

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

PHYSICAL SETTING CHEMISTRY

Wednesday, January 29, 2003 — 9:15 a.m. to 12:15 p.m., only

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.

Your answer booklet for Part B–2 and Part C is stapled in the center of this examination booklet. Open the examination booklet, carefully remove your answer booklet, and close the examination booklet. Then fill in the heading 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 your use while taking this examination.

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

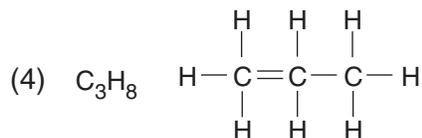
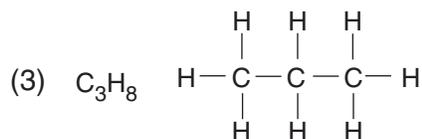
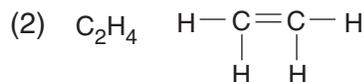
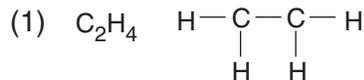
Part A

Answer all questions in this part.

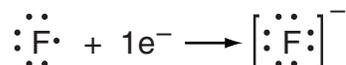
Directions (1–30): For *each* statement or question, write on the separate answer sheet the *number* of the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the *Reference Tables for Physical Setting/Chemistry*.

- Which statement best describes electrons?
 - They are positive subatomic particles and are found in the nucleus.
 - They are positive subatomic particles and are found surrounding the nucleus.
 - They are negative subatomic particles and are found in the nucleus.
 - They are negative subatomic particles and are found surrounding the nucleus.
- During a flame test, ions of a specific metal are heated in the flame of a gas burner. A characteristic color of light is emitted by these ions in the flame when the electrons
 - gain energy as they return to lower energy levels
 - gain energy as they move to higher energy levels
 - emit energy as they return to lower energy levels
 - emit energy as they move to higher energy levels
- In which list are the elements arranged in order of increasing atomic mass?
 - Cl, K, Ar (3) Te, I, Xe
 - Fe, Co, Ni (4) Ne, F, Na
- In which compound does chlorine have the highest oxidation number?
 - NaClO (3) NaClO₃
 - NaClO₂ (4) NaClO₄
- Which event must *always* occur for a chemical reaction to take place?
 - formation of a precipitate
 - formation of a gas
 - effective collisions between reacting particles
 - addition of a catalyst to the reaction system
- Which Group of the Periodic Table contains atoms with a stable outer electron configuration?
 - 1 (3) 16
 - 8 (4) 18
- From which of these atoms in the ground state can a valence electron be removed using the *least* amount of energy?
 - nitrogen (3) oxygen
 - carbon (4) chlorine
- What is the percent by mass of oxygen in H₂SO₄? [formula mass = 98]
 - 16% (3) 65%
 - 33% (4) 98%
- An atom of carbon-12 and an atom of carbon-14 differ in
 - atomic number
 - mass number
 - nuclear charge
 - number of electrons
- The strength of an atom's attraction for the electrons in a chemical bond is the atom's
 - electronegativity (3) heat of reaction
 - ionization energy (4) heat of formation
- Which type or types of change, if any, can reach equilibrium?
 - a chemical change, only
 - a physical change, only
 - both a chemical and a physical change
 - neither a chemical nor a physical change
- An increase in the average kinetic energy of a sample of copper atoms occurs with an increase in
 - concentration (3) pressure
 - temperature (4) volume

13 The empirical formula of a compound is CH_2 . Which molecular formula is correctly paired with a structural formula for this compound?



