Chapter 7 Exercises – Acids and Bases

1. Define a Bronsted-Lowry acid. Why are all water-ion acids considered to be Bronsted-Lowry acids?

2. Write the chemical equation for the addition of a proton to each of the following: NH_3, H_2O, HCO_3^-, CO_3^{2-}, CN^-, OH^-.

3. The bicarbonate ion HCO_3^- is amphoteric. Illustrate this property by using appropriate equations.

4. List all the Bronsted-Lowry acids and Bronsted-Lowry bases from among the following: SO_3^{2-}, $AlCl_3$, Cl^-, NH_4^+, H_2O, HBr.

5. Write the formulae for the following anions: aluminate, carbonate, antimonite, hypophosphite, sulfate, chlorite, hypobromite.

6. Write the formulae for the following: mercury (II) chromate, manganese (III) phosphate, nickel (II) carbonate, silver sulfate, iron (III) nitrate.

7. What is the relationship between the strength of an acid and the numerical value of k_a?

8. How will the following ions react with water: I^-, NO_2^-, K^+, Bi^{3+}, Be^{2+}?

9. Predict whether aqueous solutions of the following salts would be acidic, alkaline or close to normal: KCl, NH_4NO_2, $AlBr_3$, Na(HCOO). Supply an equation for each.

10. Predict whether aqueous solutions of the following salts would be acidic, alkaline or close to neutral: $Fe(NO_3)_3$, NH_4CN, KI, $LiCH_3COO$.

11. Identify the acids and bases according to the proton transfer concept in the following:

a) $HNO_3(l) + H_2O(l) \leftrightarrow H_3O^+(aq) + NO_3^-(aq)$

b) $HCl(g) + NH_3(g) \leftrightarrow NH_4^+(aq) + Cl^-(aq)$

c) $H_2SO_4(l) + H_2O(l) \leftrightarrow H_3O^+(aq) + HSO_4^-(aq)$

d) $H_2O(l) + H_2O(l) \leftrightarrow H_3O^+(aq) + OH^-(aq)$

12. Write equations to show how CO_2 in water becomes acidic and Na_2O in water becomes basic.

13. What is meant by hydrolysis? Give examples of three ions which each hydrolyse to give: a) an acidic solution and b) a basic solution.

a)

b)

14. 32.0 mL of a 0.1M H_2SO_4 is required to precipitate all the barium ions from a solution of $BaCl_2$. What mass of $BaCl_2$ was present in the solution?

15. Calculate the pH of the following solutions:

a) 0.10 M HBr b) 0.10 M HI c) 0.10 M HNO_3 d) 0.010 M KOH
e) 0.01 M $Ba(OH)_2$ f) 0.0164 M HCl g) 0.168 M HCl h) 0.0172 M HCl

a)
b)
c)
d)
e)
f)
g)
h)

6. Calculate the pH when the following are added to 1.00 L of 0.100 M HCl solution. Assume there is no change in volume.

a) 0.010 mol of KOH b) 0.010 mol of NaOH c) 0.050 mol of $Ba(OH)_2$
d) 0.100 mol of KOH e) 0.100 mol $Ba(OH)_2$ f) 0.082 mol $Ba(OH)_2$

a)
b)
c)
d)
e)
f)

7. Determine the pH of the solution formed by mixing equal volumes of the two solutions in each case.

a) 0.10 M HCl and 0.10 M NaOH b) 0.20 M HCl and 0.10 M NaOH
c) 0.10 M HCl and 0.20 M NaOH d) 0.40 M HCl and 0.20 M NaOH
e) 0.20 M HCl and 0.40 M NaOH f) 0.10 M HCl and 0.10 M $Ba(OH)_2$

a)
b)
c)
d)
e)
f)