Ion Flame Test Inquiry

I. Pre-lab
   A. Purpose: To determine what part of a compound in household products is responsible for flame color in a flame test.

   B. Determining the Independent and Dependent variables:
      1. The Independent variable in this experiment is ________________________.
      2. The Dependent variable in this experiment is ________________________.

   C. Write a problem statement:
      1. How will the ______________________ (I.V.) effect the _____________________ (D.V.)?

   D. Decide on a hypothesis using the If/then format:
      1. ____________________________________________
         ____________________________________________

II. During Lab:
   A. The experiment:
      1. Place a small amount of the solid compounds on an evaporating dish.
      2. Add 2 mL of methanol to dissolve the solid.
      3. Light a match and ignite the methanol.
      4. Watch the flame color and observe any changes from the control.
B. Data and Observations

<table>
<thead>
<tr>
<th>Household Product</th>
<th>Compound Formula</th>
<th>Positive Ion</th>
<th>Negative Ion</th>
<th>Flame test color</th>
<th>What ion causes color?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control ??</td>
<td>CH₃OH</td>
<td>None</td>
<td>None</td>
<td>blue</td>
<td>None</td>
</tr>
<tr>
<td>Antacid tablets</td>
<td>CaCO₃</td>
<td>Ca²⁺</td>
<td>CO₃⁻²</td>
<td>Red-orange</td>
<td></td>
</tr>
<tr>
<td>Eyewash</td>
<td>H₃BO₃</td>
<td>None</td>
<td>None</td>
<td>green</td>
<td></td>
</tr>
<tr>
<td>Plaster of Paris</td>
<td>CaSO₄</td>
<td>Ca²⁺</td>
<td>SO₄⁻²</td>
<td>Red-orange</td>
<td></td>
</tr>
<tr>
<td>Cream of Tartar</td>
<td>KC₄H₅O₆</td>
<td>K⁺</td>
<td>C₄H₅O₆⁻¹</td>
<td>Pale purple</td>
<td></td>
</tr>
<tr>
<td>Epsom salt</td>
<td>MgSO₄</td>
<td>Mg²⁺</td>
<td>SO₄⁻²</td>
<td>Blue</td>
<td></td>
</tr>
<tr>
<td>De-icer</td>
<td>CaCl₂</td>
<td>Ca²⁺</td>
<td>Cl⁻¹</td>
<td>Red-orange</td>
<td></td>
</tr>
<tr>
<td>Salt substitute</td>
<td>KCl</td>
<td>K⁺</td>
<td>Cl⁻¹</td>
<td>pale purple</td>
<td></td>
</tr>
<tr>
<td>Detergent booster</td>
<td>Na₂CO₃</td>
<td>Na¹⁺</td>
<td>CO₃⁻²</td>
<td>Orange</td>
<td></td>
</tr>
<tr>
<td>Table salt</td>
<td>NaCl</td>
<td>Na¹⁺</td>
<td>Cl⁻¹</td>
<td>Orange</td>
<td></td>
</tr>
</tbody>
</table>

Other compounds tested:
- BaCl₂ Yellow/green
- SrCl₂ Red
- LiCl Magenta
- CuCl₂ Green
- CsCl Purple
III. Post-lab questions:
   A. Why is it important to test the flame color of the methanol without any compounds dissolved in it?

   B. Do the positive ions or the negative ions cause the change in flame color? Explain why based on your observations.

   C. Which of the compounds would be a good choice for making purple fireworks? What about green fireworks?

CHALLENGE QUESTIONS:
D. Potassium gluconate (formula = $K^+C_6H_{11}O_7^-$) produces a light purple flame. Copper (II) sulfate (formula = $Cu^{2+}SO_4^{2-}$) produces a green flame. What flame color would you expect for copper (II) gluconate (formula = $Cu^{2+}[C_6H_{11}O_7^-]_2$)? Explain.

E. How could you tell the following three white artificial sweetener powders apart using the flame test? You have:
   1. Equal ($C_{14}H_{18}N_2O_5$, a non-ionic compound)
   2. Ace-K ($K^+C_3H_4NO_4S^-$)
   3. Sweet 'N Low ($Ca^{2+}[C_7H_4NO_3S^-]_2$).

F. Boric acid is a molecular, non-ionic compound. Based on its flame test there is a color observed, but is this due to positive ions or negative ions? Why?

***TURN IN THESE ANSWERS IN ON A SEPARATE SHEET OF PAPER BY JANUARY 15th, 2008 TO WIN A PRIZE FOR CORRECT ANSWERS.***