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Problems and solutions in colors, dyes and pigments chemistry: A Review

Hassan Abazied Shindy

Department of chemistry, Faculty of Science, Aswan University, Aswan, Egypt
*Corresponding author's E. mail: hashindy2@hotmail.com

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A B S T R A C T

This paper review is recommended for undergraduate students, graduate students, chemists, dyestuffs and colorists. They will find it interesting, informative and very readable. Several multi choice problems and their solutions in the basics and fundamentals of colors, dyes and pigments chemistry were represented in this paper review. Reviewing the basic information, fundamental understanding, principles and or the knowledge of colors, dyes and pigments chemistry via multi choice problems and their solutions is interesting type of reviewing and can be used as an excellent tool for measuring and or test the deep understanding of undergraduate and graduate students for colors, dyes and pigments chemistry. The paper includes, contains and or covers topics like, the relation between color and constitution and or Witt's theory, fibers, definitions for dyes and pigments and other definitions and vital informations in color, dyes and pigments chemistry. The paper also involves synthesis, properties, classifications and uses of many aromatic and or heterocyclic dyes. Such dyes, like nitro dyes, nitroso dyes, azo dyes, diarylmethane dyes, triarylmethane dyes, anthraquinone dyes, cyanine dyes, azine dyes, phthaleine dyes, indigoid dyes, acridine dyes, xanthen dyes and phthalocyanine dyes. This paper review acts as a mordant and or stabilizers for some of the basic informations, principles and or the knowledge in colors, dyes and pigments chemistry. It is valuable both for getting an overview in the field of color, dyes and pigments chemistry and as a mine of information for the dyestuff chemists. This paper review can be valuable in domestic and international chemistry forum as general and particularly, in colors, dyes and pigments chemistry. Besides, this paper review can be printed and used as a thesis and or as a note book students learning and lectures. Also, it is can be used in students examinations tests in chemistry departments and or chemistry institutions of any domestic and or international university.

Capsule Summary: Several multi choice problems and their solutions in the basics, fundamentals and/or the understanding of colors, dyes and pigments chemistry have been presented.

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INTRODUCTION

Color provide a vital enhancement to the world in which we live. Every day materials we use – textiles, paints, plastics,

papers and foodstuffs are especially appealing if they are colorful. Nature too presents a kaleidoscope of colors around our lives. Light is a form of electromagnetic radiation and delivers energy in little packets called photons. Different colors of light pack different amounts of energy in their photons. For example, photons of violet light have almost double the energy of those of red light. All materials absorb photons of some energy, but only substances that absorb photons of visible light will have color (Chandrasekaran, J., 2001). The modern theories of colors explain the color of organic compounds based on resonance effect and its correlation with absorption of light. The light waves in the UV and Visible region have high energy. When light falls on a compound, it gets absorbed and results in three types of excitation in the molecule, namely electronic, vibration and rotational. The compounds with single or multiple bonds undergo electronic excitation in UV-Visible region. In case of multiple bonded compounds, the bi electrons are responsible for selective absorption and the electronic excitation (Mehta and Mehta, 2009).

Dyes are organic compounds, which impart color to the fiber. It not only adheres to the surface of the fiber but also penetrates deep into it. For it to be a good dye, the color of a dye should be resistant towards heat, light, moisture, dilute acids, washing soaps, and so on. A dye that permanently fixes on the surface of the fiber is known as a fast dye where, as a dye that fades out, or is washed off is known as a fugitive dye (Mehta.and Mehta, 2009). Synthetic dyes today have evolved into a multi-billion dollar industry. Almost all the colors that you see today are synthetic dyes, and they are widely used for dyeing and printing in a broad range of industries. The synthetic dyes can be named according to the chemical structure of their particular chromophoric group. For example, diphenylmethane derivatives, triphenylmethane compounds, oxazine compounds, xanthene compounds, azo dyes to name a few. Most of the synthetic dyes with a few exception are aromatic organic compounds which can be divided into groups like ionic (acidic) and cationic (basic) dyes (Anonymous, 2008).

