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 total number of valence electrons in a calcium atom in the ground state?
   (1) 8  (2) 2  (3) 18  (4) 20

2. Which subatomic particles are located in the nucleus of an He-4 atom?
   (1) electrons and neutrons  (2) electrons and protons  (3) neutrons and protons  (4) neutrons, protons, and electrons

3. In the late 1800s, experiments using cathode ray tubes led to the discovery of the
   (1) electron  (2) neutron  (3) positron  (4) proton

4. The atomic mass of titanium is 47.88 atomic mass units. This atomic mass represents the
   (1) total mass of all the protons and neutrons in an atom of Ti  (2) total mass of all the protons, neutrons, and electrons in an atom of Ti  (3) weighted average mass of the most abundant isotope of Ti  (4) weighted average mass of all the naturally occurring isotopes of Ti

5. An atom of which element has the largest atomic radius?
   (1) Fe  (2) Mg  (3) Si  (4) Zn

6. Which element requires the least amount of energy to remove the most loosely held electron from a gaseous atom in the ground state?
   (1) bromine  (2) calcium  (3) sodium  (4) silver

7. A balanced equation representing a chemical reaction can be written using
   (1) chemical formulas and mass numbers  (2) chemical formulas and coefficients  (3) first ionization energies and mass numbers  (4) first ionization energies and coefficients

8. Every water molecule has two hydrogen atoms bonded to one oxygen atom. This fact supports the concept that elements in a compound are
   (1) chemically combined in a fixed proportion  (2) chemically combined in proportions that vary  (3) physically mixed in a fixed proportion  (4) physically mixed in proportions that vary

9. The percent composition by mass of nitrogen in NH₄OH (gram-formula mass = 35 grams/mole) is equal to
   (1) \( \frac{4}{35} \times 100 \)  (2) \( \frac{14}{35} \times 100 \)  (3) \( \frac{35}{14} \times 100 \)  (4) \( \frac{35}{4} \times 100 \)

10. Which Group 15 element exists as diatomic molecules at STP?
    (1) phosphorus  (2) nitrogen  (3) bismuth  (4) arsenic

11. What is the total number of electrons shared in a double covalent bond?
    (1) 1  (2) 2  (3) 3  (4) 4
12 Given the balanced equation representing a reaction:

\[ \text{Br}_2 + \text{energy} \rightarrow \text{Br} + \text{Br} \]

Which statement describes the energy change and bonds in this reaction?
(1) Energy is released as bonds are broken.
(2) Energy is released as bonds are formed.
(3) Energy is absorbed as bonds are broken.
(4) Energy is absorbed as bonds are formed.

13 Which substance can *not* be broken down by a chemical change?
(1) methane  (3) tungsten
(2) propanal  (4) water

14 Object A at 40.°C and object B at 80.°C are placed in contact with each other. Which statement describes the heat flow between the objects?
(1) Heat flows from object A to object B.
(2) Heat flows from object B to object A.
(3) Heat flows in both directions between the objects.
(4) No heat flow occurs between the objects.

15 Which unit can be used to express the concentration of a solution?
(1) L/s  (3) ppm
(2) J/g  (4) kPa

16 Which formula represents a mixture?
(1) C_6H_{12}O_6(ℓ)  (3) LiCl(aq)
(2) C_6H_{12}O_6(s)  (4) LiCl(s)

17 Which sample has particles with the *lowest* average kinetic energy?
(1) 1.0 g of I_2 at 50.°C
(2) 2.0 g of I_2 at 30.°C
(3) 7.0 g of I_2 at 40.°C
(4) 9.0 g of I_2 at 20.°C

18 Which gas sample at STP has the same total number of molecules as 2.0 liters of CO_2(g) at STP?
(1) 5.0 L of CO_2(g)  (3) 3.0 L of H_2S(g)
(2) 2.0 L of Cl_2(g)  (4) 6.0 L of He(g)

19 Petroleum can be separated by distillation because the hydrocarbons in petroleum are
(1) elements with identical boiling points
(2) elements with different boiling points
(3) compounds with identical boiling points
(4) compounds with different boiling points

