August 25, 2011

To: Core Curriculum General Education Committee (CCGEC)
c/o Julie H. Huff
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Subject: Freshman Chemistry CORE SLO Assessment Devise
a.k.a. 2011 CCGEC Progress Reports from Chemistry
From: Michel L. McKee, Chemistry Undergraduate Program Officer

The Freshman Chemistry CORE SLO Assessment Devise was administered to all students taking freshman chemistry during the Spring 2011 semester. The exams were given during one of the lab periods toward the end of the semester. Students taking the exam were given 5 points toward their grade. The exams were organized by Steve Swann, Freshman Chemistry Coordinator, and were graded by Steve and his staff. Three of the questions (3.1, 3.4, and 3.5) required written answers that were graded by the Undergraduate Curriculum Committee. The written answers were given 1, 3, or 5 points depending on the quality of the answer. For CHEM 1030 and CHEM 1040, the written answers of a random sample of about 25% of the exams were graded. For other courses, all written answers were graded. The exams were constructed such that questions 1.1 - 1.5 covered SLO#10-1, questions 2.1 - 2.5 covered SLO#10-2, questions 3.1 - 3.5 covered SLO#10-3, questions 4.1 - 4.5 covered SLO#10-5, and questions 5.1 - 5.5 covered SLO#10-5.

Here are the five subsections of SLO#10:
SLO#10-1 Historic perspective
SLO#10-2 Scientific method
SLO#10-3 Data interpretation
SLO#10-4 Social impact
SLO#10-5 Demonstrate understanding of science

There were five chemistry courses: CHEM 1020, CHEM 1030, CHEM 1040, CHEM 1120, and CHEM 1127. CHEM 1020 is the second semester of a terminal course sequence that combines general and organic chemistry. CHEM 1030 and 1040 are the two semester general chemistry courses for non-scientists. CHEM 1120 is the second semester of general chemistry for scientists and engineers. CHEM 1127 is the second semester of honors chemistry. The exams for the five courses are available to the committee at the end of this report. The results are presented in Table 1.
Table 1. Number of participants (Part.) and % correct answers

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<tr>
<th></th>
<th>Part.</th>
<th>SLO1</th>
<th>SLO2</th>
<th>SLO3</th>
<th>Written</th>
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<td>56</td>
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<td>3.6/4.4/4.3</td>
<td>37(A+B) 44(C)</td>
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<tr>
<td>CHEM 1127</td>
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<td>79</td>
<td>73</td>
<td>78</td>
<td>3.1/4.8/3.9</td>
<td>33(A+B) 32(C)</td>
<td>93</td>
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</table>

Total 1357

(a) A+B=Strongly agree or agree
C=No difference

For example in CHEM 1020, 117 students took the exam. On average for the five questions testing SLO#10-1, 41 percent of the students got the question correct. For the three written questions (3.1, 3.4, and 3.5), the average scores were 2.3, 3.5, and 2.4 out of five. For SLO#10-4, the possible answers A-E were: Strongly agree, agree, no difference, disagree, and strongly disagree. The questions asked students whether the course helped them make informed decision regarding various social issue that required an understanding of science. For CHEM 1020 students, 33% strongly agreed or agreed that the course helped them make informed decisions, while 46% felt the course made no difference.

In the Department of Chemistry and Biochemistry, the faculty generally agree that the SLOs are a waste of time. For example, we feel that SLO#10-1 (Historic perspective) is not relevant to a chemistry curriculum. The best SLO is SLO#10-5 (Demonstrate understanding of science). For this SLO, there is a clear increase. Clearly, we need to improve this number for CHEM 1020 students. However, by the second semester of general chemistry, the students have demonstrated a mastery of the topic. In CHEM 1120, the course sequence for scientists and engineers, 86 percent of students got the right answer, while for CHEM 1127, honors chemistry, 93 percent of the students got the right answer. About a third of the students in all of the courses felt that their chemistry course was helping them making informed decision regarding important social issues.

The recommendations of our committee are as follows:
1. Move the exams to a scantron format.
2. Re-word several of the questions that appeared to be ambiguous.
3. Inform the teachers of CHEM 1020 to cover more quantitative concepts in chemistry.

