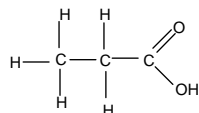


4.5 ANSWERS TO EXERCISES

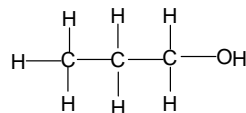
4.5 Exercise 1

1.

a) propanoic acid

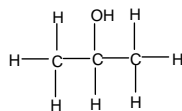


b) propan-1-ol

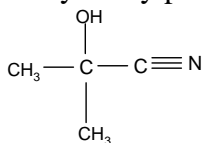


c) no reaction

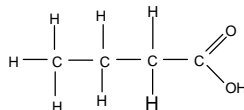
d) propan-2-ol



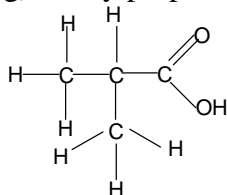
e) 2-hydroxymethylpropanenitrile



f) butanoic acid

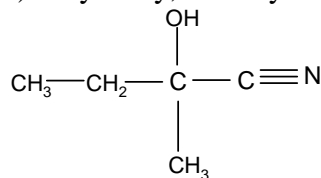


g) methylpropanoic acid



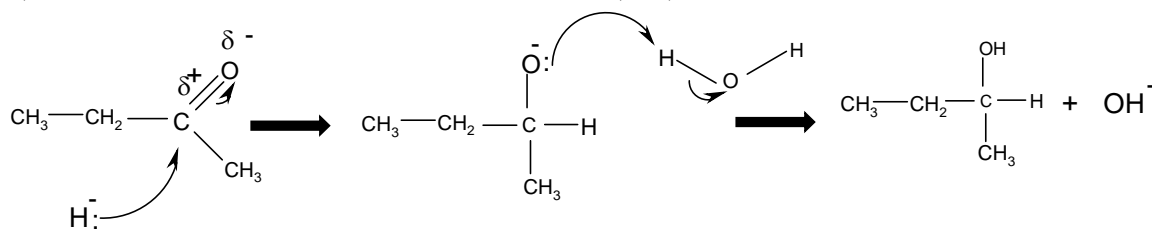
h) no reaction

i) 2-hydroxy,2-methylbutanenitrile

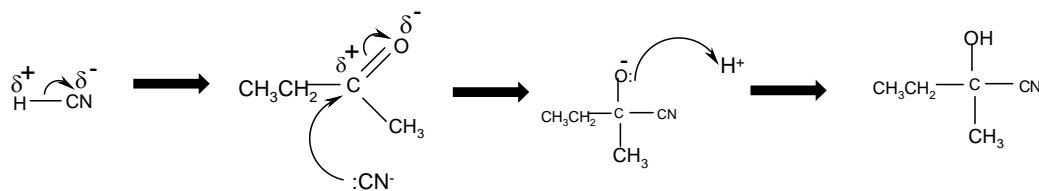


2.

a) $\text{CH}_3\text{CH}_2\text{COCH}_3 + 2[\text{H}] \rightarrow \text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$



b) $\text{CH}_3\text{CH}_2\text{COCH}_3 + \text{HCN} \rightarrow \text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CN}$

