Examination Period 3: 2018/19

LEA100919N

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<tr>
<th>Module Title</th>
<th>Leather Science 1</th>
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<tr>
<td>Level</td>
<td>Four</td>
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<tr>
<td>Time Allowed</td>
<td>One hour and thirty minutes</td>
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Instructions to students:

- Enter your student number **not** your name on all answer books.
- Answer **all** questions.
- Begin each question in a separate answer book; label each answer book clearly with the number of the question you are answering.
- The use of a calculator **is** permitted.

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Question 1

a. What is the trend in electronegativity of the elements?
   i. From the left to right hand side of the periodic table
   ii. From the first row down to lower rows

b. Write out the full electronic configuration of:
   i. Boron
   ii. Aluminium
   iii. Chloride anion (Cl-)

c. Define the following bond types:
   i. Covalent bond
   ii. Dative covalent bond
   iii. Ionic bond
   iv. Hydrogen bond

d. Shown is the skeletal structure of the amino acid asparagine with all the functional groups shown in their neutral form.

What are the three functional groups shown and would each of the groups have positive, neutral or negative charge at pH 7?
e. Explain, with example chemical structures, the difference between primary, secondary and tertiary alcohols.  

(6 marks)

f. Provide the formal IUPAC chemical names of the following skeletal structures:

(4 marks)

i. 

\[
\text{\textbf{OH}}
\]

ii. 

\[
\text{\textbf{O}}
\]

iii. 

\[
\text{\textbf{NH}_2}
\]

iv. 

\[
\text{\textbf{=}}
\]

Total: 25 marks
Question 2

a. Below is shown a cross section image of a hair shaft.

![Hair Shaft Image]

What are the three parts of hair shaft labelled and how readily are they broken down by unhairing chemistries?  
(6 marks)

b. What chemical conversion happens to keratin when undergoing “immunisation”?  
(2 marks)

c. The solubility of a saturated solution of calcium hydroxide (slaked lime) is 0.023 mol l\(^{-1}\). Assuming the ions fully dissociate when dissolved, calculate the pH of a saturated aqueous solution of calcium hydroxide.  
(6 marks)

d. 

i. Explain the term fatty acid.  
(3 marks)

ii. What functional group is formed when fatty acids react with 1,2,3-propanetriol (glycerol) to form a triglyceride?  
(1 mark)

e. Provide an iso-electric point range for raw hides and limed hides. Are they different and why?  
(3 marks)

f. Both ammonium sulphate and ammonium chloride may be used in ammonium salt deliming, which will neutralise both the pelt and residual lime present after liming to a pH of 8 – 9.

What is the difference in the calcium content of the delimed pelt from using one ammonium salt over the other, and why?  
(4 marks)

Total: 25 marks
Question 3

a. What is the primary function of fat liquoring and briefly describe how this function is achieved?  
   (3 marks)

b. With the aid of diagrams, describe the structure of a surfactant and what shape they form when dissolved in water.  
   (7 marks)

c. Sulphated and sulphited fat-liquors are the ones most commonly used in the leather. Comment on the typical differences in their chemical stability, emulsion particle size and penetrating power during the fat-liquoring process with a reason for each choice.  
   (6 marks)

d. Surfactant are commonly classified by their charge. What are the four classifications of surfactant?  
   (4 marks)

e. What are the characteristic properties of acid dyes and what is the mechanism by which they are fixed to the leather?  
   (4 marks)

f. What classification of dye would be most likely to contain the ammonium functional group?  
   (1 mark)

Total: 25 marks