

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

**PHYSICAL SETTING  
CHEMISTRY**

Wednesday, June 20, 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*.

- According to the wave-mechanical model of the atom, electrons in an atom
  - travel in defined circles
  - are most likely found in an excited state
  - have a positive charge
  - are located in orbitals outside the nucleus
- What is the total charge of the nucleus of a carbon atom?
  - 6
  - 0
  - +6
  - +12
- A sample composed only of atoms having the same atomic number is classified as
  - a compound
  - a solution
  - an element
  - an isomer
- Which two particles each have a mass approximately equal to one atomic mass unit?
  - electron and neutron
  - electron and positron
  - proton and electron
  - proton and neutron
- Which two characteristics are associated with metals?
  - low first ionization energy and low electronegativity
  - low first ionization energy and high electronegativity
  - high first ionization energy and low electronegativity
  - high first ionization energy and high electronegativity
- Which element is most chemically similar to chlorine?
  - Ar
  - F
  - Fr
  - S
- Which substance can be decomposed by chemical means?
  - ammonia
  - oxygen
  - phosphorus
  - silicon
- When an atom loses one or more electrons, this atom becomes a
  - positive ion with a radius smaller than the radius of this atom
  - positive ion with a radius larger than the radius of this atom
  - negative ion with a radius smaller than the radius of this atom
  - negative ion with a radius larger than the radius of this atom
- What is the name of the polyatomic ion in the compound  $\text{Na}_2\text{O}_2$ ?
  - hydroxide
  - oxalate
  - oxide
  - peroxide
- Given the balanced equation:
$$\text{I} + \text{I} \rightarrow \text{I}_2$$
Which statement describes the process represented by this equation?
  - A bond is formed as energy is absorbed.
  - A bond is formed and energy is released.
  - A bond is broken as energy is absorbed.
  - A bond is broken and energy is released.

- 11 An oxygen molecule contains a double bond because the two atoms of oxygen share a total of
- (1) 1 electron                      (3) 3 electrons  
(2) 2 electrons                    (4) 4 electrons
- 12 Which term is defined as a measure of the average kinetic energy of the particles in a sample?
- (1) temperature                    (3) thermal energy  
(2) pressure                        (4) chemical energy
- 13 A 3.0 M HCl(aq) solution contains a total of
- (1) 3.0 grams of HCl per liter of water  
(2) 3.0 grams of HCl per mole of solution  
(3) 3.0 moles of HCl per liter of solution  
(4) 3.0 moles of HCl per mole of water
- 14 A dilute, aqueous potassium nitrate solution is best classified as a
- (1) homogeneous compound  
(2) homogeneous mixture  
(3) heterogeneous compound  
(4) heterogeneous mixture
- 15 Given the equation representing a phase change at equilibrium:
- $$\text{C}_2\text{H}_5\text{OH}(\ell) \rightleftharpoons \text{C}_2\text{H}_5\text{OH}(\text{g})$$
- Which statement is true?
- (1) The forward process proceeds faster than the reverse process.  
(2) The reverse process proceeds faster than the forward process.  
(3) The forward and reverse processes proceed at the same rate.  
(4) The forward and reverse processes both stop.
- 16 A 5.0-gram sample of zinc and a 50.-milliliter sample of hydrochloric acid are used in a chemical reaction. Which combination of these samples has the fastest reaction rate?
- (1) a zinc strip and 1.0 M HCl(aq)  
(2) a zinc strip and 3.0 M HCl(aq)  
(3) zinc powder and 1.0 M HCl(aq)  
(4) zinc powder and 3.0 M HCl(aq)

- 17 For a given reaction, adding a catalyst increases the rate of the reaction by
- (1) providing an alternate reaction pathway that has a higher activation energy  
(2) providing an alternate reaction pathway that has a lower activation energy  
(3) using the same reaction pathway and increasing the activation energy  
(4) using the same reaction pathway and decreasing the activation energy
- 18 Which reaction releases the greatest amount of energy per 2 moles of product?
- (1)  $2\text{CO}(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g})$   
(2)  $4\text{Al}(\text{s}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{Al}_2\text{O}_3(\text{s})$   
(3)  $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{g})$   
(4)  $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$
- 19 What is the total number of carbon atoms in a molecule of ethanoic acid?
- (1) 1                                      (3) 3  
(2) 2                                      (4) 4
- 20 Given the formulas for two compounds:
- $$\begin{array}{ccccccc} & \text{H} & \text{H} & & \text{H} & \text{H} & \\ & | & | & & | & | & \\ \text{H} & - \text{C} & - \text{C} & - \text{O} & - \text{C} & - \text{C} & - \text{H} \\ & | & | & & | & | & \\ & \text{H} & \text{H} & & \text{H} & \text{H} & \end{array}$$
- and*
- $$\begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & \text{H} & & \\ & | & | & | & | & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{OH} & \\ & | & | & | & | & & \\ & \text{H} & \text{H} & \text{H} & \text{H} & & \end{array}$$
- These compounds differ in
- (1) gram-formula mass  
(2) molecular formula  
(3) percent composition by mass  
(4) physical properties at STP
- 21 A double carbon-carbon bond is found in a molecule of
- (1) pentane                              (3) pentyne  
(2) pentene                              (4) pentanol

