

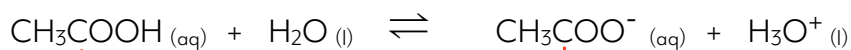
Conjugate acid-base pairs

Acid-base reactions all involve the transfer of a proton from the acid (proton donor) to the base (proton acceptor). During this reaction the acid itself becomes the 'conjugate base' of the acid and the base becomes its 'conjugate acid'.

E.g. adding ethanoic acid to water

*CH₃COO⁻ is the conjugate base
of ethanoic acid*

*H₃O⁺ is the conjugate
acid of water*



*CH₃COOH is the acid because
during the reaction it donates a
proton (H⁺) to water*

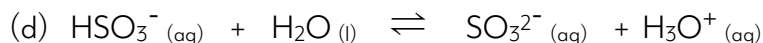
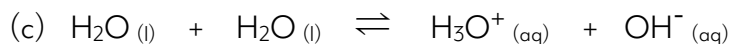
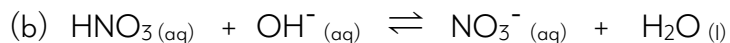
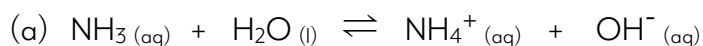
*water is the base because during
the reaction it accepts a proton
(H⁺) forming H₃O⁺*

Since this is an equilibrium, the conjugate acid, H₃O⁺, could donate a proton to the conjugate base, CH₃COO⁻, and we would be back where we started.

There are essentially two conjugate acid-base pairs in this reaction - CH₃COOH / CH₃COO⁻ and H₃O⁺ / H₂O.

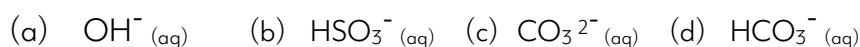
Questions

1. Identify the conjugate pairs in each of these reactions

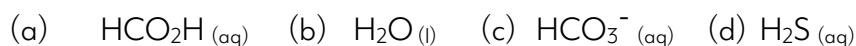


Conjugate acid-base pairs

2. Write an equation to show each of the following behaving as a base in solution - the product of the reaction will be the conjugate acid.



3. Write an equation to show the following behaving as an acid in solution - the product of the reaction will be the conjugate base.



Answers

1. (a) Base $\text{NH}_3_{(\text{aq})}$ / Conjugate acid $\text{NH}_4^+_{(\text{aq})}$; Acid $\text{H}_2\text{O}_{(\text{l})}$ / Conjugate base $\text{OH}^-_{(\text{aq})}$
(b) Base $\text{OH}^-_{(\text{aq})}$ / Conjugate acid $\text{H}_2\text{O}_{(\text{l})}$; Acid $\text{HNO}_3_{(\text{aq})}$ / Conjugate base $\text{NO}_3^-_{(\text{aq})}$
(c) Base $\text{H}_2\text{O}_{(\text{l})}$ / Conjugate acid $\text{H}_3\text{O}^+_{(\text{aq})}$; Acid $\text{H}_2\text{O}_{(\text{l})}$ / Conjugate base $\text{OH}^-_{(\text{aq})}$
(d) Base $\text{H}_2\text{O}_{(\text{l})}$ / Conjugate acid $\text{H}_3\text{O}^+_{(\text{aq})}$; Acid $\text{HSO}_3^-_{(\text{aq})}$ / Conjugate base $\text{SO}_3^{2-}_{(\text{aq})}$

2. (a) $\text{OH}^-_{(\text{aq})} + \text{H}^+_{(\text{aq})} \rightleftharpoons \text{H}_2\text{O}_{(\text{l})}$
(b) $\text{HCO}_3^-_{(\text{aq})} + \text{H}^+_{(\text{aq})} \rightleftharpoons \text{H}_2\text{SO}_4_{(\text{aq})}$
(c) $\text{CO}_3^{2-}_{(\text{aq})} + \text{H}^+_{(\text{aq})} \rightleftharpoons \text{HCO}_3^-_{(\text{aq})}$
(d) $\text{HCO}_3^-_{(\text{aq})} + \text{H}^+_{(\text{aq})} \rightleftharpoons \text{H}_2\text{CO}_3_{(\text{aq})}$

3. (a) $\text{HCO}_2\text{H}_{(\text{aq})} \rightleftharpoons \text{H}^+_{(\text{aq})} + \text{HCO}_2^-_{(\text{aq})}$
(b) $\text{H}_2\text{O}_{(\text{l})} \rightleftharpoons \text{H}^+_{(\text{aq})} + \text{OH}^-_{(\text{aq})}$
(c) $\text{HCO}_3^-_{(\text{aq})} \rightleftharpoons \text{H}^+_{(\text{aq})} + \text{CO}_3^{2-}_{(\text{aq})}$
(d) $\text{H}_2\text{S}_{(\text{aq})} \rightleftharpoons \text{H}^+_{(\text{aq})} + \text{HS}^-_{(\text{aq})}$