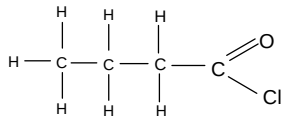
MEGA LECTURE

TOPIC 17 ANSWERS TO EXERCISES

Topic 17 Exercise 1

1. 2-hydroxypropanoyl chloride
2. methyl propanamide
3. propanoic anhydride
4. methylpropyl ethanoate
5. N-ethylpropanamide
6. N-ethylaminoethane or diethylamine
7. 2-hydroxymethylpropanenitrile
8. 2-aminobutanoic acid

9.



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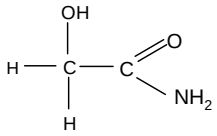

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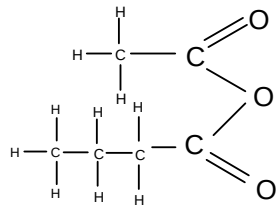

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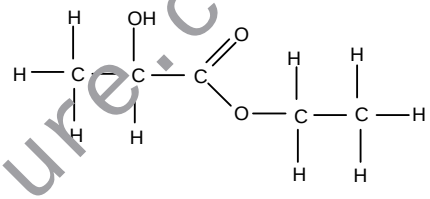

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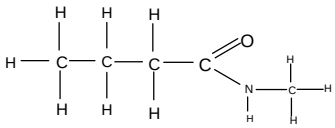

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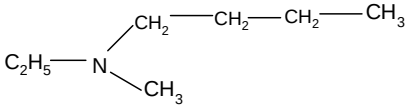

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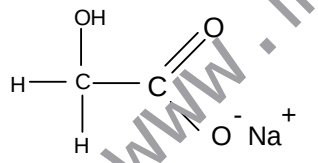

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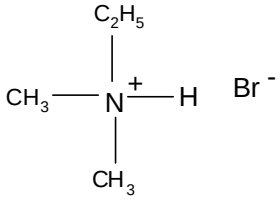


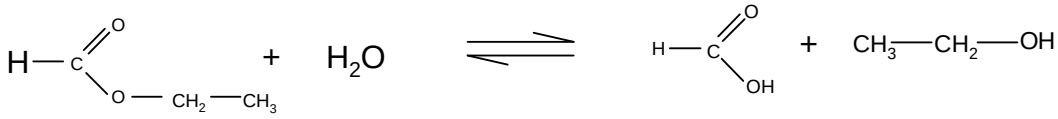
MEGA LECTURE

Topic 17 Exercise 2

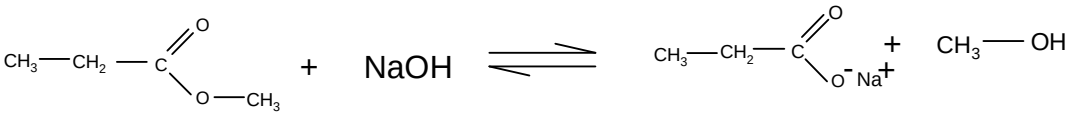
1. a) $CH_3CH_2COOH + NaOH \rightarrow CH_3CH_2COO^-Na^+ + H_2O$
   b) $2CH_3CH_2CH_2COOH + Na_2CO_3 \rightarrow 2CH_3CH_2CH_2COO^-Na^+ + CO_2 + H_2O$
   c) $HCOO^-Na^+ + HCl \rightarrow HCOOH + NaCl$
   d) $2CH_3COO^-Na^+ + H_2SO_4 \rightarrow 2CH_3COOH + Na_2SO_4$
   e) $2CH_3CH(CH_3)COOH + Na_2CO_3 \rightarrow 2CH_3CH(CH_3)COO^-Na^+ + CO_2 + H_2O$

2. a) $CH_3CH_2COOH + CH_3OH == CH_3CH_2COOCH_3 + H_2O$
   organic product = methyl propanoate
   b) $CH_3COOH + CH_3CH(OH)CH_3 == CH_3COOCH(CH_3)CH_3 + H_2O$
   organic product = methylethyl ethanoate
   c) $HCOOH + CH_3CH_2CH_2OH == HCOOCH_2CH_2CH_3 + H_2O$
   organic product = propyl methanoate
   d) $CH_3CH_2CH_2COOH + CH_3CH_2CH_2CH_2OH == CH_3CH_2CH_2COOCH_2CH_2CH_2CH_3 + H_2O$
   organic product = butyl butanoate

3. a)



b)



