Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

2.1

nucleophile: an electron-pair donor; electrophile: an electron-pair acceptor

2.2

H_2O nucleophile; NO_2^+ electrophile; CN^- nucleophile

2.3

$CH_3CH_2Br + OH^- \rightarrow CH_3CH_2OH + Br^-$; ethanol; nucleophilic substitution

2.4

orange to colourless; $C_2H_4 + Br_2 \rightarrow CH_2BrCH_2Br$; electrophilic addition

2.5

BF_3 is the Lewis acid; N donates its lone pair to B; forming a coordination (dative) bond

2.6

OH^- lone pair attacks the $\delta+$ carbon opposite Br (curly arrow to C); transition state with partial C–O and C–Br bonds; C–Br breaks and Br^- leaves (arrow from bond to Br), in one step

2.7

2-bromopropane; H^+ adds to the end carbon, which has more H atoms; the secondary carbocation formed is more stable than a primary one

3.1

(a) the halogen is more electronegative, so the carbon is $\delta+$; it attracts the lone pair of the nucleophile

(b) 1-bromobutane; the C–Br bond is weaker than the C–Cl bond, so it breaks more easily

(c) butan-1-ol

(d) heterolytic

3.2

(a) rate = $k[(CH_3)_3CBr]$

(b) slow step: C–Br breaks heterolytically to a carbocation and Br^-; curly arrow from the C–Br bond to Br; fast step: OH^- donates a lone pair to the carbocation

(c) the tertiary carbocation is stabilized by three alkyl groups; the three methyl groups block attack from the back side (steric hindrance)

(d) Br is more electronegative, so the bond is polar; Br takes both bonding electrons and leaves as Br^-