20 Which compound is insoluble in water?
(1) KOH  (3) Na_3PO_4
(2) NH_4Cl  (4) PbSO_4

21 A gas sample is at 25°C and 1.0 atmosphere. Which changes in temperature and pressure will cause this sample to behave more like an ideal gas?
(1) decreased temperature and increased pressure
(2) decreased temperature and decreased pressure
(3) increased temperature and increased pressure
(4) increased temperature and decreased pressure

22 The isotopes K-37 and K-42 have the same
(1) decay mode
(2) bright-line spectrum
(3) mass number for their atoms
(4) total number of neutrons in their atoms

23 Which element is present in all organic compounds?
(1) carbon  (3) nitrogen
(2) hydrogen  (4) oxygen
24 Each of four test tubes contains a different concentration of HCl(aq) at 25°C. A 1-gram cube of Zn is added to each test tube. In which test tube is the reaction occurring at the fastest rate?

\[
\begin{array}{cccc}
1 \text{ M HCl(aq)} & 0.1 \text{ M HCl(aq)} & 0.01 \text{ M HCl(aq)} & 0.001 \text{ M HCl(aq)} \\
10 \text{ mL} & 10 \text{ mL} & 10 \text{ mL} & 10 \text{ mL}
\end{array}
\]

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

25 Which energy conversion occurs during the operation of an electrolytic cell?
(1) chemical energy to electrical energy
(2) electrical energy to chemical energy
(3) nuclear energy to electrical energy
(4) electrical energy to nuclear energy

26 Which compound is an Arrhenius acid?
(1) CaO (3) K\textsubscript{2}O
(2) HCl (4) NH\textsubscript{3}

27 Based on the results of testing colorless solutions with indicators, which solution is most acidic?
(1) a solution in which bromthymol blue is blue
(2) a solution in which bromoresol green is blue
(3) a solution in which phenolphthalein is pink
(4) a solution in which methyl orange is red

28 According to one acid-base theory, water acts as an acid when an H\textsubscript{2}O molecule
(1) accepts an H\textsuperscript{+} (3) accepts an H\textsuperscript{-}
(2) donates an H\textsuperscript{+} (4) donates an H\textsuperscript{-}

29 In which type of reaction is an atom of one element converted to an atom of a different element?
(1) decomposition (3) saponification
(2) neutralization (4) transmutation

30 Which nuclide is listed with its half-life and decay mode?
(1) K-37, 1.24 h, α
(2) N-16, 7.2 s, β\textsuperscript{-}
(3) Rn-222, 1.6 × 10\textsuperscript{3} y, α
(4) U-235, 7.1 × 10\textsuperscript{8} y, β\textsuperscript{-}
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 The table below shows the number of subatomic particles in atom X and in atom Z.

<table>
<thead>
<tr>
<th>Atom</th>
<th>Number of Protons</th>
<th>Number of Neutrons</th>
<th>Number of Electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Z</td>
<td>6</td>
<td>7</td>
<td>6</td>
</tr>
</tbody>
</table>

Atom X and atom Z are isotopes of the element
(1) aluminum  (3) magnesium
(2) carbon    (4) nitrogen

32 The greatest composition by mass in an atom of $^{17}$O is due to the total mass of its
(1) electrons  (3) positrons
(2) neutrons   (4) protons

33 The bond between which two atoms is most polar?
(1) Br and Cl  (3) I and Cl
(2) Br and F   (4) I and F

34 In the formula $X_2(SO_4)_3$, the X represents a metal. This metal could be located on the Periodic Table in
(1) Group 1  (3) Group 13
(2) Group 2  (4) Group 14

35 At STP, which element is solid, brittle, and a poor conductor of electricity?
(1) Al  (3) Ne
(2) K   (4) S

36 Given the balanced equation representing a reaction:

$$2\text{NaCl}(ℓ) \rightarrow 2\text{Na}(ℓ) + \text{Cl}_2(g)$$

A 1170.-gram sample of NaCl(ℓ) completely reacts, producing 460. grams of Na(ℓ). What is the total mass of Cl$_2$(g) produced?
(1) 355 g  (3) 1420. g
(2) 710. g  (4) 1630. g

37 Given the formula representing a hydrocarbon:

```
C≡C
\|\|\|\|
H H H
```

The molecular formula and the empirical formula for this hydrocarbon are
(1) $C_5H_{10}$ and $CH_2$  (3) $C_4H_8$ and $CH_2$
(2) $C_5H_{10}$ and $CH_3$  (4) $C_4H_8$ and $CH_3
38 Which element forms an ionic compound when it reacts with lithium?
(1) K (3) Kr
(2) Fe (4) Br