- 22 Which changes occur when  $\text{Pt}^{2+}$  is reduced?
- (1) The  $\text{Pt}^{2+}$  gains electrons and its oxidation number increases.
  - (2) The  $\text{Pt}^{2+}$  gains electrons and its oxidation number decreases.
  - (3) The  $\text{Pt}^{2+}$  loses electrons and its oxidation number increases.
  - (4) The  $\text{Pt}^{2+}$  loses electrons and its oxidation number decreases.
- 23 Which balanced equation represents an oxidation-reduction reaction?
- (1)  $\text{BaCl}_2 + \text{Na}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{NaCl}$
  - (2)  $\text{C} + \text{H}_2\text{O} \rightarrow \text{CO} + \text{H}_2$
  - (3)  $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$
  - (4)  $\text{Mg}(\text{OH})_2 + 2\text{HNO}_3 \rightarrow \text{Mg}(\text{NO}_3)_2 + 2\text{H}_2\text{O}$
- 24 Which energy conversion occurs during the operation of a voltaic cell?
- (1) Chemical energy is spontaneously converted to electrical energy.
  - (2) Chemical energy is converted to electrical energy only when an external power source is provided.
  - (3) Electrical energy is spontaneously converted to chemical energy.
  - (4) Electrical energy is converted to chemical energy only when an external power source is provided.
- 25 An Arrhenius base yields which ion as the only negative ion in an aqueous solution?
- (1) hydride ion
  - (2) hydrogen ion
  - (3) hydronium ion
  - (4) hydroxide ion
- 26 According to one acid-base theory, a water molecule acts as an acid when the water molecule
- (1) accepts an  $\text{H}^+$
  - (2) accepts an  $\text{OH}^-$
  - (3) donates an  $\text{H}^+$
  - (4) donates an  $\text{OH}^-$
- 27 Which list of radioisotopes contains an alpha emitter, a beta emitter, and a positron emitter?
- (1) C-14, N-16, P-32
  - (2) Cs-137, Fr-220, Tc-99
  - (3) Kr-85, Ne-19, Rn-222
  - (4) Pu-239, Th-232, U-238
- 28 Which nuclear decay emission consists of energy, only?
- (1) alpha particle
  - (2) beta particle
  - (3) gamma radiation
  - (4) positron
- 29 Which balanced equation represents nuclear fusion?
- (1)  ${}_0^1\text{n} + {}_{92}^{235}\text{U} \rightarrow {}_{56}^{142}\text{Ba} + {}_{36}^{91}\text{Kr} + 3{}_0^1\text{n}$
  - (2)  ${}_{88}^{226}\text{Ra} \rightarrow {}_{86}^{222}\text{Rn} + {}_2^4\text{He}$
  - (3)  ${}_3^6\text{Li} + {}_0^1\text{n} \rightarrow {}_1^3\text{H} + {}_2^4\text{He}$
  - (4)  ${}_1^2\text{H} + {}_1^3\text{H} \rightarrow {}_2^4\text{He} + {}_0^1\text{n}$
- 30 The energy released by a nuclear reaction results primarily from the
- (1) breaking of bonds between atoms
  - (2) formation of bonds between atoms
  - (3) conversion of mass into energy
  - (4) conversion of energy into mass

Part B-1

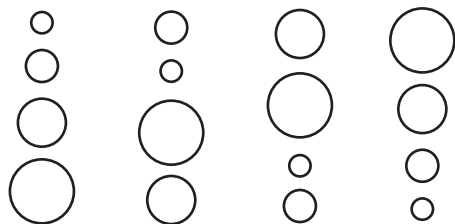
Answer all questions in this part.

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 Which electron configuration could represent a strontium atom in an excited state?

- (1) 2–8–18–7–1                      (3) 2–8–18–8–1  
 (2) 2–8–18–7–3                      (4) 2–8–18–8–2

32 Which grouping of circles, when considered in order from the top to the bottom, best represents the relative size of the atoms of Li, Na, K, and Rb, respectively?



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

33 What is the total number of neutrons in an atom of  $^{57}_{26}\text{Fe}$ ?

- (1) 26                                      (3) 57  
 (2) 31                                      (4) 83

34 At STP, which element is brittle and *not* a conductor of electricity?

- (1) S    (3) Na  
 (2) K    (4) Ar

35 What is the total number of electrons in a  $\text{Mg}^{2+}$  ion?

- (1) 10    (3) 14  
 (2) 12    (4) 24

36 Which formula represents lead(II) chromate?

- (1)  $\text{PbCrO}_4$                                   (3)  $\text{Pb}_2\text{CrO}_4$   
 (2)  $\text{Pb}(\text{CrO}_4)_2$                               (4)  $\text{Pb}_2(\text{CrO}_4)_3$

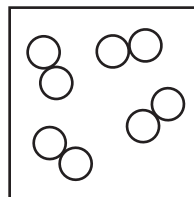
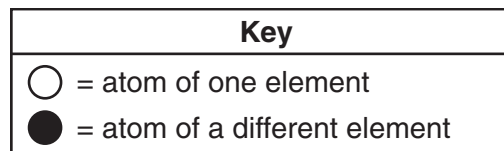
37 Compared to an electron in the first electron shell of an atom, an electron in the third shell of the same atom has

- (1) less mass                                  (3) more mass  
 (2) less energy                                (4) more energy

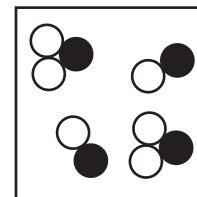
38 Which pair consists of a molecular formula and its corresponding empirical formula?

- (1)  $\text{C}_2\text{H}_2$  and  $\text{CH}_3\text{CH}_3$                   (3)  $\text{P}_4\text{O}_{10}$  and  $\text{P}_2\text{O}_5$   
 (2)  $\text{C}_6\text{H}_6$  and  $\text{C}_2\text{H}_2$                       (4)  $\text{SO}_2$  and  $\text{SO}_3$

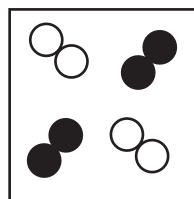
39 Which particle diagram represents a sample of one compound, only?



