AP Chemistry: Particulate Level Review

For each requested picture (particle view, microscopic view) use circles to represent the atoms (unless otherwise indicated. Different colors should be used to represent different elements.

1) Draw microscopic views (particle views) for each of the following. Each picture should have a minimum of 5 particles.

- Diatomic elemental gas
- A mixture of a diatomic gas and a monatomic gas
- A mixture of a gaseous element and a gaseous compound
- An aqueous solution of an ionic compound.

2) Consider the reaction between NO\(_{(g)}\) and O\(_2(g)\)

   a) In the box below, show 6 NO molecules and 6 O\(_2\) molecules.

   ![Diagram of NO and O\(_2\) molecules]

   The reaction proceeds to form NO\(_2(g)\).

   b) Write the balanced chemical equation for the reaction: \( 2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2 \)

   c) In the box to the right, draw the molecular representation after the reaction has gone to completion.

   d) Which substance is the limiting reactant? Justify your answer.

   \( \text{NO} \rightarrow \text{Coefficient Ratio} \)
   \( \text{NO} : \text{O}_2 : 2:1 \)

3) A) Draw structural formulas to represent the Bronsted-Lowry acid-base reaction between HF and H\(_2\)O.

   \( \text{H}^-\text{F}^- + \text{H}_2\text{O} \rightarrow \text{F}^- + \text{H}^+\text{O}^-\text{H} \)

   B) Draw structural formulas to represent the Bronsted-Lowry acid-base reaction between HF and OH\(^-\):

   \( \text{F}^- + \text{H}^+\text{O}^-\text{H} \rightarrow \text{F}^- + \text{H}^-\text{O}^-\text{H} \)
4) For the mixture of gases represented below, the total pressure is 1.5 atm. Calculate the partial pressure of each gas.

\[ P_A = \frac{5}{15} \times 1.5 = 0.5 \text{ atm} \]
\[ P_B = \frac{6}{15} \times 1.5 = 0.6 \text{ atm} \]
\[ P_C = \frac{4}{15} \times 1.5 = 0.4 \text{ atm} \]

\[ \text{At } P_A = P_T \]

5) For the weak acid, HA being titrated with a strong base (OH⁻) draw molecule pictures (in AP speak: particulate view or microscopic view) to show the progress of the titration. In the bottom row, compare the concentration of HA and A⁻ as modeled in the initial column. The best diagrams would show the sodium ion floating around, but they just complicate the picture.

Please start with 8 acid molecules.

<table>
<thead>
<tr>
<th>Initial</th>
<th>Before ½ way pt.</th>
<th>At ½ way point</th>
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<tbody>
<tr>
<td><img src="image1.png" alt="Molecule diagram" /></td>
<td><img src="image2.png" alt="Molecule diagram" /></td>
<td><img src="image3.png" alt="Molecule diagram" /></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>[HA] &gt;&gt; [A⁻]</th>
<th>[HA] ≥ [A⁻]</th>
<th>[HA] ≈ [A⁻]</th>
</tr>
</thead>
</table>

Line is for >, <, or =

<table>
<thead>
<tr>
<th>After ½ way point</th>
<th>Equivalence point</th>
<th>After equivalence point</th>
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<tbody>
<tr>
<td><img src="image4.png" alt="Molecule diagram" /></td>
<td><img src="image5.png" alt="Molecule diagram" /></td>
<td><img src="image6.png" alt="Molecule diagram" /></td>
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</tbody>
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<tr>
<th>[HA] ≤ [A⁻]</th>
<th>[HA] ≤≤ [A⁻]</th>
<th>[HA] ≤≤≤ [A⁻]</th>
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6) In the boxes below
   a) Draw a particle view of lead (II) nitrate solution.
   b) Draw the particle view of the reaction mixture after the two solutions are mixed. Justify your answer.

   | 10 mL 0.10 M KI               | 10 mL 0.10 M Pb(NO₃)₂ | After mixing |
   | Iodide ion | Potassium ion |
   |  |  |

7) a) Write the equation for the reaction between N₂ and O₂ to form NO₂ gas: \[ \text{N}_2 + \text{O}_2 \rightarrow 2 \text{NO}_2 \]
   b) Assume that 33% of the oxygen gas reacts to attain equilibrium. Draw the particle diagram for the equilibrium mixture.
   c) Based on the particle diagram, is \( K \) greater or less than 1? Justify your answer.

\[ K = \frac{[\text{N}_2\text{O}_2]^2}{[\text{N}_2][\text{O}_2]^2} = \frac{2^2}{(5)(4)^2} = \frac{4}{40} = 0.1 \]

\[ \text{OR} \]

Less than \( \frac{1}{2} \) reactants react so \( K < 1 \)

33% of 6 = 2 react O₂
∴ 1 N₂ reacts