

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

**PHYSICAL SETTING  
CHEMISTRY**

**Thursday, January 25, 2007 — 1:15 to 4:15 p.m., only**

This is a test of your knowledge of chemistry. Use that knowledge to answer all questions in this examination. Some questions may require the use of the *Reference Tables for Physical Setting/Chemistry*. You are to answer *all* questions in all parts of this examination according to the directions provided in the examination booklet.

Your answer sheet for Part A and Part B–1 is the last page of this examination booklet. Turn to the last page and fold it along the perforations. Then, slowly and carefully, tear off your answer sheet and fill in the heading.

The answers to the questions in Part B–2 and Part C are to be written in your separate answer booklet. Be sure to fill in the heading on the front of your answer booklet.

Record the number of your choice for each Part A and Part B–1 multiple-choice question on your separate answer sheet. Write your answers to the Part B–2 and Part C questions in your answer booklet. All work should be written in pen, except for graphs and drawings, which should be done in pencil. You may use scrap paper to work out the answers to the questions, but be sure to record all your answers on your separate answer sheet and in your answer booklet.

When you have completed the examination, you must sign the statement printed at the end of 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 *Reference Tables for Physical Setting/Chemistry* must be available for you to use while taking this examination.

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

**DO NOT OPEN THIS EXAMINATION BOOKLET UNTIL THE SIGNAL IS GIVEN.**

## Part A

### Answer all questions in this part.

*Directions (1–30):* For *each* statement or question, write on the 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 *Reference Tables for Physical Setting/Chemistry*.

- Which subatomic particles are located in the nucleus of a neon atom?
  - electrons and positrons
  - electrons and neutrons
  - protons and neutrons
  - protons and electrons
- The total mass of the protons in an atom of gold-198 is approximately
  - 79 atomic mass units
  - 119 atomic mass units
  - 198 atomic mass units
  - 277 atomic mass units
- In a calcium atom in the ground state, the electrons that possess the *least* amount of energy are located in the
  - first electron shell
  - second electron shell
  - third electron shell
  - fourth electron shell
- Which group of atomic models is listed in historical order from the earliest to the most recent?
  - hard-sphere model, wave-mechanical model, electron-shell model
  - hard-sphere model, electron-shell model, wave-mechanical model
  - electron-shell model, wave-mechanical model, hard-sphere model
  - electron-shell model, hard-sphere model, wave-mechanical model
- Which isotopic notation represents an atom of carbon-14?
  - ${}^6_8\text{C}$
  - ${}^8_6\text{C}$
  - ${}^6_{14}\text{C}$
  - ${}^{14}_6\text{C}$
- An atom of argon rarely bonds to an atom of another element because an argon atom has
  - 8 valence electrons
  - 2 electrons in the first shell
  - 3 electron shells
  - 22 neutrons
- The elements on the Periodic Table are arranged in order of increasing
  - boiling point
  - electronegativity
  - atomic number
  - atomic mass
- Which element is classified as a nonmetal?
  - Be
  - Al
  - Si
  - Cl
- Solid samples of the element phosphorus can be white, black, or red in color. The variations in color are due to different
  - atomic masses
  - molecular structures
  - ionization energies
  - nuclear charges
- Given the balanced equation representing the reaction between propane and oxygen:
$$\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$$
According to this equation, which ratio of oxygen to propane is correct?
  - $\frac{5 \text{ grams O}_2}{1 \text{ gram C}_3\text{H}_8}$
  - $\frac{5 \text{ moles O}_2}{1 \text{ mole C}_3\text{H}_8}$
  - $\frac{10 \text{ grams O}_2}{11 \text{ grams C}_3\text{H}_8}$
  - $\frac{10 \text{ moles O}_2}{11 \text{ moles C}_3\text{H}_8}$

11 Lithium and potassium have similar chemical properties because the atoms of both elements have the same

- (1) mass number
- (2) atomic number
- (3) number of electron shells
- (4) number of valence electrons

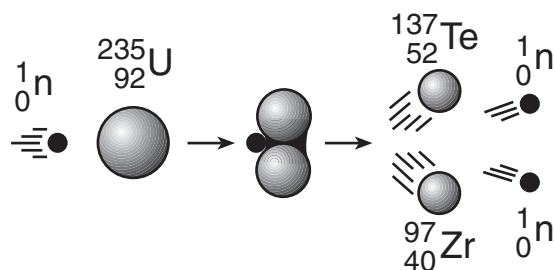
12 Which two substances are covalent compounds?

- (1)  $C_6H_{12}O_6(s)$  and  $KI(s)$
- (2)  $C_6H_{12}O_6(s)$  and  $HCl(g)$
- (3)  $KI(s)$  and  $NaCl(s)$
- (4)  $NaCl(s)$  and  $HCl(g)$

13 Which substance, when dissolved in water, forms a solution that conducts an electric current?

- (1)  $C_2H_5OH$
- (2)  $C_6H_{12}O_6$
- (3)  $C_{12}H_{22}O_{11}$
- (4)  $CH_3COOH$

14 Given the diagram representing a reaction:



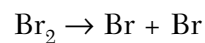
Which phrase best describes this type of reaction and the overall energy change that occurs?

- (1) nuclear, and energy is released
- (2) nuclear, and energy is absorbed
- (3) chemical, and energy is released
- (4) chemical, and energy is absorbed

15 Compared to a phosphorus atom, a  $P^{3-}$  ion has

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

16 The balanced equation below represents a molecule of bromine separating into two bromine atoms.



What occurs during this change?

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

17 Which substance can be decomposed by chemical means?

- (1) tungsten
- (2) antimony
- (3) krypton
- (4) methane

18 Bronze contains 90 to 95 percent copper and 5 to 10 percent tin. Because these percentages can vary, bronze is classified as

- (1) a compound
- (2) an element
- (3) a mixture
- (4) a substance

19 Compared to a 2.0 M aqueous solution of  $NaCl$  at 1 atmosphere, a 3.0 M aqueous solution of  $NaCl$  at 1 atmosphere has a

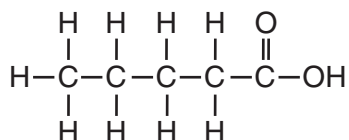
- (1) lower boiling point and a higher freezing point
- (2) lower boiling point and a lower freezing point
- (3) higher boiling point and a higher freezing point
- (4) higher boiling point and a lower freezing point

20 In which reaction are electrons transferred from one reactant to another reactant?

- (1)  $2Ca(s) + O_2(g) \rightarrow 2CaO(s)$
- (2)  $AgNO_3(aq) + KCl(aq) \rightarrow AgCl(s) + KNO_3(aq)$
- (3)  $HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(\ell)$
- (4)  $H_3O^+(aq) + OH^-(aq) \rightarrow 2H_2O(\ell)$

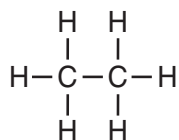
- 21 Which statement must be true for any chemical reaction at equilibrium?
- (1) The concentration of the products is greater than the concentration of the reactants.
  - (2) The concentration of the products is less than the concentration of the reactants.
  - (3) The concentration of the products and the concentration of the reactants are equal.
  - (4) The concentration of the products and the concentration of the reactants are constant.