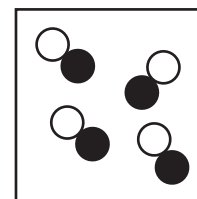
(1)



(3)



(2)



(4)

- 40 An atom in the ground state contains a total of 5 electrons, 5 protons, and 5 neutrons. Which Lewis electron-dot diagram represents this atom?



(1)      (2)      (3)      (4)

- 41 At STP, fluorine is a gas and bromine is a liquid because, compared to fluorine, bromine has

- (1) stronger covalent bonds  
 (2) stronger intermolecular forces  
 (3) weaker covalent bonds  
 (4) weaker intermolecular forces

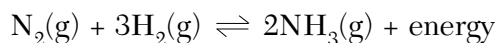
- 42 The boiling point of a liquid is the temperature at which the vapor pressure of the liquid is equal to the pressure on the surface of the liquid. What is the boiling point of propanone if the pressure on its surface is 48 kilopascals?

- (1) 25°C                      (3) 35°C  
 (2) 30°C                      (4) 40°C

- 43 At which Celsius temperature does lead change from a solid to a liquid?

- (1) 874°C                      (3) 328°C  
 (2) 601°C                      (4) 0°C

- 44 Given the equation representing a reaction at equilibrium:



Which change causes the equilibrium to shift to the right?

- (1) decreasing the concentration of  $\text{H}_2(\text{g})$   
 (2) decreasing the pressure  
 (3) increasing the concentration of  $\text{N}_2(\text{g})$   
 (4) increasing the temperature

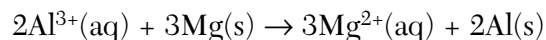
- 45 Which compound is an unsaturated hydrocarbon?

- (1) hexanal                      (3) hexanoic acid  
 (2) hexane                      (4) hexyne

- 46 The organic compound represented by the condensed structural formula  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$  is classified as an

- (1) alcohol                      (3) ester  
 (2) aldehyde                      (4) ether

- 47 Given the balanced ionic equation representing a reaction:



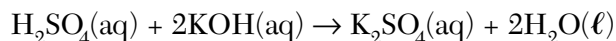
In this reaction, electrons are transferred from

- (1) Al to  $\text{Mg}^{2+}$                       (3) Mg to  $\text{Al}^{3+}$   
 (2)  $\text{Al}^{3+}$  to Mg                      (4)  $\text{Mg}^{2+}$  to Al

- 48 Which two formulas represent Arrhenius acids?

- (1)  $\text{CH}_3\text{COOH}$  and  $\text{CH}_3\text{CH}_2\text{OH}$   
 (2)  $\text{HC}_2\text{H}_3\text{O}_2$  and  $\text{H}_3\text{PO}_4$   
 (3)  $\text{KHCO}_3$  and  $\text{KHSO}_4$   
 (4)  $\text{NaSCN}$  and  $\text{Na}_2\text{S}_2\text{O}_3$

- 49 Information related to a titration experiment is given in the balanced equation and table below.



#### Titration Experiment Results

volume of $\text{H}_2\text{SO}_4(\text{aq})$ used	12.0 mL
concentration of $\text{H}_2\text{SO}_4(\text{aq})$	?
volume of $\text{KOH}(\text{aq})$ used	36.0 mL
concentration of $\text{KOH}(\text{aq})$	0.16 M

Based on the equation and the titration results, what is the concentration of the  $\text{H}_2\text{SO}_4(\text{aq})$ ?

- (1) 0.12 M                      (3) 0.24 M  
 (2) 0.16 M                      (4) 0.96 M

- 50 Which radioisotope is used in medicine to treat thyroid disorders?

- (1) cobalt-60                      (3) phosphorus-32  
 (2) iodine-131                      (4) uranium-238

**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*.

Base your answers to questions 51 through 53 on the information below.

A gas sample is held at constant temperature in a closed system. The volume of the gas is changed, which causes the pressure of the gas to change. Volume and pressure data are shown in the table below.

**Volume and Pressure of a Gas Sample**

Volume (mL)	Pressure (atm)
1200	0.5
600	1.0
300	2.0
150	4.0
100	6.0

51 On the grid *in your answer booklet*, mark an appropriate scale on the axis labeled “Volume (mL).” [1]

52 On the same grid, plot the data from the table. Circle and connect the points. [1]



53 Based on your graph, what is the pressure of the gas when the volume of the gas is 200. milliliters? [1]

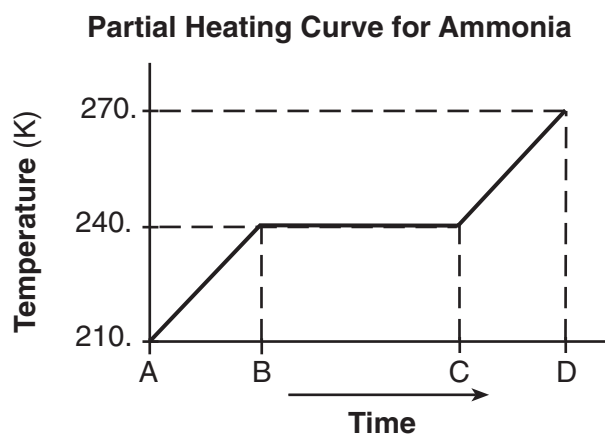
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54 Explain, in terms of collision theory, why the rate of a chemical reaction increases with an increase in temperature. [1]

55 Determine the percent composition by mass of oxygen in the compound  $C_6H_{12}O_6$ . [1]

Base your answers to questions 56 through 58 on the information below.

