

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

**EXAMINATION FOR THE ASSOCIATESHIP (ASDC) 2007**

**Paper 1**

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

9.15am – 12.30pm Tuesday 15 May 2007

(Note: Candidates must not commence writing until 9.30am but are free to study the question paper in advance. The marks for each question, or part question, are indicated in brackets, the maximum mark for each question is 20.)

Candidates are required to attempt **FIVE** questions

*Begin each question on a **SEPARATE** sheet*

1. Outline the principles underlying instrumental colour-match prediction systems. [14]  
Describe how such systems can be used to produce cost-effective recipes with desirable qualities such as a low degree of illuminant metamerism. [6]
  
2. Outline the major components of a modern reflectance spectrophotometer suitable for colour measurement. [12]  
Describe how you could test that the instrument was in good working order. [4]  
Outline the steps that you would take to ensure that reliable results could be obtained for one specific application of your choice. [4]
  
3. Review the development of colour-difference formulae after  $\Delta E^*$  (CIE  $L^*a^*b^*$ ) was established. [16]  
Describe how you would establish a suitable colour-difference tolerance limit ( $\Delta E^*$ ) for a particular application. [4]
  
4. Describe the CIE (XYZ) system of colour specification. [12]  
Explain why illuminant D65 is generally preferred to illuminant C. [4]  
Discuss the problems involved in producing a light source corresponding to D65. [4]
  
5. Give a detailed account of a colour-order system of your choice, emphasising the principles on which it is based. [12]  
Discuss the advantages and disadvantages of using colour order systems to specify the colour of a material. [8]
  
6. Explain what is meant by the terms *metamerism* and *colour constancy*, carefully distinguishing between the two. [7]  
Discuss practical situations in which *each* is important. [7]  
Outline the problems involved in quantifying *metamerism*. [6]

- 7) Describe the CIELAB colour space and explain how the total colour difference and differences in lightness, hue and chroma are defined. [10]  
 The CIE L\*a\*b\* values for a pair of coloured surfaces viewed under illuminant D65 are given in Table 7-1 below:

Table 7-1

Surface	L*	a*	b*
A	21.02	5.17	-16.58
B	19.06	4.88	-13.64

- Describe the colour of surface A and quantify the total colour difference between surface A and B. [4]  
 Calculate the chroma difference and the hue difference and interpret the results in visual terms. [6]

8. Define the terms *absorbance (optical density)* and *molar extinction coefficient*. [3]  
 Calculate the absorbance of materials that transmit (a) 50%, (b) 5% of the incident monochromatic radiation. [3]

The percentages of light *transmitted* at various wavelengths by solutions containing 0.020 g/dm<sup>3</sup> of dyes A and B 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 (0.020 g/dm <sup>3</sup> )	17.3	45.8	69.2	88.5	91.4	93.7	94.6
dye B (0.020 g/dm <sup>3</sup> )	32.1	24.4	21.7	29.6	52.1	78.7	85.6
dye A + dye B	13.5	20.4	24.2	36.1	57.0	79.7	85.6

- 9.(a) Sketch the possible spectral reflectance curves for the following coloured surfaces: [10]  
 (i) Medium orange;  
 (ii) Dark purple;  
 (iii) Mid brown;  
 (iv) White;  
 (v) Medium red.

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

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

10. Write notes on **two** of the following: [10]  
 (a) The assessment of whiteness. [10]  
 (b) Additive and subtractive mixing. [10]  
 (c) Testing for defective colour vision. [10]

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**PAPER 2**

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

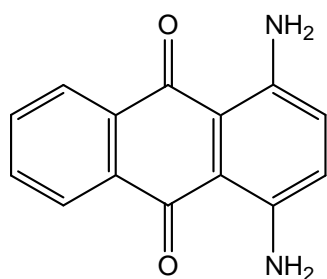
3.30pm – 6.45pm Tuesday 8 May 2007

(Note: Candidate must not commence writing until 3.45pm but are free to study the question paper in advance. The marks for each question, or part question, are indicated in brackets, the maximum marks for each question are 20.)

