equation below represents this reaction.

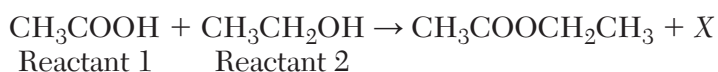


At room temperature, the reaction occurs at a very slow rate. Therefore, this process takes place in a special reaction vessel at high temperature and high pressure. A catalyst is used to increase the rate of the production of ammonia. The reaction gases are cooled to remove the ammonia as a liquid and the remaining gases are sent back to the reaction vessel.

- 74 Explain, in terms of collision theory, why reacting hydrogen and nitrogen at high temperature increases the rate of the reaction. [1]
- 75 Determine the net quantity of heat released when 1.0 mole of ammonia gas, $\text{NH}_3(\text{g})$, is produced by this reaction. [1]
- 76 Using the axes *in your answer booklet*, draw a potential energy diagram for the reaction. [1]
- 77 State, in terms of activation energy and reaction pathway, why the addition of a catalyst increases the rate of production of ammonia. [1]
-

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

In a laboratory activity, a student reacts an organic acid with an alcohol and produces a compound with a distinct odor. The incomplete equation below shows the reaction in the laboratory activity with a missing product, X.



During the laboratory activity, appropriate safety equipment is used and safety procedures are followed.

- 78 Identify the element present in the reactants that allows them to be classified as organic compounds. [1]
- 79 Write a chemical name for reactant 1. [1]
- 80 Write a formula for the missing product, X, in the equation. [1]
- 81 Identify the class of organic compounds to which $\text{CH}_3\text{COOCH}_2\text{CH}_3$ belongs. [1]
-

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

Radioactive isotopes are used in a variety of ways. Several isotopes and their uses are shown below.

Radioactive Isotopes and Their Uses

Isotope	Use
Fe-59	anemia diagnosis
I-131	thyroid function diagnosis
U-238	dating geological formations
Am-241	smoke detectors

- 82 Compare the penetrating power of the beta particle emitted from the I-131 nuclide to the penetrating power of the alpha particle emitted from the U-238 nuclide. [1]
- 83 Complete the nuclear equation, *in your answer booklet*, for the decay of the Fe-59 used to diagnose anemia disorders, by writing a notation for the missing product. [1]
- 84 Determine the fraction of an original sample of the radioactive isotope used to test for thyroid problems that remains unchanged after 24.063 days. [1]
- 85 Determine the number of neutrons in an atom of Am-241. [1]
-

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PHYSICAL SETTING CHEMISTRY

Friday, January 26, 2024 — 9:15 a.m. to 12:15 p.m., only

ANSWER BOOKLET

Student

Teacher

School Grade

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

Part B–2

51 _____

52 _____

53 _____ g

54 _____

55 _____

56 _____

57 _____

58 _____

59 _____

60 _____

61 _____

62 _____

63 _____

64 _____ M

65 _____

Part C

66 _____

67 _____

68 _____

69 _____

70 _____ mol



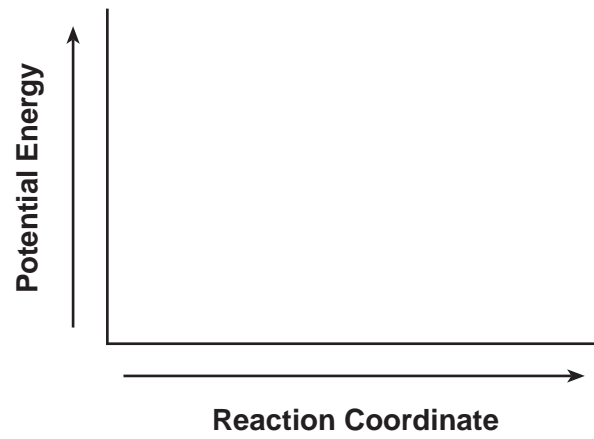
72 _____ L

73 _____

74 _____

75 _____ kJ

76



77 _____

78 _____

79 _____

80 _____

81 _____

82 _____

83 ${}_{26}^{59}\text{Fe} \rightarrow {}_{-1}^0\text{e} + \text{_____}$

84 _____

85 _____

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Regents Examination in Physical Setting/Chemistry – January 2024**Scoring Key: Parts A and B-1 (Multiple-Choice Questions)**