Michel L. McKee
Undergraduate Program Officer
Description of Assessment Process by Chemistry Undergraduate Core Curriculum

At the end of the Spring 2010 semester Steve Swann and his staff administered assessment exams for the following courses:
CHEM1020
CHEM1030
CHEM1040
CHEM1120
CHEM1127

About 1500 exams were given during the lab periods. These exams were given to assess the Student Learn Outcome (SLO). Steve Swann and his staff have graded all of the exams and tabulated the scores on Excel spreadsheets (1 spreadsheet per class and one line per lab section). There were three questions that required written answers. These three questions have not been graded. Our committee is required to analyze the results and recommend how our core courses can be improved. Please see the attached response from the Core Curriculum General Education Committee (CCGEC).

A meeting of Undergraduate Core Curriculum took place on August 10, 2011

Members of UCC:
Michael McKee <mckee@chem.auburn.edu> Chair
Rik Blumenthal <blumeri@auburn.edu>
Holly Ellis <ellishr@auburn.edu>
John Gorden <gordejd@auburn.edu>
Stewart Schneller <schütter@auburn.edu>
Michael Squillacote <squilme@auburn.edu>
Kathryn West <millyka@auburn.edu>
Freshman Chemistry Core SLO Assessment Device

Please answer the questions on the attached answer sheet. There are 25 questions. Three of the questions require written answers (3.1, 3.4, and 3.5). Please answer these three questions in the space provided. Write legibly.

**CHEM 1020**
SLO 10-1 Historical Perspective

1.1) Choose the correct association
Brönsted-Lowrey
   a) DNA base pairing
   b) Acid/Base theory
   c) Addition to CC double bonds
   d) Metabolism
   e) Designation of 3-D structures

1.2) Choose the correct association
Watson-Crick
   a) DNA base pairing
   b) Acid/Base theory
   c) Addition to CC double bonds
   d) Metabolism
   e) Designation of 3-D structures

1.3) Choose the correct association
Krebs cycle
   a) DNA base pairing
   b) Acid/Base theory
   c) Addition to CC double bonds
   d) Metabolism
   e) Designation of 3-D structures

1.4) Choose the correct association
Markovnikov
   a) DNA base pairing
   b) Acid/Base theory
   c) Addition to CC double bonds
   d) Metabolism
   e) Designation of 3-D structures

1.5) Choose the correct association
Fischer
   a) DNA base pairing
   b) Acid/Base theory
   c) Addition to CC double bonds
   d) Metabolism
   e) Designation of 3-D structures
SLO 10-2 Scientific Method

2.1) Please provide the correct answer:
   a) Collecting data, forming a hypothesis, designing a test, and forming a theory.
   b) Collecting data, forming a theory, designing a test, and forming a hypothesis.
   c) Collecting data, forming a theory, designing a test, and establishing a law.
   d) Forming a theory, collecting data to support theory, and establishing a law.
   e) Forming a theory, collecting data to support theory, and forming a hypothesis.

2.2) Choose the correct association
   Law
   a) Tentative explanation of an observation
   b) Tested hypothesis
   c) Belief
   d) Relationship that hold true in all experiments

2.3) Choose the correct association
   Theory
   a) Tentative explanation of an observation
   b) Tested hypothesis
   c) Belief
   d) Relationship that hold true in all experiments

2.4) Choose the correct association
   Hypothesis
   a) Tentative explanation of an observation
   b) Tested hypothesis
   c) Belief
   d) Relationship that hold true in all experiments

2.5) Argon dating of rock shows an age of 4 million years. If bone is bedded in the rock, this shows the bone is also 4 million years old.
   a) True
   b) False
3.1) Explain the difference between precision and accuracy.

3.2-5) The following questions refer to the plot below of the mass of precipitate \((Ag_2CO_3)\) found as a function of the initial concentrations of both \(AgNO_3\) and \(Li_2CO_3\).

