

Write condensed structural formulas of products of the following reactions. Add alternative names of the reactions and names of the reactants and products.

1.  $\text{CH}_3\text{COOH} + \text{H}_2\text{O} \rightarrow$
2.  $\text{HCOOH} + \text{H}_2\text{O} \rightarrow$
3.  $\text{CH}_3\text{-CO-COOH} + \text{H}_2\text{O} \rightarrow$
4. dehydrogenation (1<sup>st</sup> step) of:  
 $\text{CH}_3\text{-OH} \rightarrow$
5. oxidation (1<sup>st</sup> step) of  
 $\text{CH}_3\text{-CH}_2\text{-OH} \rightarrow$
6.  $\text{CH}_3\text{-CO-CH}_3 + 2\text{H} \rightarrow$
7.  $\text{HO-CH}_2\text{-CH(OH)-CHO} + 2\text{H} \rightarrow$
8.  $\text{CH}_3\text{-CH=CH-CH}_3 + \text{H}_2\text{O} \rightarrow$
9. hydration of  
 $\text{HOOC-CH=CH-COOH} \rightarrow$
10. elimination of water from:  
 $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-OH} \rightarrow$
11. dehydration of:  
 $\text{CH}_3\text{-CH}_2\text{-OH} \rightarrow$
12.  $\text{CH}_2=\text{CH}_2 + 2\text{H} \rightarrow$
13. oxidation (1<sup>st</sup> step) of:  
 $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_3 \rightarrow$
14. oxidation (1<sup>st</sup> step) of:  
 $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-CHO} \rightarrow$
15. reduction (two steps) of:  
 $\text{CH}_3\text{-COOH} \rightarrow$
16. oxidation (two steps) of:  
 $\text{CH}_3\text{-OH} \rightarrow$
17.  $\text{CH}_2=\text{CH}_2 + \text{Br}_2 \rightarrow$
18.  $\text{CH}_3\text{-CH=CH}_2 + \text{HCl} \rightarrow$
19. oxidation of a secondary hydroxyl group of:  
 $\text{HO-CH}_2\text{-CH(OH)-CH}_2\text{-OH} \rightarrow$
20. dissociation of:  
 $\text{CH}_3\text{-CH(OH)-CH}_2\text{-COOH}$

## Solution:

- $\text{CH}_3\text{COOH} + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{COO}^- + \text{H}_3\text{O}^+$   
ethanoic acid      ethanoate    hydronium  
(dissociation, ionization, deprotonation)
- $\text{HCOOH} + \text{H}_2\text{O} \rightarrow \text{HCOO}^- + \text{H}_3\text{O}^+$   
methanoic acid    methanoate    hydronium  
(dissociation, ionization, deprotonation)
- $\text{CH}_3\text{-CO-COOH} + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{-CO-COO}^- + \text{H}_3\text{O}^+$   
2-oxopropanoic acid    2-oxopropanoate    hydronium  
(dissociation, ionization, deprotonation)
- dehydrogenation (1<sup>st</sup> step) of:  
 $\text{CH}_3\text{-OH} \rightarrow \text{HCHO} + 2\text{H}$   
methanol    methanal  
(oxidation)
- oxidation (1<sup>st</sup> step) of  
 $\text{CH}_3\text{-CH}_2\text{-OH} \rightarrow \text{CH}_3\text{-CHO} + 2\text{H}$   
ethanol      ethanal  
(dehydrogenation)
- $\text{CH}_3\text{-CO-CH}_3 + 2\text{H} \rightarrow \text{CH}_3\text{-CH(OH)-CH}_3$   
propanone      propan-2-ol  
(reduction, hydrogenation)
- $\text{HO-CH}_2\text{-CH(OH)-CHO} + 2\text{H} \rightarrow \text{HO-CH}_2\text{-CH(OH)-CH}_2\text{-OH}$   
2,3-dihydroxypropanal      propan-1,2,3-triol  
(reduction, hydrogenation)
- $\text{CH}_3\text{-CH=CH-CH}_3 + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{-CH}_2\text{-CH(OH)-CH}_3$   
but-2-ene      butan-2-ol  
(addition of water, hydration)
- hydration of  
 $\text{HOOC-CH=CH-COOH} + \text{H}_2\text{O} \rightarrow \text{HOOC-CH}_2\text{-CH(OH)-COOH}$   
butenedioic acid      2-hydroxybutanedioic acid  
(addition of water)
- elimination of water from:  
 $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-OH} \rightarrow \text{CH}_3\text{-CH=CH}_2 + \text{H}_2\text{O}$   
propan-1-ol      propene  
(dehydration)
- dehydration of:  
 $\text{CH}_3\text{-CH}_2\text{-OH} \rightarrow \text{CH}_2=\text{CH}_2 + \text{H}_2\text{O}$   
ethanol      ethene  
(elimination of water)
- $\text{CH}_2=\text{CH}_2 + 2\text{H} \rightarrow \text{CH}_3\text{-CH}_3$   
ethene      ethane  
(addition of hydrogen, hydrogenation, reduction)
- oxidation (1<sup>st</sup> step) of:  
 $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_3 \rightarrow \text{CH}_3\text{-CH=CH-CH}_3 + 2\text{H}$   
butane      but-2-ene  
(elimination of hydrogen, dehydrogenation)
- oxidation (1<sup>st</sup> step) of:  
 $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-CHO} \rightarrow \text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-COOH}$   
pentanal      pentanoic acid  
(oxygenation)
- reduction (two steps) of:  
 $\text{CH}_3\text{-COOH} \rightarrow \text{CH}_3\text{-CHO} \rightarrow \text{CH}_3\text{-CH}_2\text{-OH}$   
ethanoic acid    ethanal      ethanol  
(1<sup>st</sup>: deoxygenation, 2<sup>nd</sup>: hydrogenation)
- oxidation (two steps) of:  
 $\text{CH}_3\text{-OH} \rightarrow \text{HCHO} \rightarrow \text{HCOOH}$   
methanol    methanal    methanoic acid  
(1<sup>st</sup>: dehydrogenation, 2<sup>nd</sup>: oxygenation)
- $\text{CH}_2=\text{CH}_2 + \text{Br}_2 \rightarrow \text{CH}_2\text{Br-CH}_2\text{Br}$   
ethene      1,2-dibromoethane  
(addition of bromine)
- $\text{CH}_3\text{-CH=CH}_2 + \text{HCl} \rightarrow \text{CH}_3\text{-CHCl-CH}_3$   
propene      2-chloropropane  
(addition of hydrochloric acid)
- oxidation of a secondary hydroxyl group of:  
 $\text{HO-CH}_2\text{-CH(OH)-CH}_2\text{-OH} \rightarrow \text{HO-CH}_2\text{-CO-CH}_2\text{-OH} + 2\text{H}$   
propan-1,2,3-triol      1,3-dihydroxypropanone  
(dehydrogenation)
- dissociation of:  
 $\text{CH}_3\text{-CH(OH)-CH}_2\text{-COOH} + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{-CH(OH)-CH}_2\text{-COO}^- + \text{H}_3\text{O}^+$   
3-hydroxybutanoic acid      3-hydroxybutanoate  
(ionization, deprotonation)