KEY

Practice - Acids and Bases

Part 1 - **Arrhenius Acids**

1.) Write the balanced equation for the following neutralization reactions.

a.) H_2S and $Mg(OH)_2$ Answer – $H_2S + Mg(OH)_2 \rightarrow MgS + 2\ H_2O$

b.) H_3PO_4 and RbOH Answer – $H_3PO_4 + 3\ RbOH \rightarrow Rb_3PO_4 + 3\ H_2O$

c.) HCl and $Sn(OH)_4$ Answer – $4\ HCl + Sn(OH)_4 \rightarrow SnCl_4 + 4\ H_2O$

d.) H_2SO_4 and $Fe(OH)_3$ Answer – $3\ H_2SO_4 + 2\ Fe(OH)_3 \rightarrow Fe_2(SO_4)_3 + 6\ H_2O$

e.) $H_4P_2O_7$ and NaOH Answer – $H_4P_2O_7 + 4\ NaOH \rightarrow Na_4P_2O_7 + 4\ H_2O$

2.) Write equations for the dissociation of the following acids.

a.) $HNO_{3\ (aq)}$ Answer – $HNO_3 + H_2O \rightarrow NO_3^- + H_3O^+$

b.) $HClO_4$ Answer – $HClO_4 + H_2O \rightarrow ClO_4^- + H_3O^+$

Part 2 – **Bronsted-Lowry Acids**

3.) Identify the species as acids or bases in the following equations.

a.) $HF + SO_3^{-2} \rightleftharpoons HSO_3^- + F^-$

Acid Base Acid Base

b.) $H_2O + HO_3^- \rightleftharpoons H_3O^+ + CO_3^{-2}$

Base Acid Acid Base

c.) $H_2O + NO_2^- \rightleftharpoons HNO_2 + OH^-$

Acid Base Acid Base

d.) $H_2PO_4^- + S^{-2} \rightleftharpoons HPO_4^{-2} + HS^-$

Acid Base Base Acid

e.) $N_2H_5^+ + SO_4^{-2} \rightleftharpoons HSO_4^- + N_2H_4$

Acid Base Acid Base

4.) Identify which chemicals below are amphiprotic.

H_3PO_4, HSe^-, HSO_3^-, Se^{-2}, HPO_4^{-2}

Answer - HSe^-, HSO_3^-, HPO_4^{-2} (must be negatively charged and contain a hydrogen)

5.) Write the formula for the following.

a.) Conjugate base of HSO_4^- SO_4^{-2}

b.) Conjugate acid of HSO_4^- H_2SO_4

c.) Conjugate base of OH^- O^{-2}

d.) Conjugate acid of OH^- H_2O

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6.) What is the conjugate acid for each of the following chemicals?

a.) F^- HF c.) Te^{-2} HTe^- e.) $HC_2O_4^-$ $H_2C_2O_5$

b.) HTe^- H_2Te d.) CH_3NH_2 $CH_3NH_3^+$ f.) $H_2PO_3^-$ H_3PO_3

7.) Write the Bronsted-Lowry acid-base equilibrium for the following solutions.

a.) HCN and F^- Answer - $HCN + F^- \leftrightarrow CN^- + HF$

b.) HPO_4^{-2} and SO_4^{-2} Answer - $HPO_4^{-2} + SO_4^{-2} \leftrightarrow PO_4^{-3} + HSO_4^-$

c.) HPO_4^{-2} and CH_3COO^- Answer - $HPO_4^{-2} + CH_3COO^- \leftrightarrow PO_4^{-3} + CH_3COOH$

d.) S^{-2} and HCOOH Answer - $S^{-2} + HCOOH \leftrightarrow HS^- + HCOO^-$

e.) HIO_3 and $C_2O_4^{-2}$ Answer - $HIO_3 + C_2O_4^{-2} \leftrightarrow IO_3^- + HC_2O_4^-$

f.) NO_2^- and HSO_3^- Answer - $NO_2^- + HSO_3^- \leftrightarrow HNO_2 + SO_3^{-2}$

8.) Circle the acid that is stronger.

a.) HIO_3 or CH_3COOH b.) H_2O_2 or HSO_3^- c.) $H_2PO_4^-$ or HCN

9.) Circle the base that is stronger.

b.) HCO_3^- or PO_4^{-3} b.) HPO_4^{-2} or HS^- c.) NH_3 or OH^- d.) $HCOO^-$ or HSO_3^-

10.) H_2Te is a stronger acid than H_2S. Write the formulas of the conjugate bases and explain which base is stronger. HTe^- and HS^-

Answer - The HS^- will be the stronger base. Stronger acids produce weaker bases. The stronger the acid the more it ionises and the less likely the reverse reaction will occur, or in other words the less likely the conjugate base will push the reverse reaction.

11.) Write the chemical equation for each of the following.

a.) F^- as a base Answer – $F^- + H_2O \leftrightarrow HF + OH^-$

b.) HNO_2 as an acid Answer – $HNO_2 + H_2O \leftrightarrow NO_2^- + H_3O^+$

c.) $Fe(H_2O)_6^{+3}$ as an acid Answer – $Fe(H_2O)_6^{+3} + H_2O \leftrightarrow Fe(H_2O)_5(OH)^{+2} + H_3O^+$

d.) HCO_3^- as a base Answer – $HCO_3^- + H_2O \leftrightarrow H_2CO_3 + OH^-$