

**THE SOCIETY OF DYERS AND COLOURISTS
PERKIN HOUSE, 82 GRATTAN ROAD
BRADFORD BD1 2JB**

EXAMINATION FOR THE ASSOCIATESHIP (ASDC) 2009

Paper 1

**Theories of Colour
Colour Assessment and Measurement
Relation of Colour to Constitution**

(Note: The marks for each question, or part question, are indicated in brackets, the total marks for each question are 20.)

(**FIVE** questions only to be attempted; begin each question on a **separate** sheet)

- 1 Outline the principles underlying instrumental colour-match prediction systems. [13]
Describe the main features of an instrumental colour-match prediction system. [7]

- 2 Describe the main components of a modern reflectance spectrophotometer suitable for the colour measurement of fabric samples. [12]
Outline how you could test whether the instrument was in good working order. [4]
Indicate the steps that you would take to ensure that reliable results were obtained for one specific application of your choice. [4]

- 3 Give an account of the development of colour difference formulae since 1976. [16]
Describe how you would establish a suitable colour difference tolerance limit for a particular application. [4]

- 4 Give an account of the essential features of the CIE XYZ system of colour specification. [12]
Explain why illuminant D65 is generally preferred to illuminant C. [3]
Define dominant wavelength, excitation purity and complementary dominant wavelength. Illustrate your answer using a sketch of the CIE chromaticity diagram. [5]

5. Discuss the advantages and disadvantages of using instrumental methods rather than visual methods (based on physical samples e.g. colour atlas or grey scales) for:
 - (a) The specification of the colour of a standard [7]
 - (b) The communication of colour [6]
 - (c) The assessment of staining in fastness testing. [7]

- 6 (a) Sketch a typical spectral reflectance curve for each of the following coloured surfaces:
 (i) Yellow;
 (ii) Pink;
 (iii) Purple;
 (iv) Light grey;
 (v) Bright blue. [10]

(b) Suggest possible values of CIE L*, a* and b* for each of these surfaces. [5]

- (c) State which hues you would expect for both additive mixtures and subtractive mixtures of:
 (i) Red plus green;
 (ii) Red plus yellow plus blue;
 (iii) Blue plus yellow. [5]

7 (a) Describe the CIELAB (1976) Colour Space. [8]

(b) The colour parameters of two fabric samples are given in Table 7-1.

Table 7-1: CIELAB (1976) values for a pair of coloured fabric samples (A and B) viewed under illuminant D65.

Sample	L*	a*	b*	C*	h°
A (Standard)	72.53	-23.70	57.25		
B (Batch)	53.3			61.5	113.26

- (i). Determine the values of the missing entries in Table 7-1; [6]
 (ii) Describe, using words, the colour appearance of sample A. [2]

(c) Calculate the colour difference (ΔE_{ab}^*) between samples A and B. Interpret this result in a commercial pass/fail context. [4]

8 Define the terms *absorbance* and *molar extinction coefficient*. [3]
 Calculate the absorbance of materials that transmit (a) 50%, (b) 10% of the incident monochromatic radiation. [3]

The percentages of light *transmitted* at various wavelengths by solutions containing dyes A (0.02 g/l) and B (0.01 g/l) respectively are given below in Table 8-1, together with the corresponding values for a solution containing both dyes.

Calculate the concentrations of dye A and dye B in the mixture. [10]
 State any assumptions made and test these if possible. [4]

Table 8-1

Sample	Wavelength (/nm)						
	400	450	500	550	600	650	700
dye A (0.02 g/l)	32.1	24.4	21.7	29.6	52.1	78.7	85.6
dye B (0.01 g/l)	17.3	45.8	69.2	88.5	91.4	93.7	94.6
dye A + dye B	13.5	20.4	24.2	36.1	57	79.7	85.6

- 9 Explain what is meant by the terms *metamerism* and *colour constancy*, carefully distinguishing between the two. [8]
 Discuss a practical situation where *metamerism* is important. [4]
 Outline a quantitative method for assessing *metamerism*. [8]
- 10 Write notes on *each* of the following:
- (a) The assessment of whiteness [10]
 (b) The relationship between the chemical structure of a dye and its colour. [10]

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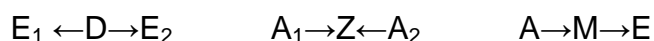
PAPER 2

**Chemistry (Structural and Physical) of Dyes, Pigments and Auxiliary
Chemicals Used in Technological Processes.**

(Note: The marks for each question, or part question, are indicated in brackets;
the maximum mark for each question is 20.)

