Use the back of this sheet to show your work for the problems on the screen. All answers should be in scientific notation. Pay attention to significant figures.

<table>
<thead>
<tr>
<th>Number</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOG_{10} 1E###</td>
<td>0.30</td>
<td>0.48</td>
<td>0.60</td>
<td>0.70</td>
<td>0.79</td>
<td>0.85</td>
<td>0.90</td>
<td>0.95</td>
</tr>
</tbody>
</table>

### Chemical Equilibrium

**Equation:**

\[ k_{H,cp} = \frac{c_{aq}}{P_{gas}} \]

**Dimension:**

\[ \text{mol}_{{gas}} \cdot \text{L}_{{soln} \cdot \text{atm}} \]

<table>
<thead>
<tr>
<th>Acid</th>
<th>Reaction</th>
<th>pK_a</th>
</tr>
</thead>
<tbody>
<tr>
<td>hydrofluoric acid</td>
<td>HF ⇌ H^+ + F</td>
<td>3.17</td>
</tr>
<tr>
<td>carbonic acid</td>
<td>H_2CO_3 ⇌ H^+ + HCO_3^-</td>
<td>6.37</td>
</tr>
<tr>
<td>bicarbonate</td>
<td>HCO_3^- ⇌ H^+ + CO_3^2^-</td>
<td>10.25</td>
</tr>
<tr>
<td>bisulfate</td>
<td>HSO_4^- ⇌ H^+ + SO_4^2^-</td>
<td>1.99</td>
</tr>
<tr>
<td>ammonium</td>
<td>NH_4^+ ⇌ H^+ + NH_3</td>
<td>9.24</td>
</tr>
<tr>
<td>hydrogen sulfide</td>
<td>H_2S ⇌ H^+ + HS</td>
<td>7.0</td>
</tr>
<tr>
<td>water</td>
<td>H_2O ⇌ H^+ + HO^-</td>
<td>15.74</td>
</tr>
<tr>
<td>ammonia</td>
<td>NH_3 ⇌ H^+ + NH_2^-</td>
<td>38</td>
</tr>
</tbody>
</table>

### Solubility Product Constants

<table>
<thead>
<tr>
<th>Formula</th>
<th>K_sp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al(OH)_3</td>
<td>3 x 10^{-34}</td>
</tr>
<tr>
<td>AlPO_4</td>
<td>9.84 x 10^{-21}</td>
</tr>
<tr>
<td>BaCO_3</td>
<td>2.58 x 10^{-9}</td>
</tr>
<tr>
<td>CaCO_3</td>
<td>3.36 x 10^{-9}</td>
</tr>
<tr>
<td>CaCO_3</td>
<td>6.0 x 10^{-9}</td>
</tr>
<tr>
<td>Ca(OH)_2</td>
<td>5.02 x 10^{-6}</td>
</tr>
<tr>
<td>FeCO_3</td>
<td>3.13 x 10^{-11}</td>
</tr>
<tr>
<td>FeS</td>
<td>8 x 10^{-19}</td>
</tr>
</tbody>
</table>

### pK_a Values

- Ni^{2+} 11
- Mn^{2+} 10
- Fe^{2+} 9
- Co^{2+} 8
- Cu^{2+} 7
- Cr^{2+} 6
- V^{2+} 5

**Ionic Radii (nm):**

0.06 0.07 0.08 0.09