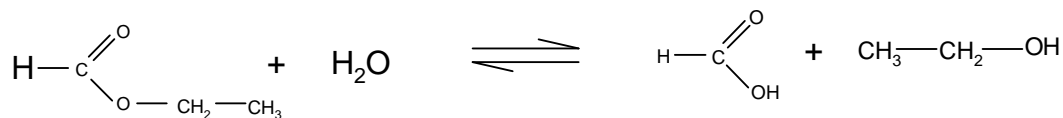


3. a) propanal and HCN b) butanone and HCN c) methylpropanal and HCN

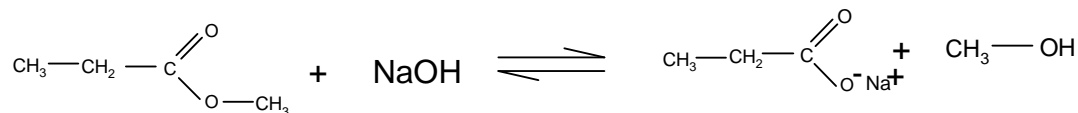
4.5 Exercise 2

1.
 - a) $\text{CH}_3\text{CH}_2\text{COOH} + \text{NaOH} \rightarrow \text{CH}_3\text{CH}_2\text{COO}^-\text{Na}^+ + \text{H}_2\text{O}$
 - b) $2\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH} + \text{Na}_2\text{CO}_3 \rightarrow 2\text{CH}_3\text{CH}_2\text{CH}_2\text{COO}^-\text{Na}^+ + \text{CO}_2 + \text{H}_2\text{O}$
 - c) $\text{HCOO}^-\text{Na}^+ + \text{HCl} \rightarrow \text{HCOOH} + \text{NaCl}$
 - d) $2\text{CH}_3\text{COO}^-\text{Na}^+ + \text{H}_2\text{SO}_4 \rightarrow 2\text{CH}_3\text{COOH} + \text{Na}_2\text{SO}_4$
 - e) $2\text{CH}_3\text{CH}(\text{CH}_3)\text{COOH} + \text{Na}_2\text{CO}_3 \rightarrow 2\text{CH}_3\text{CH}(\text{CH}_3)\text{COO}^-\text{Na}^+ + \text{CO}_2 + \text{H}_2\text{O}$
2.
 - a) $\text{CH}_3\text{CH}_2\text{COOH} + \text{CH}_3\text{OH} \rightleftharpoons \text{CH}_3\text{CH}_2\text{COOCH}_3 + \text{H}_2\text{O}$
organic product = methyl propanoate
 - b) $\text{CH}_3\text{COOH} + \text{CH}_3\text{CH}(\text{OH})\text{CH}_3 \rightleftharpoons \text{CH}_3\text{COOCH}(\text{CH}_3)\text{CH}_3 + \text{H}_2\text{O}$
organic product = methylethyl ethanoate
 - c) $\text{HCOOH} + \text{CH}_3\text{CH}_2\text{CH}_2\text{OH} \rightleftharpoons \text{HCOOCH}_2\text{CH}_2\text{CH}_3 + \text{H}_2\text{O}$
organic product = propyl methanoate
 - d) $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH} + \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH} \rightleftharpoons \text{CH}_3\text{CH}_2\text{CH}_2\text{COOCH}_2\text{CH}_2\text{CH}_2\text{CH}_3 + \text{H}_2\text{O}$
organic product = butyl butanoate

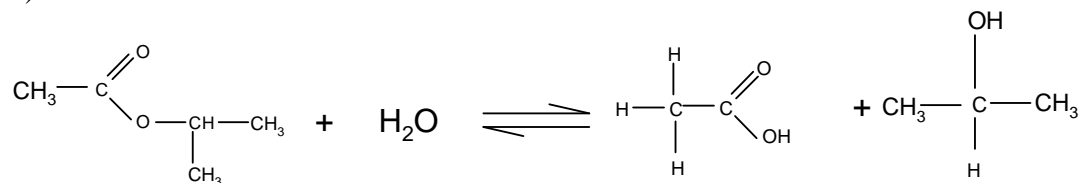
3. a)



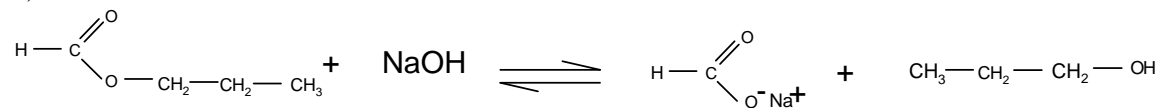
- b)



- c)

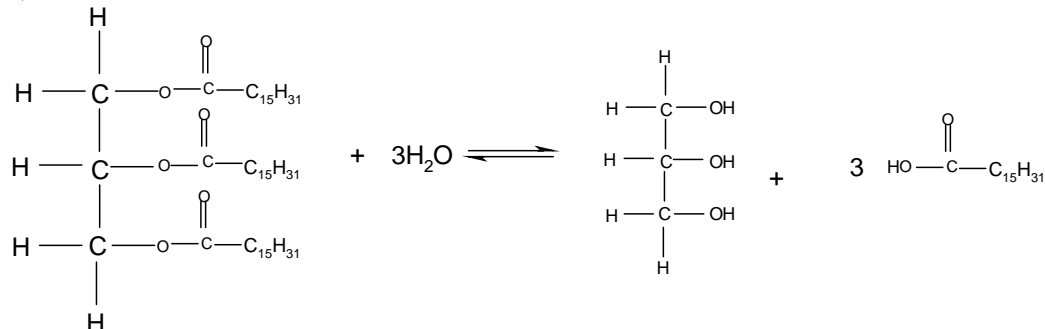


- d)

