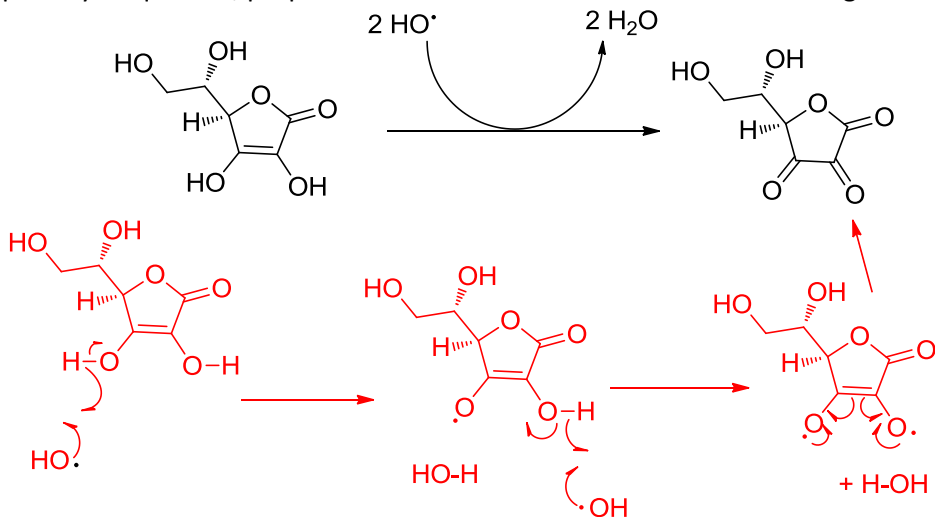
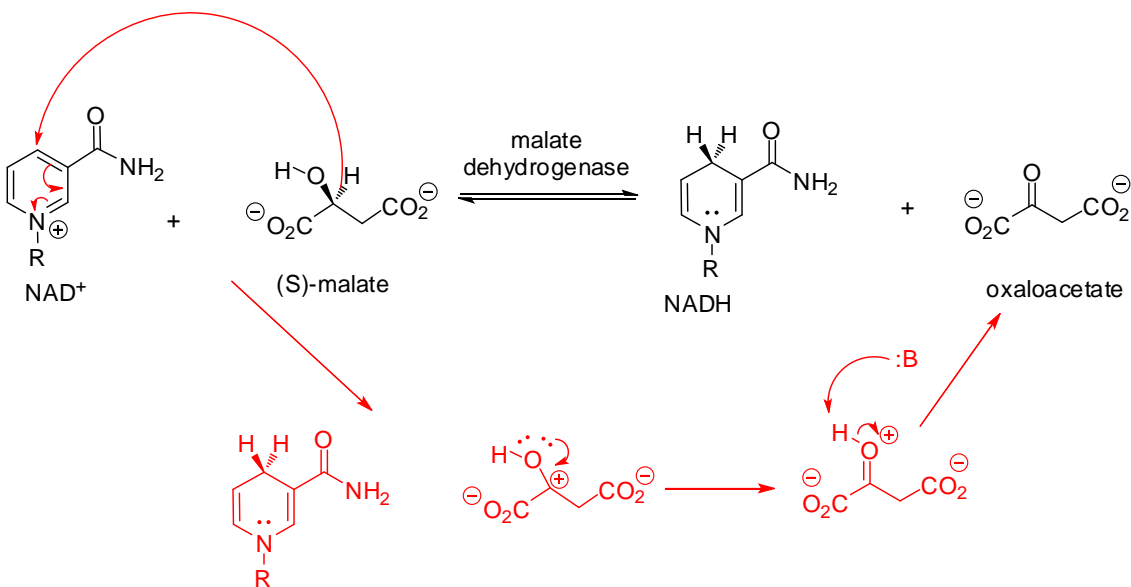


1. Vitamin C is another well-known anti-oxidant. Analyze the structure of vitamin C and, by analogy with our work with para-hydroquinone, propose a mechanism for its reduction of two dangerous hydroxyl radicals to water.

