Chem 1515
Problem Set \#12
Fall 2001

Name $\qquad$
TA Name $\qquad$
Lab Section \# $\qquad$
ALL work must be shown to receive full credit. Due 5:00 pm on Tuesday, November 6, 2001.

PS12.1. Calculate the pH of a $0.200 \mathrm{M} \mathrm{H}_{3} \mathrm{PO}_{4}$. Calculate the $\left[\mathrm{PO}_{4}{ }^{3-}\right.$ ] in the solution.

PS12.2. Predict the products of the following neutralization reactions.
a) $\mathrm{HCl}(a q)+\mathrm{NaOH}(a q) \rightarrow$
b) $\mathrm{HNO}_{3}(a q)+\mathrm{Ba}(\mathrm{OH})_{2}(a q) \rightarrow$
c) $\mathrm{NaOH}(a q)+\mathrm{H}_{2} \mathrm{CO}_{3}(a q) \rightarrow$
d) $\mathrm{NH}_{3}(a q)+\mathrm{H}_{2} \mathrm{SO}_{4}(a q) \rightarrow$
e) $\mathrm{HC}_{6} \mathrm{H}_{5} \mathrm{O}(a q)+\mathrm{NaOH}(a q) \rightarrow$
f) $\mathrm{HCN}(a q)+\mathrm{KOH}(a q) \rightarrow$

PS12.3. Given a solution containing the following ions (neglect the counter-ion for the moment), write a reaction (with water) and indicate whether the ion acts as an acid or as a base.
a) $\mathrm{F}^{-}(a q)$
b) $\mathrm{ClO}_{2}^{-(a q)}$
c) $\mathrm{NO}_{2}^{-}(a q)$
d) $\mathrm{NH}_{4}^{+}(a q)$
e) $\mathrm{CH}_{3} \mathrm{NH}_{3}^{+}(a q)$
f) $\mathrm{C}_{2} \mathrm{H}_{5} \mathrm{NH}_{3}^{+}(a q)$

PS12.4. Can you make any generalizations about the acid-base character of the ions in Problem \#12.3? If so, state them.

PS12.5. Indicate an acid and a base which could react, in a neutralization reaction, to form each of the following salts. In some cases water will be present as another product.
a) $\mathrm{NaC}_{6} \mathrm{H}_{7} \mathrm{O}_{6}(a q)$
b) $\mathrm{KClO}(a q)$
c) $\left(\mathrm{CH}_{3}\right)_{2} \mathrm{NH}_{2} \mathrm{NO}_{3}(a q)$
d) $\mathrm{NH}_{4} \mathrm{Br}(a q)$
e) $\mathrm{KCl}(a q)$
f) $\left(\mathrm{NH}_{4}\right)_{2} \mathrm{SO}_{4}(a q)$

PS12.6. If each salt in Problem 12.5 is added to water, indicate whether the resulting solution is acidic, basic or neutral.

PS12.7. Calculate the pH of the following salt solutions
a) $0.243 \mathrm{M} \mathrm{NaC}_{6} \mathrm{H}_{7} \mathrm{O}_{6}$
b) $0.319 \mathrm{M} \mathrm{C}_{5} \mathrm{H}_{5} \mathrm{NHClO}_{4}$
c) 0.890 M KCl
d) $0.572 \mathrm{M} \mathrm{KC}_{3} \mathrm{H}_{5} \mathrm{O}_{2}$
e) $1.00 \mathrm{M} \mathrm{NaHSO}_{4}$

PS12.8. In the series of oxyacids, $\mathrm{XOH}, \mathrm{OXOH}$, and $\mathrm{O}_{2} \mathrm{XOH}$, list the acids in order of increasing acid strength. Justify your answer.