A 5.00-gram sample of liquid ammonia is originally at 210. K. The diagram of the partial heating curve below represents the vaporization of the sample of ammonia at standard pressure due to the addition of heat. The heat is *not* added at a constant rate.



Some physical constants for ammonia are shown in the data table below.

**Some Physical Constants for Ammonia**

specific heat capacity of $\text{NH}_3(\ell)$	4.71 J/g•K
heat of fusion	332 J/g
heat of vaporization	1370 J/g

- 56 In the space *in your answer booklet*, calculate the total heat absorbed by the 5.00-gram sample of ammonia during time interval *AB*. Your response must include *both* a correct numerical setup and the calculated result. [2]
- 57 Describe what is happening to *both* the potential energy and the average kinetic energy of the molecules in the ammonia sample during time interval *BC*. Your response must include *both* potential energy and average kinetic energy. [1]
- 58 Determine the total amount of heat required to vaporize this 5.00-gram sample of ammonia at its boiling point. [1]
-



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

The unbalanced equation below represents the decomposition of potassium chlorate.



- 59 Balance the equation *in your answer booklet*, using the smallest whole-number coefficients. [1]
- 60 Determine the oxidation number of chlorine in the reactant. [1]
- 
- 61 Complete the nuclear equation *in your answer booklet*. Include the symbol, atomic number, and mass number for the missing particle. [1]
- 62 Explain, in terms of electronegativity, why a P–Cl bond in a molecule of  $\text{PCl}_5$  is more polar than a P–S bond in a molecule of  $\text{P}_2\text{S}_5$ . [1]
- 63 A 1.00-mole sample of neon gas occupies a volume of 24.4 liters at 298 K and 101.3 kilopascals. In the space *in your answer booklet*, calculate the density of this sample. Your response must include *both* a correct numerical setup and the calculated result. [2]
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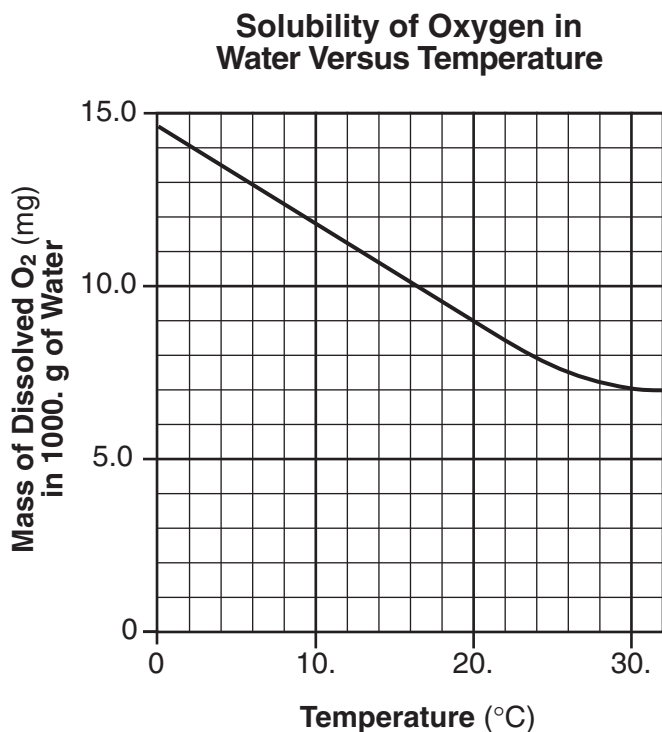
## Part C

### Answer all questions in this part.

*Directions (64–82):* 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.

Scientists who study aquatic ecosystems are often interested in the concentration of dissolved oxygen in water. Oxygen,  $O_2$ , has a very low solubility in water, and therefore its solubility is usually expressed in units of milligrams per 1000. grams of water at 1.0 atmosphere. The graph below shows a solubility curve of oxygen in water.



- 64 A student determines that 8.2 milligrams of oxygen is dissolved in a 1000.-gram sample of water at 15°C and 1.0 atmosphere. In terms of saturation, what type of solution is this sample? [1]
- 65 Explain, in terms of molecular polarity, why oxygen gas has low solubility in water. Your response must include *both* oxygen and water. [1]
- 66 An aqueous solution has 0.0070 gram of oxygen dissolved in 1000. grams of water. In the space *in your answer booklet*, calculate the dissolved oxygen concentration of this solution in parts per million. Your response must include *both* a correct numerical setup and the calculated result. [2]
-

Base your answers to questions 67 and 68 on the information below.

Sulfur dioxide,  $\text{SO}_2$ , is one gas produced when fossil fuels are burned. When this gas reacts with water in the atmosphere, an acid is produced forming acid rain. The pH of the water in a lake changes when acid rain collects in the lake.

Two samples of the same rainwater are tested using two indicators. Methyl orange is yellow in one sample of this rainwater. Litmus is red in the other sample of this rainwater.

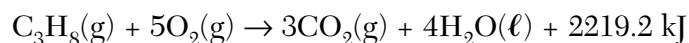
67 Identify a possible pH value for the rainwater that was tested. [1]

68 Write the formula for *one* substance that can neutralize the lake water affected by acid rain. [1]

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Base your answers to questions 69 through 72 on the information below.

Propane is a fuel that is sold in rigid, pressurized cylinders. Most of the propane in a cylinder is liquid, with gas in the space above the liquid level. When propane is released from the cylinder, the propane leaves the cylinder as a gas. Propane gas is used as a fuel by mixing it with oxygen in the air and igniting the mixture, as represented by the balanced equation below.



A small amount of methanethiol, which has a distinct odor, is added to the propane to help consumers detect a propane leak. In methanethiol, the odor is caused by the thiol functional group ( $-\text{SH}$ ). Methanethiol,  $\text{CH}_3\text{SH}$ , has a structure that is very similar to the structure of methanol.