14 Given the equation:



This equation represents the formation of a

- (1) fluoride ion, which is smaller in radius than a fluorine atom
- (2) fluoride ion, which is larger in radius than a fluorine atom
- (3) fluorine atom, which is smaller in radius than a fluoride ion
- (4) fluorine atom, which is larger is radius than a fluoride ion

15 The high electrical conductivity of metals is primarily due to

- (1) high ionization energies
- (2) filled energy levels
- (3) mobile electrons
- (4) high electronegativities

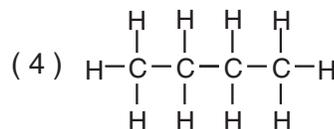
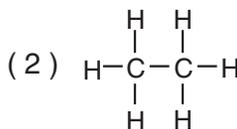
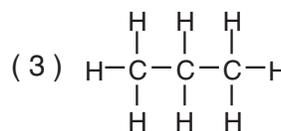
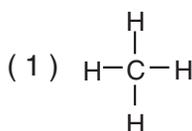
16 One similarity between all mixtures and compounds is that both

- (1) are heterogeneous
- (2) are homogeneous
- (3) combine in a definite ratio
- (4) consist of two or more substances

17 Which phase change results in the release of energy?

- (1) $\text{H}_2\text{O}(s) \rightarrow \text{H}_2\text{O}(\ell)$
- (2) $\text{H}_2\text{O}(s) \rightarrow \text{H}_2\text{O}(g)$
- (3) $\text{H}_2\text{O}(\ell) \rightarrow \text{H}_2\text{O}(g)$
- (4) $\text{H}_2\text{O}(g) \rightarrow \text{H}_2\text{O}(\ell)$

18 Which compound has an isomer?



19 What occurs when $\text{NaCl}(s)$ is added to water?

- (1) The boiling point of the solution increases, and the freezing point of the solution decreases.
- (2) The boiling point of the solution increases, and the freezing point of the solution increases.
- (3) The boiling point of the solution decreases, and the freezing point of the solution decreases.
- (4) The boiling point of the solution decreases, and the freezing point of the solution increases.

20 Which radioisotope is a beta emitter?

- (1) ^{90}Sr
- (2) ^{220}Fr
- (3) ^{37}K
- (4) ^{238}U

21 When a mixture of water, sand, and salt is filtered, what passes through the filter paper?

- (1) water, only
- (2) water and sand, only
- (3) water and salt, only
- (4) water, sand, and salt

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 According to Table N, which radioactive isotope is best for determining the actual age of Earth?

- (1) ^{238}U (3) ^{60}Co
(2) ^{90}Sr (4) ^{14}C

32 Given the following solutions:

Solution A: pH of 10

Solution B: pH of 7

Solution C: pH of 5

Which list has the solutions placed in order of increasing H^+ concentration?

- (1) A, B, C (3) C, A, B
(2) B, A, C (4) C, B, A

33 Which statement explains why nuclear waste materials may pose a problem?

- (1) They frequently have short half-lives and remain radioactive for brief periods of time.
(2) They frequently have short half-lives and remain radioactive for extended periods of time.
(3) They frequently have long half-lives and remain radioactive for brief periods of time.
(4) They frequently have long half-lives and remain radioactive for extended periods of time.

34 A compound whose water solution conducts electricity and turns phenolphthalein pink is

- (1) HCl (3) NaOH
(2) $\text{HC}_2\text{H}_3\text{O}_2$ (4) CH_3OH

35 Which of the following solids has the highest melting point?

- (1) $\text{H}_2\text{O}(s)$ (3) $\text{SO}_2(s)$
(2) $\text{Na}_2\text{O}(s)$ (4) $\text{CO}_2(s)$

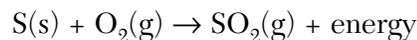
36 Hydrogen has three isotopes with mass numbers of 1, 2, and 3 and has an average atomic mass of 1.00794 amu. This information indicates that

- (1) equal numbers of each isotope are present
(2) more isotopes have an atomic mass of 2 or 3 than of 1
(3) more isotopes have an atomic mass of 1 than of 2 or 3
(4) isotopes have only an atomic mass of 1

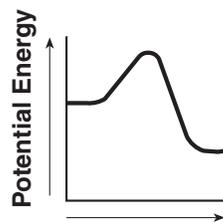
37 Which list of elements contains two metalloids?

- (1) Si, Ge, Po, Pb (3) Si, P, S, Cl
(2) As, Bi, Br, Kr (4) Po, Sb, I, Xe

38 Given the reaction:

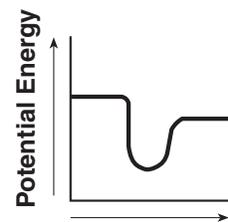


Which diagram best represents the potential energy changes for this reaction?



