

Solutions

Original marking guidance: M1 method, A1 accuracy, B1 explanation.

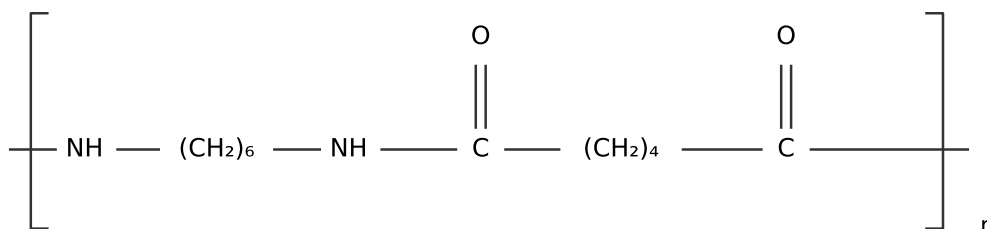
2.1 $\text{C}_4\text{H}_9\text{NH}_2 + \text{H}_2\text{O} \rightleftharpoons \text{C}_4\text{H}_9\text{NH}_3^+ + \text{OH}^-$. Nitrogen accepts a proton from water, increasing OH^- .

2.2 It binds H^+ as a base, forming butylammonium; it donates an electron pair to Cu^{2+} as a ligand, forming a coordinate bond.

2.3 The first amine product is also a nucleophile and can react again. Excess ammonia makes its attack more likely relative to amine attack, reducing but not eliminating further substitution.

3.1

Condensation polymer repeat unit



Nylon-6,6: open bonds continue through the brackets; amide links lie in the backbone.

B1 six-carbon diamine skeleton; B1 four- CH_2 diacid skeleton with both carbonyl carbons; B1 correct amide links; B1 open bonds/brackets/n.

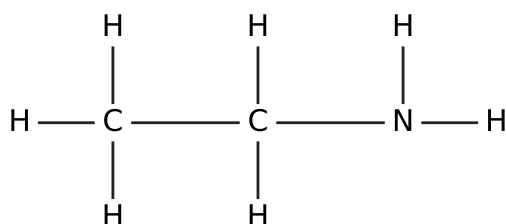
3.2 $[-\text{CH}_2-\text{CH}(\text{CONH}_2)-]$; $[-\text{CH}_2-\text{CH}(\text{OH})-]$. Poly(propenamide) forms by addition across $\text{C}=\text{C}$ without loss of a small molecule.

3.3 Nitrous acid from NaNO_2 /acid below about 10°C ; alkaline phenol coupling; $-\text{N}=\text{N}-$ azo linkage. Warming increases decomposition of the unstable diazonium salt.

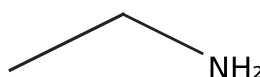
3.4

Ethanamine (ethylamine)

Displayed formula

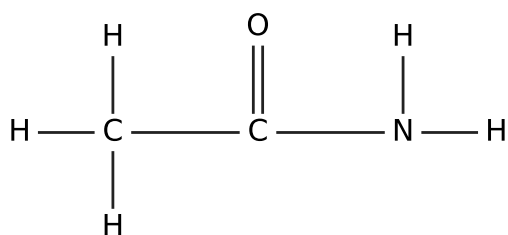


Skeletal formula

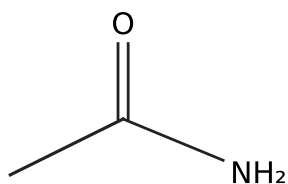


Ethanamide

Displayed formula

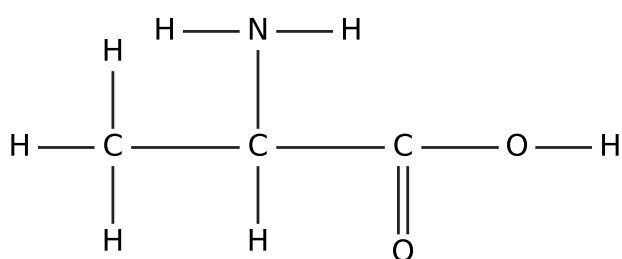


Skeletal formula

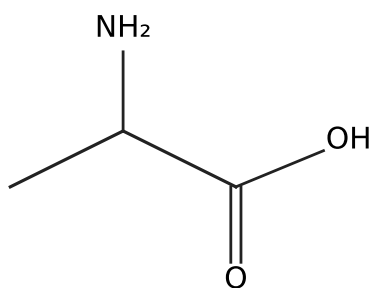


2-aminopropanoic acid (alanine; uncharged form)

Displayed formula



Skeletal formula



B1 each correct displayed formula; B1 each correct skeletal formula (six marks total).