Information Bulletin

Chemistry 30

2011 – 2012 Diploma Examinations Program

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This document was written primarily for:

Students	✓
Teachers	✓ of Chemistry 30
Administrators	✓
Parents	
General Audience	
Others	

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Contents

Please note that if you cannot access one of the direct website links referred to in this document, you can find Diploma Examination-related materials on the Alberta Education website at education.alberta.ca.

Course Objectives

Chemistry 30 is intended to develop students' understanding of the interconnecting ideas and chemistry principles that transcend and unify the natural-science disciplines and their relationship to the technology that students use in their daily lives. It is of utmost importance to remember that Chemistry 30 is an experimental discipline that develops the knowledge, skills, and attitudes to help students become capable of and committed to setting career and/or life goals, make informed choices, and act in ways that will improve the level of scientific awareness essential for a scientifically literate society. Laboratory experience is an essential component of the Chemistry 30 course.

Students of Chemistry 30 are expected to develop an aptitude for collecting data, observing, analyzing, forming generalizations, hypothesizing, and making inferences from observations. The course is designed to promote students' understanding of chemistry concepts, and their ability both to apply these concepts to relevant situations and to communicate in the specialized language of chemistry.

Success in Chemistry 30 requires the successful completion of Science 10, Chemistry 20, and concurrent mathematics courses that develop the requisite knowledge and skills.

Performance Expectations

Curriculum Standards

Provincial curriculum standards help to communicate how well students need to perform to be judged as having achieved the objectives specified in the *Chemistry 20–30 Program of Studies*, 2007. The specific statements of standards are written primarily to inform Chemistry 30 teachers as to what extent students must know the Chemistry 30 content and demonstrate the required skills to pass the examination.

Acceptable Standard

Students who meet the *acceptable standard* in Chemistry 30 will receive a final course mark of 50% to 79%. These students demonstrate a basic understanding of the nature of scientific investigation by designing, observing, performing, and interpreting simple laboratory tests. They can readily interpret data that are presented in simple graphs, tables, and diagrams, and can translate symbolic representations into word descriptions. They are able to recognize and provide definitions for key chemical terms, and can predict the physical and chemical properties of compounds. They are able to balance simple equations (combustion, formation, neutralization, or oxidation–reduction) and can solve standard, single-step, stoichiometric problems based upon these equations. Following laboratory procedures does not present a problem for these students, nor does using the data booklet to extract relevant information. These students compose clear and logical descriptive or explanatory statements to answer closed-response questions that involve individual chemistry concepts.

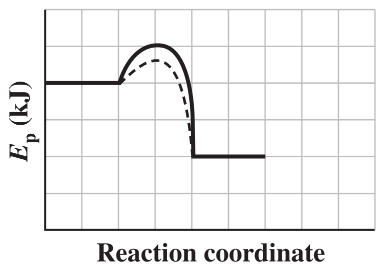
Examples of Acceptable-Standard Questions

Use the following information to answer the next question.

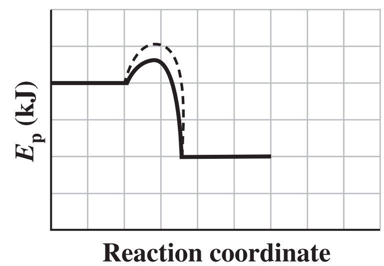
Dr. Richard Trotter has developed what could be the first cost-effective process for limiting methane emissions from underground coal mines. In this process, methane and oxygen are reacted at 800 °C in the presence of a catalyst. The products of this process are carbon dioxide gas and liquid water.

1. Which of the following potential energy diagrams represents both the catalyzed (**----**) and uncatalyzed reactions (**—**) for this process?

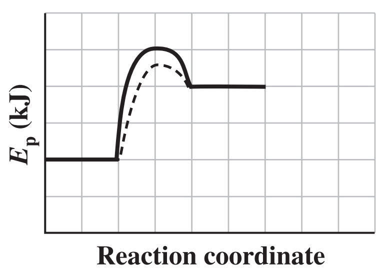
A.



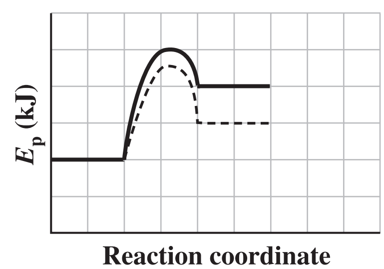
B.



C.



D.



------- Catalyzed ——— Uncatalyzed

Use the following information to answer the next question.

To determine the concentration of a $Sn^{2+}(aq)$ solution, a student titrated a 50.00 mL sample of acidified $Sn^{2+}(aq)$ with 1.44 mmol/L $KMnO_4(aq)$. The titration required 24.83 mL of $KMnO_4(aq)$ in order to reach a pale pink endpoint.

2. The balanced net ionic equation for this titration reaction is

A. $2\,MnO_4^-(aq) + 16\,H^+(aq) + 5\,Sn^{2+}(aq) \rightarrow 2\,Mn^{2+}(aq) + 8\,H_2O(l) + 5\,Sn^{4+}(aq)$

B. $2\,MnO_4^-(aq) + 16\,H^+(aq) + 5\,Sn^{2+}(aq) \rightarrow 2\,Mn^{2+}(aq) + 8\,H_2O(l) + 5\,Sn(s)$

C. $MnO_4^-(aq) + 8\,H^+(aq) + Sn^{2+}(aq) \rightarrow Mn^{2+}(aq) + 4\,H_2O(l) + Sn^{4+}(aq)$

D. $MnO_4^-(aq) + 8\,H^+(aq) + Sn^{2+}(aq) \rightarrow Mn^{2+}(aq) + 4\,H_2O(l) + Sn(s)$

Standard of Excellence

Students who achieve the *standard of excellence* in Chemistry 30 will receive a final course mark of 80% or higher. In addition to meeting the expectations for the *acceptable standard* of performance, these students demonstrate an interest in chemistry and can articulate chemistry concepts well. They can readily interpret interrelated sets of data such as complex graphs, tables, and diagrams. When presenting scientific data, they select the most appropriate and concise format. These students can analyze and evaluate experimental designs. They generate their own laboratory procedures when given a clearly defined problem, recognize weaknesses in laboratory work, and find ways to correct the weaknesses. They are able to formulate their own equations for formation, combustion, neutralization, redox, and equilibrium reaction expressions, and can solve many variations of stoichiometric problems based upon these equations. They transfer what they observe in a laboratory setting into equation form and express scientific ideas clearly. They solve problems that involve the overlapping of two or more concepts. The most significant characteristic of this group is that they solve problems of a new and unique nature, and extrapolate these solutions to higher levels of understanding. Open-ended questions do not pose problems for them. These students communicate clearly and concisely, using appropriate scientific vocabulary and conventions.

Examples of Standard of Excellence Questions

Use the following information to answer the next question.

Four Reaction Equations	**Key**			
$In(s) + La^{3+}(aq) \rightarrow$ no reaction	**1**	In(s)	**5**	$In^{3+}(aq)$
$Np(s) + La^{3+}(aq) \rightarrow Np^{3+}(aq) + La(s)$	**2**	Np(s)	**6**	$Np^{3+}(aq)$
$Np(s) + Nd^{3+}(aq) \rightarrow Np^{3+}(aq) + Nd(s)$	**3**	Nd(s)	**7**	$Nd^{3+}(aq)$
$La(s) + Nd^{3+}(aq) \rightarrow$ no reaction	**4**	La(s)	**8**	$La^{3+}(aq)$

Numerical Response

1. Arranged in order from **strongest** to **weakest**, the oxidizing agents above are _____, _____, _____, and _____.

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

Use the following information to answer the next question.

$$CO_2(g) + H_2(g) \rightarrow CO(g) + H_2O(g) \qquad K_c = 0.137$$

2. If the temperature of the system at equilibrium is increased, then the concentration of the carbon dioxide and the value of K_c will

A. decrease and stay the same, respectively

B. increase and stay the same, respectively

C. increase and decrease, respectively

D. decrease and increase, respectively

Use the following information to answer the next question.