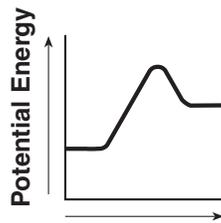
Reaction Coordinate

(1)



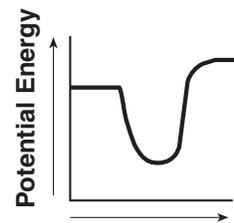
Reaction Coordinate

(3)



Reaction Coordinate

(2)



Reaction Coordinate

(4)

- 39 A chemist performs the same tests on two homogeneous white crystalline solids, A and B. The results are shown in the table below.

	Solid A	Solid B
Melting Point	High, 801°C	Low, decomposes at 186°C
Solubility in H ₂ O (grams per 100.0 g H ₂ O at 0°C)	35.7	3.2
Electrical Conductivity (in aqueous solution)	Good conductor	Nonconductor

The results of these tests suggest that

- (1) both solids contain only ionic bonds
- (2) both solids contain only covalent bonds
- (3) solid A contains only covalent bonds and solid B contains only ionic bonds
- (4) solid A contains only ionic bonds and solid B contains only covalent bonds

- 40 Solubility data for four different salts in water at 60°C are shown in the table below.

Salt	Solubility in Water at 60°C
A	10 grams / 50 grams H ₂ O
B	20 grams / 60 grams H ₂ O
C	30 grams / 120 grams H ₂ O
D	40 grams / 80 grams H ₂ O

Which salt is most soluble at 60°C?

- (1) A
 - (2) B
 - (3) C
 - (4) D
- 41 Which phase change represents a *decrease* in entropy?
- (1) solid to liquid
 - (2) gas to liquid
 - (3) liquid to gas
 - (4) solid to gas
- 42 Given the equation:
- $$2 \text{C}_2\text{H}_2(\text{g}) + 5 \text{O}_2(\text{g}) \rightarrow 4 \text{CO}_2(\text{g}) + 2 \text{H}_2\text{O}(\text{g})$$
- How many moles of oxygen are required to react completely with 1.0 mole of C₂H₂?
- (1) 2.5
 - (2) 2.0
 - (3) 5.0
 - (4) 10

- 43 A student intended to make a salt solution with a concentration of 10.0 grams of solute per liter of solution. When the student's solution was analyzed, it was found to contain 8.90 grams of solute per liter of solution. What was the percent error in the concentration of the solution?

- (1) 1.10%
- (2) 8.90%
- (3) 11.0%
- (4) 18.9%

- 44 What is the molarity of a solution of NaOH if 2 liters of the solution contains 4 moles of NaOH?

- (1) 0.5 M
- (2) 2 M
- (3) 8 M
- (4) 80 M

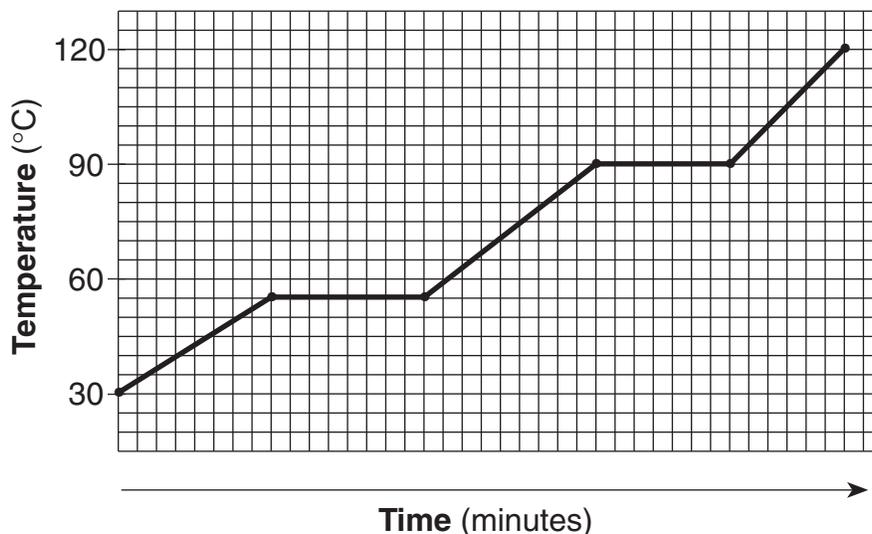
- 45 A gas occupies a volume of 40.0 milliliters at 20°C. If the volume is increased to 80.0 milliliters at constant pressure, the resulting temperature will be equal to

