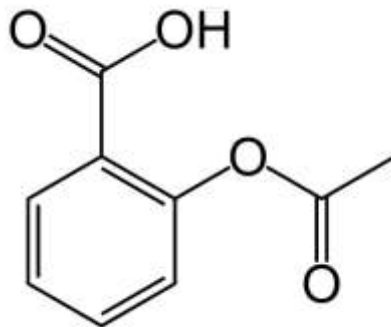


Useful drugs for specific disease targets...

Aspirin

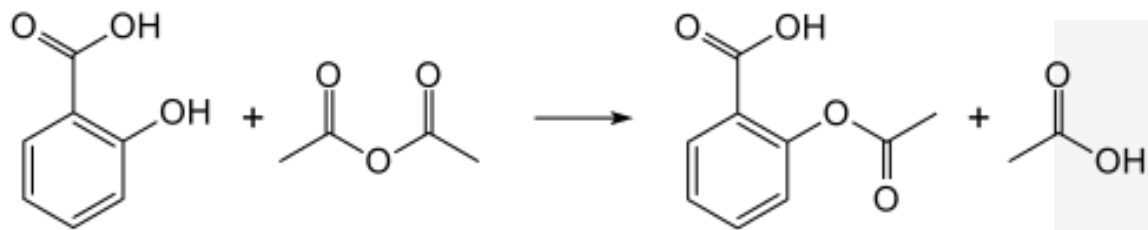
(Acetyl Salicylic Acid)



PROPERTIES

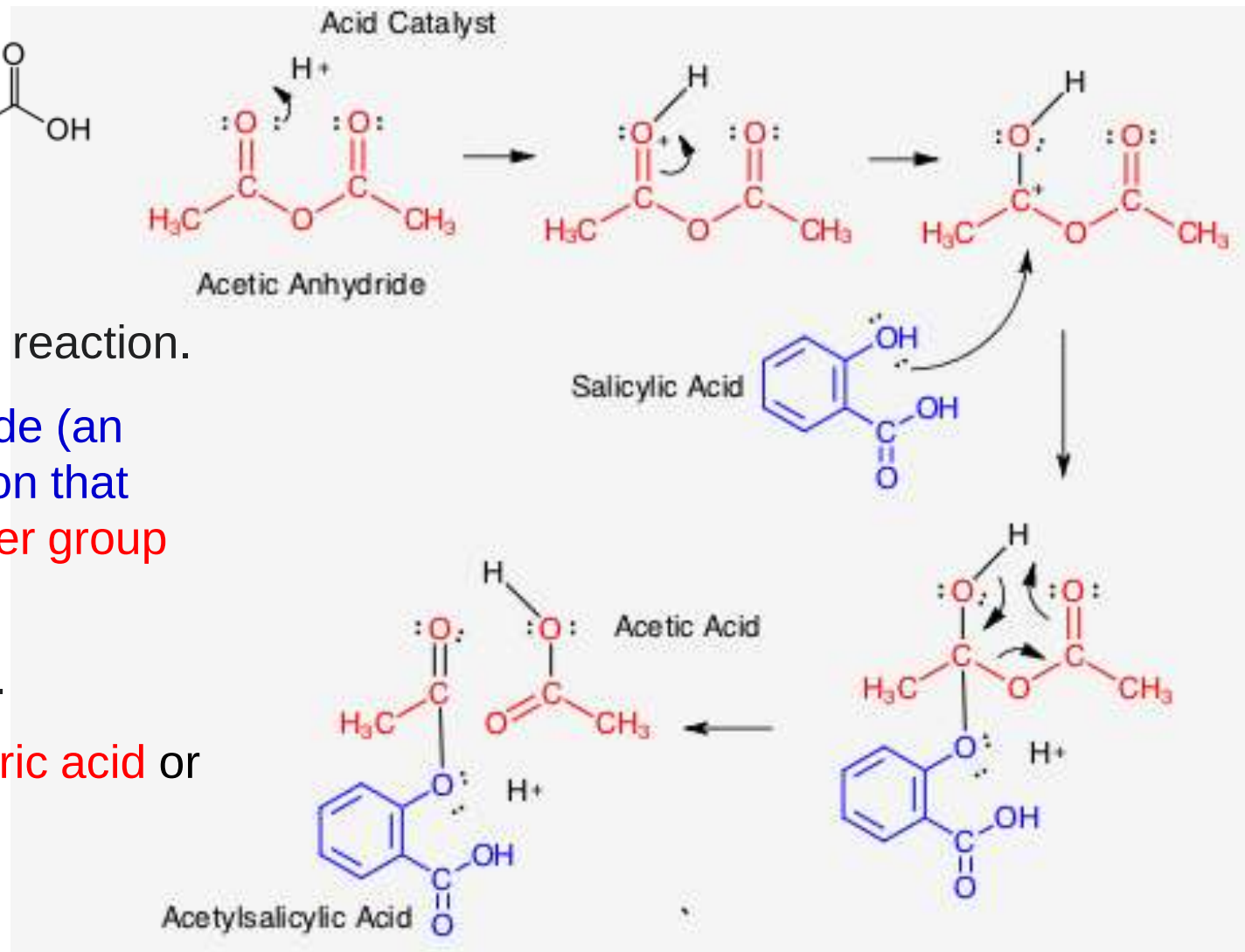
- Acetylsalicylic Acid is a colourless / white crystalline solid.
- It has a smell similar to that of vinegar, because of the hydrolysis of Acetylsalicylic Acid yields salicylic acid and acetic acid
- It is bitter in taste, and density is 1.4 g/cc
- The melting point of aspirin is 135 °C, & decomposes at higher temperature soluble in water, ethyl ether, ethanol, and chloroform.