3.2) Identify the species that are soluble
   a) \(Li_2CO_3\), \(AgNO_3\), \(LiNO_2\), \(Ag_2CO_3\)
   b) \(Li_2CO_3\), \(AgNO_3\), \(LiNO_2\)
   c) \(Li_2CO_3\), \(AgNO_3\)
   d) \(Ag_2CO_3\)
   e) \(LiNO_2\)

3.3) The dashed line indicates the amount of precipitate when
   a) \(Li_2CO_3\) is the limiting reagent
   b) \(AgNO_3\) is the limiting reagent
   d) \(Ag_2CO_3\) is the limiting reagent
   e) \(LiNO_2\) is the limiting reagent

3.4) The data you actually used in lab was the average of the results of multiple students. Explain why it is better to use an average rather than the results of just one student.

3.5) When calculating the average value, must all data point be used? If not, what criterion may be used to justify ignoring one student’s value?
SLO #10-4 Social Impact

Evaluate the extent to which you think the following statements are true.

4.1) Having taken this course has enhanced my ability to make informed decisions regarding Global Warming/Climate Change
   a) Strongly agree
   b) Agree
   c) No difference
   d) Disagree
   e) Strongly disagree

4.2) Having taken this course has enhanced my ability to make informed decisions regarding challenge of acid rain.
   a) Strongly agree
   b) Agree
   c) No difference
   d) Disagree
   e) Strongly disagree

4.3) Having taken this course has enhanced my ability to make informed decisions regarding regulation of chemical pollutants.
   a) Strongly agree
   b) Agree
   c) No difference
   d) Disagree
   e) Strongly disagree

4.4) Having taken this course has enhanced my ability to make informed decisions regarding transportation fuels (i.e. ethanol, electricity, hydrogen).
   a) Strongly agree
   b) Agree
   c) No difference
   d) Disagree
   e) Strongly disagree

4.5) Having taken this course has enhanced my ability to make informed decisions regarding government of science.
   a) Strongly agree
   b) Agree
   c) No difference
   d) Disagree
   e) Strongly disagree
SLO #10-5 Demonstrate understanding of science

5.1) What is the formula for sodium sulfate?
   a) NaS
   b) NaSO₃
   c) Na₂SO₄
   d) NaSO₄
   e) NaSO

5.2) What is the correct stoichiometry for the reaction
     \[ a \text{ C}_2\text{H}_4 + b \text{ O}_2 \rightarrow c \text{ CO}_2 + d \text{ H}_2\text{O} \]
   a) \( \text{abcd} = 1111 \)
   b) \( \text{abcd} = 2222 \)
   c) \( \text{abcd} = 1212 \)
   d) \( \text{abcd} = 1322 \)
   e) \( \text{abcd} = 2121 \)

5.3) What is the unit for \(10^3\) meters?
   a) kilometer
   b) millimeter
   c) centimeter
   d) megameter
   e) decimeter

5.4) How many moles of water are in 36.0 g of H₂O? (At. Wt. H=1.0 amu; O=16.0 amu)
   a) 1.0 moles
   b) 2.0 moles
   c) 0.5 moles
   d) 4.0 moles
   e) 10.0 moles

5.5) How many protons and neutrons are in the isotope \(^{14}_{6}\text{C}\)?
   a) 14p, 6n
   b) 6p, 14n
   c) 14p, 20n
   d) 6p, 8n
   e) 8p, 6n
Freshman Chemistry Core SLO Assessment Device

Please answer the questions on the attached answer sheet. There are 25 questions. Three of the questions require written answers (3.1, 3.4, and 3.5). Please answer these three questions in the space provided. Write legibly.

CHEM 1120
SLO 10-1 Historical Perspective

1.1) The name Faraday is most closely associated with which of the following areas:
   a) Electrochemistry
   b) Thermochemistry
   c) Acid/Base Chemistry
   d) Quantum Mechanics
   e) Equilibrium

1.2) The name Gibbs is most closely associated with which of the following areas:
   a) Electrochemistry
   b) Thermochemistry
   c) Acid/Base Chemistry
   d) Quantum Mechanics
   e) Equilibrium

1.3) Le Chatelier’s Principle is most closely associated with which of the following areas:
   a) Electrochemistry
   b) Thermochemistry
   c) Acid/Base Chemistry
   d) Quantum Mechanics
   e) Equilibrium