Pigments are chemical compounds which reflect only certain wavelengths of visible light. This makes them appear colorful. Flowers, corals, and even animal skin contain pigments which give them their colors. More important than their reflection of light is the ability of pigments to absorb certain wavelengths. Because they interact with light to absorb certain wavelengths, pigments are useful to plants and other autotrophs-organisms which make their own food using photosynthesis. In plants, algae, and cyanobacteria, pigments are the means by which the energy of sunlight is captured for photosynthesis. However, since each pigment reacts with only a narrow range of the spectrum, there is usually a need to produce several kinds of pigments, each of a different color, to capture more of the sun's energy (Anonymous, 2013).

I recommend this paper review (Anonymous, 2012a,b,c; Bahl and Bahl, 2009; Finar, 1990; Shindy, 2012a,b; Wade and Jr, 1999) unreservedly to everyone interested in the subject, chemistry libraries and also in the personal bookshelves of every organic heterocyclic and/or aromatic dyes chemists.

Problems in colors, dyes and pigments chemistry

Following are multi choice problems in colors, dyes and pigments chemistry. For each problem there are three solutions a, b and c, but only one solution of them is correct. Choose the correct one

1-Methyl red is:
a- Acidic dye.
b- Basic dye.
c- Neutral dye.
2- The auxochromes in methyl red dye is:
a-NH_2 group.
b-N,N-dimethylamino group.
c-N-methylamino group.
3- The group which when present singly is not able to impart colour to a compound is termed:
a-A weak chromophore.
b-A strong chromophore.
c-Auxochromes.
4- Acridine dyes are:
a- Anionic dyes.
b- Cationic dyes.
c- Zwitter ion dyes.
5- Gives two mesomeric structures in acid media:
a- Ethyl red.
b- Yellow naphthol.
c- Methyl red.
6- The groups that bring about deepening of colour called:
a- Bathochromic groups.
b- Hypsochromic group.
c- Positive groups.
7- Dibenzo-1,4-pyran is the parent substance in:
a- Phenolphthaleine dyes.
b- Xanthen dyes.
c- Triarylmethane dyes.
8- NMe_2 group is the auxochromes in:
a- Pyronine G.
b- Picric acid.
c- Orange II.
9- Phenolphthaleine in very strong basic media (pH > 12) gives:
a- Red colour solution.
b- Orange colour solution.
c- Colourless solution.
10- Methyl red is synthesized by coupling diazotized anthranilic acid with:
a- N-methylaniline.
b- N,N-dimethylaniline.
c- N,N-diethylaniline.
11- Methyl red used as:
a- Indicator in acid-base titrations.
b- Antitumor agents.