39 Given the formula representing a molecule:
\[ \text{H} - \text{C} \equiv \text{C} - \text{H} \]
The molecule is
(1) symmetrical and polar
(2) symmetrical and nonpolar
(3) asymmetrical and polar
(4) asymmetrical and nonpolar

40 Which compound has both ionic and covalent bonds?
(1) CO₂ (3) NaI
(2) CH₃OH (4) Na₂CO₃

41 A cylinder with a movable piston contains a sample of gas having a volume of 6.0 liters at 293 K and 1.0 atmosphere. What is the volume of the sample after the gas is heated to 303 K, while the pressure is held at 1.0 atmosphere?
(1) 9.0 L (3) 5.8 L
(2) 6.2 L (4) 4.0 L

42 What is the minimum amount of heat required to completely melt 20.0 grams of ice at its melting point?
(1) 20.0 J (3) 6680 J
(2) 83.6 J (4) 45 200 J

43 As the temperature of a chemical reaction in the gas phase is increased, the rate of the reaction increases because
(1) fewer particle collisions occur
(2) more effective particle collisions occur
(3) the required activation energy increases
(4) the concentration of the reactants increases

44 The entropy of a sample of CO₂ increases as the CO₂ changes from
(1) gas to liquid (3) liquid to solid
(2) gas to solid (4) solid to gas

45 Which two factors must be equal when a chemical reaction reaches equilibrium?
(1) the concentration of the reactants and the concentration of the products
(2) the number of reactant particles and the number of product particles
(3) the rate of the forward reaction and the rate of the reverse reaction
(4) the mass of the reactants and the mass of the products

46 Which formula represents an unsaturated hydrocarbon?
(1) C₅H₁₂ (3) C₇H₁₆
(2) C₆H₁₄ (4) C₈H₁₄

47 The reaction between an organic acid and an alcohol produces
(1) an aldehyde (3) an ether
(2) a ketone (4) an ester

48 Which balanced equation represents a redox reaction?
(1) \( \text{AgNO}_3(\text{aq}) + \text{NaCl}(\text{aq}) \rightarrow \text{AgCl(s)} + \text{NaNO}_3(\text{aq}) \)
(2) \( \text{H}_2\text{CO}_3(\text{aq}) \rightarrow \text{H}_2\text{O}(\ell) + \text{CO}_2(\text{g}) \)
(3) \( \text{NaOH}(\text{aq}) + \text{HCl}(\text{aq}) \rightarrow \text{NaCl}(\text{aq}) + \text{H}_2\text{O}(\ell) \)
(4) \( \text{Mg}(s) + 2\text{HCl}(\text{aq}) \rightarrow \text{MgCl}_2(\text{aq}) + \text{H}_2(\text{g}) \)

49 A solution with a pH of 2.0 has a hydronium ion concentration ten times greater than a solution with a pH of
(1) 1.0 (3) 3.0
(2) 0.20 (4) 20.

50 Which isotope is used to treat cancer?
(1) C-14 (3) Co-60
(2) U-238 (4) Pb-206

Part B–2

Answer all questions in this part.

Directions (51–63): 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.

51 In your answer booklet, write an electron configuration for a silicon atom in an excited state. [1]

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

![Densities of Group 14 Elements](image)

52 Identify one element from this table for each type of element: metal, metalloid, and nonmetal. [1]

53 Calculate the volume of a tin block that has a mass of 95.04 grams at STP. Your response must include both a numerical setup and the calculated result. [2]

Base your answers to questions 54 through 56 on the elements in Group 2 on the Periodic Table.

54 State the general trend in first ionization energy for the elements in Group 2 as these elements are considered in order from top to bottom in the group. [1]

55 State, in terms of the number of electron shells, why the radius of a strontium atom in the ground state is larger than the radius of a magnesium atom in the ground state. [1]

56 Explain, in terms of atomic structure, why the elements in Group 2 have similar chemical properties. [1]
Base your answers to questions 57 and 58 on the information below.