- (1) $20^\circ\text{C} \times \frac{80.0 \text{ mL}}{40.0 \text{ mL}}$
- (2) $20^\circ\text{C} \times \frac{40.0 \text{ mL}}{80.0 \text{ mL}}$
- (3) $293 \text{ K} \times \frac{80.0 \text{ mL}}{40.0 \text{ mL}}$
- (4) $293 \text{ K} \times \frac{40.0 \text{ mL}}{80.0 \text{ mL}}$

- 46 According to Reference Table J, which of these metals will react most readily with 1.0 M HCl to produce H₂(g)?

- (1) Ca
- (2) K
- (3) Mg
- (4) Zn

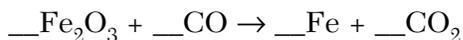
47 The graph below represents the heating curve of a substance that starts as a solid below its freezing point.



What is the melting point of this substance?

- (1) 30°C (3) 90°C
 (2) 55°C (4) 120°C

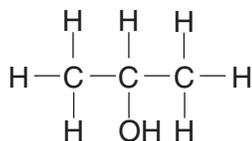
48 Given the unbalanced equation:



When the equation is correctly balanced using the *smallest* whole-number coefficients, what is the coefficient of CO?

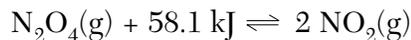
- (1) 1 (3) 3
 (2) 2 (4) 4

49 Which type of organic compound is represented by the structural formula shown below?



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

50 Given the system at equilibrium:



What will be the result of an increase in temperature at constant pressure?

- (1) The equilibrium will shift to the left, and the concentration of NO₂(g) will decrease.
 (2) The equilibrium will shift to the left, and the concentration of NO₂(g) will increase.
 (3) The equilibrium will shift to the right, and the concentration of NO₂(g) will decrease.
 (4) The equilibrium will shift to the right, and the concentration of NO₂(g) will increase.

Part B–2

Answer all questions in this part.

Directions (51–61): Record your answers in the spaces provided in your answer booklet. Some questions may require the use of the *Reference Tables for Physical Setting/Chemistry*.

51 In the boxes provided *in your answer booklet*:

a Draw *two* different compounds, one in each box, using the representations for atoms of element X and element Z given below. [1]

Atom of element X = ○

Atom of element Z = ●

b Draw a mixture of these two compounds. [1]

52 At equilibrium, nitrogen, hydrogen, and ammonia gases form a mixture in a sealed container. The data table below gives some characteristics of these substances.

Data Table

Gas	Boiling Point	Melting Point	Solubility in Water
Nitrogen	-196°C	-210°C	insoluble
Hydrogen	-252°C	-259°C	insoluble
Ammonia	-33°C	-78°C	soluble

Describe how to separate ammonia from hydrogen and nitrogen. [1]

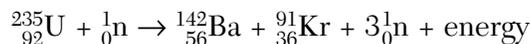
Base your answers to questions 53 through 55 on the diagram of a voltaic cell provided *in your answer booklet* and on your knowledge of chemistry.

53 On the diagram provided *in your answer booklet*, indicate with one or more arrows the direction of electron flow through the wire. [1]

54 Write an equation for the half-reaction that occurs at the zinc electrode. [1]

55 Explain the function of the salt bridge. [1]

56 Given the nuclear equation:



a State the type of nuclear reaction represented by the equation. [1]

b The sum of the masses of the products is slightly less than the sum of the masses of the reactants. Explain this loss of mass. [1]

c This process releases greater energy than an ordinary chemical reaction does. Name another type of nuclear reaction that releases greater energy than an ordinary chemical reaction. [1]

Base your answers to questions 57 through 60 on the information below.