**Candidates are required to answer FIVE questions. Begin each question on
a separate sheet.**

- 1 Using Winther symbols, disazo dyes are shown as falling into three classes:-



Explain what is meant by the above three schemes. [10]

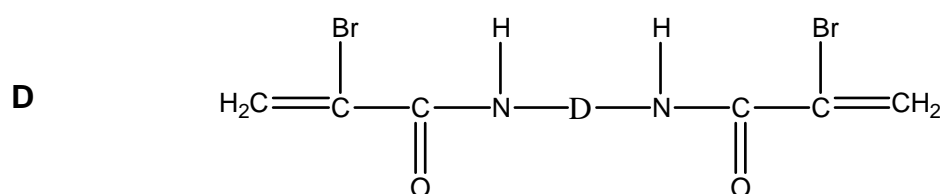
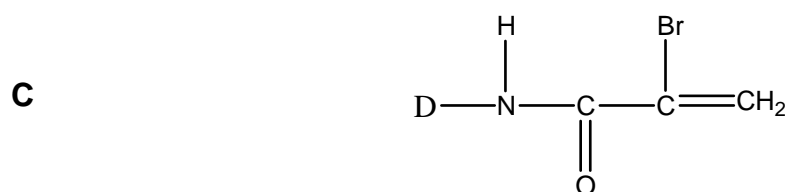
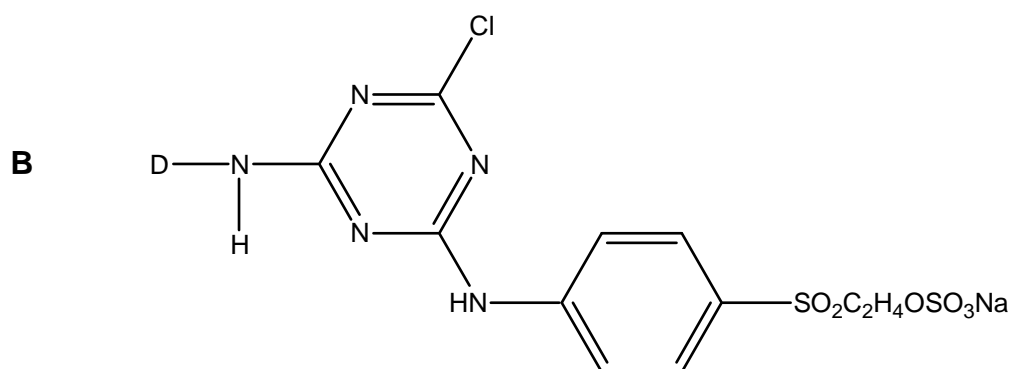
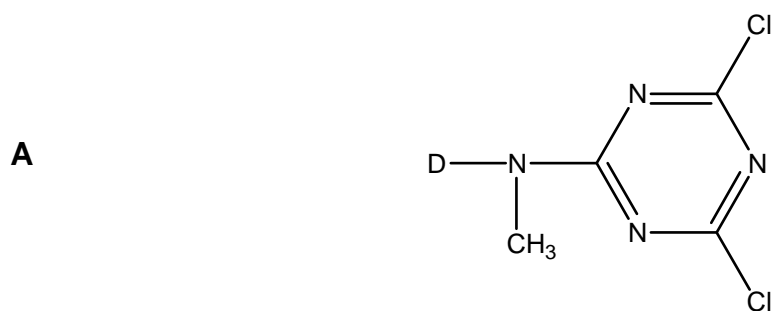
Give the structural formula of a compound representative of each of
A, D, E, M and Z. [10]

- 2 Give an account of the role of nitrogen in the structure of colorants. [20]

- 3 Give an account of the chemistry of basic dyes and of the retarding
agents used in their application to acrylic fibres. [20]

- 4 Use structural formulae to illustrate those features which give yellow,
red and blue azo pigments. [12]
Give an account of the auxiliaries used in pigment printing. [8]

5 Four water-soluble dyes have the structures represented by **A**, **B**, **C** and **D**.



(in all the above structures, D = chromogen)

- (i) Identify the type of dye represented by each of the structures **A**, **B**, **C** and **D** [4]
 - (ii) Indicate the fibre for which each dye would be most suitable [4]
 - (iii) Indicate schematically how each would react with the respective fibre [6]
 - (iv) For each one, outline the dyeing properties and application procedures, indicating the auxiliaries needed. [6]
- 6 Explain the differences in structure between anionic, cationic, non-ionic and amphoteric surface active agents. [5 marks for each type]

- 7 Explain the *essential* structural features of vat dyes. [5]
Explain *why* and *how* these dyes are converted into their leuco compounds. [5]
Explain the *essential* structural difference between vat and sulphur dyes. [5]
Indicate the auxiliaries used in the exhaust application of vat dyes to cotton. [5]
- 8 Write an essay on fluorescent brightening agents. [20]
- 9 Describe the structure of starch-, alginic acid- and acrylic acid- based thickening agents used in textile printing. [5 marks for each]
With reference to the above thickening agents, indicate how they would be likely to behave if used in the application of reactive dyes. [5]
- 10 Answer **two** of the following. [10 marks for each]
- (a) Explain the reasons why in recent years some countries have banned selected azo dyes on health and safety grounds.
 - (b) Describe developments that have taken place in response to environmental concerns over the application of reactive dyes.
 - (c) Discuss the environmental aspects of the reducing agents available for use with *either* vat *or* sulphur dyes.
 - (d) Explain the meaning and implications of the abbreviations COD, BOD and AOX.
 - (e) Compare the environmental aspects of the agents available for the bleaching of cotton.
 - (f) Explain the environmental problems posed by metal-containing dyes (including mordant dyes) and indicate any proposals for overcoming these.

