Examination Period 3: 2016/17

**LEA300417N**

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<th>Module Title</th>
<th>Leather Science 3</th>
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<tr>
<td>Level</td>
<td>Six</td>
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<tr>
<td>Time Allowed</td>
<td>Two Hours</td>
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Instructions to students:

- Enter your student number **not** your name on all answer books.
- Answer **all** questions.
- All questions are equally weighted. Where a question has more than one part the division of marks is stated.
- Only work recorded in the answer books will be assessed.
- Clearly write your answers in your answer book.
- Clearly write the question number next to your answer.
- If you wish to change your answer, cross out the original answer.
- Please write in pen only.
- Neither books nor notes may be taken into the examination.
- The use of a non-programmable calculator is permitted.
- You may detach the supplementary material from the examination paper.

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Answer all questions.

Question 1

a. Name and describe the five phases of animal decomposition in the correct order. (8 marks)

b. Outline the conditions that have an effect on bacterial growth, explain how/why they affect the growth and describe how tanners try to control these conditions when preserving an unprocessed hide/skin. (13 marks)

c. In scientific terms: define red heat, what it is caused by, and explain how it will affect the quality of the leather. (4 marks)

Total: 25 marks

Question 2

a. Scientifically define the term “enzyme.” (3 marks)

b. With the use of a fully labelled Maxwell-Boltzmann distribution curve and an energy profile diagram; draw a comparison between two reactions (one without enzyme present and one with enzyme present) to show how an enzyme increases the rate of a reaction. (10 marks)

c. Define the Michaelis constant (K_m) and explain how it relates to the Michaelis-Menten equation. Also explain what information this value reveals about an enzyme. (9 marks)

d. With the aid of a diagram, explain competitive inhibition of an enzyme. (3 marks)

Total: 25 marks
Question 3

a. What do the terms “thermoplastic” and “thermoset” mean and what are the implications for their physical properties?  
   (4 marks)

b. Polyurethanes contain a repeating carbamate linkage. Draw the chemical structure of this linkage.  
   (1 mark)

c. Although polyesters are normally thermoplastics, thermoset varieties do exist. At a molecular level how do these two polymers differ? How is this difference achieved?  
   (3 marks)

d. ‘Faux’ leather can often be made using polyvinylchloride (PVC) which is formed by a chain growth mechanism. Using PVC as an example draw a reaction mechanism for the formation of PVC, making clear the three named steps.  
   (8 marks)

e. What is the primary function of fatliquoring? Explain why it is necessary.  
   (3 marks)

f. Anionic fatliquors are often fats that are suphited or sulphated so that they have self-emulsifying properties. Explain what an emulsion is and use drawings of a sulphite group and a sulphate group to explain how the properties of these functional groups enable the fatliquor to be self-emulsifying.  
   (6 marks)

Question 4

a. An ongoing research question is the effect that water has on the mechanical properties, and thus mechanical performance, of leather. What analytical method(s) could be used to help accurately characterise the effect of the water content on the mechanical properties? In your answer include:
   - Briefly how each instrument works;
   - What each method will show?
   - How this information would help?  
   (12 marks)
b. High-performance liquid chromatography (HPLC) can often be used in leather research to isolate and analyse individual components of a mixture.

i. How does chromatography such as HPLC work? (4 marks)

ii. How does HPLC help with analysis? (3 marks)

c. Dashpots and springs are the two basic elements used in theoretical models for viscoelastic materials. With the aid of diagrams use these two elements to demonstrate what the Maxwell, Voigt and Four Element models look like and explain why each model was an improvement on the other. (6 marks)

Total: 25 marks
End of Paper