c- Laxative.
12-In acidic solution methyl red gives:
a- Blue colour.
b- Brown colour.
c- Red colour.
13-In alkaline solution methyl red gives:
a- yellow colour.
b- Red colour.
c- Green colour.
14- The chromophore in methyl red dye:
a- Azo group.
b- Azoxy group.
c- Nitroso group.
15- Methyl red is:
a- Anionic dye.
b- Cationic dye.
c- Zwitterion dye.
16- In acid media methyl red gives:
a- Two mesomeric structures.
b- Three mesomeric structures.
c- Four mesomeric structure.
17- Bathochromic groups are:
a- Groups that bring about deepening of color.
b- Groups that bring about lightining of colour.
c- Positive groups.
18- Hypsochromic groups are:
a- Groups that bring about deeping of colour.
b- Groups that bring about lightining of colour.
c- Negative groups.
19- Examples for strong chromophoric groups are:
a- C=C, C=O, C=S.
b- NO_2, N=O, N=N.
c- NH_2, NHR, NR_2, OH.
20- Examples for weak chromophoric groups are:
a- C=C, C=O, C=S..
b- NO_2, N=O, N=N.
c-- NH_2, NHR, NR_2, OH
21- The group which when present singly is sufficient to give colour to a compound is termed:
a- Auxochrome.
b- Strong chromophore.
c- Weak chromophore.
22- The parent substance in the xanthen dyes is:
a- Dibenzo-1,4-pyran.
b- Dinaphtho-1,4-pyran.
c- Dipyrido-1,4-pyran.
23- The auxochromes in pyronine G is:
a- NH_2 group.
b- NHMe group.
c- NMe_2 group.
24- The auxochromes in methylene blue is:
a- NH_2 group.
b- NHMe group.
c- NMe_2 group.
25- Synthesized by coupling diazotized anthranilic acid with N,N-dimethylaniline:
a- Congo red.
b- Ethyl red.
c- Methyl red.
26- Acridine dyes are:
a- Acidic dyes.
b- Basic dyes.
c- Neutral dyes.
27- Used as indicator in acid-base titrations:
a- Green resorcin.
b- Green naphthol.
c- Methyl red.
28- Have a yellow colour in alkaline solution:
a- Methyl red.
b- Congo red.
c- Ethyl red.
29- C=C, C=O and C=S are:
a- Strong chromophores.
b- Weak chromophores.
c- Auxochromes.
30- NO_2, N=O, N=N are:
a- Strong chromophones.
b- Weak chromophones.
c- Auxochromes.
31- Azo group is the chromophore in:
a- Ethyl red.
b- Methyl red.
c- Indigotin.
32- Have red colour in acidic solution:
a- Congo red.
b- Methyl red.
c- Ethyl red.
33- N,N-dimethylamino group is the auxochromes in:
a- Congo red.
b- Methyl red.
c- Ethyl red.
34- NMe_2 groups are the auxochromes in:
a- Methylene blue.
b- Congo red.
c- Alizarin.
35- The groups that bring about lightining of colour called:
a- Bathochromic groups.
b- Hypsochromic groups.
c- Negative groups.
36- A weak chromophore defined as:
a-A group, which when present singly is not able to impart colour to a compound.
b-A group, which when present singly is sufficient to give colour to the compound.
c-Electron donating group.
37- NMe group is the auxochromes in:
a- Pyronine G.
b- Picric acid.
c-Orange II.
38- The leuco form of methylene blue [leuco methylene blue (colourless)] formed by:
a- Reduction.
b- Oxidation.
c- Alkylation.

39- Xanthen dyes are:
a- Alicyclic yes.
b- Aromatic dyes.
c- Heterocyclic dyes.
40- Acridine dyes are:
a- Heterocyclic dyes.
b- Aromatic dyes.
c- Alicyclic dyes.
41- A strong chromophore defined as:
a-A group which when present singly is not able to impart colour to a compound.
b-A group, which when present singly is sufficient to give colour to the compound.
c-Electron releasing group.
42- Used in biological staining:
a- Methylene blue.
b- Congo red.
c- Acid red.
43- Pyronine G is:
a- Aromatic dye.
b- Heterocyclic dye.
c- Alicyclic dye.
44- Methyl red gives two mesomeric structures in:
a- Acid media.
b- Basic media.
c- Neutral media.
45- Acridine dyes are:
a- Anionic dyes.
b- Cationic dyes.
c- Zwitter ion dyes.
46- It is the chief constituent of the madder root:
a- Alizarin.
b- Phenolphthaleine.
c- Eoscin.
47- Xanthen dyes are:
a- Anionic dyes.
b- Cationic dyes.
c- Zwitter ion dyes.
48- Pyronine G is:
a- Acidic dye.
b- Basic dye.
c- Neutral dye.
49- Acridine dyes are:
a- Acidic dyes.
b- Basic dyes.
c- Neutral dyes.
50- Pyronine G is:
a- Zwitter ion dye.
b- Anionic dye.
c- Cationic dye.
51- The chromophore in p.hydroxy azo benzene is:
a- Azo group.
b- Azoxy group.
c- Hydroxy group.
52- The auxochrome in p.hydroxy azo benzene is:
a- Azo group.
b- Azoxy group.
c- Hydroxy group.
53- The chromophore in benzene azo resorcinol is:
a- 2OH group.
b- N=N group.
c-N=O group.
54- the auxochromes in benzene azo resorcinol is:
a- 2OH group.
b- N=N group.
c-N=O group.
55- Mophene dye is:
a- Azine dye.
b- Azo dye.
c- Acridine dye.
56- Mophene dye is:
a- Anionic dye.
b- Zwitter ion dye.
c- Cationic dye.
57- The chromophores in phenyl azo 1-naphthol and phenyl azo 2-naphthol dyes are:
a- Nitro group.
b- Nitroso group.
c- Azo group.
58- The auxochromes in phenyl azo 1-naphthol and phenyl azo 2-naphthol dyes are:
a- OH groups.
b- NH_2 groups.
c- NHMe groups.
59- Mophene dye is:
a- Acidic dye.
b- Basic dye.
c- Neutral dye.
60- The chromophore in benzene azo p.cresol is:
a- Azoxy group.
b- Nitroso group.
c- Azo group.
61- The auxochromes in benzene azo p.cresol is:
a- OH group.
b- NH_2 group.
c- NMe_2 group.
62- Xanthen dyes are:
a- Acidic dyes.
b- Basic dyes.
c- Neutral dyes.
63- Entering NO_2 as a chromophore in benzene to give nitro benzene changes its colour from colourless to:
a- Yellow.
b- Orange.
c- Red.
64- Entering OH group as a auxochromes in nitro benzene to give ortho and/or para hydroxyl nitro benzene changes its colour from yellow to:
a- Purple.
b- Orange.
c- Blue.
65- Entering azo group as a chromophore in biphenyl ring to give azo benzene changes its colour from colourless to:
a- Purple.