Heat is added to a sample of liquid water, starting at 80.°C, until the entire sample is a gas at 120.°C. This process, occurring at standard pressure, is represented by the balanced equation below.

\[ \text{H}_2\text{O}(\ell) + \text{heat} \rightarrow \text{H}_2\text{O}(g) \]

57 In the box in your answer booklet, using the key, draw a particle diagram to represent at least five molecules of the product of this physical change at 120.°C. [2]

58 On the diagram in your answer booklet, complete the heating curve for this physical change. [1]

Base your answers to questions 59 and 60 on the information below.

In the gold foil experiment, a thin sheet of gold was bombarded with alpha particles. Almost all the alpha particles passed straight through the foil. Only a few alpha particles were deflected from their original paths.

59 State one conclusion about atomic structure based on the observation that almost all alpha particles passed straight through the foil. [1]

60 Explain, in terms of charged particles, why some of the alpha particles were deflected. [1]

Base your answers to questions 61 through 63 on the information below.

<table>
<thead>
<tr>
<th>Compound</th>
<th>Boiling Point (°C)</th>
<th>Solubility in 100. Grams of H\textsubscript{2}O at 20.°C (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ammonia</td>
<td>−33.2</td>
<td>56</td>
</tr>
<tr>
<td>methane</td>
<td>−161.5</td>
<td>0.002</td>
</tr>
<tr>
<td>hydrogen chloride</td>
<td>−84.9</td>
<td>72</td>
</tr>
</tbody>
</table>

61 Convert the boiling point of hydrogen chloride at standard pressure to kelvins. [1]

62 Explain, in terms of molecular polarity, why hydrogen chloride is more soluble than methane in water at 20.°C and standard pressure. [1]

63 Explain, in terms of intermolecular forces, why ammonia has a higher boiling point than the other compounds in the table. [1]
Part C

Answer all questions in this part.

Directions (64–81): 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 64 through 66 on the information below.

The diagram below represents an operating voltaic cell at 298 K and 1.0 atmosphere in a laboratory investigation. The reaction occurring in the cell is represented by the balanced ionic equation below.

\[ 2\text{Ag}^+(aq) + \text{Ni}(s) \rightarrow 2\text{Ag}(s) + \text{Ni}^{2+}(aq) \]

64 Identify the anode in this cell. [1]

65 Determine the total number of moles of \( \text{Ni}^{2+}(aq) \) ions produced when 4.0 moles of \( \text{Ag}^+(aq) \) ions completely react in this cell. [1]

66 Write a balanced half-reaction equation for the reduction that occurs in this cell. [1]
Base your answers to questions 67 through 69 on the information below.

Gasoline is a mixture composed primarily of hydrocarbons such as isooctane, which is also known as 2,2,4-trimethylpentane.

Gasoline is assigned a number called an octane rating. Gasoline with an octane rating of 87 performs the same as a mixture that consists of 87% isooctane and 13% heptane.

An alternative fuel, E-85, can be used in some automobiles. This fuel is a mixture of 85% ethanol and 15% gasoline.

67 State the octane rating of a gasoline sample that performs the same as a mixture consisting of 92% isooctane and 8% heptane. [1]

68 In the space in your answer booklet, draw a structural formula for a molecule of 2,2,4-trimethylpentane. [1]

69 Identify the functional group in a molecule of ethanol in the alternative fuel E-85. [1]

Base your answers to questions 70 through 72 on the information below.

Hydrogen peroxide, H₂O₂, is a water-soluble compound. The concentration of an aqueous hydrogen peroxide solution that is 3% by mass H₂O₂ is used as an antiseptic. When the solution is poured on a small cut in the skin, H₂O₂ reacts according to the balanced equation below.

\[ 2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2 \]

70 Identify the type of chemical reaction represented by the balanced equation. [1]

71 Calculate the total mass of H₂O₂ in 20.0 grams of an aqueous H₂O₂ solution that is used as an antiseptic. Your response must include both a numerical setup and the calculated result. [2]

72 Determine the gram-formula mass of H₂O₂. [1]
The catalytic converter in an automobile changes harmful gases produced during fuel combustion to less harmful exhaust gases. In the catalytic converter, nitrogen dioxide reacts with carbon monoxide to produce nitrogen and carbon dioxide. In addition, some carbon monoxide reacts with oxygen, producing carbon dioxide in the converter. These reactions are represented by the balanced equations below.

