The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
CHEMISTRY

Tuesday, January 21, 2025 — 1:15 to 4:15 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 The subatomic particles in the nucleus of an oxygen atom include

(1) electrons, only
(2) neutrons, only
(3) protons and neutrons
(4) protons and electrons

2 Which phrase describes the charges and numbers of protons and electrons in an atom?

(1) have opposite charges and are equal in number
(2) have opposite charges and are unequal in number
(3) have the same charge and are equal in number
(4) have the same charge and are unequal in number

3 In the wave-mechanical model, which term identifies a region in an atom of lithium that is the most probable location of electrons in the ground state?

(1) hard sphere
(2) polar bond
(3) orbital
(4) spectrum

4 An atom of C-12 in the ground state and an atom of C-13 in the ground state are defined as isotopes of carbon because these atoms have the same number of protons and

(1) the same number of neutrons
(2) the same number of electron shells
(3) a different number of neutrons
(4) a different number of electron shells

5 At STP, which property can be used to differentiate between a 2.0-gram sample of oxygen, $O_2(g)$, and a 2.0-gram sample of helium, He(g)?

(1) mass
(2) temperature
(3) reaction with sodium
(4) phase of each sample

6 How do the molecular structures and properties of oxygen, O_2, and ozone, O_3, compare?

(1) They have different molecular structures and the same properties.
(2) They have different molecular structures and different properties.
(3) They have the same molecular structure and the same properties.
(4) They have the same molecular structure and different properties.

7 Which substance can be broken down by chemical means?

(1) aluminum
(2) ammonia
(3) argon
(4) arsenic

8 Which type of bonding is present in a sample of zinc at STP?

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

9 Which formula represents a nonpolar molecule?

(1) CH_4
(2) HCl
(3) H_2O
(4) NH_3

10 Given the equation representing a reaction:

$$F + F \rightarrow F_2$$

What occurs during this reaction?

(1) Energy is absorbed as a bond is formed.
(2) Energy is released as a bond is formed.
(3) Energy is absorbed as a bond is broken.
(4) Energy is released as a bond is broken.

11 Based on Table *S*, an atom of which element in Group 16 has the greatest attraction for electrons in a chemical bond?

(1) oxygen
(2) sulfur
(3) selenium
(4) tellurium

12 A solution is made by completely dissolving a sample of sodium hydrogen carbonate in water. This solution is classified as a

(1) heterogeneous compound
(2) heterogeneous mixture
(3) homogeneous compound
(4) homogeneous mixture

13 In which sample of matter can the proportion of its components be varied?

(1) $Cl_2(g)$
(2) $Br_2(\ell)$
(3) KCl(s)
(4) KBr(aq)

14 According to the kinetic molecular theory, the particles of an ideal gas have

(1) attractive forces between them
(2) random, constant, straight-line motion
(3) a greater size than the distance between them
(4) collisions that increase the total energy of gas particles

15 A chemical reaction is most likely to occur when reactant particles collide with the proper orientation and proper

(1) charge
(2) energy
(3) mass
(4) volume

16 At STP, which sample contains the same number of molecules as 44 liters of $NO_2(g)$ at STP?

(1) 22 L of $CO_2(g)$
(2) 44 L of $O_2(g)$
(3) 66 L of $O_2(g)$
(4) 88 L of $O_2(g)$

17 Based on Table *I*, which chemical change is exothermic?

(1) $N_2(g) + O_2(g) \rightarrow 2NO(g)$
(2) $N_2(g) + 2O_2(g) \rightarrow 2NO_2(g)$
(3) $2C(s) + 3H_2(g) \rightarrow C_2H_6(g)$
(4) $2C(s) + 2H_2(g) \rightarrow C_2H_4(g)$

18 Which term identifies a factor that affects the rate of a chemical reaction?

(1) decay mode
(2) isotopic abundance
(3) nuclear stability
(4) surface area

19 Which phrase represents the net amount of energy released or absorbed during a chemical reaction?

(1) the kinetic energy of the reactants plus the potential energy of the products
(2) the kinetic energy of the reactants minus the potential energy of the products
(3) the potential energy of the products plus the potential energy of the reactants
(4) the potential energy of the products minus the potential energy of the reactants

20 A catalyst increases the rate of a chemical reaction by providing an alternate reaction pathway that has a

(1) higher activation energy
(2) lower activation energy
(3) higher potential energy for the reactants
(4) lower potential energy for the reactants

21 Systems in nature tend to undergo changes toward

(1) lower energy and less disorder
(2) lower energy and more disorder
(3) higher energy and less disorder
(4) higher energy and more disorder

22 Atoms of which element bond with each other to form chains, rings, and networks?

(1) calcium
(2) carbon
(3) chlorine
(4) cobalt

23 A molecule of which compound contains an −OH functional group?

(1) propanamide
(2) 1-propanamine
(3) propanal
(4) 1-propanol

24 Which statement explains why butane and methylpropane are isomers of each other?

(1) They have the same molecular formula and the same structure.
(2) They have the same molecular formula and different structures.
(3) They have different molecular formulas and the same structure.
(4) They have different molecular formulas and different structures.