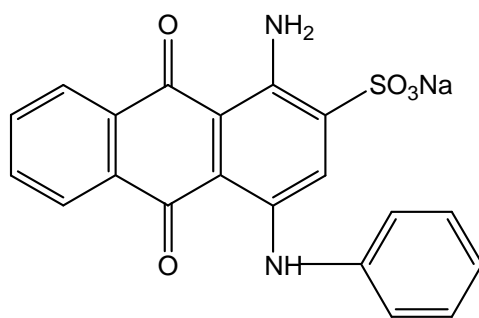
**Candidates are required to answer FIVE questions, begin each question on a separate sheet**

1. Explain the meaning of the terms  
(i) chromophore [1]  
(ii) auxochrome [1]  
Name three chromophores. [3]  
Give a structural example of a colorant for each of your named chromophores, indicate the *application* class of each and explain the part played by chemical groups *other than the chromophore* in making that colorant appropriate for application to a particular substrate. [5 for each chromophore]
  
2. Explain the following:  
(i) the difference between dyes and pigments. [6]  
(ii) why disperse dyes are considered to be dyes rather than pigments despite being substantially insoluble in water. [6]  
Describe, with chemical equations, how pigments (as azoic combinations) are synthesised on cotton. [ 8]
  
3. Give an account of the reactive systems used in fibre-reactive dyes. [20]
  
4. Write an essay on "Fluorescent brightening agents for cotton". [20]

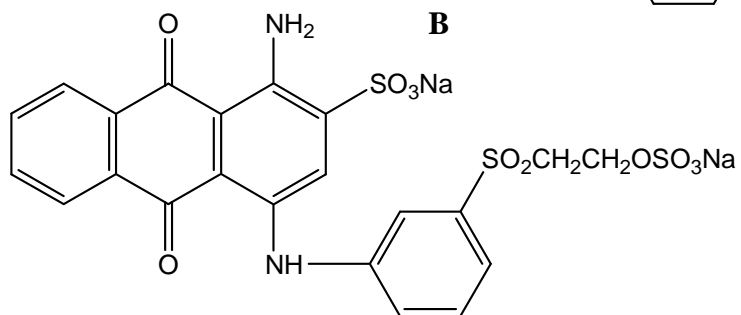
5.



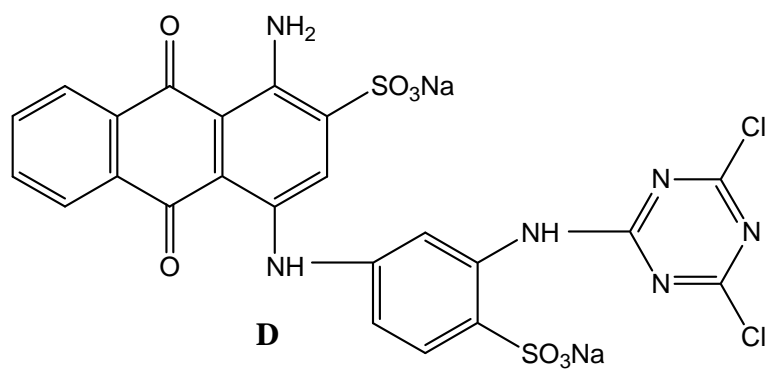
**A**



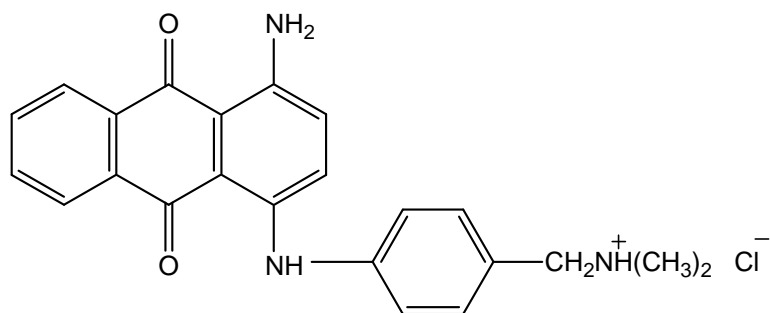
**B**



**C**



**D**



**E**

The colorant structures **A-E** are all based on 1:4-diaminoanthraquinone.

(i) Identify the application type of each colorant.

[2 for each]

(ii) Indicate appropriate substrates for each colorant and *briefly* outline a suitable dyeing process.