Sulfur dioxide gas reacts with oxygen to form sulfur trioxide gas, as represented by the following equilibrium equation. $$2\,SO_2(g) + O_2(g) \rightleftharpoons 2\,SO_3(g)$$

Numerical Response

3. In order to obtain the equilibrium system above, 2.60 mol of $SO_2(g)$ and 2.30 mol of $O_2(g)$ are injected into a 1.00 L container. When the system reaches equilibrium, the concentration of the remaining $SO_2(g)$ is 1.32 mol/L. The concentration of $O_2(g)$ at equilibrium is __________ .

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

Examination Specifications and Design

Each Chemistry 30 Diploma Examination is designed to reflect the core content outlined in the *Chemistry 30 Program of Studies*, 2007. The examination is limited to those expectations that can be measured by a machine-scored paper-and-pencil test. Therefore, the percentage weightings shown below will not necessarily match the percentage of class time devoted to each unit.

The content of the Chemistry 30 Diploma Examinations is emphasized as follows.

General Outcomes (GOs)

Unit A (GO 1 and 2)	Thermochemical Changes
Unit B (GO 1 and 2)	Electrochemical Changes
Unit C (GO 1 and 2)	Chemical Changes of Organic Compounds
Unit D (GO 1 and 2)	Chemical Equilibrium Focusing on Acid-Base Systems

Scientific Process and Communication Skills

Students will

- formulate questions about observed relationships and plan investigations of questions, ideas, problems, and issues
- conduct investigations into relationships among observable variables and use a broad range of tools and techniques to gather and record data and information
- analyze data and apply mathematical and conceptual models to develop and assess possible solutions
- work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results

Science, Technology, and Society Connections (STS)

Students will

- explain that technological problems often require multiple solutions that involve different designs, materials, and processes, and that have both intended and unintended consequences
- explain that scientific knowledge may lead to the development of new technologies and new technologies may lead to or facilitate scientific discovery
- explain that the goal of technology is to provide solutions to practical problems
- explain that scientific knowledge and theories develop through hypotheses, the collection of evidence, investigation, and the ability to provide explanations
- explain that the goal of science is knowledge about the natural world
- explain that the products of technology are devices, systems, and processes that meet given needs; however, these products cannot solve all problems
- explain that the appropriateness, risks, and benefits of technologies need to be assessed for each potential application from a variety of perspectives, including sustainability
- describe science and technology applications that have developed in response to human and environmental needs
- explain that science and technology have influenced, and have been influenced by, historical development and societal needs
- explain how science and technology are developed to meet societal needs and expand human capability
- explain how science and technology have both intended and unintended consequences for humans and the environment
- explain that technological development may involve the creation of prototypes, the testing of prototypes, and the application of knowledge from related scientific and interdisciplinary fields

Examination Specifications

Question Format	*Number of Questions*	*Percentage Emphasis*
Multiple Choice	44	73%
Numerical Response	16	27%

Emphasis

The approximate emphasis of each unit in the examination is given below.

Machine-Scored Content	*Range of Percentage Emphasis*
Thermochemical Changes	20%–22%
Electrochemical Changes	29%–32%
Chemical Changes of Organic Compounds	18%–20%
Chemical Equilibrium Focusing on Acid-Base Systems	29%–32%

This change in emphasis is designed to reflect the percentage emphasis on chemical changes of organic compounds stated in the program of studies. On previous examinations, there were insufficient numbers of field-tested questions to be able to include this 18%–20% emphasis on these general outcomes.

NEW

Format Changes

The formatting of content in some examination booklets has changed slightly. The instructions pages now begin on the inside front cover, and the side, top, and bottom page margins are narrower than before. **The changes are not a misprint.** As a result of these changes, the total amount of paper used each year in printing the examinations will decrease by several tonnes.

The format changes do not apply to all diploma examination booklets. French-language booklets, Part A booklets, and Readings booklets still use the old format. Also, the size of the print is unchanged.

Assessment of Skills and STS Connections

Chemistry 30 examination questions are intended to measure students' understanding of chemistry concepts. It is important to remember that some questions will measure students' understanding and use of skills associated with scientific inquiry, and some questions have been designed to measure students' understanding of the connections between science and technology, and between science, technology, and society. As a result, many questions measure how well students can apply the skills and knowledge they have acquired in science to everyday life.

Teachers may find it helpful to use the following acronym when interpreting the program of studies document and planning instruction.

A – attitudes (for learning and inquiry in chemistry, skills, and knowledge)
S – skills
K – knowledge

Specific skills and STS concepts that can be tested are identified within the program of studies in regular typeface.

Teachers and individuals in industries, businesses, and post-secondary institutions have been helpful both in providing real-life contexts for STS questions, and in making connections between real life and the program of studies. The development of test items, from the writing stage until they appear on an examination, may take a number of years.

Machine-Scored Questions

Each examination contains both multiple-choice and numerical-response questions.

Some examination questions are organized into sets that relate to broad contexts; therefore, a set of questions may assess students' ability to integrate several GOs. Some questions will measure achievement of knowledge and/or skills; some will also measure achievement of scientific process and communication skills outcomes and/or STS outcomes.

Answers for multiple-choice questions are recorded in the first section of the machine-scored answer sheet, and answers for numerical-response questions are recorded in the second section on the same side of the same machine-scored answer sheet.

Multiple-choice questions are of two types: discrete and context dependent. A discrete question stands on its own without any additional directions or information. It may take the form of a question or an incomplete statement. A context-dependent question provides information separate from the question stem. Many of the multiple-choice questions are context dependent. A particular context may be used for more than one multiple-choice question as well as for one or more numerical-response questions.

Numerical-response questions are of three types: calculation of numerical values, selection of numbered events or structures from a list or diagram, and determination of the sequence of listed events. Students should remember that in some numerical-response questions, a number may be used more than once in an answer and there may be more than one correct answer. Please refer to the question below as an example of changes to existing NR item types.

Use the following information to answer the next question.

Reduction Half-Reaction

$$Am^{4+}(aq) + e^- \rightarrow Am^{3+}(aq) \qquad E° = +2.60\ V$$

$$Tl^{3+}(aq) + 2\,e^- \rightarrow Tl^{+}(aq) \qquad E° = +1.25\ V$$

$$Ac^{3+}(aq) + 3\,e^- \rightleftharpoons Ac(s) \qquad E° = -2.20\ V$$

$$Cs^{+}(aq) + e^- \rightleftharpoons Cs(s) \qquad E° = -3.03\ V$$

Species

1	$Am^{4+}(aq)$	**5**	$Am^{3+}(aq)$
2	$Tl^{3+}(aq)$	**6**	$Tl^{+}(aq)$
3	$Ac^{3+}(aq)$	**7**	$Ac(s)$
4	$Cs^{+}(aq)$	**8**	$Cs(s)$

Numerical Response

1. Match the species numbered above with the descriptors given below. You may use a number more than once.

Strongest oxidizing agent ____________ (Record in the **first** column)

Weakest reducing agent ____________ (Record in the **second** column)

Species with the greatest attraction to electrons ____________ (Record in the **third** column)

Species that loses three electrons ____________ (Record in the **fourth** column)

(Record your answer in the numerical-response section on the answer sheet.)

