1. Hypochlorous acid, HOCl, is used as a disinfectant for drinking water and is a weak acid with a $K_a = 3.0 \times 10^{-8}$ in pure water at $25^\circ C$. Calculate the pH of a 0.020 M solution. (8)

What is the percent dissociation of the 0.020 M HOCl solution? (4)

If hydrochloric acid, HCl (aq), was added to the HOCl solution above, what would happen to the percent dissociation of hypochlorous acid? Explain. (2)

Would HOCl be more or less dissociated in seawater, 0.5 M NaCl? Why? (2)

The dissociation reaction of HOCl is probably an endothermic reaction. Why? (2)

Where is the dissociation of HOCl greater in water at $3^\circ C$ or $75^\circ C$? Explain. (2)
2. Here is the acid distribution diagram for a weak acid, HA, with a $K_a = 3.17 \times 10^{-6}$. The general rule of thumb used by chemists is that a good buffer involves a weak acid and its salt in the pH range of $pK_a \pm 1$. Shade in red the area on the diagram below that indicates this rule. (10)

What are the limits of the salt/acid ratio for this general rule of thumb? Explain how you determined this.

3. Laundry bleach, such as Clorox®, is a salt solution of 0.75M NaOCl. Calculate the pH of bleach. $K_a$ for HOCl = $3.0 \times 10^{-8}$ (8)

What is the percent hydrolysis for the 0.75M NaOCl solution? (4)

If Drano, NaOH, was added to the bleach, what happens to the percent hydrolysis? Explain. (3)
4. Consider the titration curve given below to address the questions. (25)

What is being titrated? Explain your choice.

Place an X on the equivalence point.

What information does the first derivative provide?

The three boxes on the graph are indicator color change ranges. Which indicator works for this titration?

a  b  c

What is the $K_a$ of the acid? ______________

What is present in the solution being titrated at the volumes of titrant listed in the table?

<table>
<thead>
<tr>
<th>Volume of titrant</th>
<th>List all substances</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 mL</td>
<td></td>
</tr>
<tr>
<td>3 mL</td>
<td></td>
</tr>
<tr>
<td>10 mL</td>
<td></td>
</tr>
<tr>
<td>14 mL</td>
<td></td>
</tr>
<tr>
<td>18 mL</td>
<td></td>
</tr>
</tbody>
</table>

Why is the equivalence point pH alkaline?