b- Green.
c- Orange/red.
66- Entering OH group as a auxochromes in azo benzene to give p.hydroxy azo benzene changes its colour from orange/red to:
a- Bright red.
b- Violet.
c- Green.
67- Entering NH_2 group as a auxochromes in nitro benzene to give p. and/or o-nitro aniline changes its colour from yellow to:
a- Red.
b- Purple.
c- Orange.
68- Entering OH group in triphenylmethane to give triphenylcarbinol changes its colour from colourless to:
a- Pink.
b- Red.
c- purple.
69- Introducing additional carbonyl group to acetone to give biacetyl changes its colour from colourless to:
a- Violet.
b- Yellow.
c- Red.
70- Introducing methylene group between the two carbonyl group in biacetyl to give acetylacetone changes its colour from yellow to:
a- Blue.
b- Green.
c- Colourless.
71- Introducing two carbonyl groups in benzene to give para benzoquinone changes its colour from colourless to:
a- Orange.
b- Yellow.
c- Red.
72- Introducing two carbonyl groups in naphthalene to give 1,4-naphthoquinone changes its colour from colourless to:
a- Red.
b- Yeloow.
c- Orange.
73- Introducing additional benzene ring to anthracene to give the more conjugated naphthacene changes its colour from colourless to:
a- Orange.
b- Yellow.
c- Red.
74- Entering NH_2 group as auxochromes in triphenylcarbinol changes its colour from pink to:
a- Yellow.
b- Red.
c- Blue.
75- The chromophore in p.amino azo benzene is:
a- Azo group.
b- Azoxy group.
c- Nitroso group.
76- The auxochromes in p.amino azo benzene is:
a- OH group.
b- NH_2 group.
c- NHMe group.
77- p.Amino azo benzene is yellow in colour but in acidic medium it appears:
a- Red.
b- Purple.
c- Violet.
78- p.Amino azo benzene have two mesomeric structures in:
a- Acidic media.
b- Basic media.
c- Neutral media.
79- In acidic media p.amino azo benzene have:
a- Three mesomeric structures.
b- Two mesomeric structures.
c- Four mesomeric structures.
80- German chemist O, N. Witt suggested the chromophore – auxochromes theory for coloured organic compounds in:
a- 1880.
b- 1867.
c- 1876.
81- The chromophore – auxochromes theory was suggested in 1876 by the German chemist:
a- O. N. Witt.
b- I. .L. Finar.
c- H .W. Vogel.
82- Introducing two carbonyl group in benzene to give o.benzo quinone changes its colour from colourless to:
a- Yellow.
b- Deep red.
c- Orange.
83- Martius yellow is:
a- Azo dye.
b- Nitroso dye.
c- Nitro dye.
84- The chromophore in martius yellow dye is:
a- Nitro groups.
b- Nitroso groups.
c- Azo groups.
85- The auxochromes in martius yellow dye is:
a- $NHCH_3$ group.
b- NMe_2 group.
c- OH group.
86- Martius yellow synthesized by sulphonation of 1-naphthol followed by:
a- Nitration.
b- Alkylation.
c- Bromination.
87- The first commercial phthalocyanine dye was:
a- Monastral fast blue B5.
b- Alizarin.
c- Fluoresceine.
88- Monastral fast blue B5 is:
a- Aluminium phthalocyanine dye.
b- Copper phthalocyanine dye.
c- Chromium phthalocyanine dye.
89- The white light in the visible region consists of:
a- Seven colors.