22 Given the structural formula:

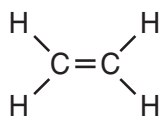


What is the IUPAC name of this compound?

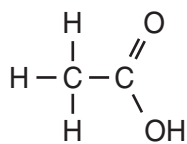
- (1) pentanal
  - (2) pentanol
  - (3) methyl pentanoate
  - (4) pentanoic acid
- 23 Which structural formula represents an unsaturated hydrocarbon?



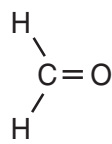
(1)



(3)



(2)

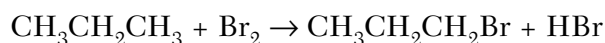


(4)

- 24 Which group of nuclear emissions is listed in order of increasing charge?
- (1) alpha particle, beta particle, gamma radiation
  - (2) gamma radiation, alpha particle, beta particle
  - (3) positron, alpha particle, neutron
  - (4) neutron, positron, alpha particle

- 25 Two substances have different physical and chemical properties. Both substances have molecules that contain two carbon atoms, one oxygen atom, and six hydrogen atoms. These two substances must be
- (1) isomers of each other
  - (2) isotopes of each other
  - (3) the same compound
  - (4) the same hydrocarbon

26 Given the balanced equation representing a reaction:



This organic reaction is best classified as

- (1) an addition reaction
  - (2) an esterification reaction
  - (3) a polymerization reaction
  - (4) a substitution reaction
- 27 In terms of energy and entropy, systems in nature tend to undergo changes toward
- (1) higher energy and higher entropy
  - (2) higher energy and lower entropy
  - (3) lower energy and higher entropy
  - (4) lower energy and lower entropy

28 Given the structural formula:



What is the total number of electrons shared in the bond between the two carbon atoms?

- (1) 6
  - (2) 2
  - (3) 3
  - (4) 4
- 29 Which compound has hydrogen bonding between its molecules?
- (1)  $\text{CH}_4$
  - (2)  $\text{CaH}_2$
  - (3)  $\text{KH}$
  - (4)  $\text{NH}_3$
- 30 Which ion is the only negative ion produced by an Arrhenius base in water?
- (1)  $\text{NO}_3^-$
  - (2)  $\text{Cl}^-$
  - (3)  $\text{OH}^-$
  - (4)  $\text{H}^-$

Part B-1

Answer all questions in this part.

Directions (31–50): For each statement or question, write on the 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 *Reference Tables for Physical Setting/Chemistry*.

31 When the elements in Group 1 are considered in order from top to bottom, each successive element at standard pressure has

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

32 Which isotopic notation identifies a metalloid that is matched with the corresponding number of protons in each of its atoms?

- (1)  $^{24}\text{Mg}$  and 12 protons
- (2)  $^{28}\text{Si}$  and 14 protons
- (3)  $^{75}\text{As}$  and 75 protons
- (4)  $^{80}\text{Br}$  and 80 protons

33 At STP, which list of elements contains a solid, a liquid, and a gas?

- (1) Hf, Hg, He
- (2) Cr, Cl<sub>2</sub>, C
- (3) Ba, Br<sub>2</sub>, B
- (4) Se, Sn, Sr

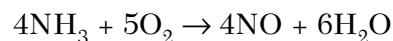
34 Element X reacts with iron to form two different compounds with the formulas FeX and Fe<sub>2</sub>X<sub>3</sub>. To which group on the Periodic Table does element X belong?

- (1) Group 8
- (2) Group 2
- (3) Group 13
- (4) Group 16

35 The molar mass of Ba(OH)<sub>2</sub> is

- (1) 154.3 g
- (2) 155.3 g
- (3) 171.3 g
- (4) 308.6 g

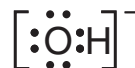
36 Given the balanced equation representing a reaction:



What is the *minimum* number of moles of O<sub>2</sub> that are needed to completely react with 16 moles of NH<sub>3</sub>?

- (1) 16 mol
- (2) 20. mol
- (3) 64 mol
- (4) 80. mol

37 Which Lewis electron-dot diagram correctly represents a hydroxide ion?



(1)



(3)



(2)



(4)

38 A 10.0-gram sample of which element has the *smallest* volume at STP?

- (1) aluminum
- (2) magnesium
- (3) titanium
- (4) zinc

39 At which temperature would atoms of a He(g) sample have the greatest average kinetic energy?

- (1) 25°C
- (2) 37°C
- (3) 273 K
- (4) 298 K

- 40 A student prepares four aqueous solutions, each with a different solute. The mass of each dissolved solute is shown in the table below.

**Mass of Dissolved Solute  
for Four Aqueous Solutions**

Solution Number	Solute	Mass of Dissolved Solute (per 100. g of H <sub>2</sub> O at 20.°C)
1	KI	120. g
2	NaNO <sub>3</sub>	88 g
3	KCl	25 g
4	KClO <sub>3</sub>	5 g

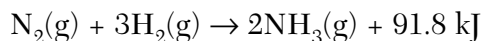
Which solution is saturated?

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

- 41 At room temperature, a mixture of sand and water can be separated by

- (1) ionization  
(2) combustion  
(3) filtration  
(4) sublimation

- 42 Given the balanced equation representing a reaction at 101.3 kPa and 298 K:



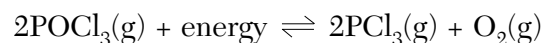
Which statement is true about this reaction?

- (1) It is exothermic and  $\Delta H$  equals  $-91.8 \text{ kJ}$ .  
(2) It is exothermic and  $\Delta H$  equals  $+91.8 \text{ kJ}$ .  
(3) It is endothermic and  $\Delta H$  equals  $-91.8 \text{ kJ}$ .  
(4) It is endothermic and  $\Delta H$  equals  $+91.8 \text{ kJ}$ .