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Paper 3

Chemistry (Structural and Physical) of Polymers

(Note: The marks for each question, or part question, are indicated in brackets, the total marks for each question are 20.)

(**FIVE** questions only to be attempted; begin each question on a **separate** sheet)

Candidates may use calculators. Graph paper will be supplied.

- 1 Give the chemical repeat structures of:
- (a) nylon 6.6
 - (b) nylon 6. [4]
- Describe the differences in polymerisation mechanisms for the two polymers. [12]
- Nylon 6 was originally described as ‘deep dyeing’ nylon. Explain, on the basis of the mechanisms of polymerisation, why nylon 6 has a greater uptake of acid dyes than does nylon 6.6 under similar dyebath conditions. [4]
- 2 Describe BOTH of the following processes, which involve the use of concentrated NaOH solutions, and explain the effects on the physical structure and properties of the two textile fibres:
- (a) mercerising cotton fabric and yarn [10]
 - (b) weight reduction of polyester yarn. [10]
- 3 Describe the essential steps in determining the RMM of a polymer by dilute solution viscometry. [8]
- The following flow times, as a function of concentration, were recorded for a series of polymer solutions using a capillary viscometer:
- | | | | | | |
|---|-----|-----|-----|-----|-------|
| Polymer conc ⁿ x 10 ⁴ /g cm ⁻³ | 0 | 4 | 8 | 12 | 16 |
| Flow time/secs | 108 | 136 | 172 | 216 | 269.5 |
- Calculate the Limiting Viscosity Number (Intrinsic Viscosity) and use this to calculate the Viscosity Average RMM ($\langle M_v \rangle$) from the Mark-Houwink equation:
- $$[\eta] = K \cdot \langle M_v \rangle^a$$
- where $K = 1.81 \times 10^{-3}$ and $a = 0.93$. [10]
- Explain the significance of the exponent ‘a’ in terms of the shape of the polymer chains in solution. [2]

- 4 Briefly describe the molecular basis of rubber elasticity. [8]
Use this mechanism to explain:
(a) the need to vulcanise natural rubber [4]
(b) how thermoplastic elastomers function without chemical crosslinks [4]
(c) why it is easier to produce elastomers that function at high temperatures than ones that function at low temperatures. [4]
- 5 Fibres are frequently described as “two-phase polymers”; explain what is meant by this term. [6]
Describe in detail the importance of each phase in the processing and dyeing of synthetic fibres. [14]
- 6 Describe the process of manufacture of secondary cellulose acetate. [16]
Secondary cellulose acetate is frequently called cellulose diacetate. Explain why this latter name is incorrect. [4]
- 7 Write notes on *TWO* of the following:
(a) plasticisers [10]
(b) fillers [10]
(c) blowing agents. [10]
- 8 Give a detailed account of the chemical structure of wool, particularly those features responsible for the setting and dyeing behaviour of wool. [20]
- 9 Write an essay on the chemistry of permanent press/durable press/crease-resistant treatments for cotton fabrics. [20]
- 10 Write an essay on the chemistry of polymers used as thickening agents in textile printing. [20]

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Paper 4

Industrial Organisation and Management

(Note: The marks for each question, or part question, are indicated in brackets, the total marks for each question are 20.)

(**FIVE** questions only to be attempted; begin each question on a **separate** sheet)

- 1 Discuss the purpose of a job description and write a job description for the human resources manager of a coloration company. [20]

- 2 Write an essay on the use of financial incentives to achieve designated targets in the coloration industry. [20]

- 3 Discuss the importance of monthly accounts to the financial management of a coloration company. [20]

- 4 Discuss the public relations function in the coloration industry, with particular reference to its strategic importance. [20]

- 5 Describe how the effective use of the internet may be used to promote a coloration company. [20]

- 6 Write an essay on the principles of total quality management. [20]

- 7 Discuss how the effects of climate change could impact the future of the coloration industry. [20]

- 8 Write an essay on 'Management is a Team Activity' with reference to the coloration industry. [20]

- 9 Discuss how the turmoil in global financial markets, which started during the second half of 2007, could impact on the performance of the coloration industry in 2009. [20]

- 10 Discuss the possible advantages and disadvantages of a strategic alliance between two companies in the coloration industry. [20]