Synthetic Route of Aspirin



- The synthesis of aspirin is an esterification reaction.
- Salicylic acid is treated with acetic anhydride (an acid derivative), causing a chemical reaction that turns OH group of salicylic acid into an ester group ($R-OH \rightarrow R-OCOCH_3$).
- This process yields aspirin and acetic acid.
- The catalyst used in this reaction is sulphuric acid or phosphoric acid.

Mechanism of Aspirin Synthesis



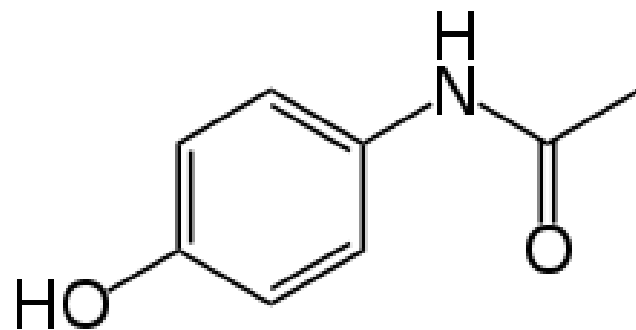
Applications of Aspirin

- In the year of 1897, Bayer laboratory gave Acetyl salicylic Acid the name of Aspirin.
- It is a very popular medicine and is available all over the world in large quantities. Ever since the naming, the commercialization of it began.
- This medicine is most commonly used as an **anti-inflammatory and antipyretic**.
- However, considering its use in recent decades, it has also gained a reputation for treating **cardiovascular diseases**.
- The other uses also include **rheumatic fever and Kawasaki disease**.
- Similarly, we also use it as an **intermediate and raw material in producing other medicines**.

Safety Hazards

- When kept at room temperature. Aspirin will remain stable.
- However, try to keep it dry so as to avoid its hydrolysis.
- If you continue **using it for a long period of time, it can result in causing gastritis and ulceration**.
- Similarly, it is also **incompatible with tough oxidizing agents and strong acids and bases**.

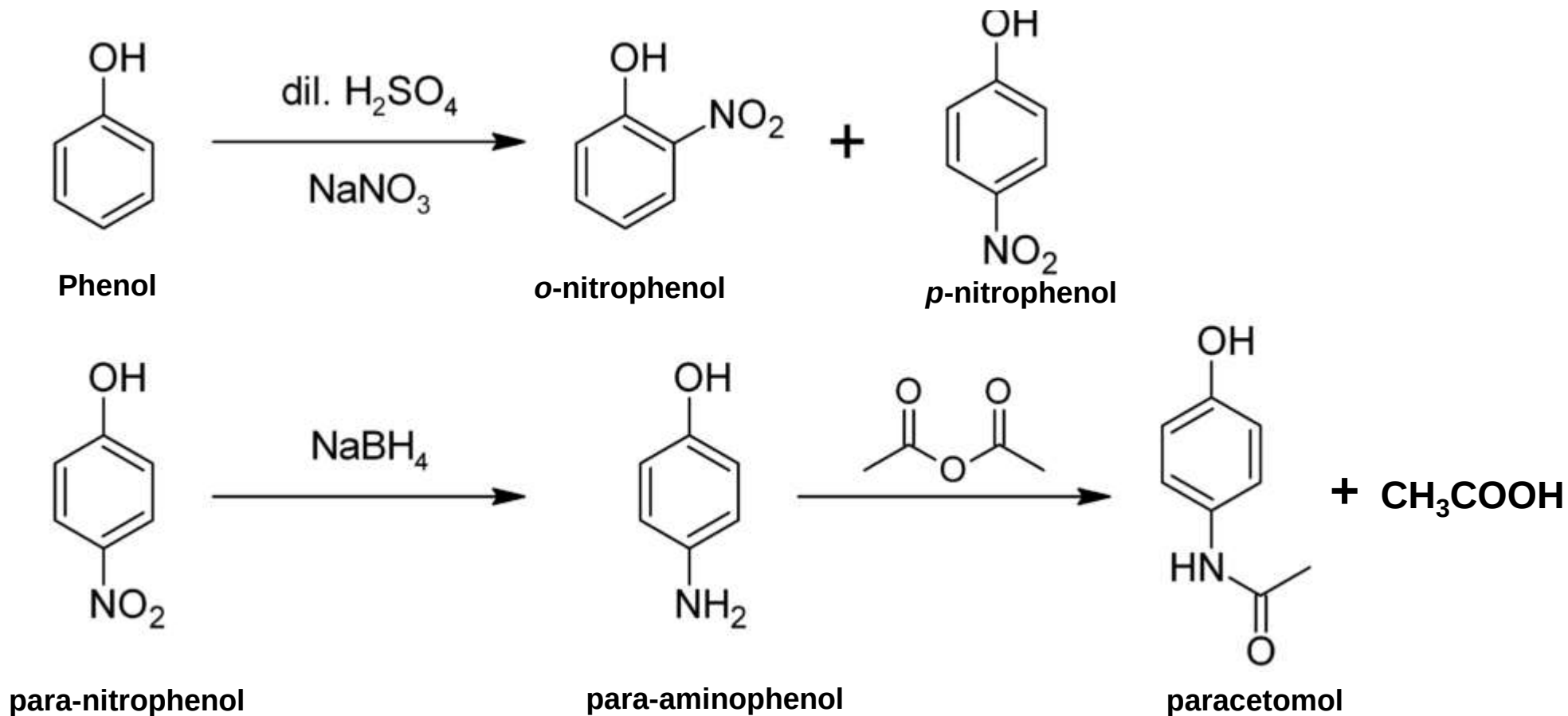
PARACETAMOL



PROPERTIES

Density	1.263 g/cm ³
Melting point	169 °C (336 °F)
Solubility in water	12.78 g/kg (20 °C) ~14 mg/ml (20 °C)