Reaction 1: \[2\text{NO}_2(g) + 4\text{CO}(g) \rightarrow \text{N}_2(g) + 4\text{CO}_2(g) + 1198.4 \text{ kJ}\]

Reaction 2: \[2\text{CO}(g) + \text{O}_2(g) \rightarrow 2\text{CO}_2(g) + 566.0 \text{ kJ}\]

73 The potential energy diagram in your answer booklet represents reaction 1 without a catalyst. On the same diagram, draw a dashed line to indicate how potential energy changes when the reaction is catalyzed in the converter. [1]

74 Determine the oxidation number of carbon in each carbon compound in reaction 2. Your response must include both the sign and value of each oxidation number. [1]
Base your answers to questions 75 through 78 on the information below.

In one trial of an investigation, 50.0 milliliters of HCl(aq) of an unknown concentration is titrated with 0.10 M NaOH(aq). During the titration, the total volume of NaOH(aq) added and the corresponding pH value of the reaction mixture are measured and recorded in the table below.

<table>
<thead>
<tr>
<th>Total Volume of NaOH(aq) Added (mL)</th>
<th>pH Value of Reaction Mixture</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.0</td>
<td>1.6</td>
</tr>
<tr>
<td>20.0</td>
<td>2.2</td>
</tr>
<tr>
<td>24.0</td>
<td>2.9</td>
</tr>
<tr>
<td>24.9</td>
<td>3.9</td>
</tr>
<tr>
<td>25.1</td>
<td>10.1</td>
</tr>
<tr>
<td>26.0</td>
<td>11.1</td>
</tr>
<tr>
<td>30.0</td>
<td>11.8</td>
</tr>
</tbody>
</table>

75 On the grid in your answer booklet, plot the data from the table. Circle and connect the points. [1]

76 Determine the total volume of NaOH(aq) added when the reaction mixture has a pH value of 7.0. [1]

77 Write a balanced equation that represents this neutralization reaction. [1]

78 In another trial, 40.0 milliliters of HCl(aq) is completely neutralized by 20.0 milliliters of this 0.10 M NaOH(aq). Calculate the molarity of the titrated acid in this trial. Your response must include both a numerical setup and the calculated result. [2]
The radioisotope uranium-238 occurs naturally in Earth’s crust. The disintegration of this radioisotope is the first in a series of spontaneous decays. The sixth decay in this series produces the radioisotope radon-222. The decay of radon-222 produces the radioisotope polonium-218 that has a half life of 3.04 minutes. Eventually, the stable isotope lead-206 is produced by the alpha decay of an unstable nuclide.

79 Explain, in terms of electron configuration, why atoms of the radioisotope produced by the sixth decay in the U-238 disintegration series do not readily react to form compounds. [1]

80 Complete the nuclear equation in your answer booklet for the decay of the unstable nuclide that produces Pb-206, by writing a notation for the missing nuclide. [1]

81 Determine the original mass of a sample of Po-218, if 0.50 milligram of the sample remains unchanged after 12.16 minutes. [1]
The University of the State of New York
REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
CHEMISTRY

Wednesday, August 18, 2010 — 12:30 to 3:30 p.m., only

ANSWER BOOKLET

Student .................................................. Sex: □ Male □ Female
Teacher .......................................................... School ..........................................................

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

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 __________________________________

52 Metal: ____________________________

   Metalloid: __________________________

   Nonmetal: __________________________

53 __________________________________

54 __________________________________

55 __________________________________

56 __________________________________

For Raters Only

51  

52  

53  

54  

55  

56  

________ cm³
Key
● = atom of hydrogen
○ = atom of oxygen
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>61</td>
<td>___________ K</td>
<td></td>
</tr>
<tr>
<td>62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>63</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Score for Part B–2
Part C

64 _______________________

65 ______________ mol

66 _______________________

67 ______________

68 _______________________

69 ______________

70 _______________________

71 _______________________

_________________ g

72 ___________________ g/mol
73 CO: __________________________

CO₂: __________________________

75 pH Value of Reaction Mixture Versus Total Volume of NaOH(aq) Added

Total Volume of NaOH(aq) Added (mL)

76 _________________ mL
77

78

M

79

80 $\rightarrow ^{4}_{2}\text{He} + ^{206}_{82}\text{Pb}$

81 $\text{mg}$
PS/CHEMISTRY
# SCORING KEY AND RATING GUIDE

**Part A and Part B–1**

Allow 1 credit for each correct response.