69 In the box *in your answer booklet*, draw a particle diagram to represent propane in a pressurized cylinder using the key in your answer booklet. Your response must include *at least six* molecules of propane in the gas phase and *at least six* molecules of propane in the liquid phase. [1]

70 On the diagram *in your answer booklet*, draw a potential energy diagram for this reaction. [1]

71 Determine the total amount of energy released when 2.50 moles of propane is completely reacted with oxygen. [1]

72 In the space *in your answer booklet*, draw a structural formula for a molecule of methanethiol. [1]

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Base your answers to questions 73 through 76 on the information below.

The table below lists physical and chemical properties of six elements at standard pressure that correspond to known elements on the Periodic Table. The elements are identified by the code letters, *D*, *E*, *G*, *J*, *L*, and *Q*.

**Properties of Six Elements at Standard Pressure**

<u>Element D</u> Density 0.00018 g/cm <sup>3</sup> Melting point -272°C Boiling point -269°C Oxide formula (none)	<u>Element E</u> Density 1.82 g/cm <sup>3</sup> Melting point 44°C Boiling point 280°C Oxide formula E <sub>2</sub> O <sub>5</sub>	<u>Element G</u> Density 0.53 g/cm <sup>3</sup> Melting point 181°C Boiling point 1347°C Oxide formula G <sub>2</sub> O
<u>Element J</u> Density 0.0013 g/cm <sup>3</sup> Melting point -210°C Boiling point -196°C Oxide formula J <sub>2</sub> O <sub>5</sub>	<u>Element L</u> Density 0.86 g/cm <sup>3</sup> Melting point 64°C Boiling point 774°C Oxide formula L <sub>2</sub> O	<u>Element Q</u> Density 0.97 g/cm <sup>3</sup> Melting point 98°C Boiling point 883°C Oxide formula Q <sub>2</sub> O

- 73 What is the total number of elements in the “Properties of Six Elements at Standard Pressure” table that are solids at STP? [1]
- 74 An atom of element *G* is in the ground state. What is the total number of valence electrons in this atom? [1]
- 75 Letter *Z* corresponds to an element on the Periodic Table other than the six listed elements. Elements *G*, *Q*, *L*, and *Z* are in the same group on the Periodic Table, as shown in the diagram below.

G
Q
L
Z

Based on the trend in the melting points for elements *G*, *Q*, and *L* listed in the “Properties of Six Elements at Standard Pressure” table, estimate the melting point of element *Z*, in degrees Celsius. [1]

- 76 Identify, by code letter, the element that is a noble gas in the “Properties of Six Elements at Standard Pressure” table. [1]
-

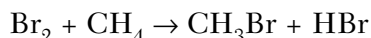
Base your answers to questions 77 through 79 on the information below.

Ozone gas,  $O_3$ , can be used to kill adult insects in storage bins for grain without damaging the grain. The ozone is produced from oxygen gas,  $O_2$ , in portable ozone generators located near the storage bins. The concentrations of ozone used are so low that they do not cause any environmental damage. This use of ozone is safer and more environmentally friendly than a method that used bromomethane,  $CH_3Br$ . However, bromomethane was more effective than ozone because  $CH_3Br$  killed immature insects as well as adult insects.

Adapted From: *The Sunday Gazette* (Schenectady, NY) 3/9/03

77 Determine the total number of moles of  $CH_3Br$  in 19 grams of  $CH_3Br$  (gram-formula mass = 95 grams/mol). [1]

78 Given the balanced equation for producing bromomethane:



Identify the type of organic reaction shown. [1]

79 Based on the information in the passage, state *one* advantage of using ozone instead of bromomethane for insect control in grain storage bins. [1]

---

Base your answers to questions 80 through 82 on the information below.

In living organisms, the ratio of the naturally occurring isotopes of carbon, C-12 to C-13 to C-14, is fairly consistent. When an organism such as a woolly mammoth died, it stopped taking in carbon, and the amount of C-14 present in the mammoth began to decrease. For example, one fossil of a woolly mammoth is found to have  $\frac{1}{32}$  of the amount of C-14 found in a living organism.

80 Identify the type of nuclear reaction that caused the amount of C-14 in the woolly mammoth to *decrease* after the organism died. [1]

81 Determine the total time that has elapsed since this woolly mammoth died. [1]

82 State, in terms of subatomic particles, how an atom of C-13 is different from an atom of C-12. [1]

---

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The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING CHEMISTRY

Wednesday, June 20, 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

Wednesday, June 20, 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	15	
C	20	
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**

51-52

**Pressure Versus Volume  
 of a Gas Sample**

53 \_\_\_\_\_ atm

**For Raters Only**

51

52

53

For Raters  
Only

54 \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

54

55 \_\_\_\_\_ %

55

56

56

\_\_\_\_\_ J

57 \_\_\_\_\_  
\_\_\_\_\_

57

58 \_\_\_\_\_ J

58

59 \_\_\_\_\_  $\text{KClO}_3(\text{s}) \rightarrow$  \_\_\_\_\_  $\text{KCl}(\text{s}) +$  \_\_\_\_\_  $\text{O}_2(\text{g})$