- 43 Which balanced equation represents a phase equilibrium?

- (1)  $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$   
(2)  $2\text{NO}_2(\text{g}) \rightleftharpoons \text{N}_2\text{O}_4(\text{g})$   
(3)  $\text{Cl}_2(\text{g}) \rightleftharpoons \text{Cl}_2(\ell)$   
(4)  $3\text{O}_2(\text{g}) \rightleftharpoons 2\text{O}_3(\text{g})$

- 44 Given the system at equilibrium:



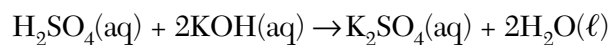
Which changes occur when O<sub>2</sub>(g) is added to this system?

- (1) The equilibrium shifts to the right and the concentration of PCl<sub>3</sub>(g) increases.  
(2) The equilibrium shifts to the right and the concentration of PCl<sub>3</sub>(g) decreases.  
(3) The equilibrium shifts to the left and the concentration of PCl<sub>3</sub>(g) increases.  
(4) The equilibrium shifts to the left and the concentration of PCl<sub>3</sub>(g) decreases.

- 45 What is the oxidation number of chromium in the chromate ion, CrO<sub>4</sub><sup>2-</sup>?

- (1) +6  
(2) +2  
(3) +3  
(4) +8

46 Given the balanced equation representing a reaction:



Which type of reaction is represented by this equation?

- (1) decomposition            (3) single replacement  
(2) neutralization           (4) synthesis

47 In which 0.01 M solution is phenolphthalein pink?

- (1)  $\text{CH}_3\text{OH}(\text{aq})$             (3)  $\text{CH}_3\text{COOH}(\text{aq})$   
(2)  $\text{Ca}(\text{OH})_2(\text{aq})$         (4)  $\text{HNO}_3(\text{aq})$

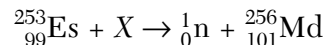
48 As the pH of a solution is changed from 3 to 6, the concentration of hydronium ions

- (1) increases by a factor of 3  
(2) increases by a factor of 1000  
(3) decreases by a factor of 3  
(4) decreases by a factor of 1000

49 If  $\frac{1}{8}$  of an original sample of krypton-74 remains unchanged after 34.5 minutes, what is the half-life of krypton-74?

- (1) 11.5 min                    (3) 34.5 min  
(2) 23.0 min                   (4) 46.0 min

50 Given the nuclear equation:



Which particle is represented by X?

- (1)  ${}^4_2\text{He}$                         (3)  ${}^1_0\text{n}$   
(2)  ${}^0_{-1}\text{e}$                         (4)  ${}^0_{+1}\text{e}$

## Part B–2

### Answer all questions in this part.

*Directions (51–66):* 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 Naturally occurring boron is composed of two isotopes. The percent abundance and the mass of each isotope are listed below.
- 19.9% of the boron atoms have a mass of 10.013 atomic mass units.
  - 80.1% of the boron atoms have a mass of 11.009 atomic mass units.

In the space *in your answer booklet*, calculate the atomic mass of boron. Your response must include *both* a correct numerical setup and the calculated result. [2]

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

During a laboratory activity, a student reacted a piece of zinc with 0.1 M HCl(aq).

- 52 Complete the equation *in your answer booklet* by writing the formula of the missing product. [1]
- 53 Based on Reference Table J, identify *one* metal that does *not* react spontaneously with HCl(aq). [1]
- 

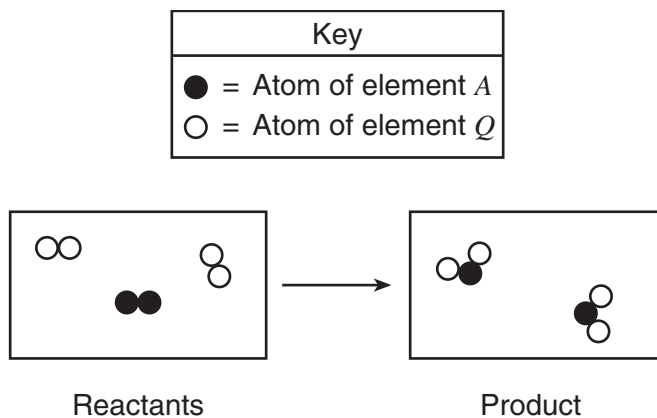
- 54 A hydrated compound contains water molecules within its crystal structure. The percent composition by mass of water in the hydrated compound  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$  has an accepted value of 20.9%. A student did an experiment and determined that the percent composition by mass of water in  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$  was 21.4%.

In the space *in your answer booklet*, calculate the percent error of the student's experimental result. Your response must include *both* a correct numerical setup and the calculated result. [2]



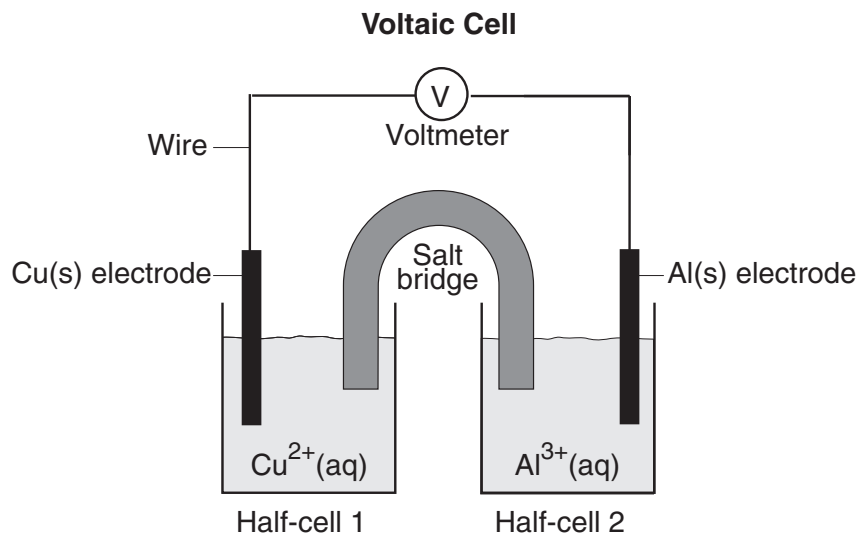
Base your answers to questions 55 through 57 on the information below.

The particle diagrams below represent the reaction between two nonmetals,  $A_2$  and  $Q_2$ .