1.4) Henry’s Law is most closely associated with which of the following areas:
   a) Electrochemistry
   b) Thermochemistry
   c) Acid/Base Chemistry
   d) Quantum Mechanics
   e) Equilibrium

1.5) The name G.N. Lewis is most closely associated with which of the following areas:
   a) Electrochemistry
   b) Thermochemistry
   c) Acid/Base Chemistry
   d) Quantum Mechanics
   e) Equilibrium
SLO 10-2 Scientific Method

2.1) Please provide the correct answer:
   a) Collecting data, forming a hypothesis, designing a test, and forming a theory.
   b) Collecting data, forming a theory, designing a test, and forming a hypothesis.
   c) Collecting data, forming a theory, designing a test, and establishing a law.
   d) Forming a theory, collecting data to support theory, and establishing a law.
   e) Forming a theory, collecting data to support theory, and forming a hypothesis.

2.2) Choose the correct association
    Law
    a) Tentative explanation of an observation
    b) Tested hypothesis
    c) Belief
    d) Relationship that hold true in all experiments

2.3) Choose the correct association
    Theory
    a) Tentative explanation of an observation
    b) Tested hypothesis
    c) Belief
    d) Relationship that hold true in all experiments

2.4) Choose the correct association
    Hypothesis
    a) Tentative explanation of an observation
    b) Tested hypothesis
    c) Belief
    d) Relationship that hold true in all experiments

2.5) Argon dating of rock shows an age of 4 million years. If bone is bedded in the rock, this shows the bone is also 4 million years old.
    a) True
    b) False
SLO 10-3 Data Interpretation

3.1) Explain the difference between precision and accuracy.

3.2-5) The following questions refer to the plot below of the mass of precipitate (Ag₂CO₃) found as a function of the initial concentrations of both AgNO₃ and Li₂CO₃.

3.2) Identify the species that are soluble
   a) Li₂CO₃, AgNO₃, LiNO₂, Ag₂CO₃
   b) Li₂CO₃, Ag₂CO₃, LiNO₂
   c) Li₂CO₃, AgNO₃
   d) Ag₂CO₃
   e) LiNO₂

3.3) The dashed line indicates the amount of precipitate when
   a) Li₂CO₃ is the limiting reagent
   b) AgNO₃ is the limiting reagent
   d) Ag₂CO₃ is the limiting reagent
   e) LiNO₂ is the limiting reagent

3.4) The data you actually used in lab was the average of the results of multiple students. Explain why it is better to use an average rather than the results of just one student.

3.5) When calculating the average value, must all data point be used? If not what criterion may be used to justify ignoring one student’s value?
SLO #10-4 Social Impact

Evaluate the extent to which you think the following statements are true.

4.1) Having taken this course has enhanced my ability to make informed decisions regarding Global Warming/Climate Change
   a) Strongly agree
   b) Agree
   c) No difference
   d) Disagree
   e) Strongly disagree

4.2) Having taken this course has enhanced my ability to make informed decisions regarding challenge of acid rain.
   a) Strongly agree
   b) Agree
   c) No difference
   d) Disagree
   e) Strongly disagree

4.3) Having taken this course has enhanced my ability to make informed decisions regarding regulation of chemical pollutants.
   a) Strongly agree
   b) Agree
   c) No difference
   d) Disagree
   e) Strongly disagree

4.4) Having taken this course has enhanced my ability to make informed decisions regarding transportation fuels (i.e. ethanol, electricity, hydrogen).
   a) Strongly agree
   b) Agree
   c) No difference
   d) Disagree
   e) Strongly disagree

4.5) Having taken this course has enhanced my ability to make informed decisions regarding government of science.
   a) Strongly agree
   b) Agree
   c) No difference
   d) Disagree
   e) Strongly disagree
SLO #10-5 Demonstrate understanding of science

5.1) What is the formula for sodium sulfate?
   a) NaS
   b) NaSO₃
   c) Na₂SO₄
   d) NaSO₄
   e) NaSO