25 Molecules of which two substances each contain a multiple covalent bond?

(1) ethene and ethane
(2) ethene and ethyne
(3) methane and ethane
(4) methane and ethyne

26 Which term identifies a type of organic reaction?

(1) deposition
(2) substitution
(3) solidification
(4) vaporization

27 Which statement identifies where oxidation and reduction occur in an electrochemical cell?

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

28 Which type of reaction yields a salt and water as the only products?

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

29 In which process are heavy nuclei split into lighter nuclei?

(1) nuclear fission
(2) nuclear fusion
(3) single replacement
(4) double replacement

30 Which statement explains the large amount of heat produced during a fission reaction?

(1) Chemical bonds are broken.
(2) Chemical bonds are formed.
(3) Energy is converted to mass.
(4) Mass is converted to energy.

Part B–1

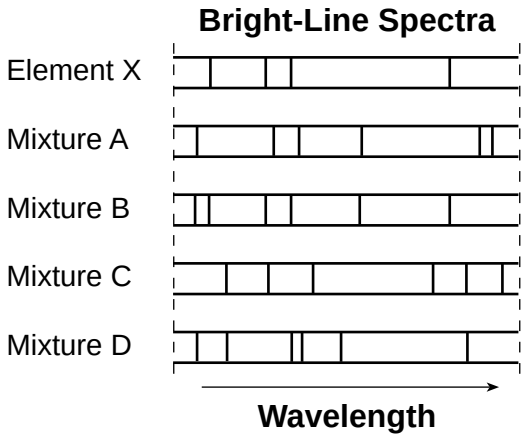
Answer all questions in this part.

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 What is the approximate mass of an ion that has 12 protons, 13 neutrons, and 10 electrons?

(1) 22 u
(2) 23 u
(3) 25 u
(4) 35 u

32 Given the bright-line spectrum of element *X* and the spectra of four mixtures:



Which mixture contains element *X*?

(1) Mixture *A*
(2) Mixture *B*
(3) Mixture *C*
(4) Mixture *D*

33 What is the number of valence electrons in an atom in the ground state with an electron configuration of 2-8-18-3?

(1) 18
(2) 2
(3) 3
(4) 31

34 Which statement describes the general trends in electronegativity and atomic radius as the first seven elements in Period 3 are considered in order of increasing atomic number?

(1) Electronegativity decreases and atomic radius decreases.
(2) Electronegativity decreases and atomic radius increases.
(3) Electronegativity increases and atomic radius decreases.
(4) Electronegativity increases and atomic radius increases.

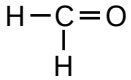
35 What is a chemical name for $KClO_2$?

(1) potassium chlorate
(2) potassium chlorite
(3) potassium hypochlorite
(4) potassium perchlorate

36 What is the percent by mass of oxygen in CH_3COOH (gram-formula mass = 60. g/mol)?

(1) 27%
(2) 32%
(3) 53%
(4) 60.%

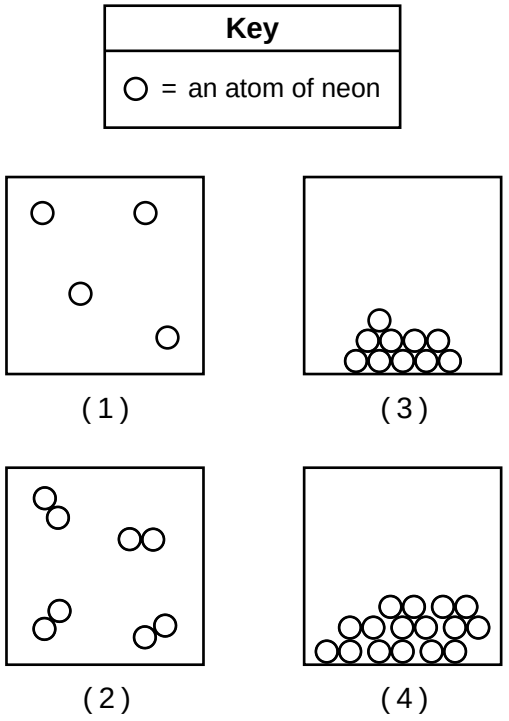
37 Given the formula for a compound:



How many electrons are shared between the carbon atom and the oxygen atom in a molecule of this compound?