Synthetic Route of Paracetamol



Application of Paracetamol

- **Paracetamol** is a **common painkiller** (**analgesic**) **used** to treat **aches and pain**.
- It can also be **used** to reduce a high temperature (**antipyretic**).
- but it has **no useful anti-inflammatory properties**.
- It's available combined with other painkillers and anti-sickness medicines.
- It's also an **ingredient in a wide range of cold and flu remedies**.
- **Paracetamol's** effects are thought to be related to **inhibition of prostaglandin synthesis**.
- **Paracetamol** is readily absorbed from the **gastrointestinal tract**.

Safety Hazards

- Adverse effects of Paracetamol are rare but **hypersensitivity including skin rash may occur**.
- There have been reports of blood disorders (dyscrasias including thrombocytopenia, neutropenia, pancytopenia, leukopenia and agranulocytosis) but these were not necessarily causality related to Paracetamol
- **Very rare cases of serious skin reactions have been reported.**

Dyes- Definition , Classification of Dyes, Disadvantages of Natural Dyes and Synthetic Dyes, Chemistry of Dyeing,
Example for dyes: Methyl Orange, Malachite Green Dye, Rosaniline Dye, Phenolphthalein Dye, Indigotin

- ❖ Dyes are colored organic compounds and they are used to impart the color to various substances or materials like fabrics, paper, food, hair and drugs etc.
- ❖ With regard to their solubility, organic colorants fall into two classes, viz. dyes and pigments.
- ❖ The key distinction is that dyes are soluble in water or in an organic solvent, while pigments are insoluble in both types of liquid media.
- ❖ Dyes are used to color substrates to which they have affinity.
- ❖ Pigments can be used to color any polymeric substrate
- ❖ Mechanistically in dyes, the surface coloration only is involved while the pigment is mixed with the polymer before fiber or moulded article formation.

To be used, dye must possess these four properties:

- (i) Color
- (ii) Solubility in water or in an organic solvent
- (iii) Ability to be absorbed and retained by fiber (substantively) or to be chemically combined with it (reactivity)
- (iv) Ability to withstand washing, dry cleaning and exposure to light

Classification of Dyes-1

1. On the basis of Sources ...

(a) Natural dyes:

- ❖ Natural dyes are dyes or colorants derived from **plants, invertebrates, or minerals**. The majority of natural dyes are **vegetable dyes from plant sources—roots, berries, bark, leaves, and wood**—and other biological sources such as **fungi and lichens**.

There are two types of natural dyes.

Additive dyes (*non-substantive*) such as *madder* must use a **mordant** (a chemical that fixes a dye) to bond with fibers. These are the most common type and have been used for at least 2,000 years.

Substantive dyes require **no pretreatment to the fabric** (e.g., indigo, orchil and turmeric) and there are three types:

- direct dye** (*for cotton, e.g., turmeric, safflower*);
- acid dye** (*for silk and wool, e.g., saffron, lac*) or
- basic dye** (*for silk and wool, e.g., berberine*).

- ❖ **Mordants** are chemical compounds that *combine with the fiber and the dye forming a chemical bridge between the two.*
- ❖ Common mordants are weak organic acids, such as acetic or tannic acid, and metal salts including aluminum, ammonium or potassium sulfate, ferrous sulfate, and copper sulfate.
- ❖ Usually, the textile to be dyed is simmered in a mordant solution before dyeing (*pre-mordanting*). Other options include adding the mordant to the dye bath or treating with another mordant after dyeing to shift the color.
- ❖ *Natural mordant dyes are either monogenetic or polygenetic;*
monogenetic dyes produce only one colour irrespective of mordant,
whereas polygenetic dyes produce different colours according to the mordant employed (e.g., logwood, alizarin, fustic and cochineal).

Disadvantages of Natural Dyes

- Before the advent of synthetic dyes, natural dyes were widely used, often together with mordants such as alum, to dye natural fibres including wool, linen, cotton and silk, but their use declined after the discovery of synthetic dyes.
- However, interest in natural dyes has been revived owing to increasing demands on manufacturers to produce more environmentally friendly alternatives to petrochemical-derived dyes.
- One main issue associated with the use of natural dyes in the coloring of textiles is their poor to moderate light-fastness, and despite their long tradition, not all natural dyes are especially environmentally friendly.
- Some natural dyes have no or little affinity for the textile materials and they require heavy-metal salts as mordants for fixation and color-fastness.
- Natural dyes may be sustainable but they need water and land to produce and there is insufficient dye yield per acre of plant material to sustain industrial-scale production.