b- Eight colors.
c- Six colors.
90- Cochineal is:
a- Anthraquinone dye.
b- Azine dye.
c- Cyanine dye.
91-Nomex, a strong fire retardant fabric, is made from:
a-meta-phthalic acid and meta-diamino benzene.
b- terphthalic acid (para-phthalic acid) and para-diamino benzene.
c-ortho-phthalic acid and ortho-diamino benzene.
92-Kevlar fabric, used for making a variety of clothing accessories, fire cord and bulletproof vests , is made from:
a-meta-phthalic acid and meta-diamino benzene.
b-terphthalic acid (para-phthalic acid) and para-diamino benzene.
c- ortho-phthalic acid and ortho-diamino benzene.
93-Kodel fibers is superior when used in clothing applications and fine light weight quilting, is made from dimethyl terphthalate and:
a- 1,4-di(hydroxymethyl)cyclohexane.
b- 1,4-di(hydroxymethyl)cyclopentane.
c- 1,4-di(hydroxymethyl)cyclobutane.
94-Nomex fibres, are:
a-polyamide fibres.
b-polyester fibres.
c-polyacrylonitrile fibres.
95-Kevlar fibres, are:
a-polyester fibres.
b-polyamide fibres.
c-orlon fibres.
96-Kodel fibres are:
a-polyacrylonitrile fibres.
b-polyamide fibres.
c-polyester fibres.
97-Condensation polymerization reaction between meta-phthalic acid and meta-diamino benzene gives:
a-Nomex fibres.
b-kevlar fibres.
c-kodel fibres.
98-Condensation polymerization reaction between terphthalic acid(para-phthalic acid) and para-diamino benzene gives:
a-kodel fibres.
b-kevlar fibres.
c-nomex fibres.
99-Condensation polymerization reaction between dimethyl terphthalate and 1,4-di(hydroxymethyl) cyclohexane gives:
a-kevlar fibres.
b-kodel fibres.
c-nomex fibres.
100-The trade and/or famous name of 1,1-diethyl- 4,4-trimethine cyanine iodide dye is:
a-Ethyl red.
b-Pinacyanol.
c-Kryptocyanine
101-Quinoline blue is the trade and/or famous name of:
a-1,1-diisoamyl-4,4-monomethine cyanine iodide.
b-1,1-diisopropyl-4,4-monomethine cyanine iodide.
c-1,1-diisobutyl-4,4-monomethine cyanine iodide.
102-The color of cyanine dyes in highly strong acid media is:
a-Violet.
b-Yellow and/or colorless.
c-Blue.
103-Quinoline blue prepared through the action of alkalei on the isoamyl quaternary salt of:
a-Quinoline and isoquinoline.
b-Quinoline and quinaldine.
c-Quinoline and lepidine.
104-Used as indicators in acid/base titrations:
a-Phenolphthaleine.
b-Phenolphthaleine sulphone.
c-Alizarin.
105-The first known cyanine dye was:
a-Ethyl red.
b-Quinoline blue.
c-Pinacyanol.
106-Can be used as acid/base indicators in analytical chemistry:
a-Nitroso dyes.
b-Nitro dyes.
c-Cyanine dyes.
107-1,1-diisoamyl-4,4-monomethine cyanine iodide is the scientific name of:
a-Methylene blue.
b-Quinoline blue.
c-Kryptocyanine.
108-Alizarin dye have red color in presence of:
a-Aluminium mordant.
b-Iron mordant.
c-Chromium mordant.
109-Quinoline blue classified as:
a-Cyanine dye.
b-Phthaleine dye.
c-Diarylmethane dye.
110- Alizarin dye have violet color in presence of:
a-Aluminium mordant.
b-Iron mordant.
c-Chromium mordant.
111-Quinoline blue classified as:
a-Monomethine cyanine.
b-Dimethine cyanine dye.
c-Trimethine cyanine dye..
112-Alizarin dye has brownish-red color with:
a-Aluminium mordant.
b-Iron mordant.
c-Chromium mordant.
113-Quinoline blue classified as:
a-Methine cyanine dye.
b-Styryl cyanine dye.
c-Mero cyanine dye.
114-The color of Alizarin dye in presence of aluminium mordant is:
a-Red.

