



Final Exam of First Semester 2016/2017

Course: Chemistry of dyes
Code: PDFW 3104

Second year student
Time: 180 min.
(3 pages)

Textile Printing Dept.
Full mark: (60)

First Question: (10 points)

I. Put (T) for true and (F) for false answers in the following statements.

II. Correct the false ones.

1. The method of application of some dyes requires them to form insoluble compounds within the fabric. (T)

2. The ultra-violet region starts above 360nm. (F)

The ultra-violet region starts below 360nm.

3. If a light source is deficient in any colour band, the light appears to be coloured in the complementary colour. (T)

4. The chromophore is usually electron withdrawing. (T)

5. A dye will run if it has a strong affinity for the material it is attached to, or a much stronger affinity for a non-aqueous solvent. (F)

A dye will run if it has a weak affinity for the material it is attached to, or a much stronger affinity for a non-aqueous solvent.

6. The azo group ($—N=N—$) will react with other aromatic molecules to form the azo compounds that are widely distributed in several different classes of dye. (T)

7. The introduction of one or more sulfonic acid groups into dye intermediates is often conducted to confer water solubility and provide fiber affinity. (T)

8. Sulfonation of benzene is a reversible reaction and accompanied by disassociation of water, which results in increase the sulfuric acid concentration. (F)

Sulfonation of benzene is a reversible reaction and accompanied by disassociation of water, which results in decrease the sulfuric acid concentration.

9. Diazo component is treated in low temperature, acid conditions with sodium nitrite to form a stable diazonium salt. (F)

Diazo component is treated in low temperature, acid conditions with sodium nitrite to form an unstable diazonium salt.

10. When a more reactive system is sulfonated, less stringent conditions are required. (T)

Second Question: (10 points)

Choose the right answer in the following questions:

1. *If a light source is deficient in orange colour band, the light appears to be coloured in:*
 - a. Green-yellow
 - b. **Green-blue**
 - c. Blue-green

2. *The meta position in a dye has:*
 - a. The longest wavelength.
 - b. **The shortest wavelength**
 - c. No wavelength.

3. *The color is appeared bright when the absorption band is:*
 - a. Broad.
 - b. **Narrow and sharp.**
 - c. Neither.

4. *Pigments tend to be present as:*
 - a. **Insoluble suspension in a drying oil.**
 - b. Soluble suspension in a drying oil.
 - c. Insoluble suspension in water.

5. *Diazotisation involves a primary aromatic amine, called:*
 - a. The diazo component.
 - b. The azo component.
 - c. The coupling component.

6. *The main dye molecule of madder is:*
 - a. **Alizarin.**
 - b. Haematoxylin
 - c. Carminic acid

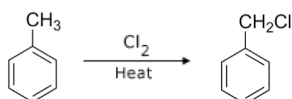
7. *The structure of Tyrian Purple is almost identical to that of indigo, The crucial difference is:*
 - a. The substitution of two oxygens for two of the aromatic hydrogens.
 - b. The substitution of two chlorines for two of the aromatic hydrogens.
 - c. **The substitution of two bromines for two of the aromatic hydrogens.**

8. *The cochineal dye is extracted from*
 - a. Plant origin.
 - b. **Animal origin.**
 - c. Mineral origin.

9. Nitro groups serve as:

- Chromophores and auxochromes
- Precursors for amino groups
- Both.

10. If chlorine reacts with boiling methylbenzene in the absence of a catalyst but in the presence of UV light:



- Substitution happens in the methyl group rather than the ring and benzyl chloride is formed.
- Substitution happens in the ring than the methyl group rather and chlorotoluene is formed.
- Both.

Third Question: (10 points)

Name the following:

- The major wavelength or wavelengths reflected from the material. *Hue*
- The ability of the dye to resist fading. The causes of fading are UV radiation from sunlight, and washing. *Colour fastness*
- A structural change, which causes the absorption band to longer wavelengths. *Bathochromic shift*
- The classification of dyes, which used most widely by both the synthetic dye chemist and the dye technologist. *Chemical Classification*
- The dyestuff is placed in a suitable container, adding liquid usually water and then leaving the container alone for a period of time. *Putrefaction/Fermentation*
- The raw materials used to synthesize organic dyes. *Dye intermediates*
- The process involves the introduction of one or more nitro (NO₂) groups into aromatic ring systems. *Nitration*
- The conversion of a primary aromatic amine to a diazonium compound. *Diazotization*
- The most important class of dyes, comprising over 50 % of total world dyestuffs production. *Azo dyes*
- A change in colour caused by the chemical alteration of unstable dye molecules to a less strongly coloured or colourless form. *Fading*

Fourth Question: (30 points)

i. How can a dye molecule's hue be altered?

(5 points)

A bathochromic shift may be caused by increasing the electron-withdrawing power of the chromophore (X or Y), increasing the electron-donating power of the auxochrome (Y or X) and by increasing the length of the conjugated system connecting the two. (It must be remembered that the system shown below is symmetrical, so the chromophore and auxochrome are interchangeable here, but this is not always the case.)

The position of the chromophore and auxochrome also has an effect. In general, the meta position (M) has the shortest wavelength, and the para (P) and ortho (O) absorption wavelengths are approximately equal, and longer than meta. Again this is due to resonance forms.

ii. Outline the advantages and disadvantages of natural dyes:

(5 points)

Advantages of natural dyes

- Natural dyes can exhibit better biodegradability.
- They have a higher compatibility with the environment.
- They also can show more friendly to the environment, a lower toxicity and allergic reaction than synthetic dyes.
- Their color is very brilliant.
- They have wonderful rich colors.
- Those are fast and permanent unlike chemical ones and are fast to washing and light.

