Write the hydrolysis equations for each substance below. Calculate the $K_a$ or $K_b$ (as appropriate) for each of these aqueous solutions. Assuming each solution has the same concentration, rate the solutions from highest pH to lowest pH. You may find Tables 17.1 and 17.2 (in your text) helpful.

A  CH$_3$NH$_2$
B  LiOOCN
C  HI
D  NH$_4$Cl
E  NaOCl
F  Ba(NO$_3$)$_2$

Highest pH 1  A  2  E  3  B  4  F  5  D  6  C  Lowest pH

Explain your reasoning below (Show Calculations that include the reaction! Use back if needed.)

A  \[ \text{CH}_3\text{NH}_2 + \text{H}_2\text{O} \rightleftharpoons \text{CH}_3\text{NH}_3^+ + \text{OH}^- \]
\[ K_b = [\text{CH}_3\text{NH}_3^=][\text{OH}^-]/[\text{CH}_3\text{NH}_2] \]
\[ 4.4 \times 10^{-4} = K_b \]

D  \[ \text{NH}_4\text{Cl} \rightarrow \text{NH}_4^+ + \text{Cl}^- \]
\[ \text{NH}_4^+ \rightleftharpoons \text{H}^+ + \text{NH}_3 \]
\[ K_b \text{ of NH}_3 = 1.8 \times 10^{-5} \]
\[ K_a \text{ of NH}_4^+ = 5.6 \times 10^{-10} \]

B  \[ \text{LiOOCN} \rightarrow \text{Li}^+ + \text{OCN}^- \]
\[ \text{OCN}^- + \text{H}_2\text{O} \rightleftharpoons \text{HOCN} + \text{OH}^- \]
\[ K_a \text{ of HOOCN} = 3.5 \times 10^{-4} \]
\[ K_b \text{ of OCN}^- = 1.0 \times 10^{-14}/3.5 \times 10^{-4} = 2.9 \times 10^{-11} \]

E  \[ \text{NaOCl} \rightarrow \text{Na}^+ + \text{OCl}^- \]
\[ \text{OCl}^- + \text{H}_2\text{O} \rightleftharpoons \text{HOC} + \text{OH}^- \]
\[ K_a \text{ of HOOC} = 3.5 \times 10^{-8} \]
\[ K_b \text{ of OCl}^- = 1.0 \times 10^{-14}/3.5 \times 10^{-8} \]
\[ K_b \text{ of OCl}^- = 2.9 \times 10^{-7} \]

C  \[ \text{HI} \rightarrow \text{H}^+ + \text{I}^- \]
strong acid; lowest pH

F  \[ \text{Ba(NO}_3)_2 \rightarrow \text{Ba}^{2+} + 2 \text{NO}_3^- \]
no further reactions
\[ \text{pH} \approx 7 \]

Bases will have higher pH values (pH>7) than acids (pH<7). A strong acid (HI) will have a lower pH than weak acids. The higher the $K_b$, the stronger the base and the higher the pH. High $K_b$ values indicate more OH$^-$ which indicates lower H$^+$. The higher the $K_a$, the stronger the acid, more H$^+$ is produced and the lower the pH.