[2 for each]

6. 2,5-dichloroaniline, when diazotised and coupled to 2-naphthol, gives product *F*.  
The same amine, when diazotised and coupled to the anilide of 3-hydroxy-2-naphthoic acid, gives product *G*.  
Write balanced equations to illustrate the synthesis of products *F* and *G*. [12]  
Briefly indicate appropriate conditions for the diazotisation and coupling reactions. [4]  
State the application class of products *F* and *G* and briefly explain why type *G* products are generally preferred. [4]
7. Write an essay on "Environmental aspects pertaining to chrome and metal complex dyes". [20]
8. Describe in detail the chemical structure and application properties of anionic, cationic and non-ionic surfactants. [20]
9. Discuss environmental concerns and any subsequent developments in respect of *four* of the following:  
(i) electrolytes in the application of reactive dyes to cotton.  
(ii) residual reactive dyes in effluent.  
(iii) halogen-containing bleaching agents.  
(iv) reducing agents for vat and sulphur dyes.  
(v) surfactants.  
(vi) emulsion thickening agents in textile printing.  
(vii) yarn sizing agents.  
[each part carries 5 marks]
10. Write an essay on **one** of the following:  
(i) The chemistry and use of enzymes.  
(ii) Reducing systems for vat dyes.  
(iii) The chemistry and use of cationic retarding agents for application of basic dyes to acrylic fibres. [20]

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**PAPER 3**

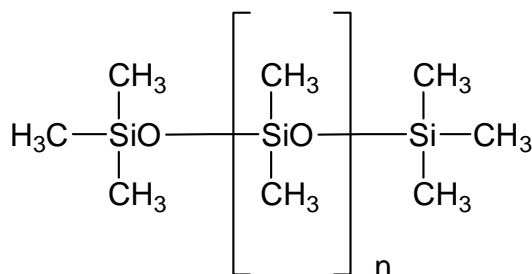
**Chemistry (Structural and Physical) of Polymers.**

3.30pm – 6.45pm Wednesday 9 May 2007

(Note: Candidate must not commence writing until 3.45pm but are free to study the question paper in advance. The marks for each question, or part question, are indicated in brackets, the maximum marks for each question are 20.)

**Candidates are required to answer FIVE questions, begin each question on a separate sheet**

1. Describe the chemical structure of proteins with reference to wool. [12]  
Explain the chemical reactions associated with the dyeing and setting of wool. [8]
2. Explain what is meant by number-average molar mass and by weight-average molar mass with respect to polymers. [8]  
Describe what is meant by the polydispersity of a polymer and indicate its significance. [6]  
Indicate how relative molar mass influences the glass transition temperature, the melting point and solubility of polymers. [6]
3. Write an essay on "The polymer types used as thickening agents in textile printing". [20]
4. Give an account of the action of acids and alkalis on wool and cotton. [10]  
Show how this behaviour is reflected in the processing methods used for these fibres. [10]
5. Write an essay on "Polymer solubility and the behaviour characteristics of polymer solutions". [20]
6. Identify the type of polymer represented by the structure: [2]





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**EXAMINATION FOR THE ASSOCIATESHIP (ASDC) 2007**

**Paper 4**

**Industrial Organisation and Management**

10.30am – 1.45pm Monday 14 May 2007

(Note: Candidates must not commence writing until 10.45am but are free to study the question paper in advance. The marks for each question, or part question, are indicated in brackets. The maximum mark for each question is 20.)

Candidates are required to attempt **FIVE** questions

*Begin each question on a **SEPARATE** sheet*

1. Write a job description for the personnel manager of a company involved in coloration. [20]
2. Discuss the strategy you would adopt in the evaluation and subsequent purchase of new machinery. [20]
3. Discuss the importance of a safe working environment and the relationship with current safety and health legislation. [20]
4. Write an essay on energy conservation in the coloration industry. [20]
5. Outline the case both in favour of and against research and development in the coloration industry. [20]
6. Discuss how you would raise finance, including the preparation of a business plan, for establishing a new dyeing and finishing company. [20]
7. Discuss the strengths and weaknesses of different types of management organisation, with particular reference to your present company or one with which you may be familiar. [20]
8. Describe how you would introduce an effective method of stock control into a dyeing and finishing company. [20]
9. Write an essay on the role of information technology (IT) in design, coloration and retailing. [20]
10. Discuss how the preparation of regular management accounts is of fundamental importance to the profitable operation of a dyeing and finishing company. [20]