Chem 1C Grading Notes

EXAMS

The following table explains how exam grades were calculated from raw scores.

<table>
<thead>
<tr>
<th>EXAM</th>
<th># PROBLEMS</th>
<th>POINTS / PROBLEM</th>
<th>EFFECTIVE MAXIMAL GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm 1</td>
<td>20</td>
<td>5</td>
<td>100 out of 100</td>
</tr>
<tr>
<td>Midterm 2</td>
<td>22</td>
<td>5</td>
<td>110 out of 100</td>
</tr>
<tr>
<td>Final</td>
<td>30</td>
<td>3.5</td>
<td>105 out of 100</td>
</tr>
</tbody>
</table>

The second midterm and the final exam made it possible to score more than 100% (10% effective bonus in the second midterm and 5% effective bonus in the final exam).

For example, if you solved everything on all three exams, your effective percent grades are:
- Midex1% = 100%
- Midex2% = 110%
- Finex% = 105%

and if you missed two problems on each exam, your effective percent grades are:
- Midex1% = 90%
- Midex2% = 100%
- Finex% = 98%

etc.

MCWEB

The maximal number of points you could get in McWeb if you solved everything correctly was 336 (28 assignments times 12 points each).

The effective homework percent grade is calculated as follows

Homework% = (your cumulative points * 100%) / 336

OVERALL PERCENT GRADE

The overall grade is calculated based on weights:
- Homework Problems = 10%
- Midterm Exam I = 20%
- Midterm Exam II = 30%
- Final Exam = 40%

Percent Grade = 0.10*Homework% + 0.20*MidEx1% + 0.30*MidEx2% + 0.40*Final%
FINAL EXAM GRADING NOTES

Read these notes before coming to my office hours or e-mailing me!

Grader’s notes (circled):
+1 = solved correctly
* IA = incorrect answer; also used if the answer is correct but the solution is not
* ISF = incorrect number of significant figures
* IU = incorrect or missing units
* NA = no answer
* NS = so solution

The following problems presented difficulties to most students:

<table>
<thead>
<tr>
<th>Exam Version</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem #</td>
<td>1</td>
<td>4</td>
<td>25</td>
<td>28</td>
</tr>
</tbody>
</table>

Determine the rate law and the rate constant for the following reaction based on the information provided in the table below: \( \text{H}_2 (\text{g}) + \text{Cl}_2 (\text{g}) \rightarrow 2 \text{HCl (g)} \)

Notes: Some people got punished for writing things like \( x=1; y=0 \) without explaining what \( x \) and \( y \) pertain to, or writing the rate law as “Rate = \( k[A] \)” without explaining what “\( A \)” stands for.

<table>
<thead>
<tr>
<th>Exam Version</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem #</td>
<td>5</td>
<td>26</td>
<td>29</td>
<td></td>
</tr>
</tbody>
</table>

Balance the following redox reaction in an acidic solution: \( \text{BrO}_3^- + \text{Fe}^{2+} \rightarrow \text{Br}_2 + \text{Fe}^{3+} \)

Notes: Some people had electrons included in their “balanced” equation and/or wrong stoichiometric coefficients.

<table>
<thead>
<tr>
<th>Exam Version</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem #</td>
<td>6</td>
<td>30</td>
<td>24</td>
<td></td>
</tr>
</tbody>
</table>

The rate constant for the following reaction is equal to \( k = 2.0 \times 10^7 \text{ s}^{-1} \) at room temperature. At higher temperatures, the value of \( k \) increases. What can you definitively conclude based on this information?

\[ \text{CH}_2\text{O (g)} \rightarrow \text{H}_2 (\text{g}) + \text{CO (g)} \]

___A. this reaction is exothermic
___B. this reaction is endothermic
___C. this reaction is irreversible
___D. this reaction is spontaneous

X E. this reaction has a positive activation energy
___F. this is a second-order reaction
___G. none of the above

Notes: The correct answer here is “E”. Reaction rate constant depends on temperature exponentially, with activation energy (and not the heat of the reaction!) sitting right in the exponent. Arrhenius equation.