- 55 Using the symbols  $A$  and  $Q$ , write the chemical formula of the product. [1]
- 56 Identify the type of chemical bond between an atom of element  $A$  and an atom of element  $Q$ . [1]
- 57 Compare the total mass of the reactants to the total mass of the product. [1]
- 
- 58 A potential energy diagram for a chemical reaction is shown *in your answer booklet*. On this diagram, draw a curve to show how the potential energy diagram will change when a catalyst is added to the reaction. [1]
- 59 Explain, in terms of collision theory, why an increase in temperature increases the rate of a chemical reaction. [1]
- 60 An aqueous solution contains 300. parts per million of  $KOH$ . Determine the number of grams of  $KOH$  present in 1000. grams of this solution. [1]

Base your answers to questions 61 through 63 on the diagram below. The diagram shows a voltaic cell with copper and aluminum electrodes immediately after the external circuit is completed.



- 61 Balance the redox equation *in your answer booklet*, using the smallest whole-number coefficients. [1]
- 62 As this voltaic cell operates, the mass of the Al(s) electrode decreases. Explain, in terms of particles, why this decrease in mass occurs. [1]
- 63 Explain the function of the salt bridge. [1]
- 
- 64 Identify *two* indicators from Reference Table M that are yellow in solutions with a pH of 5.5. [1]
- 65 Explain, in terms of molecular structure or distribution of charge, why a molecule of methane is nonpolar. [1]
- 66 A liquid boils when the vapor pressure of the liquid equals the atmospheric pressure on the surface of the liquid. Using Reference Table H, determine the boiling point of water when the atmospheric pressure is 90. kPa. [1]
-

## Part C

### Answer all questions in this part.

*Directions (67–83):* 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 67 through 70 on the information below, which describes the proposed discovery of element 118.

In 1999, a nuclear chemist and his team announced they had discovered a new element by crashing krypton atoms into lead. The new element, number 118, was assigned the name ununoctium and the symbol Uuo. One possible isotope of ununoctium could have been Uuo-291.

However, the discovery of Uuo was not confirmed because other scientists could not reproduce the experimental results published by the nuclear chemist and his team. In 2006, another team of scientists claimed that they produced Uuo. This claim has yet to be confirmed.

Adapted from *Discover* January 2002

- 67 Based on atomic number, in which group on the Periodic Table would element 118 be placed? [1]
- 68 What would be the total number of neutrons present in a theoretical atom of Uuo-291? [1]
- 69 What would be the total number of electrons present in a theoretical atom of Uuo-291? [1]
- 70 Explain why being able to reproduce scientific results is an important component of scientific research. [1]
-

Base your answers to questions 71 through 74 on the information below.

Have you ever seen an insect called a water strider “skating” across the surface of a calm pond? Have you ever “floated” a sewing needle on the water in a glass? If you have, then you’ve observed one of water’s many amazing properties.

Water’s surface tension keeps the water strider and the sewing needle from sinking into the water. Simply stated, the surface tension is due to the forces that hold the water molecules together. Without these intermolecular forces, the water strider and the sewing needle would sink below the surface of the water.

The surface tension of water at various temperatures is given in the data table below.

**Surface Tension at Different Water Temperatures**

Water Temperature (°C)	Surface Tension (mN/m)
10.	74.2
25	72.0
50.	67.9
75	63.6
100.	58.9

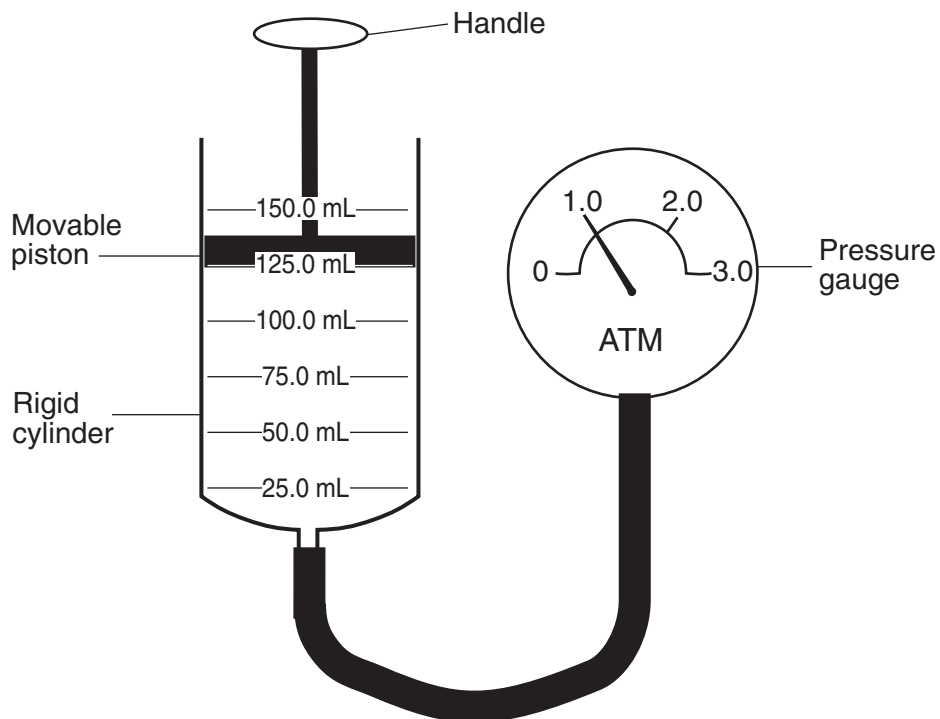
- 71 On the grid *in your answer booklet*, plot the data from the data table. Circle and connect the five points. [1]



- 72 According to your graph, what is the surface tension of water at 60.°C? [1]
- 73 State the relationship between the surface tension and the temperature of water. [1]
- 74 The surface tension of liquid tetrachloromethane,  $\text{CCl}_4$ , at 25°C is 26.3 millinewtons/meter (mN/m). Compare the intermolecular forces between molecules of  $\text{CCl}_4$  to the intermolecular forces between molecules of water,  $\text{H}_2\text{O}$ , at 25°C. [1]
-

Base your answers to questions 75 through 77 on the information below.

A rigid cylinder is fitted with a movable piston. The cylinder contains a sample of helium gas,  $\text{He}(g)$ , which has an initial volume of 125.0 milliliters and an initial pressure of 1.0 atmosphere, as shown below. The temperature of the helium gas sample is  $20.0^\circ\text{C}$ .