b-Blue.
c-Violet.
115-The color of Alizarin dye in presence of iron mordant is:
a-Violet.
b-Orange.
c-Purple.
116-The color of Alizarin dye with chromium mordant is:
a-Blue.
b-Brownish-red.
c-Yellow.
117-The first known cyanine dye, Quinoline blue was prepared by Greville Willams in:
a-1656.
b-1756.
c-1856
118-Kodel fibers, prepared by condensation polymerization reaction between dimethyl terphthalate and:
a- 1,4-di(hydroxymethyl)cyclohexane.
b- 1,4-di(hydroxyethyl)cyclohexane.
c- 1,4-di(hydroxpropyl)cyclohexane.
119-Kevlar fibres, prepared by condensation polymerization reaction between terphthalic acid(para-phthalic acid) and:
a-para-dihydroxy benzene.
b-para-diamino benzene.
c-para-dimethoxy benzene.
120-Nomex fibres, prepared by condensation polymerization reaction between meta-phthalic acid and:
a-meta-diethoxy benzene.
b-meta-dihydroxy benzene.
c-meta-diamino benzene.
121-The scientific name of Quinoline blue is:
a-1,1-diisoamyl-2,2-monomethine cyanine iodide.
b-1,1-diisoamyl-2,4-monomethine cyanine iodide.
c-1,1-diisoamyl-4,4-monomethine cyanine iodide.
122-The sensitivity effect of cyanine dyes on silver halide emulsion was first discovered by:
a- H.W.Vogel.
b-I. L. Finar.
c-F. M. Hamer.
123-The first human-made and/or synthetic organic dye mauveine was discovered by William Henry Perkin, he obtained this dye by oxidation of impure:
a-Phenol.
b-Aniline.
c-Toluene.
124-The first known cyanine dye, Quinoline blue was prepared by:
a- H.W.Vogel
b- F. M. Hamer.
c-Greville Willams.
125-The first human-made and/or synthetic organic dye mauveine was discovered by William Henry Perkin in:
a-1856.
b-1865.
c-1870.
126-The first human-made and/or synthetic organic dye mauveine was discovered by:
a-Greville Willams.
b-William Henry Perkin.
c- H.W.Vogel
127-The first human-made and/or synthetic organic dye was:
a-Indigotin.
b-Alizarin
c-Mauveine
128- Introducing additional benzene ring to naphthacene to give the more conjugated pentacene changes its colour from yellow to:
a- Orange.
b- Blue.
c-Red.
129-Cyanine dyes usually prepared in presence of:
a-Acidic catalyst.
b-Basic catalyst.
c-No catalyst.
130-Trimethine cyanine dyes, also named:
a-Carbocyanine dyes.
b-Dicarbocyanine dyes.
c-Tricarbocyanine dyes.

The solutions in colors, dyes and pigments chemistry

Following are solutions of the previous multi choice problems in colors, dyes and pigments chemistry. For each problem, the correct solution has been chosen.