Answer: 1517

Use the following information to answer the next question.

Chemicals

1	$O_2(g)$	**4**	$H_2O(l)$
2	$CO(g)$	**5**	$H_2O(g)$
3	$CO_2(g)$	**6**	$C_6H_{12}O_6(aq)$

Numerical Response

1. Match the chemicals numbered above with the statements given below. You may use a number more than once.

The reactants of photosynthesis are: ________ and ________ .
Record in the **first** column — Record in the **second** column

The products of complete hydrocarbon combustion in an open system are: ________ and ________ .
Record in the **third** column — Record in the **fourth** column

(Record your answer in the numerical-response section on the answer sheet.)

Acceptable Answers: **3435**
4335
3453
4353

Use the following information to answer the next question.

Carbon-Containing Compounds

1	$CCl_4(l)$	**5**	$CO(g)$
2	$Fe_3C(s)$	**6**	$C_3H_8(g)$
3	$C_2H_2(g)$	**7**	$NaCN(s)$
4	$C_2H_5OH(l)$	**8**	$MgCO_3(s)$

Numerical Response

9. The compounds above that can be classified as organic are numbered _____, _____, _____, and _____.

(Record all **four digits** of your answer in **any order** in the numerical-response section on the answer sheet.)

Answer: 1346 (These digits can be recorded in any order.)

During the 2011 – 2012 school year, some field tests of numerical-response items will allow for the scoring of part marks. Possible numerical-response items of this type are as follows:

Example 1

Use the following information to answer the next question.

> Under certain circumstances, the acidified potassium chlorate undergoes disproportionation to form potassium chloride and potassium perchlorate, as shown in the following **unbalanced** equation.
>
> $$\_\_KClO_3(aq) \rightleftharpoons \_\_KCl(aq) + \_\_KClO_4(aq)$$

Numerical Response

1. When this equation is balanced using lowest whole number coefficients, the

coefficient for $KClO_3(aq)$ is __________ (Record in the **first** column)

coefficient for $KCl(aq)$ is __________ (Record in the **second** column)

coefficient for $KClO_4(aq)$ is __________ (Record in the **third** column)

number of electrons transferred is __________ (Record in the **fourth** column)

(Record your answer in the numerical-response section on the answer sheet.)

Answer: **4136** for 2 marks; **413_** for 1 mark; **11_6** for 1 mark; consider **_ _ _ 6** for 1 mark

Discussion:

There are two distinct tasks here; the first is to balance the disproportionation equation, and the second is to determine the number of electrons transferred, either by constructing a reduction half-reaction in acid solution, or by considering the changes in oxidation number for the chlorine atoms.

Students who are able to do both tasks will record the answer **4136**, and will receive both marks allocated to the question.

Students who are able to do the first task, but not the second, will record the answer **413_**. They will receive one of the two marks allocated to the question.

Students who are unable to do the first task, but are able to do the second by constructing a reduction half-reaction, will record the answer **11_6**. They will receive one of the two marks allocated to the question. Students who are unable to do the first task, but are able to do the second by considering the changes in oxidation number for chlorine, will record the answer **_ _ _6**. Awarding them one of the two marks allocated to the question should be considered.

Example 2

Use the following information to answer the next question.

A student wants to test the following hypothesis about the strength of chlorinated carboxylic acids:

If the number of chlorine atoms in a chlorinated carboxylic acid increases, then so does the strength of the acid.

She identifies the following possible variables:

1 The pH of the acid sample
2 The molar mass of the acid
3 The mass of acid in the sample
4 The volume of acid in the sample
5 The molar concentration of the acid sample
6 The number of carbon atoms in the acid molecule
7 The number of chlorine atoms in the acid molecule

Numerical Response

2. In an effective experimental design for testing this hypothesis,

the manipulated variable is numbered ________ (Record in the **first** column)
the responding variable is numbered ________ (Record in the **second** column)
one controlled variable is numbered ________ (Record in the **third** column)
another controlled variable is numbered ________ (Record in the **fourth** column)

(Record your answer in the numerical-response section on the answer sheet.)

Answer: 7156 or **7165** for 2 marks; **71_ _** for 1 mark; consider **_ _ 56** or **_ _ 65** for 1 mark

Discussion:

There are two distinct tasks here; the first is to identify the manipulated and responding variables in the experimental design, and the second is to identify the variables that need to be controlled in order to make the design valid.

Students who are able to do both tasks will record either the answer **7156** or the answer **7165**, and will receive both marks allocated to the question.

Students who are able to do the first task, but not the second, will record the answer **71 _ _**. They will receive one of the two marks allocated to the question, as they have identified the key step in the experimental design.

Students who are unable to do the first task, but are able to do the second by considering the variables that could interfere with the hypothesis, will record either the answer **_ _ 56** or the answer **_ _ 65**. Awarding them one of the two marks allocated to the question should be considered.

One mark may not be considered automatic, as any experimental design that fails to identify manipulated and responding variables is automatically invalid.

Assessment of Communication Skills in the Classroom

Although written-response questions are no longer part of the Chemistry 30 Diploma Examination, we encourage the use of written-response questions in classroom assessment. In this way, there can be a greater assessment of the outcomes included in the program of studies.

The following pages give examples of written-response questions, together with scoring rubrics and examples of student work.

Chemistry is a discipline in which there is a stringent set of rules for proper scientific communication. Communication skills are most evident and can be directly assessed on the written-response questions.

In previous years, we have scored analytic-style written-response questions out of 6, with 5 marks for chemistry content and 1 mark for communication. The communication mark is partially determined by the extent to which the question has been attempted. Communication is marked based on organization, clarity, use of correct scientific conventions, and use of proper language conventions.

Proper scientific conventions include:

- labelling of graphs and diagrams
- mathematical formulas and equations
- significant digits, units of measurement, and unit conversion
- states of matter
- abbreviations

In previous years, we have scored holistic written-response questions using the holistic scoring rubrics, which integrate the assessment of communication skills into the marking matrix that is used to assess the overall response.

Therefore, on the analytic questions, communication skills can be assessed more independently; whereas on the holistic question, communication can be assessed as part of the total response.

The intent of evaluating communication is to reward students for creating responses that are on topic, clear, concise, and well written using the conventions of scientific language.

Communication Guidelines for Classroom Assessment

The following list is a set of guidelines that were used during the marking of the communication scale for any of the written-response questions.

- Do not score work that the student has indicated should not be scored—this includes partially erased or clearly crossed-out work.
- If a student's response contains contradictory information, then score the work as either ambiguous or incorrect.
- Do not score any irrelevant and extra information that is not incorrect but that does not contribute to the correct response.
- The omission of leading zeros is not a scientific error and therefore will not be scored as such.
- States, units, significant digits, and ion charges must be included within the response. The student must be consistent in their use. (The exception to this is equilibrium expressions, which do not require units.) Units used should respect the conventions of the International System of Units (SI).
- Significant digits in the final recorded answer must be correct. It is not necessary to carry extra significant digits in intermediate steps, but it is a preferred practice to carry at least one extra digit throughout intermediate steps. If the number of significant digits in intermediate steps has been truncated (is less than the required number), then this will be considered an error.
- If spelling and grammatical errors limit the understanding of the response and cause ambiguity, then this will be considered a communication error.
- Graphs should include an appropriate title, labelled axes with units, and an appropriate scale. The manipulated variable should always be on the *x*-axis.
- When the student is asked to draw a diagram of a cell, the diagram should include labels for the anode, cathode (or the specific substances), reagent solutions (electrolytes), a salt bridge or porous cup, voltmeter or power source, and a connecting wire to the electrodes. Students are not required, unless specifically asked, to label the migration of ions, the solution in the salt bridge (although the diagram or procedure should indicate that there is a solution present), or the electron flow. If a student chooses to include these labels, then they will also be marked as part of the response.
- The *y*-axis on an energy diagram can be labelled E_p, H, or ΔH with appropriate units. However, on diploma examinations and field tests the *y*-axis will be labelled E_p (kJ).
- Portions of a response not assessed for chemistry marks will not be assessed for communication.