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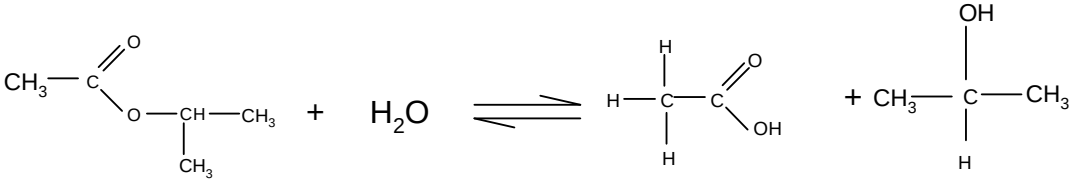
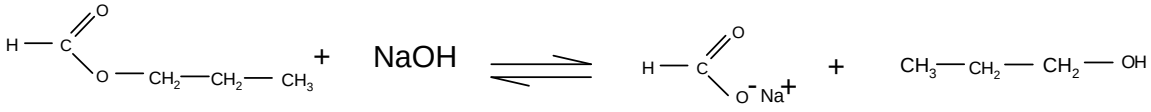
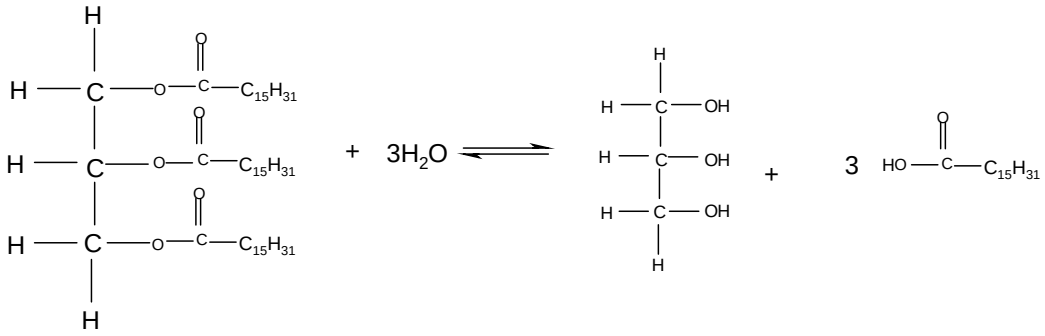


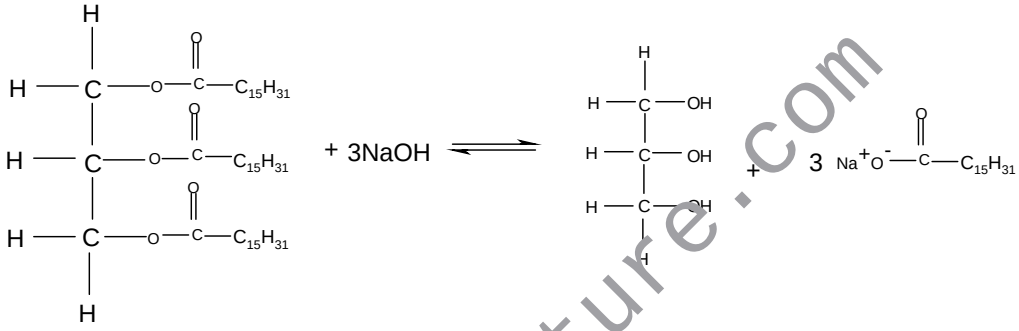
d)



4. a)



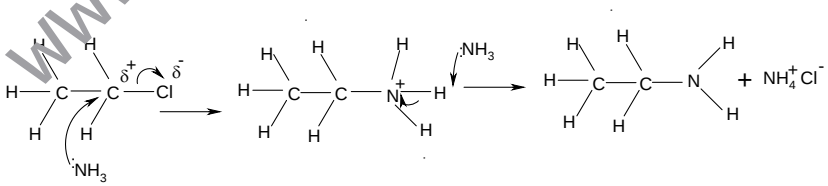
b)



Reaction (a) takes place in the stomach
The fatty acids are used in cell membranes
The glycerol is used as an energy source
Reaction (b) is carried out industrially
The glycerol is used in pharmaceutical and cosmetic preparations
The carboxylate salts are used as soaps

Topic 17 Exercise 3

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



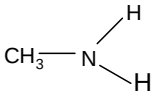
b) $C_2H_5NH_2 + C_2H_5Cl \rightarrow (C_2H_5)_2NH + HCl$
$(C_2H_5)_2NH + C_2H_5Cl \rightarrow (C_2H_5)_3N + HCl$
$(C_2H_5)_3N + C_2H_5Cl \rightarrow (C_2H_5)_4N^+Cl^-$

c) starting compound – CH_3CN
reagent – $LiAlH_4$ in dry ether
$CH_3CN + 4[H] \rightarrow CH_3CH_2NH_2$

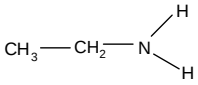
d) The reduction from a nitrile will give a higher yield

as the primary amine is the only product formed

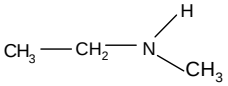
2. a) $CH_3Br + 2NH_3 \rightarrow CH_3NH_2 + NH_4Cl$