Each molecule listed below is formed by sharing electrons between atoms when the atoms within the molecule are bonded together.

Molecule A: Cl_2

Molecule B: CCl_4

Molecule C: NH_3

57 In the box provided *in your answer booklet*, draw the electron-dot (Lewis) structure for the NH_3 molecule. [1]

58 Explain why CCl_4 is classified as a nonpolar molecule. [1]

59 Explain why NH_3 has stronger intermolecular forces of attraction than Cl_2 . [1]

60 Explain how the bonding in KCl is different from the bonding in molecules A, B, and C. [1]

61 How is the bonding between carbon atoms different in unsaturated hydrocarbons and saturated hydrocarbons? [1]

Part C

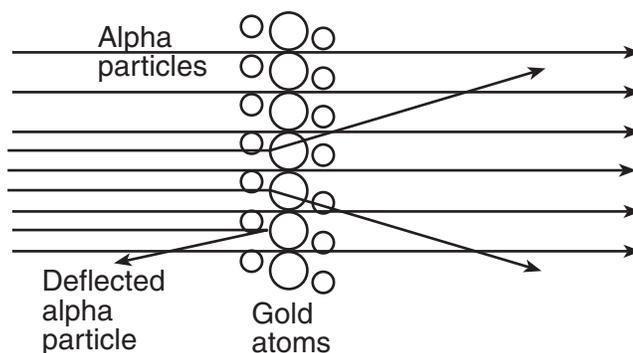
Answer all questions in this part.

Directions (62–74): 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 62 through 64 on the information and diagram below.

One model of the atom states that atoms are tiny particles composed of a uniform mixture of positive and negative charges. Scientists conducted an experiment where alpha particles were aimed at a thin layer of gold atoms.

Most of the alpha particles passed directly through the gold atoms. A few alpha particles were deflected from their straight-line paths. An illustration of the experiment is shown below.



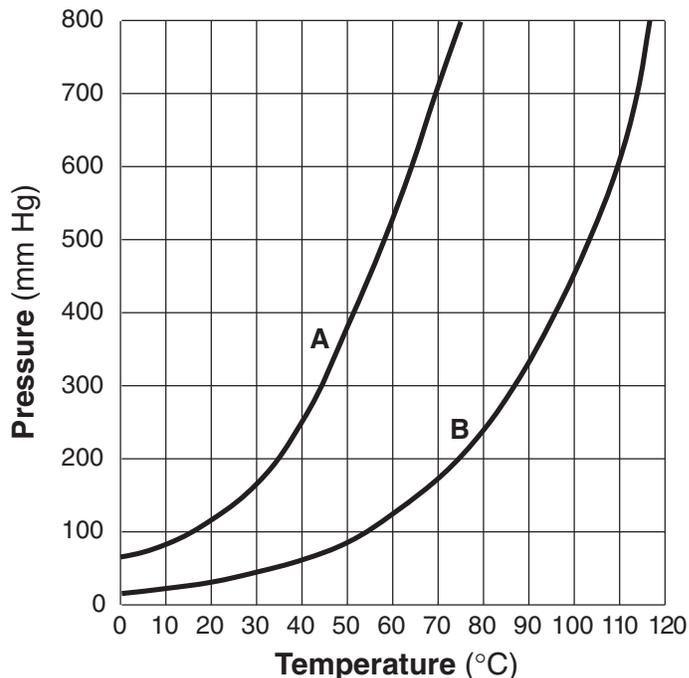
- 62 Most of the alpha particles passed directly through the gold atoms undisturbed. What does this evidence suggest about the structure of the gold atoms? [1]
- 63 A few of the alpha particles were deflected. What does this evidence suggest about the structure of the gold atoms? [1]
- 64 How should the original model be revised based on the results of this experiment? [1]
-

Base your answers to questions 65 through 67 on the information below.

When cola, a type of soda pop, is manufactured, $\text{CO}_2(\text{g})$ is dissolved in it.

