

Name _____

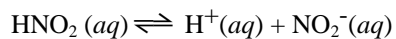
AP Chemistry

HW 4: Due 11/21/14 Complete both the multiple choice and free response question. All answers will be graded. Show all work. Box and clearly label all final answers

Multiple Choice – Circle and write the correct answer on the line in front of the question.

1. _____ Which of the following CANNOT occur together in solution?
a. H_3PO_4 and H_2PO_4^- b. HCO_3^- and CO_3^{2-} c. Na^+ and SO_4^{2-}
d. $\text{C}_2\text{O}_4^{2-}$ and $\text{H}_2\text{C}_2\text{O}_4$ e. HPO_4^{2-} and PO_4^{3-}
2. _____ Which of the following best describes the pH of a 0.01 molar solution of HBrO ($K_a = 2 \times 10^{-9}$)?
a. Less than or equal to 2.0 b. Between 2 and 7 c. 7
d. Between 7 and 11 e. Greater than or equal to 11
3. _____ Which of the acids below has the strongest conjugate base?
a. H_2SO_3 b. HSO_3^- c. HClO_4 d. HClO_3 e. H_3BO_3
4. _____ $\text{HCN}(\text{aq}) + \text{C}_2\text{H}_3\text{O}_2^-(\text{aq}) \rightleftharpoons \text{HC}_2\text{H}_3\text{O}_2(\text{aq}) + \text{CN}^-(\text{aq})$
The reaction represented above has an equilibrium constant equal to 2.7×10^{-5} . Which of the following can be concluded from this information?
a. $\text{C}_2\text{H}_3\text{O}_2^-(\text{aq})$ is a stronger base than $\text{CN}^-(\text{aq})$
b. $\text{HCN}(\text{aq})$ is a stronger acid than $\text{HC}_2\text{H}_3\text{O}_2(\text{aq})$
c. The conjugate base of $\text{HCN}(\text{aq})$ is $\text{CN}^-(\text{aq})$
d. The equilibrium constant will decrease with an increase in temperature.
e. The pH of a solution containing equimolar amounts of $\text{CN}^-(\text{aq})$ and $\text{HC}_2\text{H}_3\text{O}_2(\text{aq})$ is 7.0.
5. _____ Each of the following compounds was added to distilled water at 25°C . Which one produced a solution with a pH that was less than 7?
a. N_2 b. O_2 c. NaI d. MgO e. SO_2
6. _____ Which of the following best describes NH_3 ?
a. Arrhenius base b. Brønsted-Lowry base c. Lewis base
d. Arrhenius and Lewis base e. Brønsted-Lowry and Lewis base
7. _____ The strengths of five acids are listed below in decreasing order:
 $\text{HI} > \text{HClO}_2 > \text{HF} > \text{H}_2\text{O} > \text{NH}_3$
Which one of the following reactions will have an equilibrium constant less than one?
a. $\text{HClO}_2 + \text{OH}^- \rightleftharpoons \text{H}_2\text{O} + \text{ClO}_2^-$ b. $\text{HF} + \text{ClO}_2^- \rightleftharpoons \text{HClO}_2 + \text{F}^-$
c. $\text{HI} + \text{NH}_3 \rightleftharpoons \text{NH}_4^+ + \text{I}^-$ d. $\text{HI} + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{I}^-$
e. $\text{H}_2\text{O} + \text{NH}_2^- \rightleftharpoons \text{NH}_3 + \text{OH}^-$
8. _____ Which of the following is a Lewis acid-base reaction that is not a Brønsted-Lowry acid-base reaction?
a. $\text{HC}_2\text{H}_3\text{O}_2(\text{aq}) + \text{NH}_3(\text{aq}) \rightarrow \text{C}_2\text{H}_3\text{O}_2^-(\text{aq}) + \text{NH}_4^+(\text{aq})$ b. $\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s})$
c. $\text{Zn}(\text{OH})_2(\text{s}) + 2 \text{OH}^-(\text{aq}) \rightarrow [\text{Zn}(\text{OH})_4]^{2-}(\text{aq})$ d. $2 \text{K}(\text{s}) + \text{Br}_2(\text{l}) \rightarrow 2 \text{KBr}(\text{s})$
e. $\text{N}_2\text{O}_4(\text{g}) \rightarrow 2 \text{NO}_2(\text{g})$
9. _____ The value of the acid-dissociation constant, K_a , for a weak monoprotic acid HA is 2.5×10^{-6} . The pH of 0.40 M HA is closest to:
a. 2.0 b. 3.0 c. 4.0 d. 6.0 e. 8.0
10. _____ In an aqueous solution with a pH of 11.50 at 25°C , the molar concentration of $\text{OH}^-(\text{aq})$ is approximately
a. $3.2 \times 10^{-12} \text{ M}$ b. $3.2 \times 10^{-3} \text{ M}$ c. $2.5 \times 10^{-1} \text{ M}$
d. 2.5 M e. $3.2 \times 10^{11} \text{ M}$

Free Response - Answer all of the following questions. Be sure to label and box your answers.



Nitrous acid, HNO_2 , is a monoprotic acid that dissociates in aqueous solution, as represented by the equation above.

Nitrous acid is 2.83 percent dissociated in 0.50 M $\text{HNO}_2(aq)$ at 298 K.

- Write the expression for the acid-dissociation constant, K_a , for nitrous acid and calculate its value.
- Calculate the pH of 0.50 M HNO_2 .
- Calculate the pH of a solution formed by dissolving 0.045 mole of solid sodium nitrite, NaNO_2 in 250. mL of 0.50 M HNO_2 . Assume that volume change is negligible.
- A 200. mL sample of 0.20 M HCl is added to 300. mL of 0.50 M HNO_2 . Calculate the molar concentration of nitrite ion, NO_2^- in the resulting solution.