<table>
<thead>
<tr>
<th>Part A</th>
<th>Part B–1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 . . . 2 . . . . .</td>
<td>31 . . . 2 . . . .</td>
</tr>
<tr>
<td>2 . . . 3 . . . . .</td>
<td>32 . . . 2 . . . .</td>
</tr>
<tr>
<td>3 . . . 1 . . . . .</td>
<td>33 . . . 4 . . . .</td>
</tr>
<tr>
<td>4 . . . 4 . . . . .</td>
<td>34 . . . 3 . . . .</td>
</tr>
<tr>
<td>5 . . . 2 . . . . .</td>
<td>35 . . . 4 . . . .</td>
</tr>
<tr>
<td>6 . . . 3 . . . . .</td>
<td>36 . . . 2 . . . .</td>
</tr>
<tr>
<td>7 . . . 2 . . . . .</td>
<td>37 . . . 1 . . . .</td>
</tr>
<tr>
<td>8 . . . 1 . . . . .</td>
<td>38 . . . 4 . . . .</td>
</tr>
<tr>
<td>9 . . . 2 . . . . .</td>
<td>39 . . . 2 . . . .</td>
</tr>
<tr>
<td>10 . . . 2 . . . . .</td>
<td>40 . . . 4 . . . .</td>
</tr>
<tr>
<td>11 . . . 4 . . . . .</td>
<td>41 . . . 2 . . . .</td>
</tr>
<tr>
<td>12 . . . 3 . . . . .</td>
<td>42 . . . 3 . . . .</td>
</tr>
<tr>
<td>13 . . . 3 . . . . .</td>
<td>43 . . . 2 . . . .</td>
</tr>
<tr>
<td>14 . . . 2 . . . . .</td>
<td>44 . . . 4 . . . .</td>
</tr>
<tr>
<td>15 . . . 3 . . . . .</td>
<td>45 . . . 3 . . . .</td>
</tr>
<tr>
<td>16 . . . 3 . . . . .</td>
<td>46 . . . 4 . . . .</td>
</tr>
<tr>
<td>17 . . . 4 . . . . .</td>
<td>47 . . . 4 . . . .</td>
</tr>
<tr>
<td>18 . . . 2 . . . . .</td>
<td>48 . . . 4 . . . .</td>
</tr>
<tr>
<td>19 . . . 4 . . . . .</td>
<td>49 . . . 3 . . . .</td>
</tr>
<tr>
<td>20 . . . 4 . . . . .</td>
<td>50 . . . 3 . . . .</td>
</tr>
</tbody>
</table>
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 all 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 http://www.emsc.nysed.gov/osa/ on Wednesday, August 18, 2010. 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.”

All student answer papers that receive a scale score of 60 through 64 must be scored a second time. For the second scoring, a different committee of teachers may score the student’s paper or the original committee may score the paper, except that no teacher may score the same open-ended questions that he/she scored in the first rating of the paper. The school principal is responsible for assuring that the student’s final examination score is based on a fair, accurate, and reliable scoring of the student’s answer paper.

Because scale scores corresponding to raw scores in the conversion chart may change from one examination 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:
   2-7-5
   1-8-5
   2-8-3-1

52 [1] Allow 1 credit for a response indicating one metal, one metalloid, and one nonmetal.
   Metal: tin or Sn or lead or Pb
   Metalloid: silicon or Si or germanium or Ge
   Nonmetal: carbon or C

53 [2] Allow a maximum of 2 credits, allocated as follows:

   • Allow 1 credit for a correct numerical setup. Acceptable responses include, but are not limited to:
     \[ 7.31 \text{ g/cm}^3 = \frac{95.04 \text{ g}}{V} \]
     \[ \frac{95.04}{7.31} \]
   
   • Allow 1 credit for 13.0 cm³ or for a response consistent with the student’s numerical setup. Significant figures do not need to be shown.

   Note: Do not allow credit for a numerical setup and calculated result that are not related to the concept assessed by the question.

54 [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   As atomic number increases, first ionization energy decreases.
   First ionization energy decreases.

