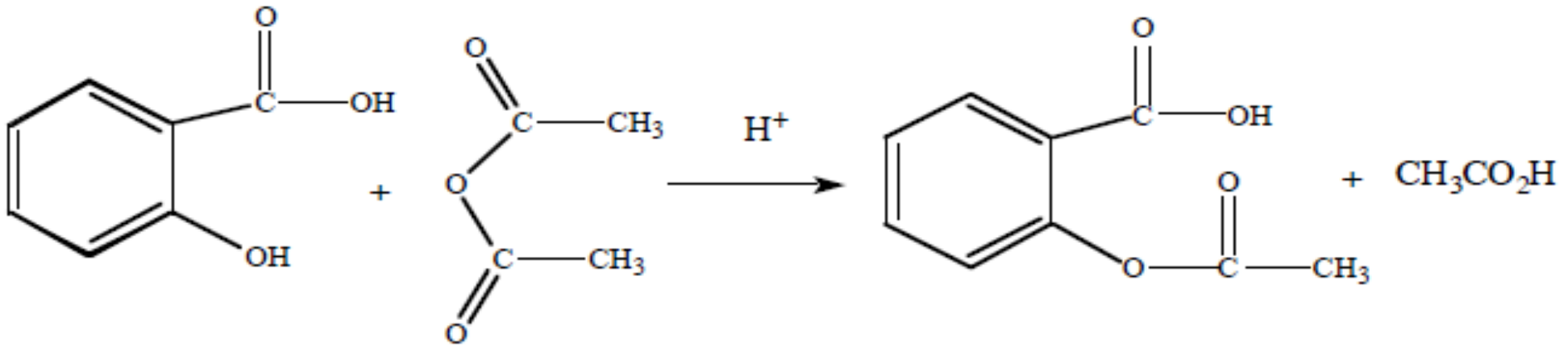
Aspirin Chemistry

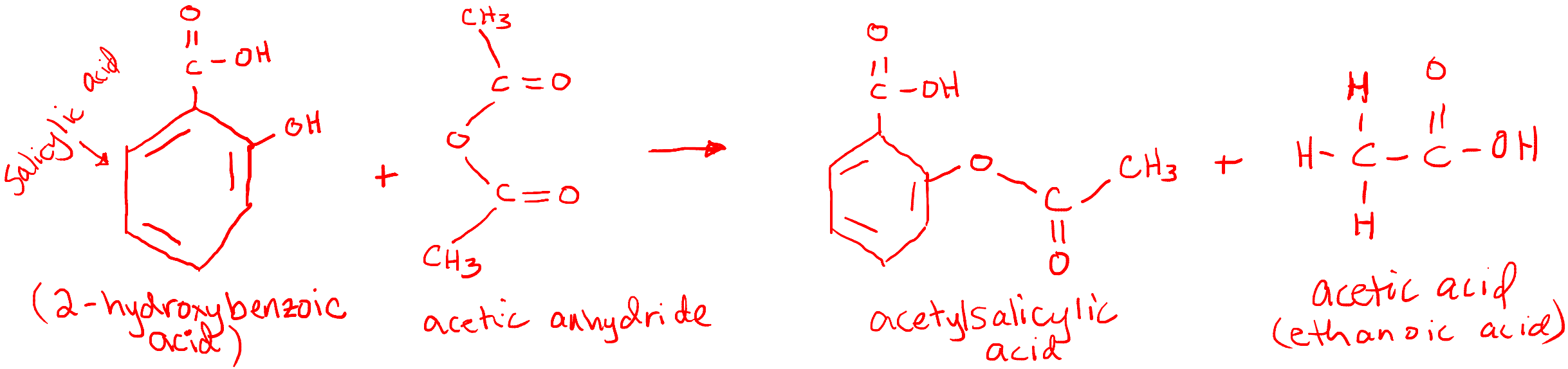


Salicylic Acid
$C_7H_6O_3$

Acetic anhydride

Acetylsalicylic acid (aspirin)
$C_9H_8O_4$

Acetic acid



Background Information

widely used!!

Aspirin
- relieves pain
- reduces fever
- reduce inflammation

- Aspirin is an effective:
  - analgesic (pain reliever)
  - antipyretic (fever reducer)
  - anti-inflammatory agent
- It is one of the most widely used non-prescription drugs.
- Use of aspirin originates in the 18th century when salicylic acid was found as an extract from willow bark.

→ 18th century, found in willow bark

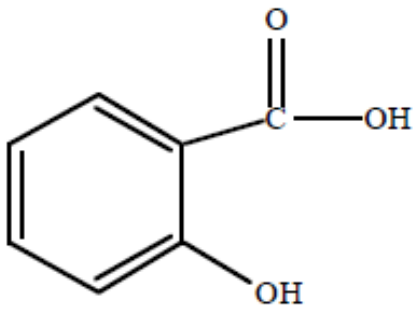
- Unpleasant side effects:
  - Irritation to the digestive tract (above the stomach)
  - Hemorrhaging of the stomach lining

Problems
- irritates the stomach and esophogus
- hemorrhaging in stomach

- In 1899, Bayer Company patented "aspirin", which is a modification of salicylic acid

- 1899 Bayer Company patents aspirin (which releases salicylic acid in the intestines)