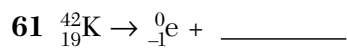
59

60 \_\_\_\_\_

60



**For Raters  
Only**



61

62 \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

62

63 \_\_\_\_\_ g/L

63

**Total Score  
for Part B-2**

**Part C**

**For Raters  
Only**

64 \_\_\_\_\_

64

65 \_\_\_\_\_

\_\_\_\_\_

65

\_\_\_\_\_

66

66

\_\_\_\_\_ ppm

67 \_\_\_\_\_

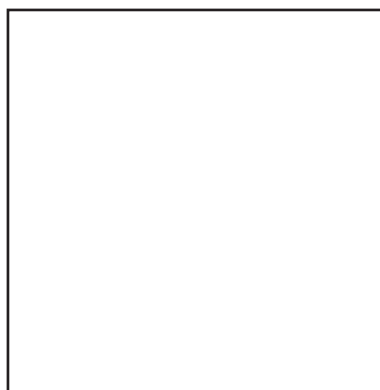
67

68 \_\_\_\_\_

68

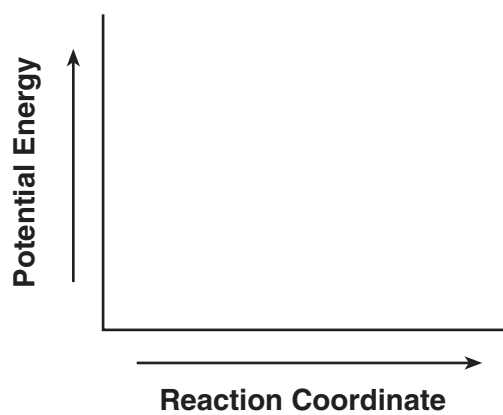
69

Key
○ = propane molecule



69

70



70

71 \_\_\_\_\_ kJ

71

72

72

**For Raters  
Only**

73 \_\_\_\_\_

73

74 \_\_\_\_\_

74

75 \_\_\_\_\_ °C

75

76 \_\_\_\_\_

76

77 \_\_\_\_\_ mol

77

78 \_\_\_\_\_

78

79 \_\_\_\_\_

79

\_\_\_\_\_

80 \_\_\_\_\_

80

81 \_\_\_\_\_ y

81

82 \_\_\_\_\_

82

\_\_\_\_\_

**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

Wednesday, June 20, 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>4</b> . . . . .	11 . . . . . <b>4</b> . . . . .	21 . . . . . <b>2</b> . . . . .	31 . . . . . <b>2</b> . . . . .	41 . . . . . <b>2</b> . . . . .
2 . . . . . <b>3</b> . . . . .	12 . . . . . <b>1</b> . . . . .	22 . . . . . <b>2</b> . . . . .	32 . . . . . <b>1</b> . . . . .	42 . . . . . <b>3</b> . . . . .
3 . . . . . <b>3</b> . . . . .	13 . . . . . <b>3</b> . . . . .	23 . . . . . <b>2</b> . . . . .	33 . . . . . <b>2</b> . . . . .	43 . . . . . <b>3</b> . . . . .
4 . . . . . <b>4</b> . . . . .	14 . . . . . <b>2</b> . . . . .	24 . . . . . <b>1</b> . . . . .	34 . . . . . <b>1</b> . . . . .	44 . . . . . <b>3</b> . . . . .
5 . . . . . <b>1</b> . . . . .	15 . . . . . <b>3</b> . . . . .	25 . . . . . <b>4</b> . . . . .	35 . . . . . <b>1</b> . . . . .	45 . . . . . <b>4</b> . . . . .
6 . . . . . <b>2</b> . . . . .	16 . . . . . <b>4</b> . . . . .	26 . . . . . <b>3</b> . . . . .	36 . . . . . <b>1</b> . . . . .	46 . . . . . <b>2</b> . . . . .
7 . . . . . <b>1</b> . . . . .	17 . . . . . <b>2</b> . . . . .	27 . . . . . <b>3</b> . . . . .	37 . . . . . <b>4</b> . . . . .	47 . . . . . <b>3</b> . . . . .
8 . . . . . <b>1</b> . . . . .	18 . . . . . <b>2</b> . . . . .	28 . . . . . <b>3</b> . . . . .	38 . . . . . <b>3</b> . . . . .	48 . . . . . <b>2</b> . . . . .
9 . . . . . <b>4</b> . . . . .	19 . . . . . <b>2</b> . . . . .	29 . . . . . <b>4</b> . . . . .	39 . . . . . <b>4</b> . . . . .	49 . . . . . <b>3</b> . . . . .
10 . . . . . <b>2</b> . . . . .	20 . . . . . <b>4</b> . . . . .	30 . . . . . <b>3</b> . . . . .	40 . . . . . <b>3</b> . . . . .	50 . . . . . <b>2</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 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 scaled score by using the conversion chart that will be posted on the Department's web site <http://www.emsc.nysed.gov/osa/> on Wednesday, June 20, 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.