- 75 Express the initial volume of the helium gas sample, in liters. [1]
- 76 The piston is pushed further into the cylinder. In the space *in your answer booklet*, show a correct numerical setup for calculating the volume of the helium gas that is anticipated when the reading on the pressure gauge is 1.5 atmospheres. The temperature of the helium gas remains constant. [1]
- 77 Helium gas is removed from the cylinder and a sample of nitrogen gas,  $\text{N}_2(g)$ , is added to the cylinder. The nitrogen gas has a volume of 125.0 milliliters and a pressure of 1.0 atmosphere at  $20.0^\circ\text{C}$ . Compare the number of particles in this nitrogen gas sample to the number of particles in the original helium gas sample. [1]
-

Base your answers to questions 78 through 81 on the information below.

In preparing to titrate an acid with a base, a student puts on goggles and an apron. The student uses burets to dispense and measure the acid and the base in the titration. In each of two trials, a 0.500 M NaOH(aq) solution is added to a flask containing a volume of HCl(aq) solution of unknown concentration. Phenolphthalein is the indicator used in the titration. The calculated volumes used for the two trials are recorded in the table below.

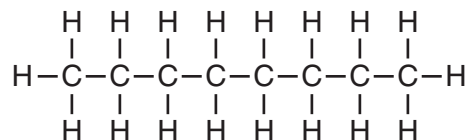
**Volumes of Base and Acid Used in Titration Trials**

		<b>Trial 1</b>	<b>Trial 2</b>
<b>Solution (aq)</b>	<b>Molarity (M)</b>	<b>Volume Used (mL)</b>	<b>Volume Used (mL)</b>
NaOH	0.500	17.03	16.87
HCl	?	10.22	10.12

- 78 Write a chemical name for the acid used in the titration. [1]
- 79 Using the volumes from trial 1, determine the molarity of the HCl(aq) solution. [1]
- 80 Based on the information given in the table, how many significant figures should be shown in the calculated molarity of the HCl(aq) solution used in trial 2? [1]
- 81 Identify *one* additional safety precaution the student should have taken before performing the titration. [1]
-

Base your answers to questions 82 and 83 on the information below.

A gasoline engine burns gasoline in the presence of excess oxygen to form carbon dioxide and water. The main components of gasoline are isomers of octane. A structural formula of octane is shown below.



One isomer of octane is 2,2,4-trimethylpentane.

- 82 In the space *in your answer booklet*, draw a structural formula for 2,2,4-trimethylpentane. [1]
- 83 Explain, in terms of the arrangement of particles, why the entropy of gasoline vapor is greater than the entropy of liquid gasoline. [1]
-

Tear Here

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING CHEMISTRY

Thursday, January 25, 2007 — 1:15 to 4:15 p.m., only

ANSWER SHEET

Student ..... Sex:  Male  Female Grade .....

Teacher ..... School .....

Record your answers to Part A and Part B-1 on this answer sheet.

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

[Box for 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

[Box for Part B-1 Score]

Write your answers to Part B-2 and Part C in your answer booklet.

The declaration below should 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

Tear Here



# PHYSICAL SETTING CHEMISTRY

Thursday, January 25, 2007 — 1:15 to 4:15 p.m., only

## ANSWER BOOKLET

Student ..... Sex:  Male  
 Female

Teacher .....

School ..... Grade .....

Answer all questions in Part B-2 and Part C. Record your answers  
in this booklet.

Part	Maximum Score	Student's Score
A	30	
B-1	20	
B-2	18	
C	17	
Total Written Test Score (Maximum Raw Score: 85)		<input type="text"/>
Final Score (from conversion chart)		<input type="text"/>
Raters' Initials: Rater 1 ..... Rater 2 .....		

Part B-2		For Raters Only
51		
_____ atomic mass units		
52 $\text{Zn(s)} + 2\text{HCl(aq)} \rightarrow$ _____ (aq) + $\text{H}_2\text{(g)}$		51 <input type="text"/>
53 _____		52 <input type="text"/>
		53 <input type="text"/>

**For Raters  
Only**

**54**

**54**

\_\_\_\_\_ %

**55**

**55**

\_\_\_\_\_

**56**

**56**

\_\_\_\_\_

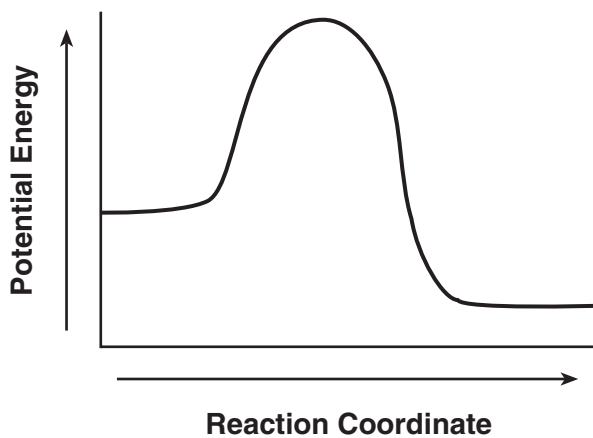
**57**

**57**

\_\_\_\_\_

\_\_\_\_\_

58



58

59

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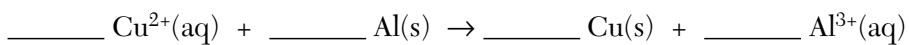
59