Analytic Communication Scoring Guide

Communication Scoring Guide for Closed-Response (Analytic) Questions

Score	Criteria
1	The teacher does not have to interpret any part of the response, and no reference to the question is needed to understand the response. The response is clear, concise, and presented in a logical manner. Scientific conventions have been followed. The response may contain a minor error.
0 **Ambiguous** **or** **>1 scientific error**	The teacher has to interpret the response (ambiguous) or the response is so poorly organized that the marker has to refer to the question in order to understand the response. The response may be ambiguous, incomprehensible, and/or disorganized, and/or contains errors (more than one) in scientific conventions.
0	**50% or less** of the question has been attempted. There is not much of a response present and not enough to score for communication.
NR	No response given.

Scientific conventions to be followed:

- Correct, appropriate units are used throughout the response.
- States are given throughout the response except in calculation labels and when a formula replaces a word in a sentence.
- Significant digits are used throughout the response.
- Branch names in organic molecules are in alphabetical order, using lowest possible numbers to indicate the position of branches.

***Note: Content and communication are scored on separate scales for the analytic question.**

Explanation of the Holistic Scoring Guide

Holistic questions are designed so that students can demonstrate their understanding of science from more than one valid approach or perspective and are assessed in a holistic fashion. The holistic question will be scored on two rubrics that total a 5-point scale.

Teachers must read the student response in its entirety in order to decide if it contains the key component(s) for the particular question. The teacher then looks for the necessary support details. These two aspects are used to assess the quality of students' responses. Communication skills and scientific conventions are considered in the determination of the overall quality of the key component(s) and support.

Holistic Scoring Rubrics

Score	Key–no Key Criteria
1 **Key** **(weight of 2)**	The student has addressed the key component(s) of the question asked. The key component(s) of the question can be found in the stem of the question.
0 **No Key**	The student has not addressed the key component(s) of the question asked.

Score	Support
3 **Very Good to Excellent**	The student has provided good support for **all** of the bullets. The support may include a minor error/weakness in **one** of the support bullets.
2 **Satisfactory to Good**	The student has provided support for the majority of the bullets but not necessarily all of the bullets. The support provided may contain minor errors/weaknesses. There is **more correct than incorrect** support.
1 **Minimal**	The student has provided minimal support for one or more of the bullets, but there are many errors throughout. There is **more incorrect than correct** support.
0 **Limited to No support**	The student has not provided enough support to demonstrate more than a limited understanding. The support is either off topic or contains major errors throughout all of the bullets.

Chemistry 30 Released Items* and *2010 Released Formative Assessment Materials

Teachers may wish to use the additional written-response items and scoring guides contained in the *Chemistry 30 2010 Released Formative Assessment Materials* to complement the assessment strategies employed.

Sample Written-Response Questions for Classroom Assessment

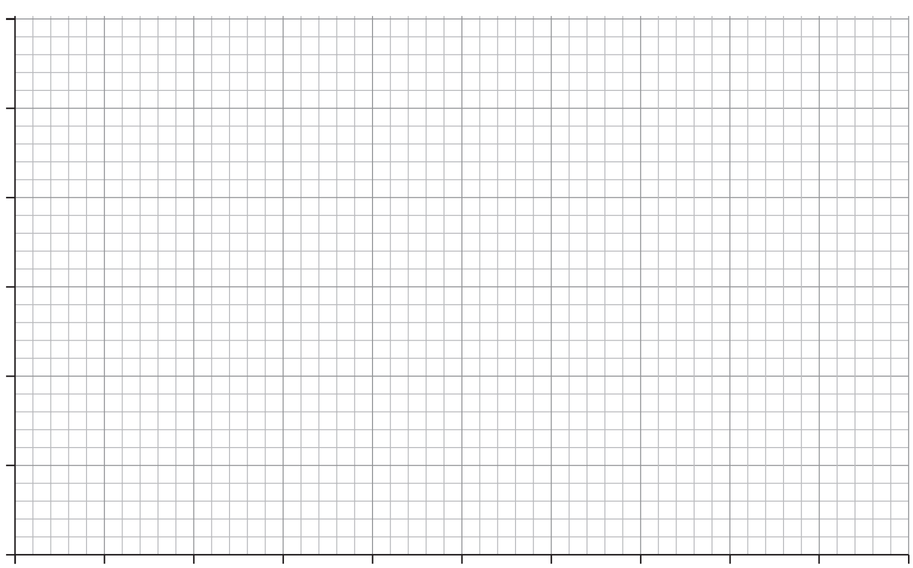
Use the following information to answer the first question.

A student titrated 10.0 mL of a 0.10 mol/L solution of sodium hypochlorite, $NaOCl(aq)$, with 0.10 mol/L $HCl(aq)$ and recorded the pH. The data are shown in the table below.

Volume of HCl(aq) (mL)	**pH**
0.0	10.2
2.0	8.0
4.0	7.6
6.0	7.2
8.0	6.8
10.0	4.2
12.0	2.0
14.0	1.8
16.0	1.6
18.0	1.5
20.0	1.5

Written Response—10%

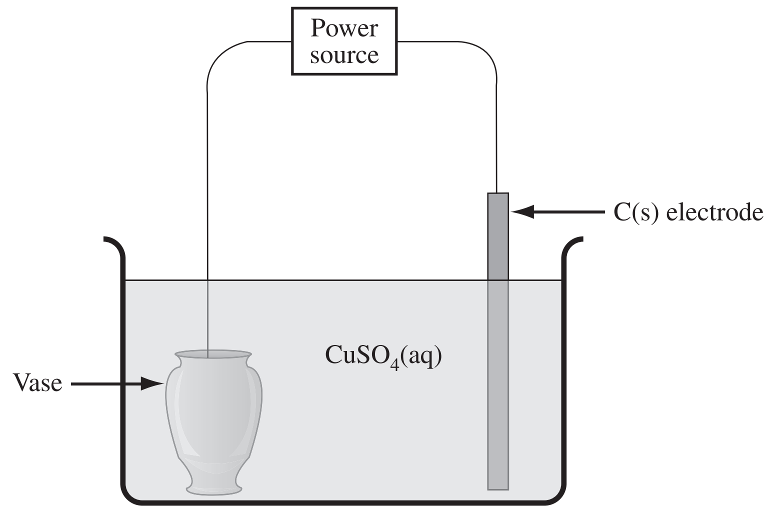
1. **a.** On the grid below, **plot** and **label** the data given above. **Identify** a buffering region.
(3 marks)



b. **Describe** the role of a buffer, and **write** the net ionic equation that represents the buffer reaction that occurs in the buffer region that you identified on your graph. **(2 marks)**

Use the following information to answer the next question.

Decorative copper coatings can be applied to objects, such as a vase, using an electrolytic process.