5.2) What is the correct stoichiometry for the reaction
   \[ a \text{ C}_2\text{H}_4 + b \text{ O}_2 \rightarrow c \text{ CO}_2 + d \text{ H}_2\text{O} \]
   a) \[ abcd = 1111 \]
   b) \[ abcd = 2222 \]
   c) \[ abcd = 1212 \]
   d) \[ abcd = 1322 \]
   e) \[ abcd = 2121 \]

5.3) What is the unit for 10³ meters?
   a) kilometer
   b) millimeter
   c) centimeter
   d) megameter
   e) decimeter

5.4) How many moles of water are in 36.0 g of H₂O? (At. Wt. H=1.0 amu; O=16.0 amu)
   a) 1.0 moles
   b) 2.0 moles
   c) 0.5 moles
   d) 4.0 moles
   e) 10.0 moles

5.5) How many protons and neutrons are in the isotope \(^{14}\text{C}\)?
   a) 14p, 6n
   b) 6p, 14n
   c) 14p, 20n
   d) 6p, 8n
   e) 8p, 6n
**Freshman Chemistry Core SLO Assessment Device**

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Freshman Chemistry Core SLO Assessment Device

Please answer the questions on the attached answer sheet. There are 25 questions. Three of the questions require written answers (3.1, 3.4, and 3.5). Please answer these three questions in the space provided. Write legibly.

CHEM 1030
SLO 10-1 Historical Perspective

1.1) Niels Bohr is most closely associated with which of the following areas:
   a) Electrochemistry
   b) Thermochemistry/Thermodynamics
   c) Acid/Base Chemistry
   d) Quantum Mechanics
   e) Atomic Structure

1.2) The name Brønsted is most closely associated with which of the following areas:
   a) Electrochemistry
   b) Thermochemistry/Thermodynamics
   c) Acid/Base Chemistry
   d) Quantum Mechanics
   e) Atomic Structure

1.3) The name Boyle is most closely associated with which of the following areas:
   a) Electrochemistry
   b) Thermochemistry/Thermodynamics
   c) Acid/Base Chemistry
   d) Quantum Mechanics
   e) Atomic Structure

1.4) Term Hess’s Law is most closely associated with which of the following areas:
   a) Electrochemistry
   b) Thermochemistry/Thermodynamics
   c) Acid/Base Chemistry
   d) Quantum Mechanics
   e) Atomic Structure

1.5) The name Rutherford is most closely associated with which of the following areas:
   a) Electrochemistry
   b) Thermochemistry/Thermodynamics
   c) Acid/Base Chemistry
   d) Quantum Mechanics
   e) Atomic Structure
SLO 10-2 Scientific Method

2.1) Please provide the correct answer:
   a) Collecting data, forming a hypothesis, designing a test, and forming a theory.
   b) Collecting data, forming a theory, designing a test, and forming a hypothesis.
   c) Collecting data, forming a theory, designing a test, and establishing a law.
   d) Forming a theory, collecting data to support theory, and establishing a law.
   e) Forming a theory, collecting data to support theory, and forming a hypothesis.

2.2) Choose the correct association
    Law
    a) Tentative explanation of an observation
    b) Tested hypothesis
    c) Belief
    d) Relationship that hold true in all experiments

2.3) Choose the correct association
    Theory
    a) Tentative explanation of an observation
    b) Tested hypothesis
    c) Belief
    d) Relationship that hold true in all experiments

2.4) Choose the correct association
    Hypothesis
    a) Tentative explanation of an observation
    b) Tested hypothesis
    c) Belief
    d) Relationship that hold true in all experiments

2.5) Argon dating of rock shows an age of 4 million years. If bone is bedded in the rock, this shows the bone is also 4 million years old.
    a) True
    b) False
3.1) Explain the difference between precision and accuracy.

3.2-5) The following questions refer to the plot below of the mass of precipitate \((\text{Ag}_2\text{CO}_3)\) found as a function of the initial concentrations of both \(\text{AgNO}_3\) and \(\text{Li}_2\text{CO}_3\).