Examination	Date	Question Number	Scoring Key	Question Type	Credit	Weight
Physical Setting/Chemistry	January '24	1	1	MC	1	1
Physical Setting/Chemistry	January '24	2	2	MC	1	1
Physical Setting/Chemistry	January '24	3	3	MC	1	1
Physical Setting/Chemistry	January '24	4	4	MC	1	1
Physical Setting/Chemistry	January '24	5	1	MC	1	1
Physical Setting/Chemistry	January '24	6	3	MC	1	1
Physical Setting/Chemistry	January '24	7	4	MC	1	1
Physical Setting/Chemistry	January '24	8	3	MC	1	1
Physical Setting/Chemistry	January '24	9	3	MC	1	1
Physical Setting/Chemistry	January '24	10	4	MC	1	1
Physical Setting/Chemistry	January '24	11	1	MC	1	1
Physical Setting/Chemistry	January '24	12	3	MC	1	1
Physical Setting/Chemistry	January '24	13	4	MC	1	1
Physical Setting/Chemistry	January '24	14	4	MC	1	1
Physical Setting/Chemistry	January '24	15	3	MC	1	1
Physical Setting/Chemistry	January '24	16	1	MC	1	1
Physical Setting/Chemistry	January '24	17	1	MC	1	1
Physical Setting/Chemistry	January '24	18	3	MC	1	1
Physical Setting/Chemistry	January '24	19	2	MC	1	1
Physical Setting/Chemistry	January '24	20	3	MC	1	1
Physical Setting/Chemistry	January '24	21	2	MC	1	1
Physical Setting/Chemistry	January '24	22	1	MC	1	1
Physical Setting/Chemistry	January '24	23	2	MC	1	1
Physical Setting/Chemistry	January '24	24	1	MC	1	1
Physical Setting/Chemistry	January '24	25	3	MC	1	1
Physical Setting/Chemistry	January '24	26	3	MC	1	1
Physical Setting/Chemistry	January '24	27	2	MC	1	1
Physical Setting/Chemistry	January '24	28	2	MC	1	1
Physical Setting/Chemistry	January '24	29	1	MC	1	1
Physical Setting/Chemistry	January '24	30	4	MC	1	1
Physical Setting/Chemistry	January '24	31	3	MC	1	1
Physical Setting/Chemistry	January '24	32	2	MC	1	1
Physical Setting/Chemistry	January '24	33	4	MC	1	1
Physical Setting/Chemistry	January '24	34	3	MC	1	1
Physical Setting/Chemistry	January '24	35	4	MC	1	1
Physical Setting/Chemistry	January '24	36	3	MC	1	1
Physical Setting/Chemistry	January '24	37	1	MC	1	1
Physical Setting/Chemistry	January '24	38	3	MC	1	1
Physical Setting/Chemistry	January '24	39	4	MC	1	1
Physical Setting/Chemistry	January '24	40	3	MC	1	1
Physical Setting/Chemistry	January '24	41	2	MC	1	1
Physical Setting/Chemistry	January '24	42	1	MC	1	1
Physical Setting/Chemistry	January '24	43	4	MC	1	1
Physical Setting/Chemistry	January '24	44	3	MC	1	1
Physical Setting/Chemistry	January '24	45	4	MC	1	1
Physical Setting/Chemistry	January '24	46	3	MC	1	1
Physical Setting/Chemistry	January '24	47	4	MC	1	1
Physical Setting/Chemistry	January '24	48	4	MC	1	1
Physical Setting/Chemistry	January '24	49	1	MC	1	1
Physical Setting/Chemistry	January '24	50	3	MC	1	1