(b) Synthetic Dyes

- Synthetic dyes are manufactured from organic molecules. Before synthetic dyes were discovered in 1856, **dyestuffs were manufactured from natural products but batches of natural dye were never exactly alike in hue and intensity**, whereas **synthetic dyestuffs can be manufactured consistently**.
- The use of computers and computer color matching (CCM) produces color that is identical from batch to batch.
- Discovery of first synthetic dye: **William Henry Perkin**, an eighteen-year-old English chemist, was **searching for a cure for malaria, a synthetic quinine, and accidentally discovered the first synthetic dye**.
 - **He found that the oxidation of aniline could color silk.**
 - **From a coal tar derivative he made a reddish purple dye. The brilliant purple was called mauve.**
- The dye was not stable to sunlight or water and faded easily to the color presently named mauve, a pale purple. This discovery resulted in additional research with coal tar derivatives and other organic compounds and an entire new industry of synthetic dyes was born.
- In the twenty-first century, **synthetic dyes are less expensive**, have **better colorfastness**, and completely **dominate the industry** as compared with natural dyes. Thousands of distinctly different synthetic dyes are manufactured in the world.

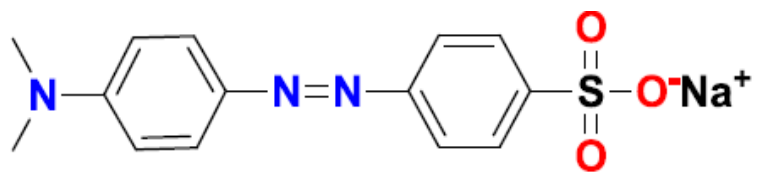
Classification of Dyes-2

2. On the basis of Chromophore ...

Dyes may be classified according to *chromophore* present in their structures.

(a) Azo dyes:

- Azo dyes are characterised by presence in the molecule of one or more azo groups $\text{—N}=\text{N—}$, which form bridges between organic residues, of which at least one is usually an aromatic nucleus.
- Many methods are available for preparing azo compounds, but manufacture of azo dyes is always based on the coupling of diazonium compounds with phenols, naphthols, arylamines, pyrazolones or other suitable components to give hydroxyazo or aminoazo compounds.
- In the resulting dyes the **azo group is the chromophore** and the **hydroxyl or amino group is an auxochrome**.
- The importance of **azo dyes** is shown by the fact that they account for over 60% of the total number of dye structures known to be manufactured.

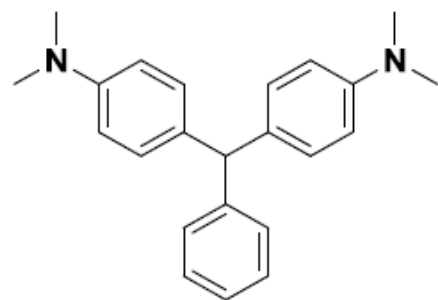


Methyl Orange Dye

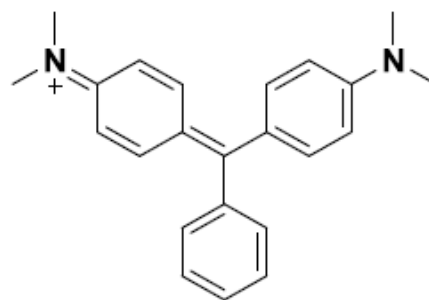
- A full range of shades is available, but on hydrophilic fibres the blues and greens lack fastness to light unless they are metallised; the metallised derivatives have dull shades.
- The chemistry of these dyes ranges from simple **monoazo** compounds to complex **polyazo structures** with a molecular weight of **1800 or more**, and their properties vary accordingly.

(b) Triphenylmethane Dyes:

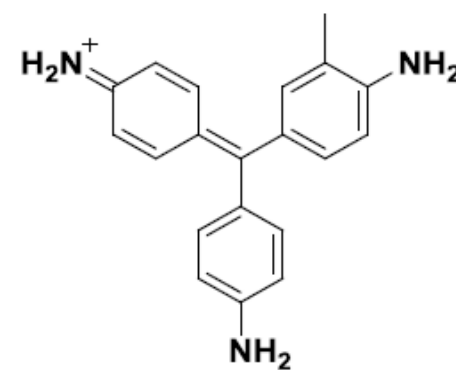
- Synthetic organic dyes having molecular structures based upon that of the hydrocarbon **triphenylmethane**.
- They have **poor resistance to light** and **to chemical bleaches** and are used mainly in **copying papers**, in **hctograph** and **printing inks**, and in **textile applications for which lightfastness is not an important requirement**.
- *The triphenylmethane derivatives are among the oldest man-made dyes*, a practical process for the manufacture of **rosaniline** having been **developed in 1859**. Several other members of the class were discovered before their chemical constitutions were fully understood. **Crystal violet**, the most important of the group, was introduced in **1883**.
- **The range of colours is not complete but includes reds, violets, blues, and greens**. *They are applied by various techniques, but most belong to the basic class, which are adsorbed from solution by silk or wool*, but **have little affinity for cotton unless it has been treated with a mordant such as tannin**.



