

Amines, amino acids and condensation polymers in action

Chemistry grades 11-12 (A Level · IB · Class 11-12) · Test answers (mark scheme)

Model answers with the marking points are shown below. Award each mark only for a correct statement or a correct step, and allow error carried forward in the calculations.

Level: Chemistry grades 11-12 (A Level · IB · Class 11-12) · **Curriculum:** A Level 3.3.11-3.3.13

Question 1 Basic strength (3 marks)

- Ethylamine** (smaller pK_b).
- In ethylamine the alkyl group donates electron density to nitrogen, so the lone pair is more available to accept H^+ . In phenylamine the lone pair is delocalised into the ring, so it is less available.

Marking: 1 for ethylamine; 1 for donation by the alkyl group; 1 for delocalisation in phenylamine.

Question 2 pH of dimethylamine (3 marks)

$[OH^-] = \sqrt{(5.4 \times 10^{-4} \times 0.0400)} = \sqrt{(2.16 \times 10^{-5})} = 4.65 \times 10^{-3} \text{ mol/dm}^3$. $pOH = -\log(4.65 \times 10^{-3}) = 2.33$. $pH = 14.00 - 2.33 = \mathbf{11.67}$.

Marking: 1 for $[OH^-]$; 1 for pOH ; 1 for pH .

Question 3 Serine melting point (2 marks)

- $HOCH_2CH(NH_3^+)COO^-$** , the zwitterion.
- It is an ionic lattice held by strong electrostatic attraction, so a lot of energy is needed to melt it.

Marking: 1 for the zwitterion; 1 for ionic attraction.

Question 4 Poly(lactic acid) (3 marks)

- An **ester** link forms and **water** is lost.
- Repeat unit $-OCH(CH_3)CO-$ is $C_3H_4O_2$: $36.0 + 4.0 + 32.0 = \mathbf{72.0}$. Chain: $450 \times 72.0 = \mathbf{32\,400}$.

Marking: 1 for ester and water; 1 for 72.0; 1 for 32 400.

Question 5 Tripeptide (3 marks)

- a. X and Y are **peptide (amide) links**, -CO-NH- .
b. Two links form, so two water molecules are lost: $75 + 89 + 105 - 2 \times 18 = 269 - 36 =$
233.

Marking: 1 for peptide link; 1 for subtracting 2×18 ; 1 for 233.

Question 6 Nylon or polypropene (2 marks)

Nylon-6,6 has polar amide links that are hydrolysed by water and acid, which breaks the chain into monomer salts. Poly(propene) has only non-polar C-C and C-H bonds that water and acid cannot attack.

Marking: 1 for hydrolysis of amide links; 1 for non-polar carbon chain.

Question 7 Hydrogen bonds in DNA (2 marks)

A = T = 15, so A-T pairs = 15. G + C = $80 - 30 = 50$, so G-C pairs = 25. Hydrogen bonds = $15 \times 2 + 25 \times 3 = 30 + 75 =$ **105**.

Marking: 1 for 15 and 25 pairs; 1 for 105.

Question 8 Choosing the reagent (2 marks)

Excess ammonia in ethanol, heated in a sealed tube. If ammonia is limited, the propylamine formed acts as a nucleophile and reacts further with 1-bromopropane to give secondary and tertiary amines.

Marking: 1 for excess ammonia with ethanol; 1 for further substitution.