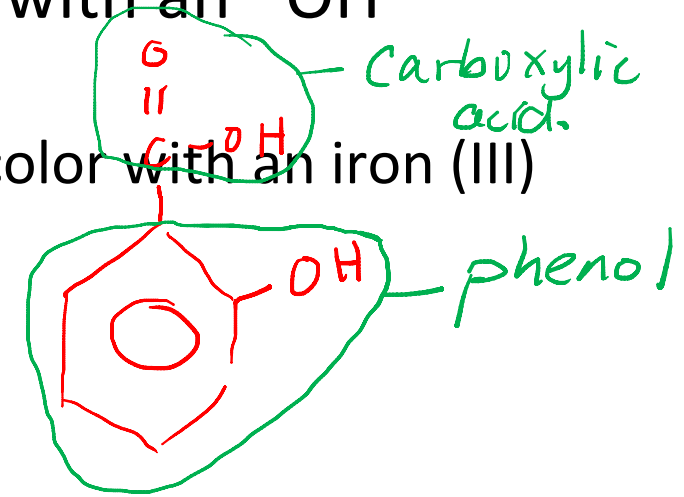
Salicylic Acid



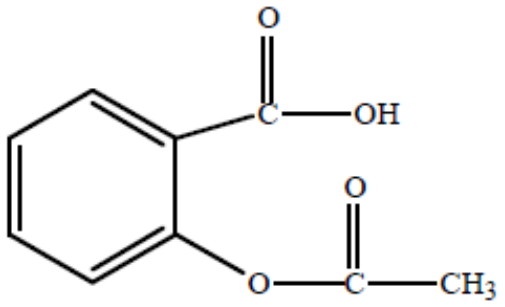
Salicylic Acid
$C_7H_6O_3$

- IUPAC name is 2-hydroxybenzoic acid
- Upsets stomach lining
- Contains a phenol group (benzene with an –OH attached)
  - Phenol will test positive as a purple color with an iron (III) chloride test

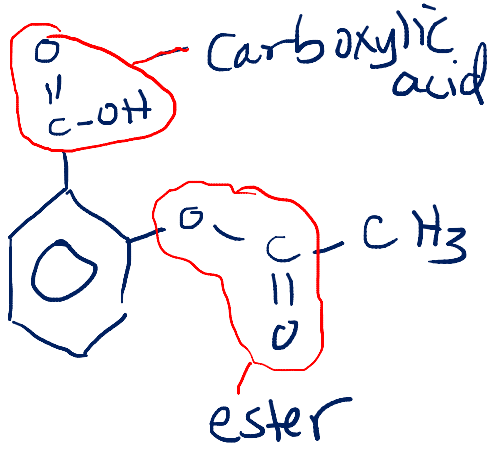
Phenol test = (+) with a purple color when reacted with iron (III) chloride.



Acetylsalicylic Acid (Aspirin)



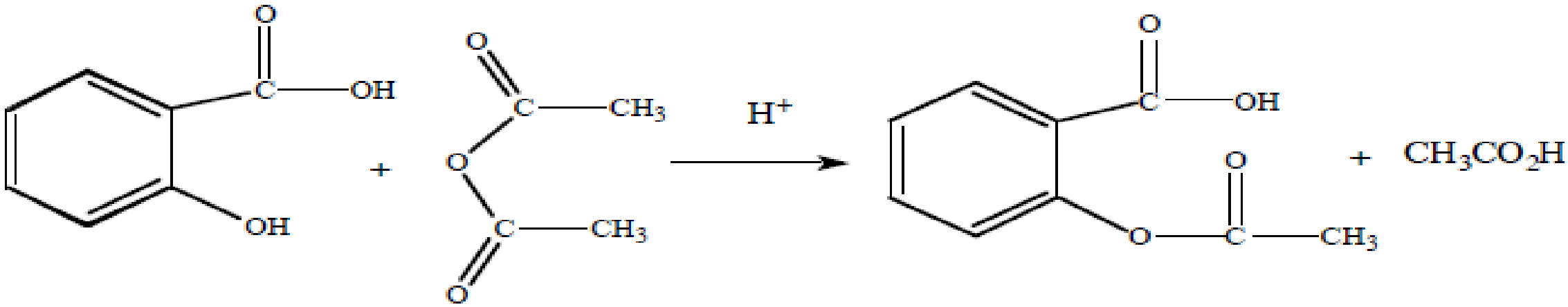
Acetylsalicylic acid (aspirin)
$C_9H_8O_4$



NO Phenol!!

- The esterified compound is much less irritating to the stomach, but still is irritating
- An aspirin tablet contains 300-400 mg of the active ingredient, with a starch binder
  - Starch tests positive with iodine, turning a deep purple/black/bluish color
- When ingested, it is broken down into salicyclic acid
  - Partially in the stomach, but mostly in the basic conditions of the small intestine
  - It is then absorbed into the bloodstream.

pH > 7



Salicylic Acid
$C_7H_6O_3$

Acetic anhydride

Acetylsalicylic acid (aspirin)
$C_9H_8O_4$

Acetic acid

- Contains phenol which turns the FeCl3 purple
- Active ingredient that provides medicinal properties
- upsets stomach lining

- When ingested it remains relatively stable until it hits the basic environment of the small intestine
- Gets broken down into the active salicylic acid far below the stomach
- Delivered in the body during blood stream

Summary of Aspirin Lab Observations

- One measure of aspirin purity is to investigate any unreacted salicylic acid remaining in the product using the $FeCl_3$ test for phenol
- More salicylic acid remained in the crude product (showed a slight purple color
- Refined aspirin had little to no salicylic acid remaining
- Commercial aspirin had a significant amount of salicylic acid (indicating less refined than what we made)
- Aspirin doesn’t break down much in the simulated stomach acid environment (little dissolved)
- Aspirin does break down in the simulated in basic environment of the small intestine (completely dissolved)