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

38 Which particle model diagram represents the arrangement of particles in a sample of neon at STP?



39 The volume of a 150.0-gram sample of copper at 298 K and 101.3 kPa is 16.7 cm^3. The mass of the copper sample is expressed to how many significant figures?

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

40 Which statement describes the energy transfer that occurs when a sample of copper at 100.°C is placed in a sample of water at 20.°C?

(1) Thermal energy is transferred from the copper to the water.
(2) Thermal energy is transferred from the water to the copper.
(3) Chemical energy is transferred from the copper to the water.
(4) Chemical energy is transferred from the water to the copper.

41 Which change will cause an open flask half-filled with water at 295 K and 1.0 atm to reach phase equilibrium?

(1) increase the pressure
(2) increase the temperature
(3) remove some of the water
(4) seal the flask with a stopper

42 What is the amount of heat released when 1.0 mole of $NH_3(g)$ is formed from its elements at 101.3 kPa and 298 K?

(1) 45.9 kJ
(2) 91.8 kJ
(3) 137.7 kJ
(4) 183.6 kJ

43 Given the equation representing a phase change for carbon dioxide, $CO_2(s)$:

$$CO_2(s) + \text{energy} \rightarrow CO_2(g)$$

Which statement describes this phase change in terms of energy and entropy?

(1) The phase change is endothermic and entropy increases.
(2) The phase change is endothermic and entropy decreases.
(3) The phase change is exothermic and entropy increases.
(4) The phase change is exothermic and entropy decreases.

44 Which equation represents an oxidation half-reaction?

(1) $Br_2 \rightarrow 2Br^- + 2e^-$
(2) $Br_2 + 2e^- \rightarrow 2Br^-$
(3) $Mn^{2+} + 2e^- \rightarrow Mn$
(4) $Mn \rightarrow Mn^{2+} + 2e^-$

45 Which equation represents a redox reaction?

(1) $C(s) + O_2(g) \rightarrow CO_2(g)$
(2) $CaO(s) + H_2O(\ell) \rightarrow Ca(OH)_2(s)$
(3) $MgCO_3(s) \rightarrow MgO(s) + CO_2(g)$
(4) $Cu(OH)_2(s) \rightarrow CuO(s) + H_2O(\ell)$

46 Based on Table *J*, which metal will react spontaneously with $Fe^{2+}(aq)$ ions?

(1) copper
(2) gold
(3) magnesium
(4) silver

47 Based on Table *F*, a saturated solution of which compound is the best conductor of electricity?

(1) $CaCO_3$
(2) $BaSO_4$
(3) $Mg(OH)_2$
(4) $NaNO_3$

48 Given the equation representing a system at equilibrium:

$$HSO_3^-(aq) + H_2O(\ell) \rightleftharpoons SO_3^{2-}(aq) + H_3O^+(aq)$$

According to one acid-base theory

(1) HSO_3^- acts as an acid because it is an H^+ donor
(2) HSO_3^- acts as an acid because it is an H^+ acceptor
(3) H_2O acts as an acid because it is an H^+ donor
(4) H_2O acts as an acid because it is an H^+ acceptor

49 What is the pH value of an aqueous solution with a hydronium ion concentration 1000 times greater than an aqueous solution with a pH value of 5.0?

(1) 1.0
(2) 2.0
(3) 8.0
(4) 14.0

50 Which energy source is paired with a risk associated with its usage?

(1) Nuclear fission produces stable isotopes.
(2) Nuclear fission produces radioactive waste.
(3) Voltaic cells produce stable isotopes.
(4) Voltaic cells produce radioactive waste.

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

Base your answers to questions 52 and 53 on the information below and on your knowledge of chemistry.

The atomic mass and natural abundance for the two naturally occurring isotopes of copper are shown in the table below.

Naturally Occurring Isotopes of Copper

Isotope	**Atomic Mass** (u)	**Natural Abundance** (%)
Cu-63	62.93	69.15
Cu-65	64.93	30.85

52 Show a numerical setup for calculating the atomic mass of the element copper. [1]

53 A technician determined the percent natural abundance of Cu-65 in a sample to be 31.47%. Determine the percent error for this percent natural abundance of Cu-65 compared to the accepted value shown in the table. [1]

Base your answers to questions 54 through 56 on the information below and on your knowledge of chemistry.

The elements beryllium, magnesium, calcium, strontium, and barium are located in Group 2 on the Periodic Table. These Group 2 elements have both similarities and differences in their physical and chemical properties.