55 [1] Allow 1 credit. Acceptable responses include, but are not limited to:
   A strontium atom in the ground state has two more electron shells than a magnesium atom in the ground state.
   An Mg atom has fewer electron shells.
56 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

In the ground state, an atom of each element has two valence electrons.

The number of electrons in the outermost shell of each atom is the same.

57 [2] Allow a maximum of 2 credits, allocated as follows:

• Allow 1 credit for at least five water molecules.

• Allow 1 credit for all the particles drawn to represent the gas phase.

**Example of a 2-credit response:**

![Key diagram](image)

58 [1] Allow 1 credit for drawing a line horizontally to represent the phase change and extending the line with a positive slope to represent the gas phase, only.

**Example of a 1-credit response:**

![Temperature vs Heat Added graph](image)

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

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

- Alpha particles are positive and are repelled by the nucleus that is also positive.
- Both protons and alpha particles are positively charged so they repel each other.
- Protons and alpha particles have the same charge.

61 [1] Allow 1 credit for 188 K. Significant figures do not need to be shown.

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

- Molecules of \( \text{CH}_4 \) are nonpolar, but molecules of \( \text{HCl} \) and \( \text{H}_2\text{O} \) are both polar.
- Hydrogen chloride and water are both polar.

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

- Ammonia has stronger intermolecular forces than either methane or hydrogen chloride.
- Ammonia has hydrogen bonding.
Part C

Allow a total of 20 credits for this part. The student must answer all questions in this part.

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

\[ \text{Ni(s)} \]

the nickel electrode

**Note:** Do not allow credit for \( \text{Ni}^2\text{+}(aq) \).

65 [1] Allow 1 credit for 2.0 mol. Significant figures do not need to be shown.

66 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

\[ \text{Ag}^+ + e^- \rightarrow \text{Ag} \]

\[ 2\text{Ag}^+ + 2e^- \rightarrow 2\text{Ag} \]


68 [1] Allow 1 credit.

