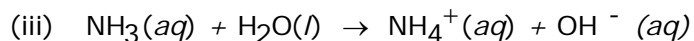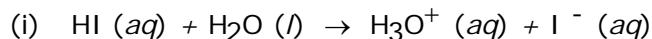## Session #26: Homework Solutions

Problem #1
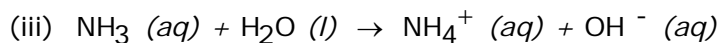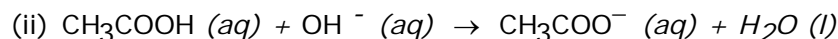
(a) Identify the conjugate acid-base pairs in the following reactions:

   (i) HI (aq) + H_2O (l) $\rightarrow$ H_3O^+ (aq) + I^- (aq)

   (ii) CH_3COOH (aq) + OH^- (aq) $\rightarrow$ CH_3COO^- (aq) + H_2O (l)

   (iii) NH_3 (aq) + H_2O(l) $\rightarrow$ NH_4^+ (aq) + OH^- (aq)

(b) Identify which of the following cannot be a Brønsted base and give a reason for your choices: H_3O^+, $AlCl_4^-$, CN^-, O^{2-}, SiH_4, AsH_3.

(c) Estimate the pH and pOH of a 0.03091 M solution of hydroiodic acid ($K_a \cong 10^9$).

Solution

(a) (i) HI(aq) + H_2O (l) $\rightarrow$ H_3O^+ (aq) + I^- (aq)

   (ii) CH_3COOH (aq) + OH^- (aq) $\rightarrow$ CH_3COO^- (aq) + H_2O (l)

   (iii) NH_3 (aq) + H_2O (l) $\rightarrow$ NH_4^+ (aq) + OH^- (aq)
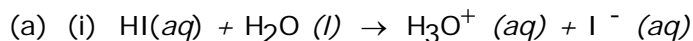
(b) H_3O^+, $AlCl_4^-$, and SiH_4. SiH_4 and $AlCl_4^-$ cannot accept a proton due to lack of unpaired electrons. While H_3O^+ does have a pair of nonbonding electrons and so, in principle, could accept another proton, H_4O^{2+} is not observed.

(c) HI is a strong acid $\Rightarrow$ complete dissociation

   $\therefore$ 0.03091 M HI (aq) $\Rightarrow$ 0.03091 M = $\left[H^+\right]$ = $\left[I^-\right]$

   $\therefore$ pH = $-\log_{10}\left[H^+\right]$ = $-\log_{10}$ 0.03091 = 1.51

   pOH + pH = 14 $\Rightarrow$ pOH = 12.49

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Fall 2009