3.2) Identify the species that are soluble
a) \(\text{Li}_2\text{CO}_3, \text{AgNO}_3, \text{LiNO}_2, \text{Ag}_2\text{CO}_3\)
b) \(\text{Li}_2\text{CO}_3, \text{AgNO}_3, \text{LiNO}_2\)
c) \(\text{Li}_2\text{CO}_3, \text{AgNO}_3\)
d) \(\text{Ag}_2\text{CO}_3\)
e) \(\text{LiNO}_2\)

3.3) The dashed line indicates the amount of precipitate when
a) \(\text{Li}_2\text{CO}_3\) is the limiting reagent
b) \(\text{AgNO}_3\) is the limiting reagent
d) \(\text{Ag}_2\text{CO}_3\) is the limiting reagent
e) \(\text{LiNO}_2\) is the limiting reagent

3.4) The data you actually used in lab was the average of the results of multiple students. Explain why it is better to use an average rather than the results of just one student.

3.5) When calculating the average value, must all data point be used? If not what criterion may be used to justify ignoring one student’s value?
SLO #10-4 Social Impact

Evaluate the extent to which you think the following statements are true.

4.1) Having taken this course has enhanced my ability to make informed decisions regarding Global Warming/Climate Change
   a) Strongly agree
   b) Agree
   c) No difference
   d) Disagree
   e) Strongly disagree

4.2) Having taken this course has enhanced my ability to make informed decisions regarding challenge of acid rain.
   a) Strongly agree
   b) Agree
   c) No difference
   d) Disagree
   e) Strongly disagree

4.3) Having taken this course has enhanced my ability to make informed decisions regarding regulation of chemical pollutants.
   a) Strongly agree
   b) Agree
   c) No difference
   d) Disagree
   e) Strongly disagree

4.4) Having taken this course has enhanced my ability to make informed decisions regarding transportation fuels (i.e. ethanol, electricity, hydrogen).
   a) Strongly agree
   b) Agree
   c) No difference
   d) Disagree
   e) Strongly disagree

4.5) Having taken this course has enhanced my ability to make informed decisions regarding government of science.
   a) Strongly agree
   b) Agree
   c) No difference
   d) Disagree
   e) Strongly disagree
SLO #10-5 Demonstrate understanding of science

5.1) What is the formula for sodium sulfate?
   a) NaS  
   b) NaSO₃  
   c) Na₂SO₄  
   d) NaSO₄  
   e) NaSO

5.2) What is the correct stoichiometry for the reaction
      \[ \text{a } C_2H_4 + \text{b } O_2 \rightarrow \text{c } CO_2 + \text{d } H_2O \]
      a) \text{abcd}= 1111  
      b) \text{abcd}= 2222  
      c) \text{abcd}= 1212  
      d) \text{abcd}= 1322  
      e) \text{abcd}= 2121

5.3) What is the unit for \(10^3\) meters?
   a) kilometer  
   b) millimeter  
   c) centimeter  
   d) megameter  
   e) decimeter

5.4) How many moles of water are in 36.0 g of H₂O? (At. Wt. H=1.0 amu; O=16.0 amu)
   a) 1.0 moles  
   b) 2.0 moles  
   c) 0.5 moles  
   d) 4.0 moles  
   e) 10.0 moles

5.5) How many protons and neutrons are in the isotope \(^{14}\text{C}\)?
   a) 14p, 6n  
   b) 6p, 14n  
   c) 14p, 20n  
   d) 6p, 8n  
   e) 8p, 6n
Freshman Chemistry Core SLO Assessment Device

Name: _______________________________ Date: ______________________________

Lab: _______________________________ Lab TA: ______________________________

SLO #10-1
1.1. ______ 1.2. ______ 1.3. ______ 1.4. ______ 1.5. ______

SLO #10-2
2.1. ______ 2.2. _____ 2.3. _____ 2.4. _____ 2.5. _____

SLO #10-3
3.1.

3.2. _____ 3.3. ______

3.4.

3.5.

SLO #10-4
4.1. _____ 4.2. _____ 4.3. _____ 4.4. _____ 4.5. _____

SLO #10-5
5.1. _____ 5.2. _____ 5.3. _____ 5.4. _____ 5.5. _____
Freshman Chemistry Core SLO Assessment Device

Please answer the questions on the attached answer sheet. There are 25 questions. Three of the questions require written answers (3.1, 3.4, and 3.5). Please answer these three questions in the space provided. Write legibly.