Written Response—10%

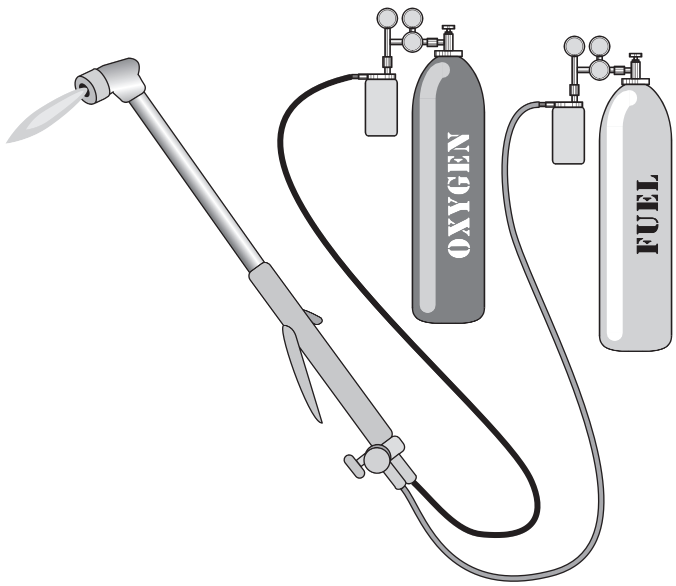
2. **a.** **Write** the two half-reaction equations that occur in this cell, and **identify** one observation that could be made during the operation of the cell. **(3 marks)**

b. **Calculate** the mass of copper that could be produced in the electrolytic cell when a current of 3.00 A is applied for 20.0 min. **(2 marks)**

Use the following information to answer the next question.

A cutting torch can be used to cut metal in places such as construction sites, shipyards, and rail yards. The flame used for cutting is produced by a combustion reaction in which a gaseous fuel is mixed with oxygen and forced through a nozzle in the cutting torch. Gaseous products are formed.

Two gases that can be used as fuel in a cutting torch are hydrogen gas, $H_2(g)$, and ethyne gas, $C_2H_2(g)$, which is commonly known as acetylene.

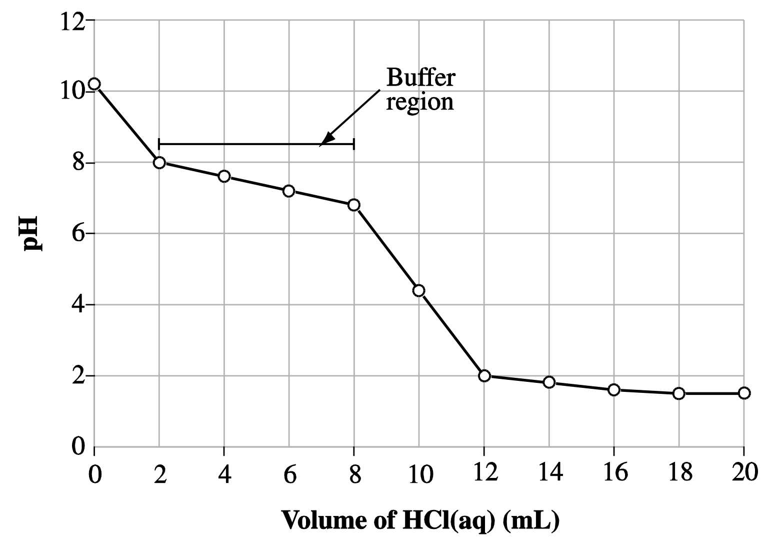


Written Response—15%

3. **Compare**, in terms of energy, the use of hydrogen gas and ethyne gas as fuels, and **identify** which of the two is the better fuel to use in a cutting torch.

Your response should include

- a balanced chemical equation representing the combustion reaction for each fuel
- enthalpy calculations for the combustion of 1.00 g of each fuel in kJ/g
- identification of the better fuel in terms of energy per gram of fuel and one other reason for choosing the fuel

Question	Marks	Sample Response	Comments	Bubble #
1.a.	3	**Titration of NaOCl(aq) with HCl(aq)**  Note: the buffer region as shown on their graph, and not a single point	• 1 mark for title and axis labels (with appropriate scale) • 1 mark for plotted points (or correct curve) • 1 mark for labelling the buffer region, approx 2-8 mL, (consistent with graph before equivalence point)	1
1.b.	2	A buffer maintains a relatively constant pH (resists change in pH) **<u>Or</u>** reacts with a strong acid or base to form its conjugate weak acid/base pair. $OCl^-(aq) + H_3O^+(aq) \rightarrow HOCl(aq) + H_2O(l)$ OR $HOCl(aq) + H_2O(l) \rightleftharpoons OCl^-(aq) + H_3O^+(aq)$ Note: equilibrium equation is acceptable because it can indicate either direction, and $H^+(aq)$ ion versus $H_3O^+(aq)$ is acceptable	• 1 mark for description • 1 mark for **net** ionic equation consistent with label on graph	2
	1	Communication—See Guide	Use Analytic Scoring Guide	3
		Total possible marks = 6		

Marker ID Number _________

Question 2 – Holistic Scoring Criteria

Question	Marks	Sample Response	Comments	Bubble #
2.a.	3	Cathode $Cu^{2+}(aq) + 2e^{-} \rightarrow Cu(s)$ Anode $2H_2O(l) \rightarrow O_2(g) + 4H^{+}(aq) + 4e^{-}$ **Observations** • Blue colour in solution disappears. • Copper-coloured electroplate forms at the cathode (vase). • Mass of the cathode (vase) increases. • Gas bubbles form at the anode (inert C(s) electrode). Relight glowing splint • Solution becomes more acidic over time (pH decreases).	• 1 mark for oxidation half-reaction equation • 1 mark for reduction half-reaction equation • 1 mark for one observation consistent with reactions	1
2.b.	2	$Cu^{2+}(aq) + 2e^{-} \rightarrow Cu(s)$ $m_{Cu} = \frac{(3.00\text{ C/s})(20.0\text{ min} \times 60\text{ s/min})}{9.65 \times 10^{4}\text{ C/mol}} \times \frac{1}{2} \times 63.55\text{ g/mol}$ (0.0373 moles of electrons) (0.0187 moles of Cu(s)) =1.19 g	• 1 mark for method • 1 mark for correct answer	2
	1	Communication—See Guide	Use Analytic Scoring Guide	3
		Total possible marks = 6		

<table>
<tr><th>Marks</th><th>Sample Response</th><th>Comments</th><th>Bubble #</th></tr>
<tr><td>5</td><td>

$2\,H_2(g) + O_2(g) \rightarrow 2\,H_2O(g)$

$\Delta H° = (2\text{ mol})(-241.8\text{ kJ/mol}) = -483.6\text{ kJ}$ (−241.8 kJ/mol)

$\Delta H°_{H_2} = n\Delta H°_{H_2} = \frac{-483.6\text{ kJ}}{2\text{ mol}} \times \frac{1\text{ mol}}{2.02\text{ g}} = -120\text{ kJ/g}$

$2\,C_2H_2(g) + 5\,O_2(g) \rightarrow 4\,CO_2(g) + 2\,H_2O(g)$

$\Delta H°_{C_2H_2} = \sum n\Delta_f H°_{products} - \sum n\Delta_f H°_{reactants}$

$= \left[(4\text{ mol})\frac{-393.5\text{ kJ}}{\text{mol}} + (2\text{ mol})\frac{-241.8\text{ kJ}}{\text{mol}}\right] - \left[(2\text{ mol})\frac{+227.4\text{ kJ}}{\text{mol}} + (5\text{ mol})\frac{0\text{ kJ}}{\text{mol}}\right] = -2\,512.4\text{ kJ}$

(−1 256.2 kJ/mol)

$\Delta H°_{C_2H_2} = n\Delta H° = \frac{-2512.4\text{ kJ}}{2\text{ mol}} \times \frac{1\text{ mol}}{26.04\text{ g}} = -48.2\text{ kJ/g}$