54 Based on the location of Group 2 elements on the Periodic Table, state the element classification of these elements. [1]

55 Explain, in terms of electron shells, why the atomic radius of a calcium atom in the ground state is greater than the atomic radius of a magnesium atom in the ground state. [1]

56 State the general trend in first ionization energy for the Group 2 elements, beryllium through barium, as these elements are considered in order of increasing atomic number. [1]

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

Diagram 1 represents a sample of $N_2(g)$ and the conditions of pressure, volume, and temperature of the gas in a sealed, rigid cylinder with a movable piston. Diagram 2 represents a sample of $O_2(g)$ and the conditions of pressure, volume, and temperature of the gas in a sealed, rigid cylinder with a movable piston.

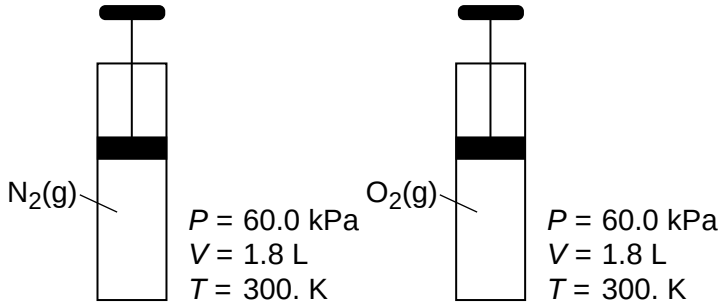


Diagram 1 **Diagram 2**

57 Compare the average kinetic energy of the gas molecules in diagram 1 to the average kinetic energy of the gas molecules in diagram 2. [1]

58 Determine the volume of the $O_2(g)$ in diagram 2 when conditions are changed to STP. [1]

59 Determine the pressure, in atmospheres, of the nitrogen gas in diagram 1. [1]

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

The boiling point for a sample of a molecular compound is 80.°C at standard pressure. The heat of fusion, H_f, of this compound is 127 joules per gram.

60 Compare the potential energy of the molecules in the sample before vaporization to the potential energy of the molecules after vaporization. [1]

61 Determine the amount of heat required to completely melt a 50.0-gram sample of this molecular compound at its melting point. [1]

62 Explain, in terms of intermolecular forces, why the boiling point of this molecular compound is *lower* than the boiling point of water at standard pressure. [1]

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

A NaOH(aq) solution and an acid-base indicator are used to determine the molarity of an HCl(aq) solution. A 15.0-milliliter sample of the HCl(aq) is exactly neutralized by 30.0 milliliters of 0.010 M NaOH(aq).

63 Identify the positive ion in the sample of HCl(aq) solution. [1]

64 Based on Table *M*, state the color of litmus when placed in a sample of the original HCl(aq) solution. [1]

65 Using the titration data, determine the concentration of the HCl(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 *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.

The table below shows three compounds that are used for medical purposes.

Formula	Medical Use
$CaSO_4$	making plaster casts
$Mg(OH)_2$	as an antacid remedy
ZnO	protection from exposure to some ultraviolet radiation

66 Identify the two types of bonding in the compound used to make plaster casts. [1]

67 Identify the noble gas that has atoms in the ground state with the same electron configuration as the positive ion in $Mg(OH)_2$ in the ground state. [1]

68 Based on Table *S*, determine the electronegativity difference for the bond between zinc and oxygen in ZnO. [1]

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

During a laboratory activity, appropriate safety equipment is used and safety procedures are followed. In a beaker, a student dissolves 0.10 mole of potassium nitrate, KNO_3, in 100. grams of water at 25°C. The gram-formula mass of KNO_3 is 101 g/mol.

69 Compare the freezing point of water at standard pressure to the freezing point of the $KNO_3(aq)$ solution at standard pressure. [1]

70 Based on Table *G*, classify, in terms of saturation, the type of KNO_3 solution made by the student. [1]

71 Describe a laboratory procedure the student can use to separate the original KNO_3 from the $KNO_3(aq)$ solution. [1]

Base your answers to questions 72 through 74 on the information below and on your knowledge of chemistry.

A major component of agricultural fertilizer is ammonium nitrate, NH_4NO_3. It is commercially produced by reacting ammonia gas with concentrated nitric acid, as shown in equation 1 below.

Equation 1: $NH_3 + HNO_3 \rightarrow NH_4NO_3 + \text{energy}$

The ammonium nitrate can decompose to produce nitrogen dioxide gas, $NO_2(g)$, which is a brown gas. When $NO_2(g)$ is placed in a sealed, glass container, some NO_2 molecules react to produce colorless N_2O_4 gas. An equilibrium system forms in the glass container, as shown in equation 2 below.

Equation 2: $2NO_2(g) \rightleftharpoons N_2O_4(g) + \text{energy}$
brown colorless

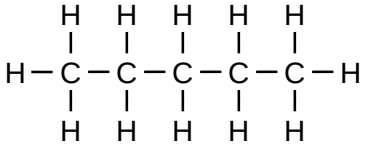
72 State, in terms of reactants and products, why the chemical reaction represented by equation 1 is a synthesis reaction. [1]

73 On the labeled axes *in your answer booklet*, draw a potential energy diagram for the reaction represented by equation 1. [1]

74 Compare the rate of the forward reaction to the rate of the reverse reaction in the equilibrium system represented by equation 2. [1]

Base your answers to questions 75 through 77 on the information below and on your knowledge of chemistry.