- 65 A capped bottle of cola contains $\text{CO}_2(\text{g})$ under high pressure. When the cap is removed, how does pressure affect the solubility of the dissolved $\text{CO}_2(\text{g})$? [1]
- 66 A glass of cold cola is left to stand 5 minutes at room temperature. How does temperature affect the solubility of the $\text{CO}_2(\text{g})$? [1]
- 67 *a* In the space provided in your answer booklet, draw a set of axes and label one of them "Solubility" and the other "Temperature." [1]
- b* Draw a line to indicate the solubility of $\text{CO}_2(\text{g})$ versus temperature on the axes drawn in part *a*. [1]
-

Base your answers to questions 68 through 70 on the graph below, which shows the vapor pressure curves for liquids A and B.



- 68 What is the vapor pressure of liquid A at 70°C ? Your answer must include correct units. [2]
- 69 At what temperature does liquid B have the same vapor pressure as liquid A at 70°C ? Your answer must include correct units. [2]
- 70 Which liquid will evaporate more rapidly? Explain your answer in terms of intermolecular forces. [2]
-

Base your answers to question 71 through 74 on the information and data table below.

A titration setup was used to determine the unknown molar concentration of a solution of NaOH. A 1.2 M HCl solution was used as the titration standard. The following data were collected.

	Trial 1	Trial 2	Trial 3	Trial 4
Amount of HCl Standard Used	10.0 mL	10.0 mL	10.0 mL	10.0 mL
Initial NaOH Buret Reading	0.0 mL	12.2 mL	23.2 mL	35.2 mL
Final NaOH Buret Reading	12.2 mL	23.2 mL	35.2 mL	47.7 mL

- 71 Calculate the volume of NaOH solution used to neutralize 10.0 mL of the standard HCl solution in trial 3. Show your work. [2]
- 72 According to Reference Table *M*, what indicator would be most appropriate in determining the end point of this titration? Give one reason for choosing this indicator. [2]
- 73 Calculate the average molarity of the unknown NaOH solution for all four trials. Your answer must include the correct number of significant figures and correct units. [3]
- 74 Explain why it is better to use the average data from multiple trials rather than the data from a single trial to calculate the results of the titration. [1]
-

Tear Here

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING CHEMISTRY

Wednesday, January 29, 2003 — 9:15 a.m. to 12:15 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

Tear Here

Tear Here

PHYSICAL SETTING CHEMISTRY

Wednesday, January 29, 2003 — 9:15 a.m. to 12:15 p.m., only

ANSWER BOOKLET

Male

Student Sex: Female

Teacher

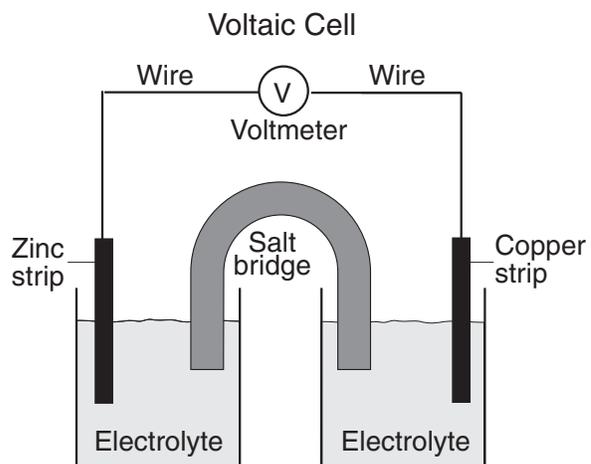
School Grade

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	14	
C	21	
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 a	<input type="text"/> <input type="text"/>	51a <input type="text"/>
b	<input type="text"/>	b <input type="text"/>
52	_____ _____	52 <input type="text"/>

53



53

54 _____

54

55 _____

55

56 *a* _____

56*a*

b _____

b

c _____

c

57



57

58 _____

58

**For Raters
Only**

59 _____

60 _____

61 _____

59

60

61

**Total Score
for Part B-2**

Part C

62 _____

63 _____

64 _____

65 _____

66 _____

62

63

64

65

66

**For Raters
Only**

67 a and b

67a

b

68 _____

68

69 _____

69

70 Liquid: _____

Explanation: _____

70

71

_____ **mL**

71

72 Indicator: _____

Reason: _____

72

73

73

74 _____

74