**Examples of 1-credit responses:**

```
H  H
H--C--H  H--C--H
  |      |      |
H--C---C---C---C---H
  |      |      |      |
H--C--H
  |      |
  H

---

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

- OH
- alcohol
- hydroxyl

**Note:** Do not allow credit for hydroxide or OH⁻.

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

- decomposition
- redox

71 [2] Allow a maximum of 2 credits, allocated as follows:

- Allow 1 credit for a correct numerical setup. Acceptable responses include, but are not limited to:

  \[ 3 = \frac{x}{20.0 \text{ g}} \times 100 \]

  \[ (20)(0.03) \]

- Allow 1 credit for 0.6 g or for a response consistent with the student’s numerical setup. Significant figures do not need to be shown.

**Note:** Do not allow credit for a numerical setup and calculated result that are not related to the concept assessed by the question.

72 [1] Allow 1 credit for 34 g/mol. Significant figures do not need to be shown.
73 [1] Allow 1 credit.  

Example of a 1-credit response:

![Potential Energy vs. Reaction Coordinate Graph]

Note: Do not allow credit if the potential energy of the reactants or products is changed.

74 [1] Allow 1 credit for a response indicating +2 for carbon in CO and +4 for carbon in CO₂.

75 [1] Allow 1 credit for correctly plotting all seven points ± 0.3 grid space. Plotted points do not need to be circled or connected.

Example of a 1-credit response:

![PH Value vs. Total Volume Graph]
Allow 1 credit for 25.0 mL ± 0.6 mL or for a response consistent with the student's graph. Significant figures do not need to be shown.

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

\[
\text{NaOH(aq) + HCl(aq) } \rightarrow \text{ NaCl(aq) + H}_2\text{O(ℓ)}
\]

\[
\text{HCl + NaOH } \rightarrow \text{ NaCl + H}_2\text{O}
\]

\[
\text{H}^+(aq) + \text{OH}^-(aq) \rightarrow \text{H}_2\text{O(ℓ)}
\]

\[
\text{H}_3\text{O}^+ + \text{OH}^- \rightarrow 2\text{H}_2\text{O}
\]

Allow a maximum of 2 credits, allocated as follows:

- Allow 1 credit for a correct numerical setup. Acceptable responses include, but are not limited to:

\[
(M)(40.0 \text{ mL}) = (0.10 \text{ M})(20.0 \text{ mL})
\]

\[
\frac{(0.1)(20)}{40}
\]

- Allow 1 credit for 0.050 M or for a response consistent with the student's numerical setup. Significant figures do not need to be shown.

Note: Do not allow credit for a numerical setup and calculated result that are not related to the concept assessed by the question.

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

- Radon-222 atoms have a complete outer shell of electrons and tend not to bond.
- There are eight valence electrons in a radon atom.
- Octet in valence shell

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

\[
\text{Po-}^{210}_{84}
\]

\[
\text{Po-210}
\]

Allow 1 credit for 8.00 mg. Significant figures do not need to be shown.
The Chart for Determining the Final Examination Score for the August 2010 Regents Examination in Physical Setting/Chemistry will be posted on the Department’s web site http://www.emsc.nysed.gov/osa/ on Wednesday, August 18, 2010. 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:

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

## August 2010 Physical Setting/Chemistry

### Question Numbers

<table>
<thead>
<tr>
<th>Key Ideas/Performance Indicators</th>
<th>Part A</th>
<th>Part B</th>
<th>Part C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math Key Idea 1</td>
<td>39, 41, 42, 53, 61</td>
<td>71, 76, 78, 81</td>
<td></td>
</tr>
<tr>
<td>Math Key Idea 2</td>
<td></td>
<td>67, 76</td>
<td></td>
</tr>
<tr>
<td>Math Key Idea 3</td>
<td>33, 41, 42, 53, 58, 61, 63</td>
<td>71, 72, 74, 78, 81</td>
<td></td>
</tr>
<tr>
<td>Science Inquiry Key Idea 1</td>
<td>33, 55, 56, 57, 60, 62</td>
<td></td>
<td>78</td>
</tr>
<tr>
<td>Science Inquiry Key Idea 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science Inquiry Key Idea 3</td>
<td>31, 35, 37, 38, 40, 48, 54</td>
<td>64, 65, 66, 67, 69, 70, 74, 75, 77</td>
<td></td>
</tr>
<tr>
<td>Engineering Design Key Idea 1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Standard 2

| Key Idea 1 |        |        |        |
| Key Idea 2 |        |        |        |
| Key Idea 3 |        |        |        |

### Standard 6

| Key Idea 1 |        |        |        |
| Key Idea 2 |        | 57, 59 |        |
| Key Idea 3 |        | 49 |        |
| Key Idea 4 |        |        |        |
| Key Idea 5 |        |        |        |

### Standard 7

| Key Idea 1 |        |        |        |
| Key Idea 2 |        |        |        |

### Standard 4 Process Skills

| Key Idea 3 | 32, 34, 36, 37, 38, 41, 43, 44, 45, 46, 47, 51, 52, 54, 55, 56, 57, 59, 60, 61 | 64, 65, 66, 68, 70, 72, 77, 78 |        |
| Key Idea 4 | 42, 50, 58 | 73, 80, 81 |        |
| Key Idea 5 | 62, 63 |        |        |

### Standard 4

| Key Idea 3 | 1, 2, 3, 4, 5, 6, 7, 8, 9, 13, 15, 16, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28 | 31, 32, 34, 35, 36, 37, 41, 43, 44, 45, 47, 48, 49, 51, 52, 53, 54, 55, 56, 57, 59, 60 | 64, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79 |
| Key Idea 4 | 14, 17, 30 | 42, 50, 58, 61 | 80, 81 |
| Key Idea 5 | 10, 11, 12, 29 | 33, 38, 39, 40, 46, 62, 63 |        |

### Reference Tables

| 2002 Edition | 1, 5, 7, 9, 10, 13, 15, 20, 22, 26, 27, 30 | 31, 33, 34, 35, 38, 40, 41, 42, 46, 47, 48, 51, 52, 53, 54, 55, 56, 59, 61, 62, 63 | 68, 69, 71, 72, 74, 78, 79, 80, 81 |
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.

All student answer papers that receive a scale score of 60 through 64 must be scored a second time to ensure the accuracy of the score. For the second scoring, a different committee of teachers may score the student’s paper or the original committee may score the paper, except that no teacher may score the same open-ended questions that he/she scored in the first rating of the paper. The school principal is responsible for assuring that the student’s final examination score is based on a fair, accurate and reliable scoring of the student’s answer paper.

Because scale scores corresponding to raw scores in the conversion chart change from one examination 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.