60

\_\_\_\_\_ g

60

61



61

62

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62

63

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63

**For Raters  
Only**

64 Indicator 1: \_\_\_\_\_

64

Indicator 2: \_\_\_\_\_

65 \_\_\_\_\_

65

\_\_\_\_\_

\_\_\_\_\_

66 \_\_\_\_\_ °C

66

**Total Score  
for Part B-2**

**Part C**

67 \_\_\_\_\_

67

68 \_\_\_\_\_

68

69 \_\_\_\_\_

69

70 \_\_\_\_\_

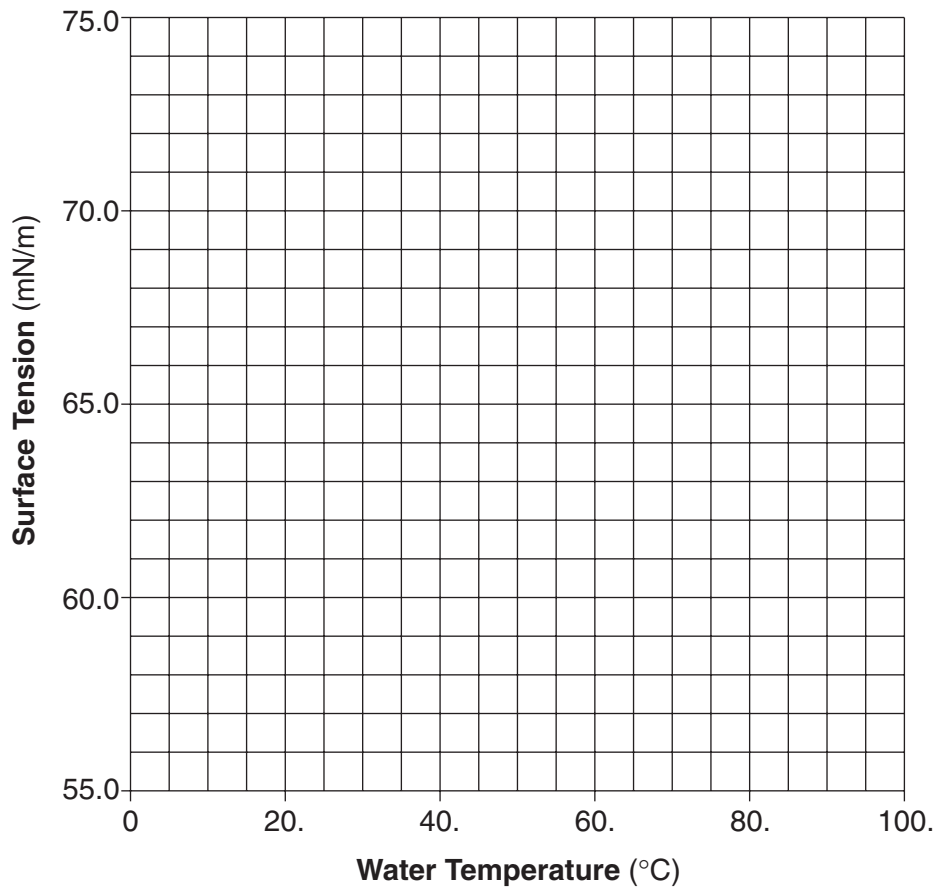
70

\_\_\_\_\_

\_\_\_\_\_

71

### Surface Tension Versus Water Temperature



71

72 \_\_\_\_\_ mN/m

72

73 \_\_\_\_\_

73

\_\_\_\_\_

74 \_\_\_\_\_

74

\_\_\_\_\_

\_\_\_\_\_

**For Raters  
Only**

75 \_\_\_\_\_ L

75

76

76

77 \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

77

78 \_\_\_\_\_

78

79 \_\_\_\_\_ M

79

80 \_\_\_\_\_

80

81 \_\_\_\_\_  
\_\_\_\_\_

81

**For Raters  
Only**

82

82

83

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83

**Total Score  
for Part C**

# FOR TEACHERS ONLY

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

## PS-CH PHYSICAL SETTING/CHEMISTRY

Thursday, January 25, 2007 — 1:15 to 4:15 p.m., only

### SCORING KEY AND RATING GUIDE

**Directions to the Teacher:**

Refer to the directions on page 3 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 <http://www.emsc.nysed.gov/osa/> and select the link "Examination Scoring Information" for any recently posted information regarding this examination. This site should be checked before the rating process for this examination begins and several times throughout the Regents examination period.

**Part A and Part B-1**

Allow 1 credit for each correct response.

Part A			Part B-1	
1 . . . . . <b>3</b> . . . . .	11 . . . . . <b>4</b> . . . . .	21 . . . . . <b>4</b> . . . . .	31 . . . . . <b>4</b> . . . . .	41 . . . . . <b>3</b> . . . . .
2 . . . . . <b>1</b> . . . . .	12 . . . . . <b>2</b> . . . . .	22 . . . . . <b>4</b> . . . . .	32 . . . . . <b>2</b> . . . . .	42 . . . . . <b>1</b> . . . . .
3 . . . . . <b>1</b> . . . . .	13 . . . . . <b>4</b> . . . . .	23 . . . . . <b>3</b> . . . . .	33 . . . . . <b>1</b> . . . . .	43 . . . . . <b>3</b> . . . . .
4 . . . . . <b>2</b> . . . . .	14 . . . . . <b>1</b> . . . . .	24 . . . . . <b>4</b> . . . . .	34 . . . . . <b>4</b> . . . . .	44 . . . . . <b>4</b> . . . . .
5 . . . . . <b>4</b> . . . . .	15 . . . . . <b>1</b> . . . . .	25 . . . . . <b>1</b> . . . . .	35 . . . . . <b>3</b> . . . . .	45 . . . . . <b>1</b> . . . . .
6 . . . . . <b>1</b> . . . . .	16 . . . . . <b>2</b> . . . . .	26 . . . . . <b>4</b> . . . . .	36 . . . . . <b>2</b> . . . . .	46 . . . . . <b>2</b> . . . . .
7 . . . . . <b>3</b> . . . . .	17 . . . . . <b>4</b> . . . . .	27 . . . . . <b>3</b> . . . . .	37 . . . . . <b>1</b> . . . . .	47 . . . . . <b>2</b> . . . . .
8 . . . . . <b>4</b> . . . . .	18 . . . . . <b>3</b> . . . . .	28 . . . . . <b>1</b> . . . . .	38 . . . . . <b>4</b> . . . . .	48 . . . . . <b>4</b> . . . . .
9 . . . . . <b>2</b> . . . . .	19 . . . . . <b>4</b> . . . . .	29 . . . . . <b>4</b> . . . . .	39 . . . . . <b>2</b> . . . . .	49 . . . . . <b>1</b> . . . . .
10 . . . . . <b>2</b> . . . . .	20 . . . . . <b>1</b> . . . . .	30 . . . . . <b>3</b> . . . . .	40 . . . . . <b>2</b> . . . . .	50 . . . . . <b>1</b> . . . . .



**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.

On the detachable answer sheet for Part A and Part B–1, indicate by means of a checkmark 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 scaled score by using the conversion chart that will be posted on the Department's web site <http://www.emsc.nysed.gov/osa/> on Thursday, January 25, 2007. The student's scaled score should be entered in the labeled box on the student's answer booklet. The scaled score is the student's final examination score.

All student answer papers that receive a scaled 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 scaled 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 18 credits for this part. The student must answer all questions in this part.**

**51** [2] Allow a maximum of 2 credits, allocated as follows:

- Allow 1 credit for a correct numerical setup. Significant figures do *not* need to be shown. Acceptable responses include, but are not limited to:

$$(10.013)(0.199) + (11.009)(0.801)$$

$$\frac{(19.9)(10.013) + (80.1)(11.009)}{100}$$

$$(10.013)(19.9\%) + (11.009)(80.1\%)$$

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

10.8 atomic mass units

10.81 atomic mass units

10.8108 atomic mass units

*or*

Allow 1 credit for a response consistent with the student's numerical setup.

