4.7 ANSWERS TO EXERCISES

4.7 Exercise 1

1. a) $C_2H_5Cl + 2NH_3 \rightarrow C_2H_5NH_2 + NH_4Cl$

- b) $C_2H_5NH_2 + C_2H_5Cl \rightarrow (C_2H_5)_2NH + HCl$ $(C_2H_5)_2NH + C_2H_5Cl \rightarrow (C_2H_5)_3N + HCl$ $(C_2H_5)_3N + C_2H_5Cl \rightarrow (C_2H_5)_4N^+Cl^-$
- c) starting compound CH₃CN reagent LiAlH₄ in dry ether CH₃CN + 4[H] → CH₃CH₂NH₂
- d) The reduction from a nitrile will give a higher yield as the primary amine is the only product formed

2. a)
$$CH_3Br + 2NH_3 \rightarrow CH_3NH_2 + NH_4Cl$$

b) $C_2H_5Cl + NH_3 \rightarrow C_2H_5NH_2 + HCl$

$$CH_3$$
— CH_2 — N
 H

c) $CH_3Br + C_2H_5NH_2 \rightarrow C_2H_5NH(CH_3) + HCl$

$$CH_3$$
 — CH_2 — N CH_3

d) $CH_3CHClCH_3 + C_2H_5NH(CH_3) \rightarrow CH_3CH(CH_3)N(C_2H_5)(CH_3) + HCl$ $CH_3 \longrightarrow CH \longrightarrow CH_3$

$$C_2H_5$$
 N
 CH_3

e) $C_2H_5Br + (C_2H_5)_3N \rightarrow (C_2H_5)_4N^+Br^-$

$$C_{2}H_{5}$$
 $C_{2}H_{5}$
 N^{+}
 $C_{2}H_{5}$
 $C_{2}H_{5}$
 $C_{2}H_{5}$
 $C_{2}H_{5}$

f) $3CH_3Cl + NH_3 \rightarrow (CH_3)_3N + 3HCl$

$$\mathsf{CH_3} - \mathsf{N} \mathsf{CH_3}$$

g)
$$CH_3CH_2CN + 4[H] \rightarrow CH_3CH_2CH_2NH_2$$

 $CH_3 \longrightarrow CH_2 \longrightarrow CH_2 \longrightarrow NH_2$

3. a)

$$\begin{bmatrix} & C_{10}H_{21} \\ C_{10}H_{21} & N & C_{10}H_{21} \\ & & C_{10}H_{21} \end{bmatrix} CI^{-1}$$

- b) quartenary ammonium salt
- c) cationic surfactant
- 4. a) i) $NH_3(aq) + H_2O(l) == NH_4^+(aq) + OH^-(aq)$ ii) $C_2H_5NH_2(aq) + H_2O(l) == C_2H_5NH_3^+(aq) + OH^-(aq)$
 - b) The solution in part (ii) will have a higher pH
 The ethyl group pushes electrons on to the N atom
 This makes the lone pair more available for donation
 - c) i) $C_2H_5NH_2 + HCl \rightarrow C_2H_5NH_3^+Cl^$
 - ii) $2(CH_3)_2NH + H_2SO_4 \rightarrow [(CH_3)_2NH]^{+}_2SO_4^{2-}$
 - iii) $(CH_3)_2NC_2H_5 + HCl \rightarrow [(CH_3)_2NHC_2H_5]^+Cl^-$