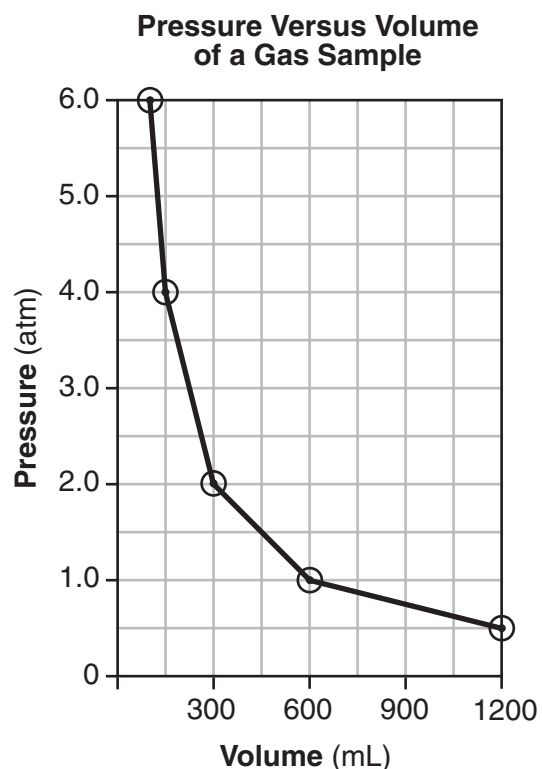
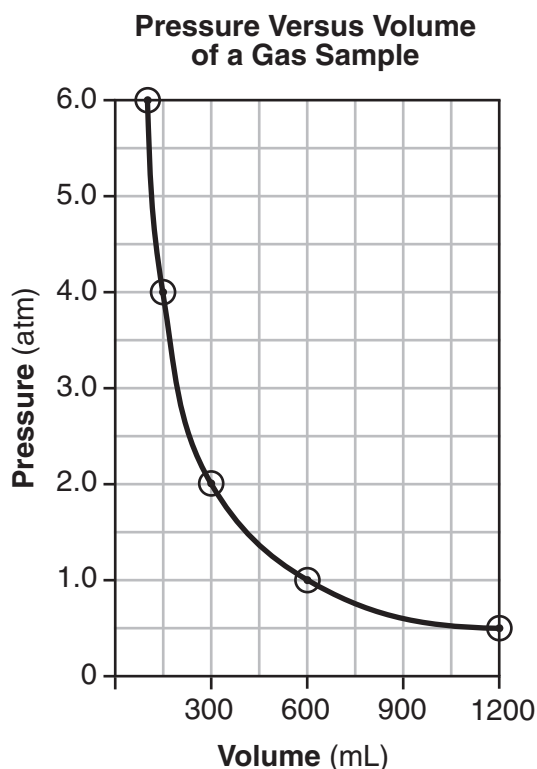
Because scaled scores corresponding to raw scores in the conversion chart may change from one examination to another, it is crucial that for each administration, the conversion chart provided for that administration be used to determine the student's final score.

**Part B–2**

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

- 51** [1] Allow 1 credit for marking an appropriate scale on the axis labeled “Volume (mL).” An appropriate scale is linear and allows a trend to be seen.
- 52** [1] Allow 1 credit for all five points plotted correctly  $\pm 0.3$  grid space. Plotted points do *not* need to be circled or connected.

**Examples of 2-credit responses to questions 51 and 52:**



- 53** [1] Allow 1 credit for 3.0 atm *or* for a response consistent with the student’s graph  $\pm 0.3$  grid space. Significant figures do *not* need to be shown.
- 54** [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- As temperature increases, the rate of a chemical reaction increases because the reactant particles move faster and collide more often.
  - More reactant molecules have sufficient activation energy.
  - The number of effective collisions per unit time increases.

- 55 [1] Allow 1 credit for 53.3%. Significant figures do *not* need to be shown.
- 56 [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:  
$$q = mC\Delta T = (5.00 \text{ g})(4.71 \text{ J/g}\cdot\text{K})(30. \text{ K})$$
$$(5)(4.71)(30)$$
  - Allow 1 credit for 710 J *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.
- 57 [1] Allow 1 credit. *Both* potential energy and kinetic energy must be included in the student's response to receive credit. Acceptable responses include, but are not limited to:
- The potential energy of the ammonia molecules increases and the average kinetic energy of the ammonia molecules remains the same.
- PE increases and KE is constant.
- 58 [1] Allow 1 credit for 6850 J. Significant figures do *not* need to be shown.
- 59 [1] Allow 1 credit for  $\underline{2} \text{ KClO}_3(\text{s}) \rightarrow \underline{2} \text{ KCl}(\text{s}) + \underline{3} \text{ O}_2(\text{g})$ .
- 60 [1] Allow 1 credit for +5.



61 [1] Allow 1 credit for  ${}_{20}^{42}\text{Ca}$ .

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

A P–Cl bond is more polar than a P–S bond because the electronegativity difference for P–Cl is 1.0 and the electronegativity difference for P–S is 0.4.

Cl has a higher electronegativity value than S.

A chlorine atom has a greater attraction for electrons in a bond than a sulfur atom.

63 [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:

$$d = \frac{m}{V} = \frac{20.179 \text{ g}}{24.4 \text{ L}}$$

$$\frac{20}{24.4}$$

- Allow 1 credit for 0.827 g/L *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.

**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:

The sample is an unsaturated solution.

unsaturated

- 65** [1] Allow 1 credit. *Both* oxygen and water must be included in the student's response to receive credit. Acceptable responses include, but are not limited to:

Oxygen molecules are nonpolar and water molecules are polar.

Because H<sub>2</sub>O and O<sub>2</sub> have different polarities, O<sub>2</sub> has low solubility in H<sub>2</sub>O.

oxygen nonpolar, water polar

- 66** [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:

$$\text{ppm} = \frac{0.0070 \text{ gram O}_2}{(1000. \text{ grams of water} + 0.0070 \text{ gram of O}_2)} \times 1\,000\,000$$

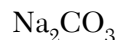
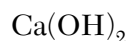
$$(0.0070 / 1000.0070) \times 1\,000\,000$$

- Allow 1 credit for 7.0 ppm *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.

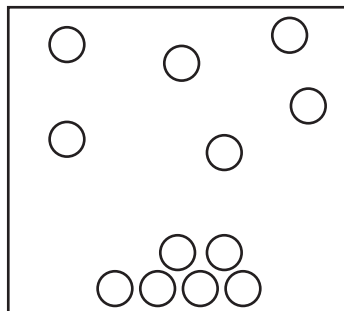
- 67** [1] Allow 1 credit for a pH value that is greater than or equal to 4.4, but is less than or equal to 5.5.