Pentane, hexane, heptane, and octane are components of gasoline. The structural formula below represents a straight-chain molecule of pentane.



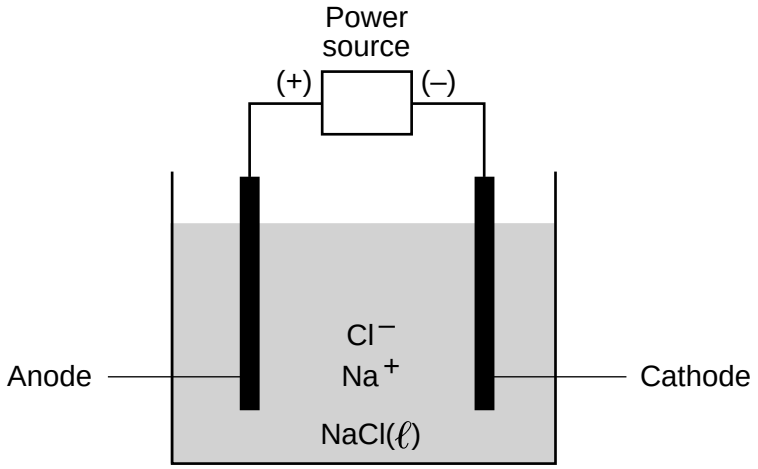
75 State the number of hydrogen atoms in a molecule of hexane. [1]

76 State, in terms of carbon-carbon bonds, why octane is a saturated hydrocarbon. [1]

77 Draw a structural formula for a straight-chain molecule of heptane. [1]

Base your answers to questions 78 through 80 on the information below and on your knowledge of chemistry.

Chlorine gas and sodium metal are two valuable industrial elements that can be produced in an electrochemical cell by an electrolytic reaction. In the reaction, liquid sodium chloride is separated into the elements by an electric current. The simplified diagram and equation below represent this process.



$$2NaCl(\ell) \longrightarrow 2Na(\ell) + Cl_2(g)$$

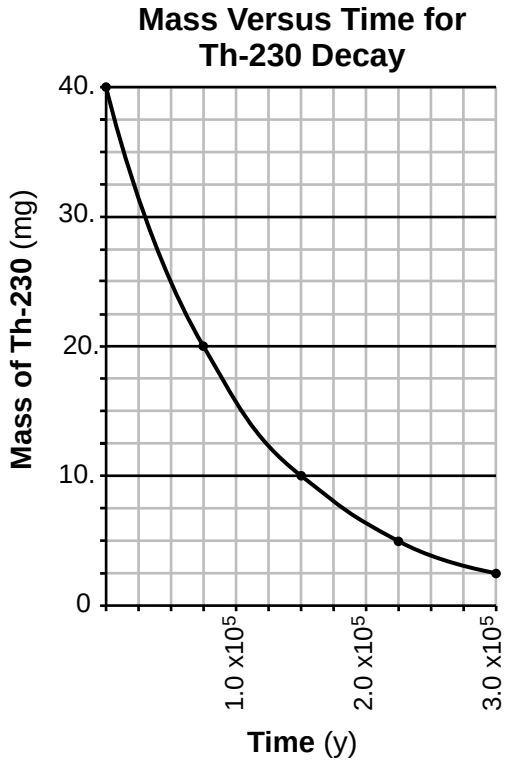
78 State, in terms of energy, why the power source is required for the cell to operate. [1]

79 State the number of moles of electrons lost when 4.0 moles of electrons are gained in this reaction. [1]

80 Determine the change in oxidation state that occurs for chlorine in this cell. [1]

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

The radioisotope U-238 changes to Pb-206 in a series of nuclear decays that can be used to determine the age of some rock layers. In one step of this nuclear decay series, U-234 produces Th-230 by alpha emission. The graph below represents the decay of a 40.-milligram sample of Th-230.



