Solutions for Acids and Bases (Review) Exercises

1. a) NaBr - neutral — Na^+ has no acidic or basic properties and since Br^- is the conjugate base of a strong acid it is a nonbase.

   b) $KC_2H_3O_2$ - basic — K^+ has no acidic or basic properties and since $C_2H_3O_2^-$ is the conjugate base of a weak acid it is a weak base.

   c) NH_4Cl - acidic — NH_4^+ is the conjugate acid of a weak base so it is a weak acid and since Cl^- is the conjugate base of a strong acid it is a nonbase.

   d) Na_3PO_4 - basic — Na^+ has no acidic or basic properties and since PO_4^{3-} is the conjugate base of a weak acid it is a weak base.

   e) $(CH_3)_4NCl$ - neutral — Neither ion has acidic or basic properties.

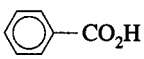
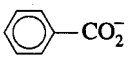
   f) $Fe(NO_3)_3$ - acidic — Fe^{3+} is a weak acid and since NO_3^- is the conjugate base of a strong acid it is a nonbase.

2. (a) HI

   each of these reactants donates H^+

   (b) H_2O

3.

conjugate pairs	
acid	base
$H_3\overset{+}{N}CH_2CH_2\overset{+}{N}H_3$	$H_3\overset{+}{N}CH_2CH_2NH_2$
H_3O^+	H_2O
 Benzoic acid	 Benzoate
 Pyridinium	 Pyridine

Solutions for Acids and Bases (Review) Exercises

4. CO_2 from the atmosphere dissolves in the water and forms carbonic acid ($CO_2 + H_2O \rightarrow H_2CO_3$).

5. (a) HNO_3 - strong acid

$0.010\ M\ HNO_3 \Rightarrow [H_3O^+] = 0.010\ M \Rightarrow pH = -\log[H_3O^+] = 2.00$

(b) KOH - strong base

$0.035\ M\ KOH \Rightarrow [OH^-] = 0.035\ M \Rightarrow [H_3O^+] = K_w/[OH^-] = (1.0 \times 10^{-14})/0.035$

$[H_3O^+] = 2.86 \times 10^{-13}\ M \Rightarrow pH = 12.54$

6.

common strong acids	
HCl	H_2SO_4
HBr	HNO_3
HI	$HClO_4$

common strong bases
alkali metal hydroxides
quaternary ammonium hydroxide (R_4NOH)

7.

$$H_2PO_4^-(aq) + H_2O(l) \overset{K_{a2}}{\rightleftharpoons} H_3O^+(aq) + HPO_4^{2-}(aq)$$

$$HC_2O_4^-(aq) + H_2O(l) \overset{K_{b2}}{\rightleftharpoons} H_2C_2O_4(aq) + OH^-(aq)$$

8. $CN^-(aq) + H_2O(l) \rightleftharpoons HCN(aq) + OH^-(aq)$

$$K_b = \frac{K_w}{K_a} = \frac{1.0 \times 10^{-14}}{6.2 \times 10^{-10}} = 1.6 \times 10^{-5}$$