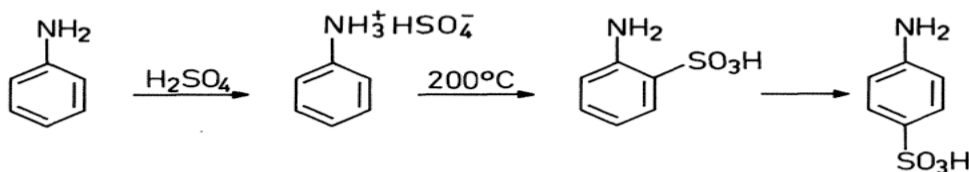
Disadvantages of natural dyes:

- The dyestuffs were difficult to store.
- Much time was spent in extracting color from these raw materials
- Much time was spent in imparting it in cloth.
- Its impossible to consider using natural dyes as a viable alternative to dyeing today's textile production.

iii. Write the Equations of the following:

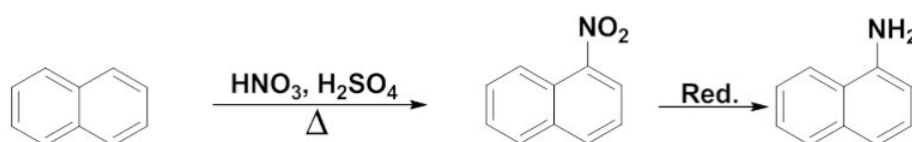
(20 points)

1. *Sulphonation of aniline.*

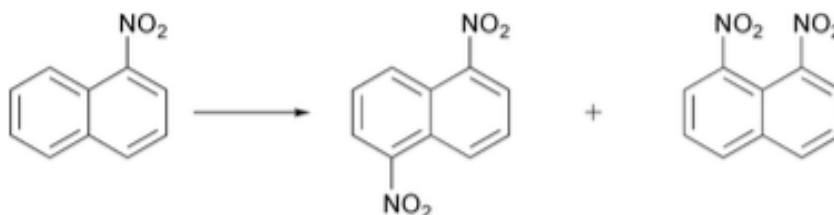


2. *Nitration of Naphthalene*

Nitration of naphthalene gives mostly the 1-nitro naphthalene (-90%), initially, a major source of 1-naphthylamine. Nitration is conducted near 35-50°C.

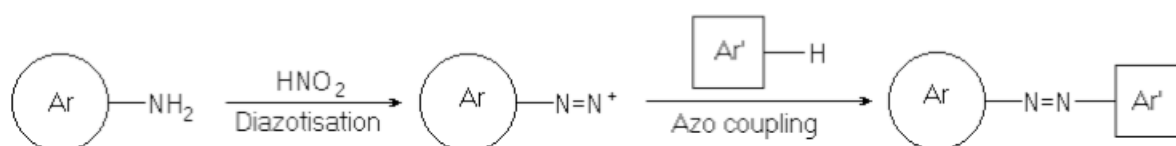


Introduction of a second nitro group takes place in the opposite ring since the existing nitro group reduces the reactivity of the ring to which it is attached.



3. *Synthesis of azo dyes including the two stages.*

An overview of azo dye synthesis is shown in figure below:



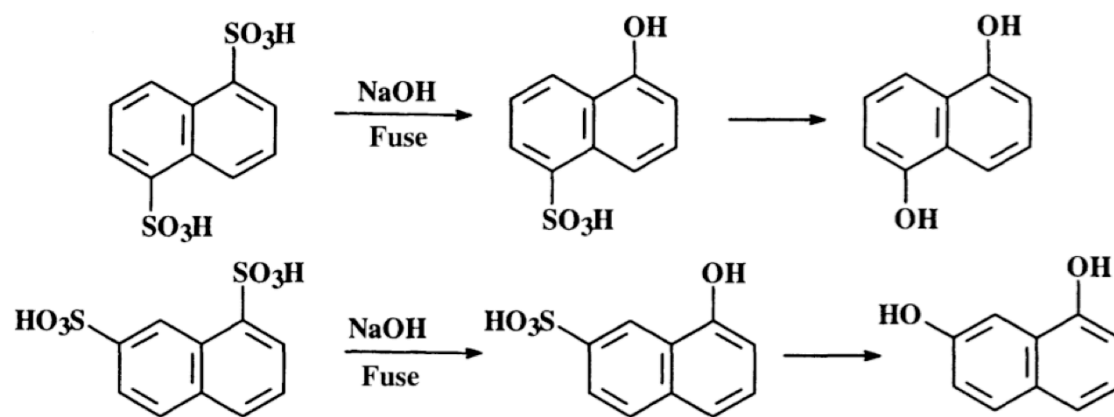
Stage 1- Diazotization

This involves a primary aromatic amine, called the diazo component. It is treated in low temperature, acid conditions with sodium nitrite to form an unstable diazonium salt

Stage 2- Azo coupling

The diazonium salt is reacted with a coupling component (for example a phenol, naphthol or an aromatic amine). This forms the stable azo dye.

4. Hydroxylation of naphthalene sulfonic



Good Luck
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