Regents Examination in Physical Setting/Chemistry – January 2024

Scoring Key: Parts B-2 and C (Constructed-Response Questions)

Examination	Date	Question Number	Scoring Key	Question Type	Credit	Weight
Physical Setting/Chemistry	January '24	51	-	CR	1	1
Physical Setting/Chemistry	January '24	52	-	CR	1	1
Physical Setting/Chemistry	January '24	53	-	CR	1	1
Physical Setting/Chemistry	January '24	54	-	CR	1	1
Physical Setting/Chemistry	January '24	55	-	CR	1	1
Physical Setting/Chemistry	January '24	56	-	CR	1	1
Physical Setting/Chemistry	January '24	57	-	CR	1	1
Physical Setting/Chemistry	January '24	58	-	CR	1	1
Physical Setting/Chemistry	January '24	59	-	CR	1	1
Physical Setting/Chemistry	January '24	60	-	CR	1	1
Physical Setting/Chemistry	January '24	61	-	CR	1	1
Physical Setting/Chemistry	January '24	62	-	CR	1	1
Physical Setting/Chemistry	January '24	63	-	CR	1	1
Physical Setting/Chemistry	January '24	64	-	CR	1	1
Physical Setting/Chemistry	January '24	65	-	CR	1	1
Physical Setting/Chemistry	January '24	66	-	CR	1	1
Physical Setting/Chemistry	January '24	67	-	CR	1	1
Physical Setting/Chemistry	January '24	68	-	CR	1	1
Physical Setting/Chemistry	January '24	69	-	CR	1	1
Physical Setting/Chemistry	January '24	70	-	CR	1	1
Physical Setting/Chemistry	January '24	71	-	CR	1	1
Physical Setting/Chemistry	January '24	72	-	CR	1	1
Physical Setting/Chemistry	January '24	73	-	CR	1	1
Physical Setting/Chemistry	January '24	74	-	CR	1	1
Physical Setting/Chemistry	January '24	75	-	CR	1	1
Physical Setting/Chemistry	January '24	76	-	CR	1	1
Physical Setting/Chemistry	January '24	77	-	CR	1	1
Physical Setting/Chemistry	January '24	78	-	CR	1	1
Physical Setting/Chemistry	January '24	79	-	CR	1	1
Physical Setting/Chemistry	January '24	80	-	CR	1	1
Physical Setting/Chemistry	January '24	81	-	CR	1	1
Physical Setting/Chemistry	January '24	82	-	CR	1	1
Physical Setting/Chemistry	January '24	83	-	CR	1	1
Physical Setting/Chemistry	January '24	84	-	CR	1	1
Physical Setting/Chemistry	January '24	85	-	CR	1	1

Key
MC = Multiple-choice question
CR = Constructed-response question

The chart for determining students' final examination scores for the **January 2024 Regents Examination in Physical Setting/Chemistry** will be posted on the Department's web site at <https://www.nysedregents.org/Chemistry/> on the day of the examination. Conversion charts provided for the previous administrations of the Physical Setting/Chemistry examination must NOT be used to determine students' final scores for this administration.

FOR TEACHERS ONLY

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

PHYSICAL SETTING/CHEMISTRY

Friday, January 26, 2024 — 9:15 a.m. to 12:15 p.m., only

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: <https://www.nysed.gov/state-assessment/high-school-regents-examinations> 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.

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*.

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 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. Do not attempt to correct the student’s work by making insertions or changes of any kind. 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: <https://www.nysed.gov/state-assessment/high-school-regents-examinations> on Friday, January 26, 2024. 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 $C_6H_{12}O_6$. The order of the elements may vary.

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

As atomic number increases, atomic radius increases.

Radius increases.

increases

53 [1] Allow 1 credit for 12 g or any value from 12 g to 12.333 g, inclusive.

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

Atoms of these elements have the same number of valence electrons.