<table>
<thead>
<tr>
<th>Exam Version</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem #</td>
<td>11</td>
<td>8</td>
<td>23</td>
<td>17</td>
</tr>
</tbody>
</table>

A certain weak base is titrated with a strong acid. The pH of the initial solution of the unknown base is 8.00. The equivalence point is reached after 250 mL of 0.10 \( M \) HCl solution is added to 250 mL solution of the unknown base. What is the value of \( pK_b \) of the unknown base?
Notes: Very few people got the correct answer here. This was the most difficult problem in the exam, in my opinion. It is a combined titration and hydrolysis problem. The correct answer is pKb=11.0.

<table>
<thead>
<tr>
<th>Exam Version</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem #</td>
<td>21</td>
<td>24</td>
<td>9</td>
<td>3</td>
</tr>
</tbody>
</table>

Write the overall reaction, identify reaction intermediate(s), and predict the rate law for the process with the following reaction mechanism:

\[
\begin{align*}
    H_2 + NO &\rightarrow H_2O + N \quad \text{(slow)} \\
    N + NO &\rightarrow N_2 + O \quad \text{(fast)} \\
    O + H_2 &\rightarrow H_2O \quad \text{(fast)}
\end{align*}
\]

Notes: The most common mistake was to write the rate law as

\[
\text{Rate} = k[H_2]^x[NO]^y \quad \text{(incorrect because x and y are not specified)}
\]

instead of:

\[
\text{Rate} = k[H_2] \ [NO]
\]

Another common mistake was in the overall reaction equation. It is obtained by summing up all the elementary steps.

<table>
<thead>
<tr>
<th>Exam Version</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem #</td>
<td>23</td>
<td>20</td>
<td>11</td>
<td>14</td>
</tr>
</tbody>
</table>

The partial pressure of each gas is 0.150 atm at equilibrium at T = 350 K. Calculate the equilibrium constant \(K_C\) for this reaction.

\[
\text{NH}_4\text{HS} (s) \rightleftharpoons \text{NH}_3 (g) + \text{H}_2\text{S} (g)
\]

Notes: This is the third time this type of problem appears on the exam, and a lot of students still do not get the answer right. Some people just calculated \(K_p\) and stopped. Others did not convert \(K_p\) into \(K_c\) correctly.

<table>
<thead>
<tr>
<th>Exam Version</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem #</td>
<td>26</td>
<td>29</td>
<td>2</td>
<td>8</td>
</tr>
</tbody>
</table>

Will a precipitate form out of solution containing \(1.00 \times 10^{-3} \text{ M}\) \(\text{Zn}^{2+}\) at \(\text{pH} = 9.0\)? Assume the solubility product of \(K_{sp} = 1.8 \times 10^{-14}\) for \(\text{Zn(OH)}_2\). Note: this is NOT a multiple choice answer; solution is required. **READ THIS:** A LOT of people provided “yes” as an answer to this problem but did not calculate the \(Q\) correctly or did another conceptual mistake in the calculation. All of them got *IA* (incorrect answer) as a result. If you believe that your calculation was in fact correct feel free to let me know.

<table>
<thead>
<tr>
<th>Exam Version</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem #</td>
<td>27</td>
<td>30</td>
<td>3</td>
<td>9</td>
</tr>
</tbody>
</table>

What is the voltage of a cell made up from \(\text{Zn/Zn}^{2+}\) and \(\text{Cu/Cu}^{2+}\) half-cells at \(25^\circ\text{C}\) when the electrochemical reaction

\[
\text{Cu}^{2+} + \text{Zn} (s) \rightleftharpoons \text{Cu} (s) + \text{Zn}^{2+}
\]

reaches complete equilibrium? The initial concentrations of \(\text{Zn}^{2+}\) and \(\text{Cu}^{2+}\) are 0.5 \(\text{M}\) and 0.7 \(\text{M}\), respectively. The standard reduction potentials are given in table below. Report your answer in **volts**. **Notes:** There was no calculation to be done in the problem. The answer is simple: “As the cell is at equilibrium the cell voltage must be 0 V”. Everyone who was trying to calculate something and/or ended up with non-zero answer lost points here.