**CHEM 1127**
SLO 10-1 Historical Perspective

1.1) The name Faraday is most closely associated with which of the following areas:
   a) Electrochemistry
   b) Thermochemistry
   c) Acid/Base Chemistry
   d) Quantum Mechanics
   e) Equilibrium

1.2) The name Gibbs is most closely associated with which of the following areas:
   a) Electrochemistry
   b) Thermochemistry
   c) Acid/Base Chemistry
   d) Quantum Mechanics
   e) Equilibrium

1.3) Le Chatelier's Principle is most closely associated with which of the following areas:
   a) Electrochemistry
   b) Thermochemistry
   c) Acid/Base Chemistry
   d) Quantum Mechanics
   e) Equilibrium

1.4) Henry's Law is most closely associated with which of the following areas:
   a) Electrochemistry
   b) Thermochemistry
   c) Acid/Base Chemistry
   d) Quantum Mechanics
   e) Equilibrium

1.5) The name G.N Lewis is most closely associated with which of the following areas:
   a) Electrochemistry
   b) Thermochemistry
   c) Acid/Base Chemistry
   d) Quantum Mechanics
   e) Equilibrium
SLO 10-2 Scientific Method

2.1) Please provide the correct answer:
   a) Collecting data, forming a hypothesis, designing a test, and forming a theory.
   b) Collecting data, forming a theory, designing a test, and forming a hypothesis.
   c) Collecting data, forming a theory, designing a test, and establishing a law.
   d) Forming a theory, collecting data to support theory, and establishing a law.
   e) Forming a theory, collecting data to support theory, and forming a hypothesis.

2.2) Choose the correct association
   Law
   a) Tentative explanation of an observation
   b) Tested hypothesis
   c) Belief
   d) Relationship that hold true in all experiments

2.3) Choose the correct association
   Theory
   a) Tentative explanation of an observation
   b) Tested hypothesis
   c) Belief
   d) Relationship that hold true in all experiments

2.4) Choose the correct association
   Hypothesis
   a) Tentative explanation of an observation
   b) Tested hypothesis
   c) Belief
   d) Relationship that hold true in all experiments

2.5) Argon dating of rock shows an age of 4 million years. If bone is bedded in the rock, this shows the bone is also 4 million years old.
   a) True
   b) False
3.1) Explain the difference between precision and accuracy.

3.2-5) The following questions refer to the plot below of the mass of precipitate (Ag$_2$CO$_3$) found as a function of the initial concentrations of both AgNO$_3$ and Li$_2$CO$_3$.

![Graph showing mass of precipitate (Ag$_2$CO$_3$) as a function of moles of Li$_2$CO$_3$ and AgNO$_3$.]

3.2) Identify the species that are soluble
   a) Li$_2$CO$_3$, AgNO$_3$, LiNO$_2$, Ag$_2$CO$_3$
   b) Li$_2$CO$_3$, AgNO$_3$, LiNO$_2$
   c) Li$_2$CO$_3$, AgNO$_3$
   d) Ag$_2$CO$_3$
   e) LiNO$_2$

3.3) The dashed line indicates the amount of precipitate when
   a) Li$_2$CO$_3$ is the limiting reagent
   b) AgNO$_3$ is the limiting reagent
   d) Ag$_2$CO$_3$ is the limiting reagent
   e) LiNO$_2$ is the limiting reagent

3.4) The data you actually used in lab was the average of the results of multiple students. Explain why it is better to use an average rather than the results of just one student.

3.5) When calculating the average value, must all data points be used? If not what criterion may be used to justify ignoring one student’s value?
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   e) 8p, 6n
10. CCGEC Comments:

Although the CHEM faculty "agree that the SLOs are a waste of time," it would seem that they should value the importance of understanding the scientific method (SLO 10.2) and interpreting data (SLO 10.3). The students only answered that question correctly 56% percent of the time. Instead of separate assessment exams, is it possible that 5-8 questions on regular exams be associated with the measures and these evaluated for assessment?