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

**52** [1] Allow 1 credit for ZnCl<sub>2</sub>.

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

Cu

Ag

gold

54 [2] Allow a maximum of 2 credits, allocated as follows:

- Allow 1 credit for a correct numerical setup. Significant figures do *not* need to be shown. Acceptable responses include, but are not limited to:

$$\frac{21.4\% - 20.9\%}{20.9\%} \times 100$$

$$\frac{21.4 - 20.9}{20.9} \times 100$$

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

2%

2.4%

2.39%

*or*

Allow 1 credit for a response consistent with the student's numerical setup.

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

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

AQ<sub>2</sub>

Q<sub>2</sub>A

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

polar covalent

covalent

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

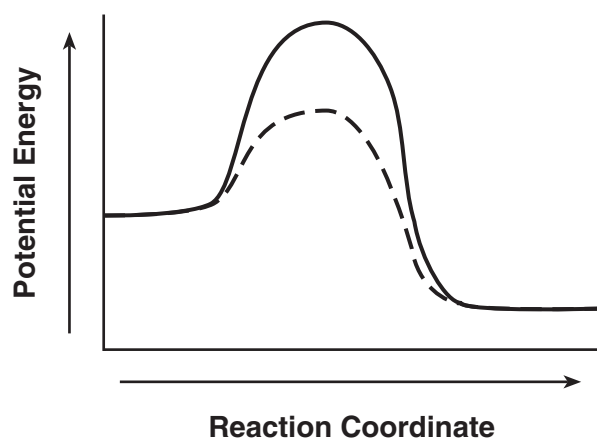
The total mass of reactants equals the total mass of product.

Mass of reactants equals mass of product.

Mass is conserved.

- 58 [1] Allow 1 credit for a correct response that shows an activation energy that is higher than the potential energy of the reactants and lower than the original activation energy.

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



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

As molecules acquire more kinetic energy, the number of effective collisions increases.

higher temperature, greater frequency of collisions

- 60 [1] Allow 1 credit for 0.300 g. Significant figures do *not* need to be shown.

- 61 [1] Allow 1 credit for  $\underline{3} \text{ Cu}^{2+}(\text{aq}) + \underline{2} \text{ Al}(\text{s}) \rightarrow \underline{3} \text{ Cu}(\text{s}) + \underline{2} \text{ Al}^{3+}(\text{aq})$ .

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

Aluminum atoms are losing electrons and becoming aluminum ions that are entering the solution.

- 63** [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- It allows migration of ions.
  - maintains neutrality
  - prevents polarization
- 64** [1] Allow 1 credit for any *two* of the following responses:
- methyl orange
  - bromthymol blue
  - thymol blue
- 65** [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- Methane is nonpolar because its molecules are symmetrical.
  - Charges are evenly distributed throughout the molecule.
- 66** [1] Allow 1 credit for  $97^{\circ}\text{C} \pm 1^{\circ}\text{C}$ .

**Part C**

**Allow a total of 17 credits for this part. The student must answer all questions in this part.**

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

Group 18

noble gases

**68** [1] Allow 1 credit for 173.

**69** [1] Allow 1 credit for 118.

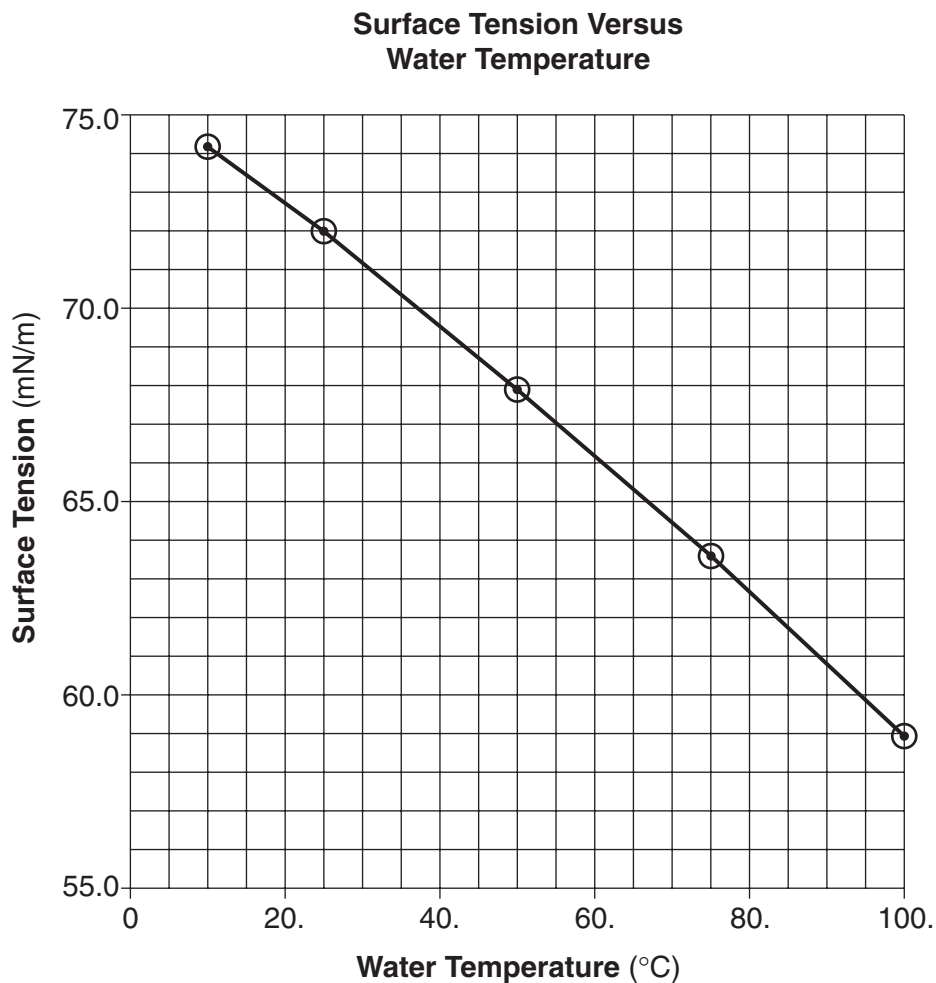
**70** [1] Allow 1 credit. Acceptable responses include, but are not limited to:

Reproducing results verifies that the results are valid.

reliability of results

- 71 [1] Allow 1 credit for correctly plotting all five points  $\pm 0.3$  grid space. Plotted points do *not* need to be circled or connected.