Sample Considerations to Support the Fuel Chosen

$H_2(g)$ – more energy produced per gram of fuel
– environmentally safe fuel because only water vapour is produced
– $H_2(g)$ is produced from fossil fuels, using a process that creates greenhouse gases
– the lightest of all the gases

$C_2H_2(g)$ – more energy produced per mole of fuel, or total energy released
– produces $CO_2(g)$, a greenhouse gas that contributes to climate change
– readily available, or widely used, or burns hotter

</td><td>

Key Component

• an energy comparison of the combustion of the two fuels (in terms of Hess's Law, kJ/mol or kJ/g)

Support Components

• correct balanced equation

• $\Delta H°$ calculation in kJ/g

• identification of the better fuel based on energy **and** one other consideration to support the fuel chosen

</td><td>1

2</td></tr>
</table>

June 2009 Holistic Split Scoring Guide

Score	Key–no Key Criteria
1 **Key** **(weighted 2)**	The student has addressed the question by comparing the two fuels, hydrogen and ethyne gas, in terms of an energy (heat of combustion) comparison. This may be in terms of kJ/g, kJ/mol, or total kJ produced using the results obtained through their calculations. Note that there may be errors in their calculations: e.g., reversing Hess's law or missing coefficients, correct calculation of Hess's Law but incorrect kJ/mol or kJ/g.
0 **No Key**	The student has not addressed the question asked, or only one fuel has been addressed and there is no comparison.

Score	Support
3 **Very Good to Excellent**	The student has provided good support for **all** of the bullets. The support may include a minor error/weakness in **one of** the support bullets.
2 **Satisfactory to Good**	The student has provided support for the majority of the bullets but not necessarily all of the bullets; the support provided may contain minor errors/weaknesses. There is **more correct than incorrect** support.
1 **Minimal**	The student has provided minimal support for one or more of the bullets, but there are many errors throughout. There is **more incorrect than correct** support.
0 **Limited to No support**	The student has not provided enough support to demonstrate more than a limited understanding. The support is either off topic or contains major errors throughout all of the bullets.

Minor errors:

Unbalanced equation

Method for calculating kJ/g is correct, but the student has made a minor calculation error (the comparison is g/kJ versus kJ/g)

Identifying the best fuel in terms of energy, and then a positive reason for the other fuel

Using $H_2O(l)$ instead of $H_2O(g)$

Major errors:

Incorrect method for calculating Hess's Law, or kJ/mol or kJ/g

Incorrect products in the equation, or a fuel other than hydrogen or ethyne is used

Not making a choice for the best fuel in terms of energy

Diploma Examination Instruction Pages

January 2012

Chemistry 30

Grade 12 Diploma Examination

Description

Time: 2 hours. This closed-book examination was developed to be completed in 2 h; however, you may take an additional 0.5 h to complete the examination.

- This examination consists of 44 multiple-choice and 16 numerical-response questions, of equal value.
- This examination contains sets of related questions. A set of questions may contain multiple-choice and/or numerical-response questions.
- A chemistry data booklet is provided for your reference.

Instructions

- Turn to the last page of the examination booklet. Carefully fold and tear out the machine-scored answer sheet along the perforation.

Note: *The perforated pages at the back of this booklet may be torn out and used for your rough work.* ***No marks*** *will be given for work done on the tear-out pages.*

- Use **only** an **HB** pencil for the answer sheet.
- Fill in the information on the back cover of the examination booklet and the answer sheet as directed by the presiding examiner.
- You are expected to provide your own calculator. You may use any scientific calculator or a graphing calculator approved by Alberta Education.
- You **must** have cleared your calculator of all information that is stored in the programmable or parametric memory.
- You may use a ruler and a protractor.
- Read each question carefully.
- Consider all numbers used in the examination to be the result of a measurement or an observation.
- When performing calculations, use the values of the constants provided in the data booklet.
- If you wish to change an answer, erase **all** traces of your first answer.
- Do **not** fold the answer sheet.
- The presiding examiner will collect your answer sheet and examination booklet and send them to Alberta Education.
- Now turn this page and read the detailed instructions for answering machine-scored questions.

Multiple Choice

- Decide which of the choices **best** completes the statement or answers the question.
- Locate that question number on the separate answer sheet provided and fill in the circle that corresponds to your choice.

Example

This examination is for the subject of

A. chemistry
B. biology
C. physics
D. science

Answer Sheet

● Ⓑ Ⓒ Ⓓ

Numerical Response

- Record your answer on the answer sheet provided by writing it in the boxes and then filling in the corresponding circles.
- If an answer is a value between 0 and 1 (e.g., 0.25), then be sure to record the 0 before the decimal place.
- **Enter the first digit of your answer in the left-hand box. Any boxes on the right that are not needed are to remain blank.**

Examples

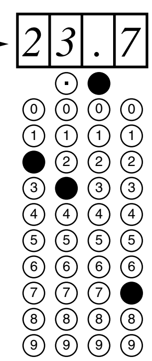
Calculation Question and Solution

The average of the values 21.0, 25.5, and 24.5 is _________.

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

Average = (21.0 + 25.5 + 24.5)/3
= 23.666…
= 23.7 (rounded to one decimal place)

Record 23.7 on the answer sheet →



Correct-Order Question and Solution

Four Subjects

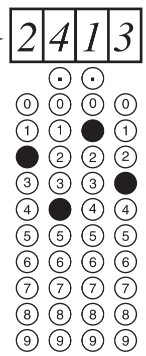
1 Physics
2 Biology
3 Science
4 Chemistry

When the subjects above are arranged in alphabetical order, their order is ____, ____, ____, and ____.

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

Answer: 2413

Record 2413 on the answer sheet →



Selection Question and Solution

Five Elements

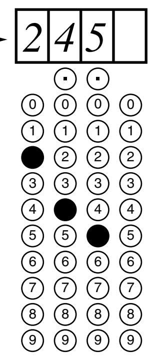
1 Carbon
2 Iron
3 Nitrogen
4 Potassium
5 Tin

The metals in the list above are numbered ___, ___, and ___.

(Record all **three digits** of your answer **in any order** in the numerical-response section on the answer sheet.)

Answer: 245

Record 245 on the answer sheet →



Scientific Notation Question and Solution

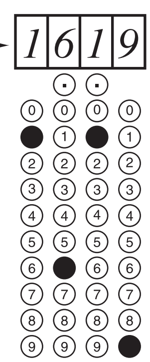
$X(g) + Y(g) \rightarrow XY(g) \qquad \Delta H^\circ = +1.61 \times 10^9$ kJ

The energy transferred when 1.00 mol of X(g) is consumed during the reaction represented by the equation above is $\boldsymbol{a.bc} \times 10^{\boldsymbol{d}}$ kJ. The values of ***a***, ***b***, ***c***, and ***d*** are ____, ____, ____, and ____.

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

Answer: 1.61×10^9 kJ

Record 1619 on the answer sheet →



Exemplars Document

Examples of questions are also posted on the website next to the *Information Bulletin* in the *Exemplars* document. There are examples for each type of question format that either have been used in previous diploma examinations or can be used in classroom assessment.

This document outlines some of the general principles of question construction used by examination developers at Learner Assessment, contains the Chemistry 30 Program of Studies outcome statements, and provides examples of questions that can be used to assess these outcome statements.

Constructing the Diploma Examination

Classroom teachers work on item-development working groups to develop questions that meet the program of studies and technical standards incorporated into the examination blueprint. The diploma examinations are composed of questions and/or question sets that have proven to be valid in field testing.