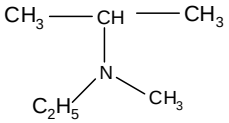
b) $C_2H_5Cl + NH_3 \rightarrow C_2H_5NH_2 + HCl$



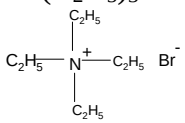
c) $CH_3Br + C_2H_5NH_2 \rightarrow C_2H_5NH(CH_3) + HBr$



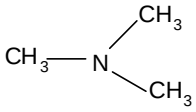
d) $CH_3CHClCH_3 + C_2H_5NH(CH_3) \rightarrow CH_3CH(CH_3)N(C_2H_5)(CH_3) + HCl$



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

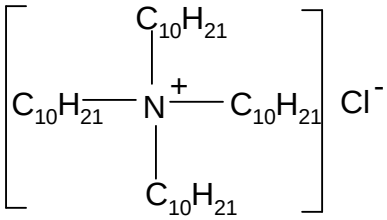


f) $3CH_3Cl + NH_3 \rightarrow (CH_3)_3N + 3HCl$



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

3. a)



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) $2(CH_3)_2NH + H_2SO_4 \rightarrow [(CH_3)_2NH_2]^+{}_2SO_4^{2-}$

iii) $(CH_3)_2NC_2H_5 + HCl \rightarrow [(CH_3)_2NHC_2H_5]^+Cl^-$

Topic 17 Exercise 4

1. a) $CH_3CH_2COCl + 2NH_3 \rightarrow CH_3CH_2CONH_2 + NH_4Cl$
organic product: propanamide

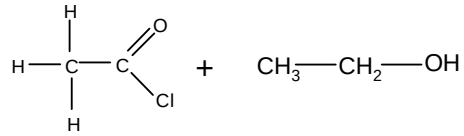
b) $(CH_3CH_2CH_2CO)_2O + CH_3CH(OH)CH_3 \rightarrow CH_3CH_2CH_2COOCH(CH_3)CH_3 + CH_3CH_2CH_2COOH$
organic products: methylethyl butanoate and butanoic acid

c) $HCOCl + 2CH_3CH_2NH_2 \rightarrow HCONHCH_2CH_3 + CH_3CH_2NH_3^+Cl^-$
organic product: N-ethyl methanamide

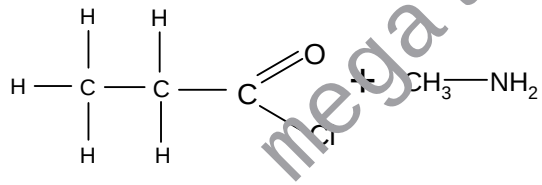
d) $(CH_3CO)_2O + CH_3CH(NH_2)CH_3 \rightarrow CH_3CONHCH(CH_3)CH_3 + CH_3COOH$
organic products: N-methylethylethanamide and ethanoic acid

e) $CH_3CH(CH_3)COCl + H_2O \rightarrow CH_3CH(CH_3)COOH + HCl$
organic products: methylpropanoic acid

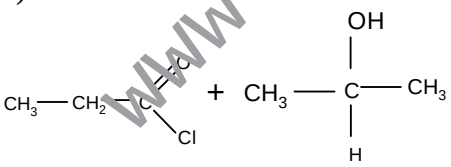
2. a)



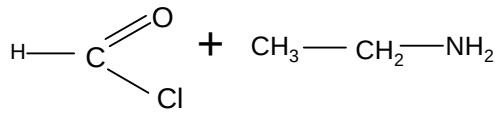
b)



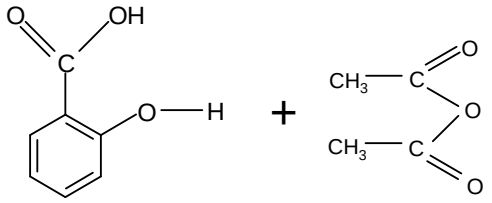
c)



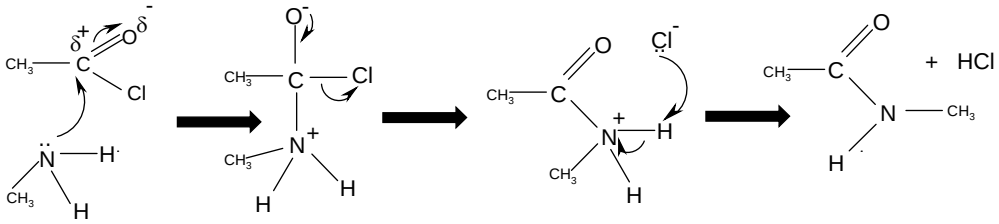
d)



e)



3. a)



b) nucleophilic addition-elimination

c) acid anhydride is cheaper than acyl chloride
the acid anhydride reaction is less violent
the acid anhydride reaction does not produce toxic fumes of HCl