81 Using the graph, determine the half-life of Th-230. [1]

82 Determine the fraction of the Th-230 sample that remains unchanged after two half-lives. [1]

83 Compare the penetrating power of a beta particle to the penetrating power of the alpha decay particle from a Th-230 atom. [1]

84 Complete the nuclear equation *in your answer booklet* for the decay of U-238 by writing a notation for the missing product. [1]

85 Explain, in terms of elements, why the nuclear decay of U-234 to Th-230 is considered a transmutation. [1]

P.S./CHEMISTRY

The University of the State of New York

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PHYSICAL SETTING
CHEMISTRY

Tuesday, January 21, 2025 — 1:15 to 4:15 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 _____

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52

53 _____ **%**

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58 _____ **L**

59 _____ **atm**

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61 _____ **J**

62 _____

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65 _____ **M**

Part C

66 _____ **and** _____

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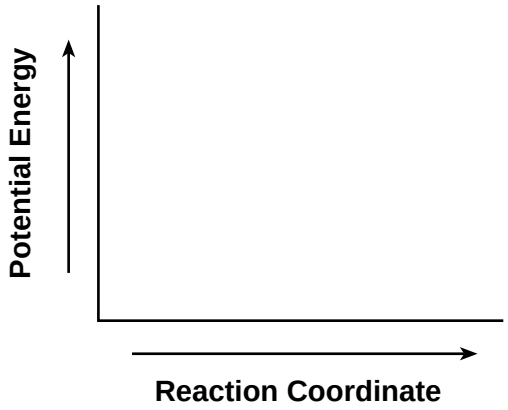
73



74 _____

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78 _____

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79 _____ **mol**

80 From _____ to _____

81 _____ **y**

82 _____

83 _____

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84 $^{238}_{92}\mathrm{U} \rightarrow {}^{4}_{2}\mathrm{He} +$ _____

85 _____

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P.S./CHEMISTRY

The State Education Department / The University of the State of New York

Regents Examination in Physical Setting/Chemistry – January 2025

Scoring Key: Parts A and B-1 (Multiple-Choice Questions)

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

Regents Examination in Physical Setting/Chemistry – January 2025

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

Examination	Date	Question Number	Scoring Key	Question Type	Credit	Weight
Physical Setting/Chemistry	January '25	**51**	-	CR	1	1
Physical Setting/Chemistry	January '25	**52**	-	CR	1	1
Physical Setting/Chemistry	January '25	**53**	-	CR	1	1
Physical Setting/Chemistry	January '25	**54**	-	CR	1	1
Physical Setting/Chemistry	January '25	**55**	-	CR	1	1
Physical Setting/Chemistry	January '25	**56**	-	CR	1	1
Physical Setting/Chemistry	January '25	**57**	-	CR	1	1
Physical Setting/Chemistry	January '25	**58**	-	CR	1	1
Physical Setting/Chemistry	January '25	**59**	-	CR	1	1
Physical Setting/Chemistry	January '25	**60**	-	CR	1	1
Physical Setting/Chemistry	January '25	**61**	-	CR	1	1
Physical Setting/Chemistry	January '25	**62**	-	CR	1	1
Physical Setting/Chemistry	January '25	**63**	-	CR	1	1
Physical Setting/Chemistry	January '25	**64**	-	CR	1	1
Physical Setting/Chemistry	January '25	**65**	-	CR	1	1
Physical Setting/Chemistry	January '25	**66**	-	CR	1	1
Physical Setting/Chemistry	January '25	**67**	-	CR	1	1
Physical Setting/Chemistry	January '25	**68**	-	CR	1	1
Physical Setting/Chemistry	January '25	**69**	-	CR	1	1
Physical Setting/Chemistry	January '25	**70**	-	CR	1	1
Physical Setting/Chemistry	January '25	**71**	-	CR	1	1
Physical Setting/Chemistry	January '25	**72**	-	CR	1	1
Physical Setting/Chemistry	January '25	**73**	-	CR	1	1
Physical Setting/Chemistry	January '25	**74**	-	CR	1	1
Physical Setting/Chemistry	January '25	**75**	-	CR	1	1
Physical Setting/Chemistry	January '25	**76**	-	CR	1	1
Physical Setting/Chemistry	January '25	**77**	-	CR	1	1
Physical Setting/Chemistry	January '25	**78**	-	CR	1	1
Physical Setting/Chemistry	January '25	**79**	-	CR	1	1
Physical Setting/Chemistry	January '25	**80**	-	CR	1	1
Physical Setting/Chemistry	January '25	**81**	-	CR	1	1
Physical Setting/Chemistry	January '25	**82**	-	CR	1	1
Physical Setting/Chemistry	January '25	**83**	-	CR	1	1
Physical Setting/Chemistry	January '25	**84**	-	CR	1	1
Physical Setting/Chemistry	January '25	**85**	-	CR	1	1

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

The chart for determining students' final examination scores for the **January 2025 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

Tuesday, January 21, 2025 — 1:15 to 4:15 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 Tuesday, January 21, 2025. The student's scale score should be entered in the box labeled "Scale Score" on the student's answer sheet. The scale score is the student's final examination score.

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

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

Part B–2

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

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

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

The boron electrons lose energy as they return to lower energy states.