After a question has been field-tested, feedback provided by students and teachers, in addition to the statistics, are reviewed before the question is deemed acceptable for a diploma examination. Before an item appears on an examination, it is reviewed and edited internally, and then reviewed externally by a working group of teachers and professionals working in the chemistry field.

To participate in our item development, examination review, or French translation working groups, teachers need to be nominated by their schools and their names submitted to Alberta Education.

Examination Security

All Chemistry 30 Diploma Examinations are secured.

More information can be found in the *General Information Bulletin* on the Alberta Education website at education.alberta.ca by following this pathway:
Teachers > (Additional Programs and Services) Diploma Exams > Diploma General Information Bulletin > Security & Examination Rules.

Maintaining Consistent Standards over Time on Diploma Examinations

The process of examination equating was suspended for the 2008–2009 school year, as it was the year of the introduction of the new program of studies in Chemistry 30. The suspension was continued for the 2009–2010 school year, as there was a major change in format to the diploma examinations, with the removal of the written-response questions.

In the 2010–2011 school year, Alberta Education conducted extensive standard-setting exercises and will be re-introducing examination equating in all examinations from January 2012 onward.

A goal of Alberta Education is to make scores achieved on examinations within the same subject directly comparable from session to session, thereby enhancing fairness to students across administrations.

In order to achieve this goal, a number of questions called anchor items remain the same from one examination to another. Anchor items are used to find out if the student population writing in one administration differs in achievement from the student population writing in another administration. Anchor items are also used to find out if the unique items (questions that are different on each examination) differ in difficulty from the unique items on the baseline examination (the first examination to use anchor items). A statistical process called equating adjusts for differences in examination form difficulty. Examination marks may be adjusted depending upon the difficulty of the examination written relative to the baseline examination. The resulting equated examination scores have the same meaning regardless of when and to whom the examination was administered. Equated diploma examination marks will be reported to students.

Because of the security required to enable fair and appropriate assessment of student achievement over time, Chemistry 30 diploma examinations will be fully secured and will not be released at the time of writing. For more information about equating, please refer to the Alberta Education website at education.alberta.ca, then follow the pathway *Administrators > Provincial Testing > Diploma Examinations > Initiative to Maintain Consistent Standards on Diploma Examinations*.

More information can be found in the *General Information Bulletin* on the Alberta Education website at education.alberta.ca by following this pathway:
Teachers > (Additional Programs and Services) Diploma Exams > Diploma General Information Bulletin > Marks, Results, & Appeals.

Reminders and Explanations

All Units

Chemistry is a laboratory science, and an essential part of laboratory activity is the design of effective tests for different hypotheses. The truth of some hypotheses is within the scope of the program of studies, while the truth of other hypotheses may be slightly beyond the program of studies. However, for all hypotheses, the design elements of the laboratory experiment will be within the program of studies. An example of a multiple-choice item and an example of a numerical-response item follow.

Use the following information to answer the next question.

A student looked at the structural formulas of different hydrocarbons and proposed the following hypothesis:

> *The more unsaturated a hydrocarbon is, the more carbon dioxide is released when the hydrocarbon is burned.*

1. To test this hypothesis, the best hydrocarbons to use are

A. Propane, butane, and pentane

B. Butane, but-1-ene, and but-1-yne

C. Propane, but-1-ene, and pent-1-yne

D. Pentane, 2-methylbutane, and 2,2-dimethylpropane

Rationales:

For A, longer chains will give more carbon dioxide, but cannot be used for testing this hypothesis on saturation levels, as all three are saturated hydrocarbons.

For B, this is correct, with the control variable of equal lengths of carbon chain.

For C, these have different degrees of saturation, but the length of the carbon chain is not controlled.

For D, these hydrocarbons are all isomeric forms of each other, so they have the same degree of saturation.

Use the following information to answer the next question.

A student wants to test the following hypothesis about the strength of chlorinated carboxylic acids:

> *If the number of chlorine atoms in a chlorinated carboxylic acid increases, then so does the strength of the acid.*

She identifies the following possible variables:

1 The pH of the acid sample
2 The molar mass of the acid
3 The mass of acid in the sample
4 The volume of acid in the sample
5 The molar concentration of the acid sample
6 The number of carbon atoms in the acid molecule
7 The number of chlorine atoms in the acid molecule

Numerical Response

2. In an effective experimental design for testing this hypothesis,

the manipulated variable is numbered ____________ (Record in the **first** column)
the responding variable is numbered ____________ (Record in the **second** column)
one controlled variable is numbered ____________ (Record in the **third** column)
another controlled variable is numbered ____________ (Record in the **fourth** column)

(Record your answer in the numerical-response section on the answer sheet.)

Answer: **7156** or **7165** for 2 marks; **71_ _** for 1 mark; consider **_ _ 56** or **_ _ 65** for 1 mark

Discussion:

There are two distinct tasks here; the first is to identify the manipulated and responding variables in the experimental design, and the second is to identify the variables that need to be controlled in order to make the design valid.

Students who are able to do both tasks will record either the answer **7156** or the answer **7165**, and will receive both marks allocated to the question.

Students who are able to do the first task, but not the second, will record the answer **71 _ _**. They will receive one of the two marks allocated to the question, as they have identified the key step in the experimental design.

Students who are unable to do the first task, but are able to do the second by considering the variables that could interfere with the hypothesis, will record either the answer _ _ **56** or the answer _ _ **65**. Awarding them one of the two marks allocated to the question should be considered.

One mark may not be considered automatic, as any experimental design that fails to identify manipulated and responding variables is automatically invalid.

Unit A

The term *calorimeter* does not always refer to a bomb calorimeter. Students should be familiar with different designs that can be used for the measurement of energy changes in a chemical system. These include designs where the temperature change of the container is accounted for, not just that of its contents.

In the assessment of outcome 30–A2.3s, students will be expected to calculate the efficiency of a thermal energy source, and to explain the discrepancies between theoretical and measured values obtained from calorimetry experiments. They are expected to predict whether a given source of error will lead to a lower or to a higher calculated value for a heat of reaction, as well as to predict whether an observed heat or temperature change is lower or higher than the theoretical heat or temperature change. Teachers should use all the approved resources to cover this outcome, and not rely wholly on any single source for information.

Unit B

Outcome 30-B2.4k: recognize that predicted reactions do not always occur.

One of the most common and demonstrable examples to illustrate this objective is the chloride anomaly. It is reasonable to expect students to be familiar with this. For further clarification please review the explanation below (taken from the *Archived Chemistry 30 Information Bulletin*).

Chloride Anomaly

Students are expected to recognize that predicted reactions do not always occur; for example, the chloride anomaly occurs during the electrolysis of solutions containing chloride ions and water as the strongest reducing agents. A common misconception is that if the minimum voltage for the electrolysis of water were applied, then the oxidation of water would occur rather than the oxidation of chloride ions. This is not correct. The reduction potentials found on the reduction potential table are determined by comparing the reduction potential of a given half-cell to the standard hydrogen half-cell. The standard hydrogen reduction potential is the reference potential against which all half-reaction potentials are assigned. This is how the reduction potentials for oxygen and hydrogen ions (+1.23 V) and chlorine (+1.36 V) half-cells are obtained. During electrolysis, the theoretical minimum voltage is the difference in reduction potential between the oxidizing agent and the reducing agent. An excess voltage, called the overvoltage, is required in order for a reaction to occur. For example, as the voltage to a standard sodium chloride electrolytic cell is increased, the chloride ions are oxidized first. The reason for this is that the overvoltage for the oxidation of water is greater than the overvoltage for the oxidation of chloride ions. A much higher potential than expected is required to oxidize water. Basically, the phenomenon is caused by difficulties in transferring electrons from the species in the solution to the atoms of the electrode across the electrode-solution interface. Because of this situation, $E°$ values must be used cautiously when one is predicting the actual order of oxidation or reduction of species in an electrolytic cell.