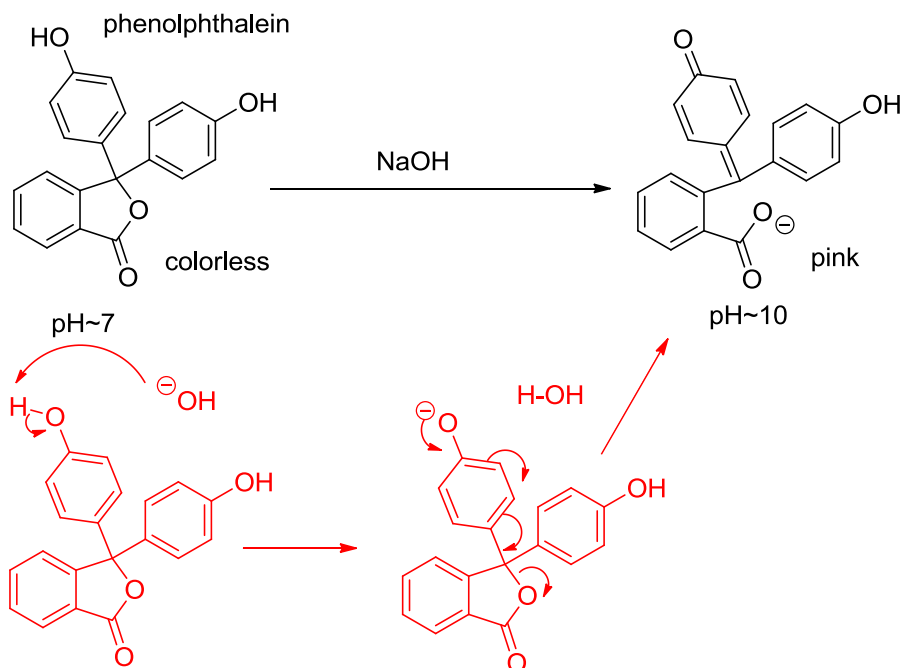


2. The citric acid cycle is the key process whereby all living cells that rely on oxygen create useful energy through oxidative metabolism. NAD⁺/NADH is a central component of the process. One example is the oxidation of malate with the enzyme malate dehydrogenase and the co-enzyme NAD⁺. Based on our discussions of NADH reduction, propose a curved arrow electron flow mechanism for the oxidation of malate to oxaloacetate.



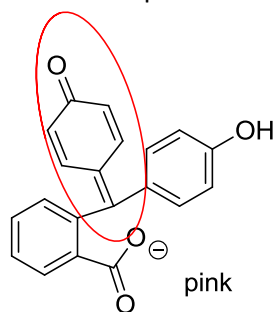
3. Phenolphthalein is a commonly used indicator dye in chemical acid-base titrations in the lab. The reaction with a base is shown below, along with the corresponding color change that helps the experimentalist detect the pH change.

a) Explain the reaction by showing electron flow arrows that convert the colorless form of phenolphthalein into the pink color structural isomer.



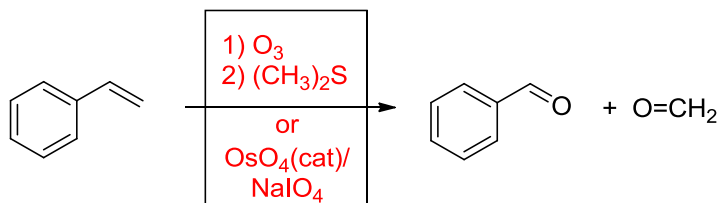
b) Identify the part of the structure that is most likely responsible for the pink color.

The pink is probably from the quinone-like structure and is due to the high level of conjugation.



4. Provide reagents for the following reactions.

a)



b)