Leucomalachite Green



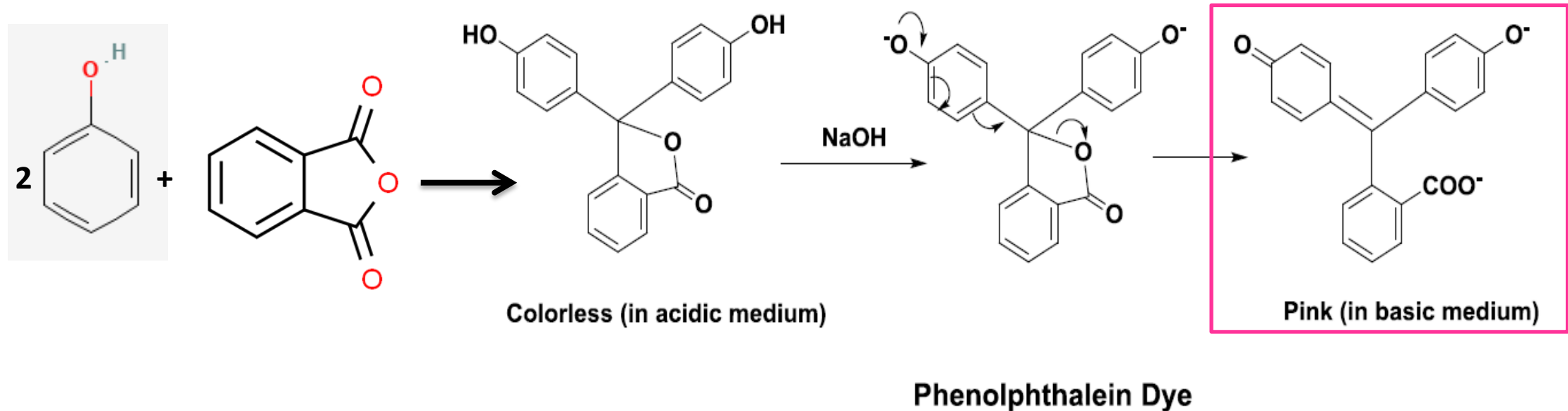
Malachite Green Dye



Rosaniline Dye
(Fuchsine Dye)

(c) Phthalein dyes:

- They are a class of dyes mainly used as **pH indicators**, due to their **ability to change colors depending on pH**.
- *They are formed by the reaction of **phthalic anhydride with various phenols***. They are a subclass of **triarylmethane dyes**.
- Common phthalein dyes include: **Phenolphthalein, o-Cresolphthalein, Dixylenolphthalein, Guaiacolphthalein, α -Naphtholphthalein**.

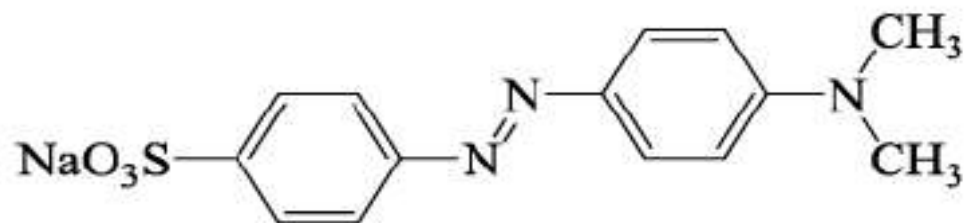


Methyl Orange

Diazo Coupling

A Synthesis of Methyl Orange

In this experiment the azo dye **methyl orange** is prepared by a electrophilic substitution with arenediazonium salts (diazo coupling).



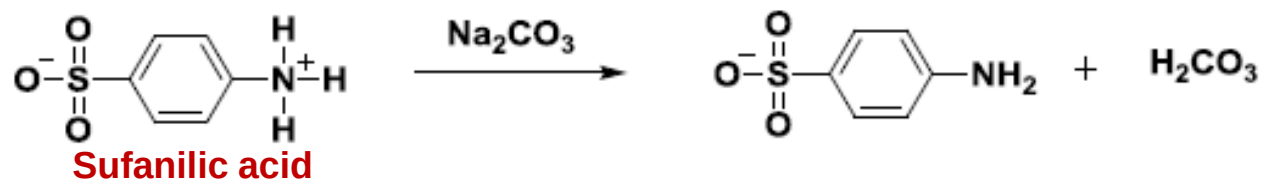
***p*-Dimethylamino-Azobenzenesulfonic Acid (Methyl Orange)**

Methyl orange is a pH indicator and due to its clear color change it is very often used in titrations. Methyl orange changes color at the pH of a mid-strength acid and is usually used in titrations for acids. Unlike a so called universal indicator, methyl orange does not have a full spectrum of color change, but has a sharper end point.

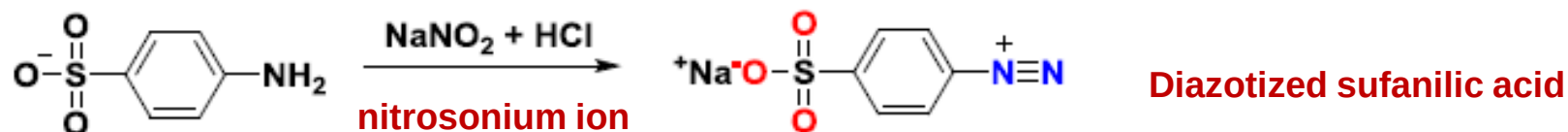
Methyl orange is prepared from sulfanilic acid and *N,N*-dimethylaniline. The first product obtained from the coupling is the bright red acid form of methyl orange, called **helianthin**. In base, helanthin is converted to the orange sodium salt, called methyl orange.