Oxidation Numbers

For assigning oxidation numbers, the Assessment Sector will use the following:

Oxygen always has an oxidation number of –2, except for peroxides, where its oxidation number is –1.

Hydrogen always has an oxidation number of +1, except for hydrides of metals in Groups 1 and 2 of the Periodic Table, where its oxidation number is –1.

Carbon can have fractional oxidation numbers, and the oxidation number of carbon in any of its compounds will represent an average oxidation number. For example, in the case of propane, C_3H_8, the oxidation number is taken as $-\frac{8}{3}$. Considering the oxidation number of each of the two end carbons as –3, and of the middle carbon as –2, is beyond the scope of the program of studies.

Unit C

Questions in all units of the course may include contexts involving organic compounds.

The term *hydrocarbon* should be strictly limited to describing molecules composed of only carbon and hydrogen atoms. For organic molecules composed of other atoms, including oxygen and halogens, the term *hydrocarbon derivative* is appropriate.

When one of the hydrogen atoms in a hydrocarbon is replaced by a hydroxyl group, either an alcohol or a phenol may be produced. The term *alcohol* will be used whenever the original hydrocarbon is aliphatic. The term *phenol* will be used whenever the hydroxyl group is attached directly to the benzene ring. Benzyl alcohols, where there is both a benzene ring and a hydroxyl group attached to a straight side chain, and not to the benzene ring, are outside the scope of the program of studies. For the diploma examination, *elimination* is considered a type of chemical reaction in which atoms are removed from adjacent carbons in a single reactant. Cracking reactions, where alkanes are reduced to alkenes, are included as elimination reactions. The definition distinguishes this reaction type from a condensation reaction, in which two molecules react and their interaction produces a water molecule.

Knowledge of both types of polymerization reaction will be tested.

Unit D

On a titration curve representing the titration of a weak acid with a strong base (or a strong acid with a weak base), a buffer region or regions occur. This is the flatter portion of the titration curve that occurs before the equivalence point when a buffer is present. In this region, the acid and its conjugate base are present in similar concentrations. Prior to this region, as strong base is added to the weak acid, the acid is converted to its conjugate base, until both are present in similar concentrations. The buffer region does not occur at the start of the titration, but only when a significant amount of strong base has been added to convert the weak acid to its conjugate base (the flat portion of the titration curve). In terms of scoring student responses, we consider buffer regions to be only those regions on the titration curve where a buffer is present.

Originally, a buffer was defined operationally as being any area on a pH graph where the titration graph of pH as a function of added titrant was essentially flat. With that definition, a strong monoprotic acid–strong monoprotic base titration would exhibit buffering regions at the beginning of the titration and at the end, separated by a near-vertical portion containing the single equivalence point . However, the only reason that these are flat is that pH is a logarithmic scale. If we have 50.0 mL of 1.00 mol/L NaOH, the pH is essentially 14, and adding 10.0 mL of 1.00 mol/L HCl will produce a pH of 13.82 as the molar concentration of NaOH is now (40.0 mL/60.0 mL) mol/L as 10.0 mL of the NaOH has been neutralized, and the new total volume is 60.0 mL. There is no equilibrium established near the reaction equivalence point, and the pH change is strictly a dilution effect.

Following the Brønsted–Lowry approach to acid–base equilibrium, the buffer was redefined in terms of requiring the presence of a conjugate acid–base pair that is in an equilibrium state, and which reacts to the stresses applied in the form of small amounts of a strong base or a strong acid. With this more modern and complete definition of buffering, there would be zero buffering regions in any strong monoprotic acid–strong monoprotic base titration.

Some titrations between polyprotic acids and polyprotic bases may go to completion, and stoichiometric methods can then be used to calculate concentrations of acids and bases from the volumes at the equivalence points. Other such titrations do not go to completion, as the acid may not be strong enough to complete all possible proton donations. The words *titrated to completion* will be used in diploma examinations to indicate that all possible proton donations have been made. Quantitative calculations of the pH of a buffer using the Henderson–Hasselbalch equation are beyond the program of studies and will not be asked. A qualitative understanding that the K_a value of the buffer must approximate the desired K_a value of the environment to be buffered is required.

General note: Teachers may find it necessary to review the use of proper scientific notation, and the use of the quantities millimoles, and millimoles per litre, when completing calculation-based problems.

Diploma Examinations Program Calculator Policy

Using Calculators

The Chemistry 30 Diploma Examination requires the use of a scientific calculator or an approved graphing calculator. The calculator directives, expectations, criteria, and keystrokes required for clearing approved calculators can be found in the *General Information Bulletin* on the Alberta Education website at education.alberta.ca by following this pathway:
Teachers > (Additional Programs and Services) Diploma Exams > Diploma General Information Bulletin > Using Calculators & Computers.

Data Booklet

The most current version of the *Chemistry 30 Data Booklet* has a publication date of 2010 and a red cover. This version replaces previous versions, which have an earlier publication date and blue covers.

Field Tests

The chemistry program is thankful to the many teachers and students who have volunteered for field test placements. The table below shows the format, number of items, and length of time for field tests available for the 2011–2012 school year. Teachers may wish to consider this table when requesting a field test placement.

	Paper	**Digital (Online)**
Number of items (MC and NR)	20	20
Test time (min)	65	65
Administration time (min)	10	15
Total time (min)	75	80

Teachers wishing to arrange for a field test must provide an appropriate length of time for the writing and administration of the exam, according to the total time listed above.

As in past years, both unit and semester-end examinations will be available.

Type of Field Test	**Semester 1**	**Semester 2**
Unit Test (20 items)	Unit A Unit B Unit C Unit D	Unit A Unit B Unit C Unit D
End of Semester (20 items)	All units	All units

NEW

Website Links

Publication/Resource (Chemistry 30 Program of Studies)	**Website**
General Information Bulletin	*education.alberta.ca*, via the pathway: *Teachers > (Additional Programs and Services) Diploma Exams > Diploma General Information Bulletin*
Chemistry 30 Information Bulletin	*education.alberta.ca*, via the pathway: *Teachers > (Additional Programs and Services) Diploma Exams > Information Bulletins*
Mathematics and Science Directing Words	*education.alberta.ca*, via the pathway: *Teachers > (Additional Programs and Services) Diploma Exams > Information Bulletins > Mathematics and Science Directing Words*
Science Process Words	*education.alberta.ca*, via the pathway: *Teachers > (Additional Programs and Services) Diploma Exams > Information Bulletins > Science Process Words*
Self-Scoring Questions (Exemplars Document)	*education.alberta.ca*, via the pathway: *Teachers > (Additional Programs and Services) Diploma Exams > Previous Diploma Examinations and Answer Keys*
Data Booklet	*education.alberta.ca*, via the pathway: *Teachers > (Additional Programs and Services) Diploma Exams > (Additional Resources–Data Booklets) Chemistry 30*
Chemistry 20–30 Program of Studies	*education.alberta.ca*, via the pathway: *Teachers > (Programs of Study) > Science > Programs of Study*
Quest A+	*https://questaplus.alberta.ca* **Note:** Unit and semester-end self-scoring practice tests can be found here.
Organization	**Website**
ATA Science Council	*sc.teachers.ab.ca*
Alberta Regional Professional Development Consortia	*arpdc.ab.ca*, via the pathway: *Regional Consortium* > select link to your region, view professional development offerings in your region, or other regions

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