1. (5 pts) For each of the bulk formulae given below, state
a) whether the compound is Ionic or Covalent
b) the formula(s) for the particles which are the “ultimate components” (i.e. the smallest units which make up this compound)

<table>
<thead>
<tr>
<th>FORMULA</th>
<th>IONIC/COVALENT</th>
<th>ULTIMATE COMPONENT(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H₄C₂O₂</td>
<td>COVALENT</td>
<td>H₂C₂O₂ molecules</td>
</tr>
<tr>
<td>K₂SO₄</td>
<td>IONIC</td>
<td>K⁺, SO₄²⁻ ions</td>
</tr>
<tr>
<td>CO₂</td>
<td>COVALENT</td>
<td>CO₂ molecules</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>IONIC</td>
<td>Fe²⁺, O²⁻ ions</td>
</tr>
</tbody>
</table>

2. (5 pts) The usual windshield washer cleaner in your car is a mixture of Water and Isopropyl Alcohol, C₃H₇OH (molecular weight = 60.08) which is usually listed on the label as 10.0%. Recalling that, in these circumstances, % is to be interpreted as grams of material per 100 ml of solution,
a) how much isopropyl alcohol, in grams, is present in a gallon of windshield washer? (you need to know that 1 gallon is equal to 3.785 liters)

\[
\text{mass of isopropyl alcohol} = \left( \frac{1.00 \text{ g}}{1 \text{ mL}} \right) \left( \frac{1000 \text{ mL}}{1 \text{ L}} \right) \times \frac{3.785 \text{ L}}{1 \text{ g}} = 378.5 \text{ g}
\]

b) If you decide that the windshield washer solution will work just as well as a 6.0% solution as the original 10.0% solution, and if you have on hand 2.0 L of windshield washer solution, explain HOW you would prepare a solution of 6% windshield washer solution?

\[
(10.0\%)(2.0 \text{ L}) = (6.0\%)(x)
\]

\[
x = \frac{3.3 \text{ L}}{1.3 \text{ L}}
\]

This is enough to prepare 3.3 L of 6.0% solution. Thus you would add 1.3 L water to the 10.0% solution to make the specified 6.0% solution.
3. (10 pts) 44.52 g of K₃PO₄ (MW = 212.0) are dissolved in water and brought to a final volume of 400.0 mL.

a) What solute particle(s) is/are present in this solution?

You have K⁺ ions and PO₄³⁻ ions.

b) What is/are their concentration, expressed in Molarity?

\[
\text{PO}_4^{3-} = \left( \frac{44.52 \text{ g K}_3\text{PO}_4}{212.0 \text{ g K}_3\text{PO}_4} \right) \left( \frac{1 \text{ K}_3\text{PO}_4}{1 \text{ K}_3\text{PO}_4} \right) \left( \frac{1 \text{ mole K}_3\text{PO}_4}{1 \text{ mole K}_3\text{PO}_4} \right) = 0.5250 \text{ M}
\]

\[
K^+ = \left( \frac{44.52 \text{ g K}_3\text{PO}_4}{212.0 \text{ g K}_3\text{PO}_4} \right) \left( \frac{1 \text{ K}_3\text{PO}_4}{6 \text{ K}^+} \right) \left( \frac{1 \text{ mole K}_3\text{PO}_4}{1 \text{ mole K}_3\text{PO}_4} \right) = 1.575 \text{ M K}^+
\]

c) If it were desired to prepare 600.0 mL of a solution whose concentration of potassium ion, K⁺ (AW = 39.00) is desired to be 0.153 M in K⁺, using K₃PO₄ (MW = 212.0) as the bulk chemical, explain

a) how much, in grams, of the parent compound K₃PO₄ is needed

\[
\text{K}_3\text{PO}_4 = \left( \frac{0.153 \text{ mmol K}^+}{\text{mL}} \right) \left( 0.600 \text{mL} \right) \left( \frac{1 \text{ K}_3\text{PO}_4}{212.0 \text{ g K}_3\text{PO}_4} \right) \left( \frac{1 \text{ g}}{1000 \text{ mL}} \right)
\]

\[
= 6.4872 \to 6.49 \text{ g K}_3\text{PO}_4
\]

b) HOW this solution is to be prepared in the laboratory.

Weigh out 6.49 g of K₃PO₄, dissolve in water, bring to a final volume of 600 mL. The resulting solution will have a K⁺ ion conc. of 0.153 M.

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