Overall preparation of methyl orange

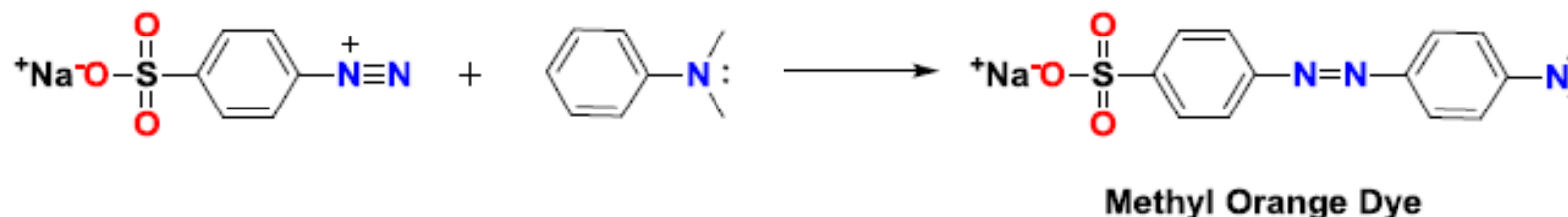
Step-1



Step-2



Step-3

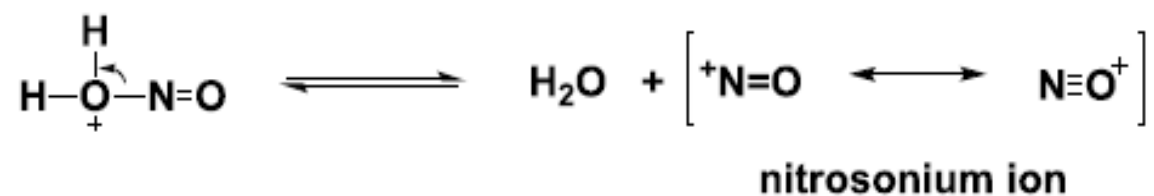
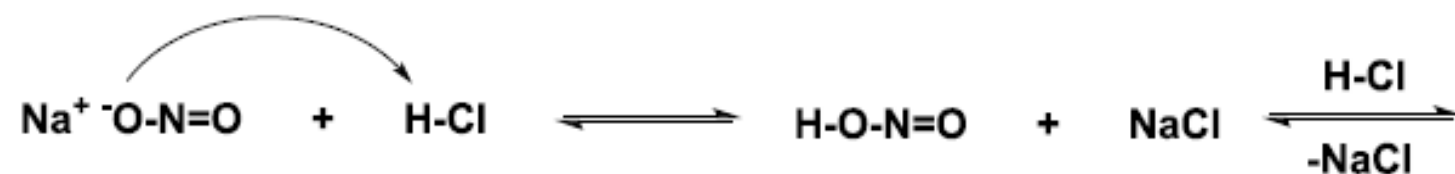


Preparation:

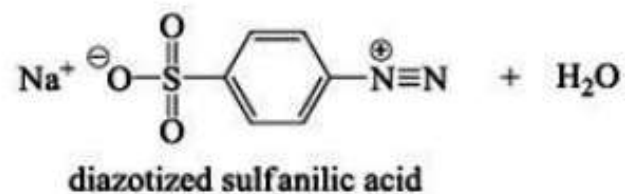
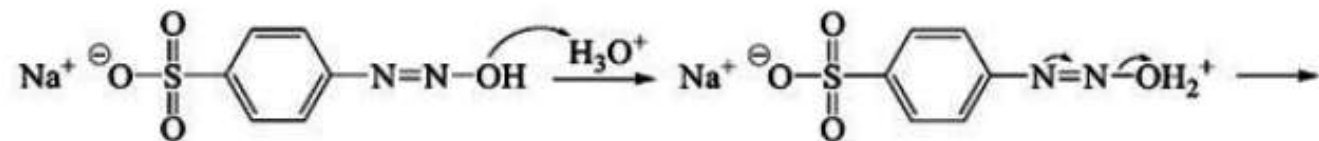
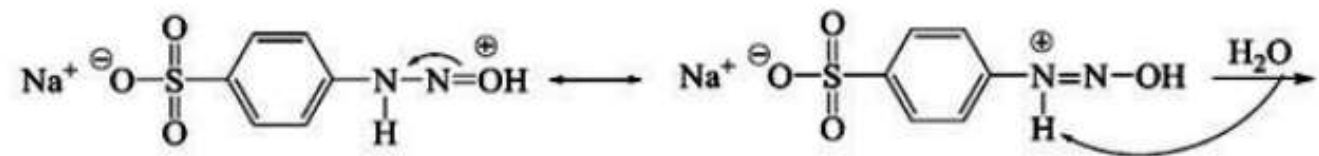
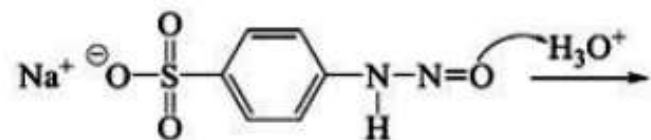
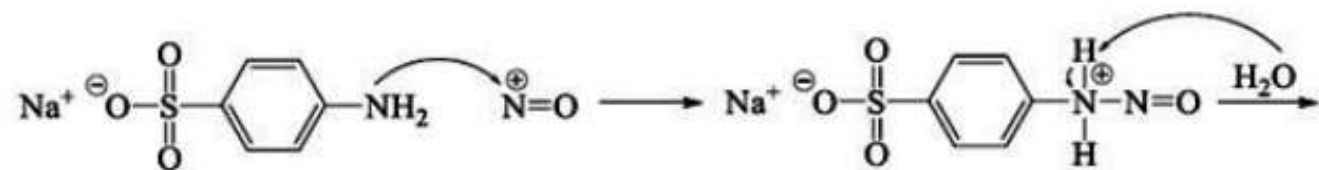
Step-1. The first step is to dissolve sulfanilic acid in basic solution.