These elements each have seven electrons in the outermost shell of their atoms.

same number of valence e^-

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

nonpolar molecule

nonpolar

56 [1] Allow 1 credit for 2.4.

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

unsaturated

not saturated

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

The ΔH for this dissolving is +14.78 kJ/mol.

The heat of solution is positive.

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

The particles are distributed uniformly throughout the mixture.

There is an even distribution of particles in the solution.

All particles are evenly dispersed.

Concentration of the particles is the same throughout the solution.

mixed uniformly

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

EF

FE

from E to F

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

The potential energy of the particles increases during melting.

The particles of the substance gain potential energy.

The PE increases.

increases

62 [1] Allow 1 credit for blue.

63 [1] Allow 1 credit for 2 *or* two.

64 [1] Allow 1 credit for 0.060 M *or* .06 M.

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

The hydroxide ion concentration of the 0.10 M KOH(aq) is greater than the hydroxide ion concentration of the resulting neutral solution.

The resulting solution has a lower concentration of OH^- .

greater in KOH solution

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:

The number of protons in an atom of O-18 is equal to the number of electrons in the atom.

The number of protons and the number of electrons are the same.

There are 8 protons and 8 electrons in an atom of O-18.

equal

same

67 [1] Allow 1 credit. The position of electrons may vary.

Examples of 1-credit responses:



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

An O-18 atom in a water molecule has two more neutrons than an O-16 atom.

The O-18 atom has 10 neutrons and the O-16 atom has 8 neutrons.

There are more neutrons in an oxygen-18 atom.

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

$$\frac{3(15.9994)}{84.00484} = \frac{x}{100}$$

$$\frac{3(16 \text{ g/mol})}{84 \text{ g/mol}} \times 100$$

$$\frac{48(100)}{84}$$

$$\frac{4800}{84}$$

Note: Do *not* allow credit if the fraction is not multiplied by 100.

70 [1] Allow 1 credit for 1.75 mol.

71 [1] Allow 1 credit for 2 NaHCO₃(s) + heat → ___ Na₂CO₃(s) + ___ H₂O(g) + ___ CO₂(g).

Allow credit even if the coefficient “1” is written in front of Na₂CO₃(s), H₂O(g), and/or CO₂(g).

72 [1] Allow 1 credit for any value from 5.6 L to 5.9 L, inclusive.

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

The helium atoms have less average kinetic energy at 200. K than at 300. K.

Energy is higher at 300 K.

lower at 200 K

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

At high temperature, molecules of H₂ and N₂ collide more frequently with greater energy.

greater frequency of collisions

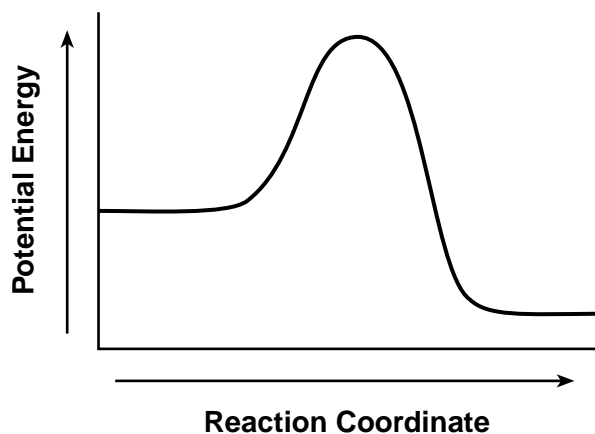
There is an increase in the percentage of effective collisions of reactant particles.

more collisions

75 [1] Allow 1 credit for 45.9 kJ *or* 46 kJ.

76 [1] Allow 1 credit for showing that the PE of the products is lower than the PE of the reactants.

Example of a 1-credit response:



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

The catalyst provides a different reaction pathway, which has a lower activation energy.

The activation energy is lower for the alternate reaction pathway.

lower energy, different mechanism

78 [1] Allow 1 credit for C *or* carbon.