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



- 72 [1] Allow 1 credit for 66.1 mN/m  $\pm 0.3$  mN/m. Significant figures do *not* need to be shown.

*or*

Allow 1 credit for a response consistent with the student's graph in question 71.

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

Surface tension will decrease as temperature increases.

as temperature  $\uparrow$ , surface tension  $\downarrow$

**Note:** Do *not* allow credit for “inverse relationship.”

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

Tetrachloromethane,  $\text{CCl}_4$ , has weaker intermolecular forces than water,  $\text{H}_2\text{O}$ .

Surface tension of water at  $25^\circ\text{C}$  is greater than  $26.3 \text{ mN/m}$ , so the intermolecular forces of water are stronger.

The forces between water molecules are greater.

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

0.1250 L

0.125 L

$1.25 \times 10^{-1} \text{ L}$

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

$$V_2 = \frac{(1.0 \text{ atm})(125.0 \text{ mL})}{1.5 \text{ atm}}$$

$$(1.0)(125) = (1.5)(V_2)$$

*or*

Allow 1 credit for a response consistent with the student's answer to question 75.

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

Both samples have the same number of particles.

Equal volumes of gases at the same temperature and pressure contain the same number of particles.

- 78** [1] Allow 1 credit for hydrochloric acid.



- 79 [1] Allow 1 credit. Significant figures do *not* need to be shown. Acceptable responses include, but are not limited to:

0.833 M

$8.3 \times 10^{-1}$  M

- 80 [1] Allow 1 credit for 3 *or* three.

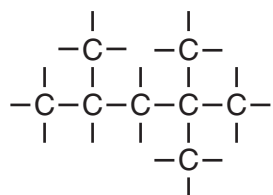
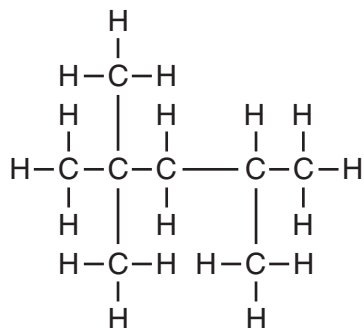
- 81 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

wearing gloves

no open-toed shoes

- 82 [1] Allow 1 credit.

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



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

The arrangement of molecules in the vapor state are more random or disordered.

Particles in the vapor state are farther apart and move more freely.

## Regents Examination in Physical Setting/Chemistry

January 2007

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

**The *Chart for Determining the Final Examination Score for the January 2007 Regents Examination in Physical Setting/Chemistry* will be posted on the Department's web site <http://www.emsc.nysed.gov/osa/> on Thursday, January 25, 2007. 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.**

### Submitting 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 [www.emsc.nysed.gov/osa/exameval](http://www.emsc.nysed.gov/osa/exameval).
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

<b>January 2007 Physical Setting/ Chemistry</b>			
<b>Question Numbers</b>			
Key Ideas	Part A	Part B	Part C
<b>Standard 1</b>			
Math Key Idea 1		35, 54	71, 75, 76, 80
Math Key Idea 2			72, 73
Math Key Idea 3		45, 51, 52, 54	
Sci. Inq. Key Idea 1		37, 62, 63, 65	77, 83
Sci. Inq. Key Idea 2			81
Sci. Inq. Key Idea 3		34, 38, 41, 47, 55, 56, 58, 62	70, 74, 78
Eng. Des. Key Idea 1			
<b>Standard 2</b>			
Key Idea 1			
Key Idea 2			
<b>Standard 6</b>			
Key Idea 1			
Key Idea 2		58	
Key Idea 3		48	75
Key Idea 4			
Key Idea 5		66	
<b>Standard 7</b>			
Key Idea 1			
Key Idea 2			
<b>Standard 4 Process Skills</b>			
Key Idea 3		31, 32, 33, 34, 35, 36, 39, 40, 41, 43, 44, 46, 47, 51, 52, 53, 55, 57, 59, 60, 61, 63, 64	67, 68, 69, 76, 79, 80, 82, 83
Key Idea 4		42, 49, 50, 58	
Key Idea 5		37, 56	
<b>Standard 4</b>			
Key Idea 3	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 13, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 30	31, 32, 33, 34, 35, 36, 38, 40, 41, 43, 44, 45, 46, 47, 48, 51, 52, 53, 54, 55, 57, 59, 60, 61, 62, 63, 64	67, 68, 69, 70, 75, 76, 77, 78, 79, 80, 81, 82, 83
Key Idea 4		39, 42, 49, 58	
Key Idea 5	9, 12, 14, 15, 16, 28, 29	37, 50, 56, 65, 66	71, 72, 73, 74
<b>Reference Tables</b>			
2002 Edition	2, 5, 6, 7, 8, 11, 12, 13, 17, 20, 22, 23, 24, 26, 30	32, 33, 34, 35, 37, 38, 39, 40, 42, 45, 46, 47, 49, 50, 52, 53, 54, 60, 62, 64, 65, 66	67, 68, 69, 75, 76, 78, 79, 80, 82



## Regents Examination in Physical Setting/Chemistry January 2007

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

Raw Score	Scaled Score	Raw Score	Scaled Score	Raw Score	Scaled Score	Raw Score	Scaled Score
85	100	63	76	41	61	19	41
84	98	62	75	40	60	18	40
83	97	61	74	39	60	17	39
82	95	60	74	38	59	16	37
81	94	59	73	37	58	15	36
80	92	58	72	36	58	14	34
79	91	57	72	35	57	13	32
78	90	56	71	34	56	12	31
77	89	55	70	33	55	11	29
76	88	54	70	32	55	10	27
75	86	53	69	31	54	9	25
74	85	52	68	30	53	8	23
73	84	51	68	29	52	7	20
72	83	50	67	28	51	6	18
71	82	49	66	27	50	5	15
70	82	48	66	26	49	4	13
69	81	47	65	25	48	3	10
68	80	46	64	24	47	2	7
67	79	45	64	23	46	1	4
66	78	44	63	22	45	0	0
65	77	43	62	21	44		
64	77	42	62	20	43		

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 scaled score that corresponds to that raw score. The scaled 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 scaled 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 scaled 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 Physical Setting/Chemistry Examination.