1) Aspirin can be made by reacting salicylic acid with acetic acid in the presence of an acid catalyst. The reaction between the phenol group (a hydroxyl group bonded directly to an aromatic reaction) and the acetic acid, however, is slow and has a relatively low yield. When acetic anhydride is used, in place of acetic acid, the reaction is much faster and has a higher yield.

Salicylic Acid   Acetic anhydride   Acetylsalicylic acid (aspirin)
$C_7H_6O_3$ $C_9H_8O_4$
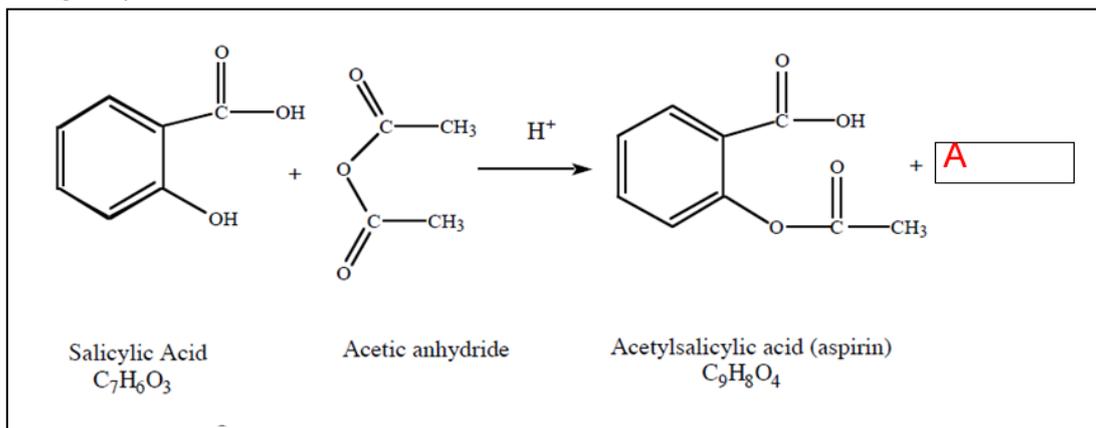
a) Identify substance "A".
b) i. In the space below write the reaction between salicylic acid and acetic acid in the presence of an acid catalyst.

Salicylic Acid
$C_7H_6O_3$
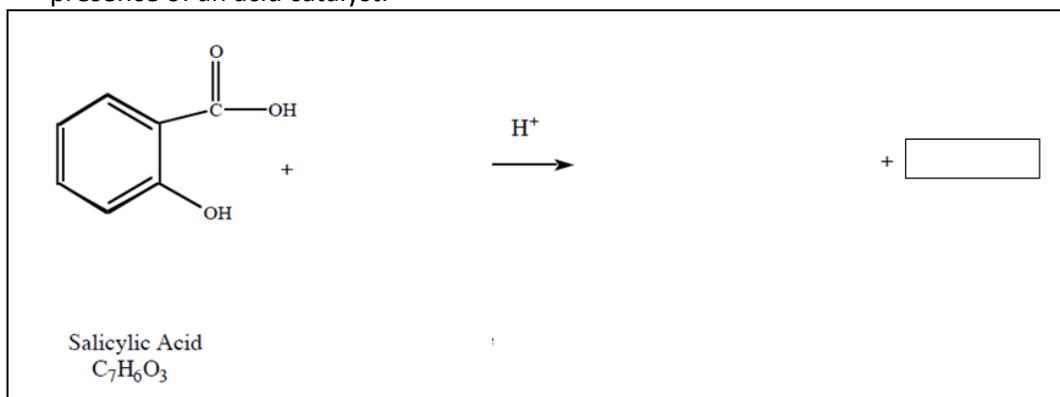
ii. What type of reaction is this? Circle the correct response
Acid/Base
Redox
Condensation
Hydrolysis
Explain.

iii. What functional groups are present in aspirin?

iv. Calculate the percentage yield for the above reaction if the amount of salicylic acid used was 1.99 g and 2.17g of aspirin was obtained.
Molar mass of aspirin 180.16 g/mol molar mass of salicylic acid is 138.12 g/mol

c) A student was asked to work out the purity of a sample of aspiring derived from the reaction above. Given a sample of the dried aspirin the student decided to dissolve the sample and titrate the resultant solution with NaOH using phenolphthalein as an indicator. Will this method work? Explain

d) A student weighed 2.10 g of salicylic acid. What volume of acetic anhydride Is needed to completely react with this amount of salicylic acid if the density of acetic anhydride is 1.082 g/mL. Molar mass of acetic anhydride is 102.1 g/mol

e) A bottle of aspirin was opened by a chemist after several years of been stored on the shelf. The chemist noticed a strong smell of vinegar.
   i. In the space below write a balanced equation for the reaction that most likely occurred.

   ii. What type of reaction took place?

f) A chemist analysed aspirin tablets for quality control. The initial step of the analysis was the standardisation of a NaOH solution. Three 25.00 mL samples of a 0.1014 mol L^{-1} solution of standardised HCl were titrated with the NaOH solution. The average volume required to reach the endpoint was 25.50 mL.
   i. Calculate the concentration of the NaOH solution in mol/Litre

   ii. What is a standard solution?

   iii. Why is NaOH not used as a primary standard?

   iv. The next step involved the following
       a) 100 tablets were crushed and placed in a 250 mL volumetric flask
       b) The flask was made up to the mark with distilled water.
       c) A 20.0 mL aliquot was taken and placed in a conical flask and titrated with the standardised NaOH solution.
       d) This was repeated several times and an average titre of 2.13 mL was obtained.
       Calculate the amount, in mg, of aspirin in each tablet.