Excited electrons emit light when they return to lower electron shells.

Excited electrons move to lower energy states.

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

$(62.93\text{ u})(0.6915) + (64.93\text{ u})(0.3085)$

$$\frac{(62.93)(69.15) + (64.93)(30.85)}{100}$$

$(30.85\%)(64.93) + (69.15\%)(62.93)$

Note: Do *not* allow credit for a numerical setup using mass numbers rather than isotopic masses.

53 [1] Allow 1 credit for 2.0% *or* for any value from 2% to 2.01%, inclusive.

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

metal

metals

alkaline earth metals

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

A calcium atom has one more electron shell than a magnesium atom.

The Ca atoms have 4 shells of electrons while the Mg atoms have only 3 shells of electrons.

Calcium atoms have more electron shells.

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

From Be through Ba for the Group 2 elements, the first ionization energy decreases.

The ionization energies decrease going down Group 2.

As atomic number increases, first ionization energy decreases.

decreases

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

The average kinetic energy of the gas molecules in diagram 1 is equal to the average kinetic energy of the gas molecules in diagram 2.

The average KE of the molecules in the two gases is the same.

equal

same

58 [1] Allow 1 credit for 0.97 L *or* any value from 0.970 L to 0.983 L, inclusive.

59 [1] Allow 1 credit for 0.592 atm *or* any value from 0.59 atm to 0.6 atm, inclusive.

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

The potential energy of the molecules is less before vaporization.

The PE is less before vaporization.

greater after vaporization

61 [1] Allow 1 credit for 6350 J.

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

This molecular compound has weaker intermolecular forces than water, which causes the compound to boil at 80.°C while water boils at 100.°C.

Water has stronger intermolecular forces than the molecular compound, which causes the boiling point of water to be higher.

This molecular compound has weaker IMFs.

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

hydronium ion	H_3O^+
hydronium	H^+
hydrogen ion	$H_3O^+(aq)$
hydrogen	$H^+(aq)$

Note: Do *not* allow credit for H *or* H_2.

64 [1] Allow 1 credit for red.

65 [1] Allow 1 credit for 0.020 M *or* 0.02 M *or* .02 M.

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:

ionic bonding and covalent bonding

polar covalent and ionic

ionic and covalent

67 [1] Allow 1 credit for Ne *or* neon.

68 [1] Allow 1 credit for 1.7.

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

Water has a higher freezing point.

The freezing point of the KNO_3 solution is lower than the freezing point of water.

The freezing point of $KNO_3(aq)$ is less.

The solution has a lower freezing point.

70 [1] Allow 1 credit for unsaturated *or* not saturated.

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

Gently heat the solution to evaporate the water until only solid KNO_3 remains.

Boil off the water.

Allow the water to evaporate.

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

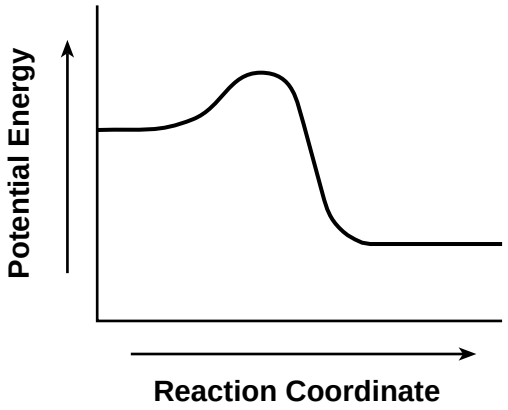
Two reactants form only one product.

Two substances react to form one substance.

Two compounds form one compound.

73 [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:



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

The rate of the forward reaction equals the rate of the reverse reaction.

Both reactions occur at the same rate.

The rates are the same.

equal

same

75 [1] Allow 1 credit for 14.

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

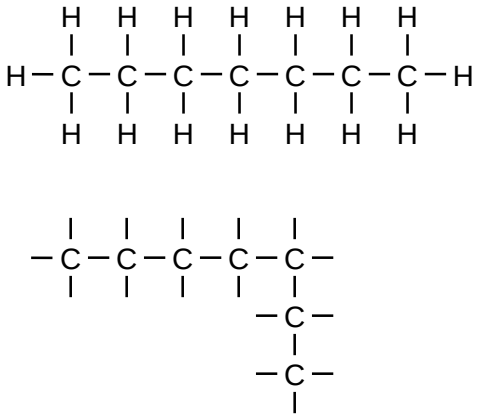
All of the carbon-carbon bonds in octane are single bonds.

There are no multiple C to C bonds in octane.

There are no C=C or C≡C bonds.

77 [1] Allow 1 credit.

Examples of 1-credit responses.



Note: Do *not* allow credit if only some of the H atoms bonded to C atoms are shown.

