Calculations in percentage yield and atom economy

Video worksheet

1. **Synthesis of Aspirin (Acetylsalicylic Acid) takes place according to the reaction below.**
   $C_7H_6O_3$ (Salicylic Acid) + $C_4H_6O_3$ (Acetic Anhydride)→$C_9H_8O_4$ (Aspirin) + $C_2H_4O_2$ (Acetic Acid)

   Molecular weights: 138 g/mol (Salicylic Acid), 102 g/mol (Acetic Anhydride), 180 g/mol (Aspirin), 60 g/mol (Acetic Acid)

   If 5.0 grams of salicylic acid is placed in the reaction chamber to obtain 6.0 grams of acetylsalicylic acid, calculate the following, to the right number of significant figures.

   - Percentage yield for this step.

   - The atom economy for this reaction pathway.

2. Synthesis of Sulfuric Acid (Contact Process) takes place via two steps listed below.

   Step 1 - $2SO_2 + O_2 \rightarrow 2\ SO_3$

   Step 2 - $SO_3 + H_2O \rightarrow H_2SO_4$

   If 6.40 grams of sulfur dioxide is placed in the reaction vessel with excess oxygen to obtain 8.00 grams of sulfuric acid, calculate the following , to the right number of significant figures.
   Molecular weights: 64 g/mol (SO_2), 32 g/mol (O_2), 80 g/mol (SO_3), 18 g/mol (H_2O), 98 g/mol (H_2SO_4)

   - Percentage yield for the overall synthesis of H_2SO_4.

   - The atom economy for this reaction pathway.

3. **Synthesis of Benzocaine**

Step 1: $C_7H_5NO_4$ (Nitrobenzoic Acid) + $3H_2$ → $C_7H_7NO_2$ (Aminobenzoic Acid) + $2H_2O$

Step 2: $C_7H_7NO_2$ (Aminobenzoic Acid) + C_2H_6O (Ethanol) → $C_9H_{11}NO_2$ (Benzocaine) + H_2O

If 10.0 grams of nitrobenzoic acid yields 8 grams of benzocaine, calculate the following , to the right number of significant figures.
Molecular weights: 167.0 g/mol (Nitrobenzoic Acid), 137.0 g/mol (Aminobenzoic Acid), 46.0 g/mol (Ethanol), 165.0 g/mol (Benzocaine), 18.0 g/mol (Water)

- Percentage yield for the overall synthesis of benzocaine.

- The atom economy for the overall reaction pathway.