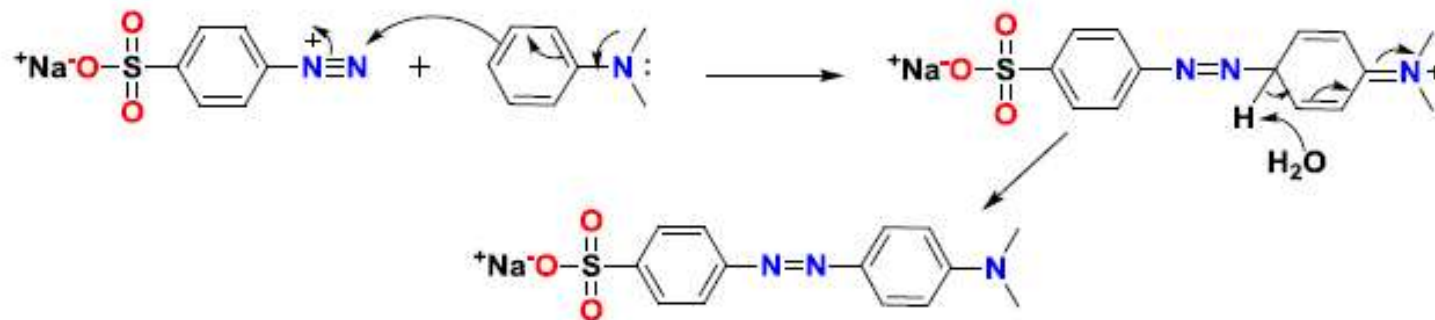
Step-2. Formation of Nitrosonium Ion



Step-3. Formation of Diazotized Sulphanilic Acid



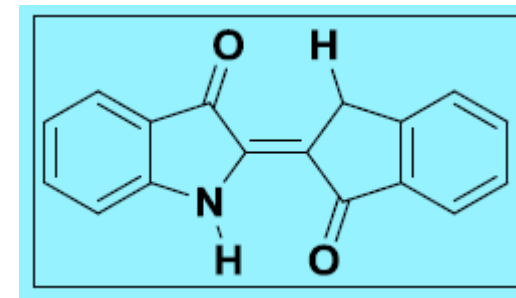
Step-4. Addition to N,N-Dimethylaniline



Methyl Orange Dye

INDIGOTIN DYE

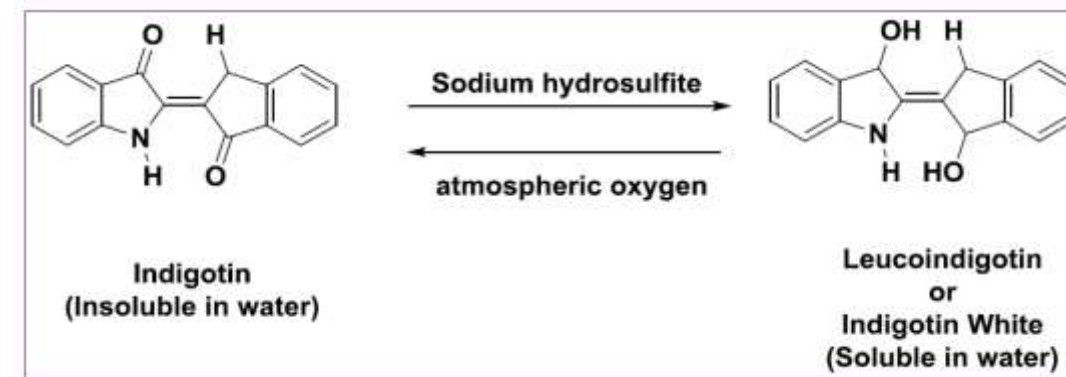
- ❖ Indigo is an ancient compound, and has been known and used as a distinctive blue dye since prehistoric times. The earliest users were from India, and the country gained its English name from the ancient Greek word for *indigo*.
- ❖ Natural blue dyes are rare. Today it will be most familiar to you as the dye used to color blue jeans.
- ❖ The chemical in indigo which is responsible for the blue colour is indigotin, which is a dark blue powder at room temperature and is insoluble in water and ethanol.
- ❖ It is most soluble in chloroform, nitrobenzene and sulphuric acid. It has a **fused nitrogen heterocyclic structure**.



- ❖ *Indigo in its synthesised or purified form is insoluble in water and other polar solvents. To overcome this problem, the dye is reduced to soluble leucoindigo (known as 'white indigo'), and applied to clothes in this form.*

