

Question 36
(18 marks)

The molecular structures of alanine and lactic acid are shown below with their molecular formulae and melting points. Alanine is an α -amino acid while lactic acid may be classified as an α -hydroxy acid.

Compound name	Alanine	Lactic acid
Molecular structure	$\begin{array}{c} \text{O} \quad \text{H} \\ \parallel \quad \\ \text{HO}-\text{C}-\text{C}-\text{NH}_2 \\ \\ \text{CH}_3 \end{array}$	$\begin{array}{c} \text{O} \quad \text{H} \\ \parallel \quad \\ \text{HO}-\text{C}-\text{C}-\text{OH} \\ \\ \text{CH}_3 \end{array}$
Molecular formula	$\text{C}_3\text{H}_7\text{NO}_2$	$\text{C}_3\text{H}_6\text{O}_3$
Melting point	297 °C (decomposes)	16.8 °C

Lactic acid is the active constituent in a popular brand of liquid toilet cleaner. A chemist transferred a 10.00 mL sample of the toilet cleaner into a beaker and found it weighed 11.218 g. To confirm the amount of lactic acid in the toilet cleaner, a volumetric analysis on this sample was completed as follows. The liquid sample was diluted with water to 100.0 mL in a volumetric flask and 10.00 mL aliquots titrated against standardised sodium hydroxide solution with a concentration of $9.861 \times 10^{-3} \text{ mol L}^{-1}$. The average titre for this analysis was 22.74 mL.

- (a) Describe the procedure for transferring the sample to the volumetric flask and diluting it for this analysis. (4 marks)

(b) Calculate the concentration of lactic acid in the toilet cleaner, in g L^{-1} . (5 marks)

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- (c) Account for the large difference in melting points between alanine and lactic acid. (4 marks)
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- (d) Under certain conditions, both alanine and lactic acid form condensation polymers which produce water molecules. Draw the structures of each polymer, showing all atoms and bonds. Each polymer should contain three repeating units. (5 marks)

Polymer formed between alanine molecules

Polymer formed between lactic acid molecules