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

Electrolytic cells require electrical energy.

The power source causes the nonspontaneous reaction to occur.

Reactions that are not spontaneous require energy from an outside source.

79 [1] Allow 1 credit for 4.0 mol *or* 4 mol.

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

From –1 to 0

From 1– to 0

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

for any value from 0.70×10^5 y to 0.80×10^5 y, inclusive

for any value from 7.0×10^4 y to 8.0×10^4 y, inclusive

for any value from 70 000 y to 80 000 y, inclusive

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

$\frac{1}{4}$

0.25

25%

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

The penetrating power of a beta particle is greater than that of an alpha particle from Th-230.

An alpha particle has less penetrating ability than a beta particle.

The β^- has a stronger penetrating power.

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

$^{234}_{90}Th$

Th-234

thorium-234

^{234}Th

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

An atom of uranium is changing to an atom of thorium.

A different element is being formed.

An isotope of U becomes an isotope of Th.

Uranium has atomic number 92 and thorium has atomic number 90.

The *Chart for Determining the Final Examination Score for the January 2025 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 Tuesday, January 21, 2025. 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.nysed.gov/state-assessment/teacher-feedback-state-assessments.
2. Click Regents Examinations.
3. Complete the required demographic fields.
4. Select the test title from the Regents Examination dropdown list.
5. Complete each evaluation question and provide comments in the space provided.
6. Click the SUBMIT button at the bottom of the page to submit the completed form.

Map to Core Curriculum

January 2025 Physical Setting/Chemistry			
Question Numbers			
Key Ideas/Performance Indicators	Part A	Part B	Part C
Standard 1			
Math Key Idea 1		39, 42, 52, 53, 59	
Math Key Idea 2		60	81, 84
Math Key Idea 3		31, 35, 36, 42, 53, 58, 59, 61	68, 75, 80, 82
Science Inquiry Key Idea 1		33, 34, 37, 38, 39, 41, 43, 44, 45, 46, 47, 48, 49, 50, 51, 56, 57, 60, 62, 63, 64, 65	66, 67, 69, 70, 71, 72, 74, 75, 76, 78, 79, 83, 85
Science Inquiry Key Idea 2			
Science Inquiry Key Idea 3		32, 33, 35, 37, 38, 41, 42, 43, 44, 45, 46, 47, 48, 53, 56, 62	71, 72, 73, 79, 80, 84, 85
Engineering Design Key Idea 1			
Standard 2			
Key Idea 1		54, 55	
Key Idea 2			
Key Idea 3			
Standard 6			
Key Idea 1		40	
Key Idea 2		38	73
Key Idea 3		49	
Key Idea 4			
Key Idea 5			81
Standard 7			
Key Idea 1			
Key Idea 2			
Standard 4 Process Skills			
Key Idea 3		31, 32, 33, 34, 38, 43, 46, 52, 54, 55, 56, 58, 63, 64, 65	69, 70, 72, 74,77, 78
Key Idea 4		60, 61	73, 81, 82, 84
Key idea 5		62	67
Standard 4			
Key Idea 3	1, 2, 3, 4, 5, 7, 12, 13, 14, 15, 16, 18, 20, 21, 22, 23, 24, 26, 27, 28	31, 32, 33, 34, 35, 36, 38, 39, 41, 43, 44, 45, 46, 47, 48, 49, 51, 52, 53, 54, 55, 56, 58, 59, 63, 64, 65	69, 70, 71, 72, 74, 75, 76, 77, 78, 79, 80, 83
Key Idea 4	17, 19, 29	40, 42, 50, 57, 60, 61	73, 81, 82, 84
Key Idea 5	6, 8, 9, 10, 11, 25, 30	37, 62	66, 67, 68, 85
Reference Tables			
2011 Edition	7, 11, 17, 23, 24, 25	31, 33, 34, 35, 36, 42, 46, 47, 53, 54, 55, 56, 58, 59, 61, 63, 64, 65	66, 67, 68, 70, 75, 76, 77, 83, 84

Regents Examination in Physical Setting/Chemistry – January 2025

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	**76**
65	**76**
64	**75**

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

Raw Score	Scale Score
41	**59**
40	**58**
39	**57**
38	**56**
37	**56**
36	**55**
35	**54**
34	**53**
33	**52**
32	**52**
31	**51**
30	**50**
29	**49**
28	**48**
27	**47**
26	**46**
25	**45**
24	**44**
23	**43**
22	**42**
21	**40**
20	**39**

Raw Score	Scale Score
19	**38**
18	**37**
17	**35**
16	**34**
15	**32**
14	**31**
13	**29**
12	**28**
11	**26**
10	**24**
9	**22**
8	**20**
7	**18**
6	**16**
5	**14**
4	**11**
3	**9**
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.