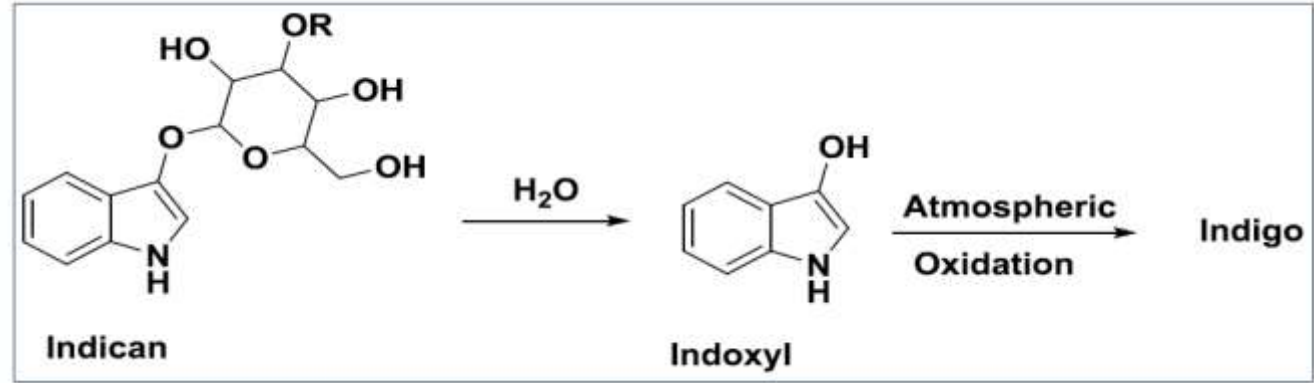
- ❖ *When exposed to atmospheric oxygen it re-oxidises to the insoluble form and regains its colour.* Originally this reduction was done with urine, although synthetic urea replaced it in the 19th century and later sodium hydrosulfite was employed as a much more effective reducing agent.

- ❖ Once the problem of applying the dye to the clothing had been overcome the insolubility of the dye is of course beneficial - it will not wash out of the fabric in water.



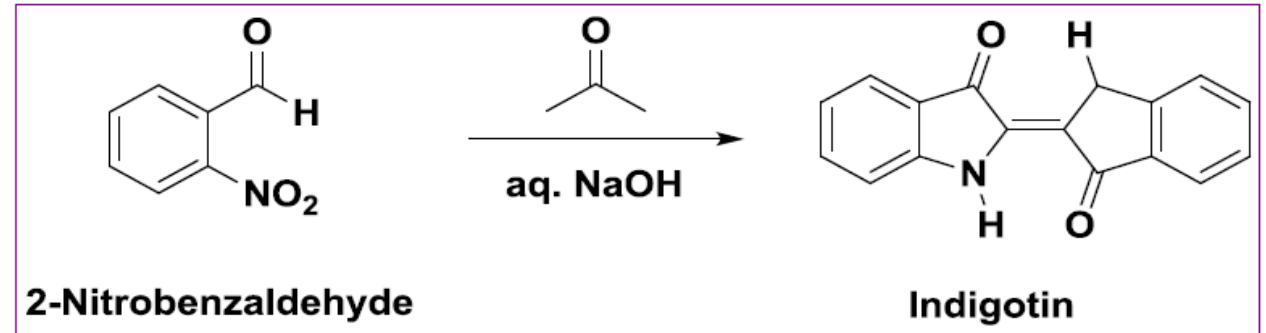
Extraction:

- Indigo has been known since ancient times and originally came from a plant extract.
- Plants of the *Indigofera* genus contain a **glycoside** called **indican** in their *leaves and stems*, which is extracted, and **acid-hydrolyzed into indoxyl**.
- Mild oxidation** in atmospheric oxygen will then **produce indigo**.

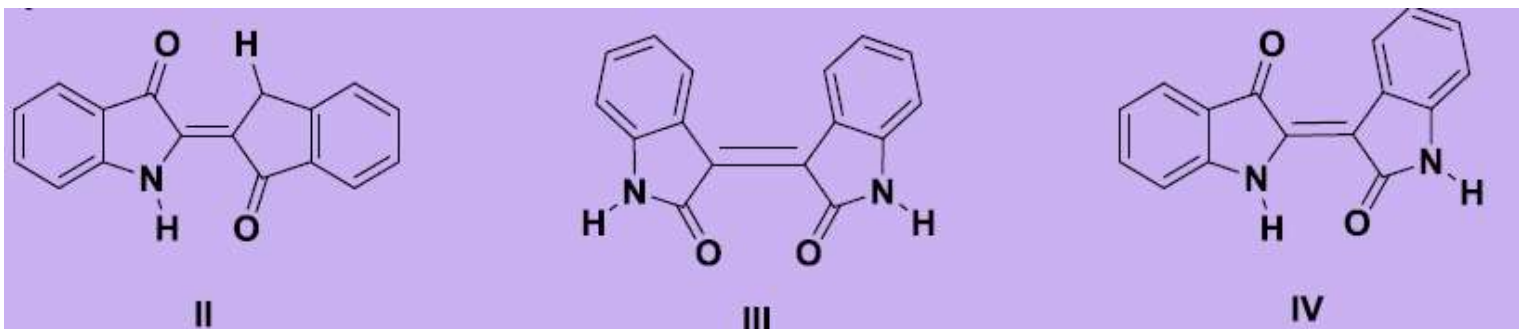


Synthesis:

- Dissolve **1 g. of O-nitrobenzaldehyde** in **3 ml of pure acetone**, add about an **equal volume of water**, which leaves a clear solution, and then, **drop by drop, sodium hydroxide solution**. Heat is developed and the solution becomes dark brown.
- After a short time the **dye separates in crystalline flakes**. Collect the precipitate at the pump after five minutes and *wash, first with alcohol then with ether*. **Indigo** so prepared is specially **pure and has a beautiful violet lustre**.



Structure of Indigo: On the basis of structure of Isatin, Indigo may possess either of the following structure (II, III and IV). All of them when oxidized yield two molecules of Isatin.



Synthesis: The structure of indigo has been further confirmed by the various synthesis of indigo.