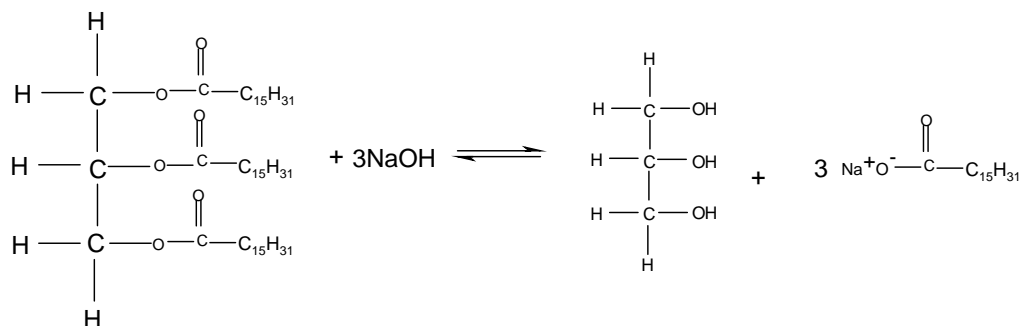


4.

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

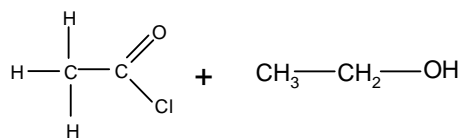
The carboxylate salts are used as soaps

4.5 Exercise 3

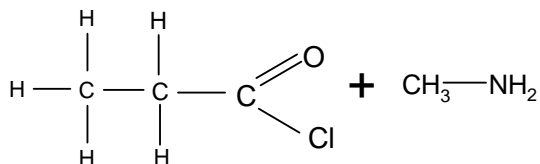
1. a) $\text{CH}_3\text{CH}_2\text{COCl} + 2\text{NH}_3 \rightarrow \text{CH}_3\text{CH}_2\text{CONH}_2 + \text{NH}_4\text{Cl}$
organic product: propanamide
- b) $(\text{CH}_3\text{CH}_2\text{CH}_2\text{CO})_2\text{O} + \text{CH}_3\text{CH}(\text{OH})\text{CH}_3 \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{COOCH}(\text{CH}_3)\text{CH}_3 + \text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$
organic products: methylethyl butanoate and butanoic acid
- c) $\text{HCOCl} + 2\text{CH}_3\text{CH}_2\text{NH}_2 \rightarrow \text{HCONHCH}_2\text{CH}_3 + \text{CH}_3\text{CH}_2\text{NH}_3^+\text{Cl}^-$
organic product: N-ethyl methanamide
- d) $(\text{CH}_3\text{CO})_2\text{O} + \text{CH}_3\text{CH}(\text{NH}_2)\text{CH}_3 \rightarrow \text{CH}_3\text{CONHCH}(\text{CH}_3)\text{CH}_3 + \text{CH}_3\text{COOH}$
organic products: N-methylethylethanamide and ethanoic acid
- e) $\text{CH}_3\text{CH}(\text{CH}_3)\text{COCl} + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{CH}(\text{CH}_3)\text{COOH} + \text{HCl}$
organic products: methylpropanoic acid

2.

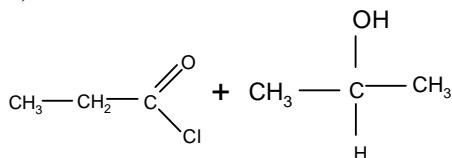
a)



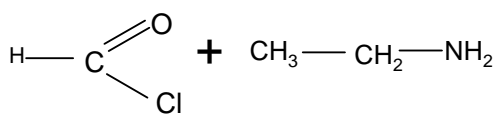
b)



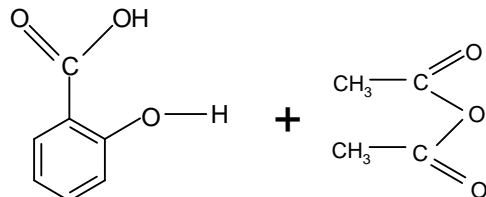
c)



d)

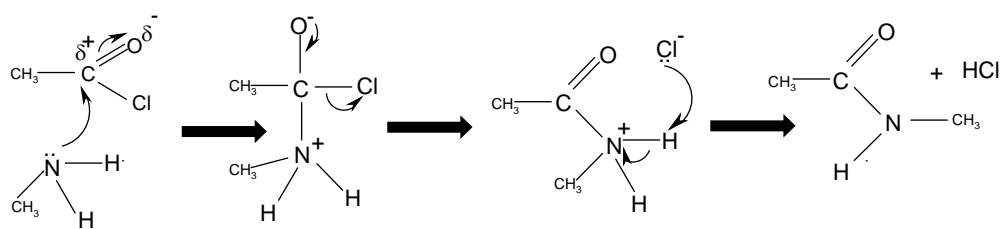


e)



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