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



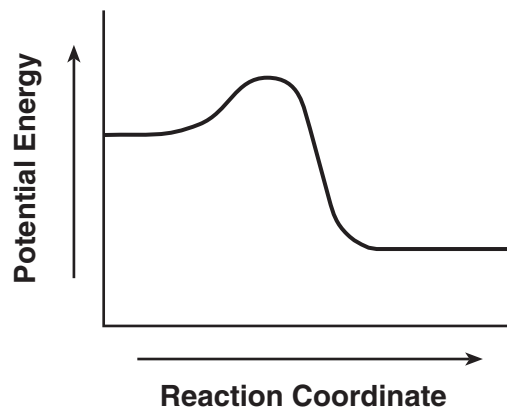
- 69 [1] Allow 1 credit. Molecules of the gas must be drawn farther apart than molecules of the liquid.

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



- 70 [1] Allow 1 credit.

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



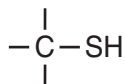
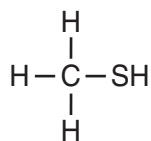
- 71 [1] Allow 1 credit. Significant figures do *not* need to be shown. Acceptable responses include, but are not limited to:

5550 kJ

$5.5 \times 10^3$  kJ

72 [1] Allow 1 credit.

**Examples of 1-credit responses:**



73 [1] Allow 1 credit for 4 *or* four.

74 [1] Allow 1 credit for 1 *or* one.

75 [1] Allow 1 credit for a temperature value below 64°C.

76 [1] Allow 1 credit for *D* *or* He.

77 [1] Allow 1 credit for 0.20 mol. Significant figures do *not* need to be shown.

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

substitution

bromination

halogenation

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

Ozone is better to use because it is safer than bromomethane.

O<sub>3</sub> is more environmentally friendly.

- 80** [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- natural transmutation
  - transmutation
  - beta decay
  - radioactive decay
- 81** [1] Allow 1 credit for 28 650 y. Significant figures do *not* need to be shown.
- 82** [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- A C-13 atom has seven neutrons and a C-12 atom has six neutrons.
  - An atom of C-13 and an atom of C-12 have different numbers of neutrons.
  - The number of neutrons is different.

## Regents Examination in Physical Setting/Chemistry

June 2007

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

**The *Chart for Determining the Final Examination Score for the June 2007 Regents Examination in Physical Setting/Chemistry* will be posted on the Department's web site <http://www.emsc.nysed.gov/osa/> on Wednesday, June 20, 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>June 2007 Physical Setting/Chemistry</b>			
<b>Question Numbers</b>			
Key Ideas/Performance Indicators	Part A	Part B	Part C
<b>Standard 1</b>			
Math Key Idea 1		42, 43, 51, 52, 56, 63	66, 77
Math Key Idea 2		53	64, 74, 75
Math Key Idea 3		55, 58, 60, 62, 63	66, 71, 77, 81
Science Inquiry Key Idea 1		37, 62	68
Science Inquiry Key Idea 2			
Science Inquiry Key Idea 3		36, 48, 49, 60	67, 73, 76
Engineering Design Key Idea 1			
<b>Standard 2</b>			
Key Idea 1			
Key Idea 2			
<b>Standard 6</b>			
Key Idea 1			72
Key Idea 2			69
Key Idea 3			
Key Idea 4		44	
Key Idea 5			
<b>Standard 7</b>			
Key Idea 1			79
Key Idea 2			
<b>Standard 4 Process Skills</b>			
Key Idea 3		31, 32, 33, 34, 35, 38, 39, 40, 43, 44, 45, 46, 47, 48, 49, 54, 59	64, 66, 67, 68, 69, 72, 73, 74, 75, 76, 77, 78, 80, 82
Key Idea 4		50, 56, 57, 58, 61	70, 81
Key Idea 5		41	65
<b>Standard 4</b>			
Key Idea 3	1, 2, 3, 4, 5, 6, 7, 13, 14, 15, 16, 17, 19, 20, 22, 23, 24, 25, 26, 28	31, 32, 33, 34, 36, 37, 38, 39, 42, 43, 44, 45, 46, 47, 48, 49, 51, 52, 53, 54, 55, 59, 60, 63	64, 66, 67, 68, 69, 72, 73, 74, 75, 76, 77, 78, 82
Key Idea 4	12, 18, 27, 29	50, 57, 58, 61	70, 71, 80, 81
Key Idea 5	8, 9, 10, 11, 21, 30	35, 40, 41, 62	65, 79
<b>Reference Tables</b>			
2002 Edition	2, 5, 6, 9, 13, 18, 19, 21, 27	31, 34, 36, 40, 42, 43, 45, 46, 47, 48, 49, 55, 56, 58, 60, 61, 62, 63	66, 67, 68, 71, 72, 73, 74, 75, 76, 77, 81, 82



## Regents Examination in Physical Setting / Chemistry June 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	75	41	60	19	41
84	98	62	74	40	60	18	40
83	96	61	73	39	59	17	38
82	95	60	73	38	58	16	37
81	93	59	72	37	58	15	35
80	92	58	71	36	57	14	34
79	90	57	71	35	56	13	32
78	89	56	70	34	56	12	30
77	88	55	69	33	55	11	28
76	87	54	69	32	54	10	26
75	86	53	68	31	53	9	24
74	85	52	67	30	52	8	22
73	83	51	67	29	52	7	20
72	82	50	66	28	51	6	17
71	81	49	66	27	50	5	15
70	80	48	65	26	49	4	12
69	80	47	64	25	48	3	9
68	79	46	64	24	47	2	7
67	78	45	63	23	46	1	4
66	77	44	62	22	45	0	0
65	76	43	62	21	43		
64	75	42	61	20	42		

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.