INSTRUCTIONS: Use a soft, #2 pencil. Your marks must be dark to be counted correctly. Bubble in Form A on your Scantron Form. Write your perm number and bubble in your perm number. Correct perm = 2 points!

Each question is worth 2 points, you will not lose more than 2 points for incorrect answers.

1. For the following reaction $K = 7.00 \times 10^{-5}$ at $675\, K$.

$$\text{NH}_4\,\text{I (s)} \rightleftharpoons \text{NH}_3\,\text{(g)} + \text{HI (g)}$$

After equilibrium was established, the volume was increased by a factor of two. As a result,

a) The reaction shifts to the left
b) The reaction shifts to the right
  
Answers are included at the end of the quiz.

c) No shift in the reaction

2. A HIGHER value of “a” in the van der Waals equation of state means that

a) the gas behaves MORE like an ideal gas
b) the gas behaves LESS like an ideal gas
c) the gas must be a noble gas
d) the gas behaves exactly like an ideal gas

3. A solution is prepared by adding 20.0 mL of 0.10 M NaOH to 30.0 mL of 0.20 M HCl. Calculate the concentration of H$^+$ in this solution.

a) 0.08 M
b) 0.12 M
c) 0.16 M
d) 0.04 M
e) 0.14 M

4. Calculate the pH of a 1.0 M HNO$_2$ solution. ($K_a = 4.6 \times 10^{-4}$ for HNO$_2$)

a) 5.3
b) 1.0
c) 1.7
d) 12.3
e) 8.7

5. A 0.1 M aqueous solution of the salt NH$_4$Cl is made. Will the solution be acidic, basic or neutral?

a) acidic
b) basic
c) neutral
6. A 0.1 M aqueous solution of the salt NH₄CN is made. Will the solution be acidic, basic or neutral?
   a) acidic
   b) basic
   c) neutral

7. A 0.1 M aqueous solution of the salt KNO₃ is made. Will the solution be acidic, basic or neutral?
   a) acidic
   b) basic
   c) neutral

8. Calculate the pH of a 1.0 M NaNO₂ solution.
   a) 5.3
   b) 1.0
   c) 1.7
   d) 12.3
   e) 8.7

9. List the **major species** present in a 1.0 M solution of HNO₃.
   a) HNO₃, NO₃⁻, H⁺, H₂O
   b) NO₃⁻, H⁺, H₂O
   c) NO₃⁻, H⁺, OH⁻, H₂O
   d) HNO₃, H₂O
   e) HNO₃, NO₃⁻, H⁺, OH⁻, H₂O

<table>
<thead>
<tr>
<th>Acid</th>
<th>HA</th>
<th>A⁻</th>
<th>(K_a)</th>
<th>p (K_a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrochloric</td>
<td>HCl</td>
<td>Cl⁻</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitric</td>
<td>HNO₃</td>
<td>NO₃⁻</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hydronium ion</strong></td>
<td>(H_3O^+)</td>
<td>(H_2O)</td>
<td>1</td>
<td>0.0</td>
</tr>
<tr>
<td>Hydrofluoric</td>
<td>HF</td>
<td>F⁻</td>
<td>6.6 x 10⁻⁴</td>
<td>3.18</td>
</tr>
<tr>
<td>Nitrous</td>
<td>HNO₂</td>
<td>NO₂⁻</td>
<td>4.6 x 10⁻⁴</td>
<td>3.34</td>
</tr>
<tr>
<td>Acetic</td>
<td>CH₃COOH</td>
<td>CH₃COO⁻</td>
<td>1.76 x 10⁻⁵</td>
<td>4.75</td>
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<tr>
<td>Carbonic (1)</td>
<td>H₂CO₃</td>
<td>HCO₃⁻</td>
<td>4.3 x 10⁻⁷</td>
<td>6.37</td>
</tr>
<tr>
<td>Hydrocyanic</td>
<td>HCN</td>
<td>CN⁻</td>
<td>6.17 x 10⁻¹⁰</td>
<td>9.21</td>
</tr>
<tr>
<td>Ammonium ion</td>
<td>NH₄⁺</td>
<td>NH₃</td>
<td>5.6 x 10⁻¹⁰</td>
<td>9.25</td>
</tr>
<tr>
<td>Carbonic (2)</td>
<td>HCO₃⁻</td>
<td>CO₃²⁻</td>
<td>4.8 x 10⁻¹¹</td>
<td>10.32</td>
</tr>
<tr>
<td><strong>Water</strong></td>
<td>H₂O</td>
<td>OH⁻</td>
<td>1.0 x 10⁻¹⁴</td>
<td>14.00</td>
</tr>
</tbody>
</table>

\[
pH = -\log [H^+] \quad [H^+] = 10^{-pH}
\]

\[
K_w = 1 \times 10^{-14} \quad \text{at} \ 25^\circ C \quad K_w = [OH^-][H^+] \quad K_w = K_aK_b
\]

**ANSWERS:**
1. b
2. b
3. a
4. c
5. a
6. b
7. c
8. e
9. b