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

ethanoic acid

acetic acid

80 [1] Allow 1 credit for H₂O *or* HOH.

81 [1] Allow 1 credit for ester *or* esters.

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

The beta emission from I-131 has a greater penetrating power than the alpha particle from U-238.

Beta particles have greater penetrating power than alpha particles.

U-238's alpha particle has a weaker penetrating power.

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



Co-59

cobalt-59



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

$$\frac{1}{8}$$

0.125

12.5%

85 [1] Allow 1 credit for 146.

Regents Examination in Physical Setting/Chemistry

January 2024

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

The *Chart for Determining the Final Examination Score for the January 2024 Regents Examination in Physical Setting/Chemistry* will be posted on the Department's web site at: <https://www.nysed.gov/state-assessment/high-school-regents-examinations> on Friday, January 26, 2024. 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 <https://www.surveymonkey.com/r/8LNLLDW>.
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 2024 Physical Setting/Chemistry			
Question Numbers			
Key Ideas/Performance Indicators	Part A	Part B	Part C
Standard 1			
Math Key Idea 1		33, 42, 63	69
Math Key Idea 2		43, 52, 57	71, 72
Math Key Idea 3		34, 40, 42, 48, 51, 53, 56, 64	70, 75, 84, 85
Science Inquiry Key Idea 1		41, 55, 58, 59, 60, 61, 65	66, 68, 73, 77, 78, 81, 82
Science Inquiry Key Idea 2		45	
Science Inquiry Key Idea 3		31, 35, 36, 37, 39, 41, 44, 46, 47, 49, 50, 54, 58, 61, 62	67, 71, 72, 75, 76, 79
Engineering Design Key Idea 1			
Standard 2			
Key Idea 1			
Key Idea 2			
Key Idea 3			
Standard 6			
Key Idea 1			
Key Idea 2		32	67
Key Idea 3		48	
Key Idea 4			
Key Idea 5		60	76
Standard 7			
Key Idea 1			
Key Idea 2			
Standard 4 Process Skills			
Key Idea 3		31, 32, 34, 38, 40, 41, 42, 44, 45, 51, 52, 54, 57, 62, 64	67, 68, 70, 71, 74, 75, 80, 81, 85
Key Idea 4		50, 58, 61	73, 76, 83, 84
Key idea 5		36	
Standard 4			
Key Idea 3	1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 18, 19, 20, 22, 23, 24, 25, 26, 27, 28, 29	31, 32, 33, 34, 37, 38, 39, 40, 41, 43, 44, 45, 46, 47, 48, 49, 51, 52, 53, 54, 57, 59, 60, 62, 63, 64, 65	66, 67, 68, 69, 70, 71, 72, 74, 75, 77, 78, 79, 80, 81, 82, 85
Key Idea 4	17, 21, 30	42, 50, 58, 61	73, 76, 83, 84
Key Idea 5	7, 12, 13, 14, 15, 16	35, 36, 55, 56	
Reference Tables			
2011 Edition	1, 3, 4, 8, 13, 16, 24, 26, 27, 29	33, 34, 35, 36, 39, 40, 42, 43, 47, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 62, 64	66, 67, 69, 75, 76, 79, 81, 82, 83, 84, 85

Regents Examination in Physical Setting/Chemistry – January 2024

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	73	41	59	19	39
84	98	62	73	40	58	18	37
83	96	61	72	39	57	17	36
82	94	60	71	38	56	16	35
81	93	59	70	37	56	15	33
80	91	58	70	36	55	14	32
79	90	57	69	35	54	13	30
78	88	56	68	34	53	12	28
77	87	55	68	33	53	11	27
76	86	54	67	32	52	10	25
75	85	53	66	31	51	9	23
74	84	52	66	30	50	8	21
73	82	51	65	29	49	7	19
72	81	50	64	28	48	6	17
71	80	49	64	27	47	5	14
70	79	48	63	26	46	4	12
69	78	47	63	25	45	3	9
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	41		
64	74	42	59	20	40		

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.