ANSWER KEY.

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Classifying Acids & Bases

Chemistry | ANSWER KEY

Brønsted-Lowry: acid = H^+ donor, base = H^+ acceptor. Conjugate pairs differ by one H^+. Strong acids: HCl, HBr, HI, HNO_3, H_2SO_4, $HClO_4$. Not on the list? Treat it as weak.

1. Label the acid, base, conjugate acid, and conjugate base in each reaction.

(a) $HNO_3 + H_2O \rightarrow H_3O^+ + NO_3^-$

acid HNO_3, base H_2O, conj. acid H_3O^+, conj. base NO_3^-

(b) $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$

acid H_2O, base NH_3, conj. acid NH_4^+, conj. base OH^-

(c) $HF + NH_3 \rightleftharpoons F^- + NH_4^+$

acid HF, base NH_3, conj. acid NH_4^+, conj. base F^-

(d) $HCO_3^- + OH^- \rightleftharpoons CO_3^{2-} + H_2O$

acid HCO_3^-, base OH^-, conj. acid H_2O, conj. base CO_3^{2-}

2. Write the conjugate base of each acid.

(a) HCl

Cl^-

(b) H_2SO_4

HSO_4^-

(c) NH_4^+

NH_3

(d) H_2O

OH^-

3. Write the conjugate acid of each base.

(a) NH_3

NH_4^+

(b) OH^-

H_2O

(c) CO_3^{2-}

HCO_3^-

(d) H_2O

H_3O^+

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4. Classify each as a strong acid, weak acid, strong base, or weak base.

(a) HBr

strong acid

(b) HF

weak acid

(c) $Ca(OH)_2$

strong base

(d) NH_3

weak base

(e) $HClO_4$

strong acid

(f) $HC_2H_3O_2$

weak acid

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5. Rank these acids from strongest to weakest: HNO_2 ($K_a = 4.5 \times 10^{-4}$), HCN (6.2×10^{-10}), $HC_2H_3O_2$ (1.8×10^{-5}), $HClO_2$ (1.1×10^{-2}).

Larger K_a = stronger. Check the exponent first: $HClO_2$ > HNO_2 > $HC_2H_3O_2$ > HCN

6. Water is amphoteric. Use problem 1 to explain what that means.

Water can act as an acid or a base. In 1(a) it accepts H^+ (base). In 1(b) it donates H^+ (acid).

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7. Which is the stronger acid: 0.001 M HCl or 1.0 M $HC_2H_3O_2$? Explain the difference between strong and concentrated.

HCl. Strength is how completely the acid ionizes: HCl is 100% ions, acetic acid is mostly molecules. Concentration is how much acid is dissolved. The acetic acid is more concentrated but still weak.

8. Why does the Brønsted-Lowry definition explain NH_3 as a base better than Arrhenius does?

NH_3 has no OH^- to release. It is a base because it accepts H^+ from water.

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