1- a-Acidic dye.
2- b- N,N-dimethylamino group.
3- a- A weak chromophore.
4- b- Cationic dyes.
5- c- Methyl red.
6-a- Bathochromic groups.
7- b- Xanthen dyes.
8- a- Pyronine G.
9- c- Colourless solution.
10- b- N,N-dimethylaniline.
11- a- Indicator in acid-base titrations.
12- c- Red colour.
13- a- Yeloow colour.
14- a- Azo group.
15- a- Anionic dye.
16- a- Two mesomeric structures.
17- a- Groups that bring about deepening of colour.
18- b- Groups that bring about lightining of colour.
19- b- NO2, N=O, N=N.
20- a- C=C, C=O, C=S.
21- b- Strong chromophore.
22- a- Dibenzo-1,4-pyran.
23- c- NMe2 group.
24- c- NMe2 group.
25- c- Methyl red.
26- b- Basic dyes.
27- c- Methyl red.
28- a- Methyl red.
29- b- Weak chromophores.

30- a- Strong chromophones.
31- b- Methyl red.
32- b- Methyl red.
33- b- Methyl red.
34- a- Methylene blue.
35- b- Hypsochromic groups.
36- a- A group, which when present singly is not able to impart colour to a compound.
37- a- Pyronine G.
38- a- Reduction.
39- c- Heterocyclic dyes.
40- a- Heterocyclic dyes.
41- b- A group, which when present singly is sufficient to give colour to the compound.
42- a- Methylene blue.
43- b- Heterocyclic dye.
44- a- Acid media.
45- b- Cationic dyes.
46- a- Alizarin.
47- b- Cationic dyes.
48- b- Basic dye.
49- b- Basic dyes.
50- c- Cationic dye.
51- a- Azo group.
52- c- Hydroxy group.
53- b- N=N group.
54- a- 2OH group.
55- a- Azine dye.
56- c- Cationic dye.
57- c- Azo group.
58- a- OH groups.
59- b- Basic dye.
60- c- Azo group.
61- a-OH group.
62- b-Basic dyes.
63- a- Yellow.
64- b- Orange.
65- c- Orange/red.
66- a- Bright red.
67- c- Orange.
68- a- Pink.
69- b- Yellow.
70- c- Colourless.
71- b- Yellow.
72- a- Red.
73- b- Yellow.
74- b- Red.
75- a- Azo group.
76- b- NH2 group.
77- c- Violet.
78- a- Acidic media.
79- b- Two mesomeric structures.
80- c- 1876.
81- a- O. N. Witt.
82- b-Deep red.
83- c- Nitro dye.
84- a- Nitro groups.
85- c- OH group.
86- a- Nitration.
87- a-Monastral fast blue B5.
88-b- Copper phthalocyanine dye.
89- a- Seven colours.
90- a- Anthraquinone dye.
91-a-meta-phthalic acid and meta-diamino benzene.
92-b-terphthalic acid (para-phthalic acid) and para-diamino benzene.
93-a- 1,4-di(hydroxymethyl)cyclohexane.
94-a-polyamide fibres.
95-b-polyamide fibres.
96-c-polyester fibres.
97-a-Nomex fibres.
98-b-kevlar fibres.
99-b-kodel fibres.
100- c-Kryptocyanine
101-a-1,1-diisoamyl-4,4-monomethine cyanine iodide.
102-b-Yellow and/or colourless.
103-c-Quinoline and lepidine.
104-a-Phenolphthaleine.
105-b-Quinoline blue.
106-c-Cyanine dyes.
107-b-Quinoline blue.
108-a-Aluminium mordant.
109-a-Cyanine dye.
110- b-Iron mordant.
111-a-Monomethine cyanine.
112-c-Chromium mordant.
113-a-Methine cyanine dye.
114-a-Red.
115-a-Violet.
116-b-Brownish-red.
117-c-1856
118-a- 1,4-di(hydroxymethyl)cyclohexane.
119-b-para-diamino benzene.
120-c-meta-diamino benzene.
121-c-1,1-diisoamyl-4,4-monomethine cyanine iodide.
122-a- H.W.Vogel.
123-b-Aniline.
124-c-Greville Willams.
125-a-1856.
126-b-William Henry Perkin.
127-c-Mauveine.
128- b- Blue.
129-b-Basic catalyst.
130-a-Carbocyanine dyes.

CONCLUSIONS

This paper review is valuable both for getting an overview in the field of color, dyes and pigments chemistry and as a mine of information for the dyestuff chemists.

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