***Chemistry***

**14: Acid-Base Equilibria**

**14.1: Brønsted-Lowry Acids and Bases**

1. Write equations that show NH3 as both a conjugate acid and a conjugate base.

Solution

One example for NH3 as a conjugate acid: ; as a conjugate base: 

3. Show by suitable net ionic equations that each of the following species can act as a Brønsted-Lowry acid:

(a) 

(b) HCl

(c) NH3

(d) CH3CO2H

(e) 

(f) 

Solution

(a) ; (b) ; (c) ; (d) ; (e) ; (f) 

5. Show by suitable net ionic equations that each of the following species can act as a Brønsted-Lowry base:

(a) H2O

(b) OH–

(c) NH3

(d) CN–

(e) S2–

(f) 

Solution

(a) ; (b) ; (c) ; (d) ; (e) ; (f) 

7. What is the conjugate acid of each of the following? What is the conjugate base of each?

(a) OH–

(b) H2O

(c) 

(d) NH3

(e) 

(f) H2O2

(g) HS–

(h) 

Solution

(a) H2O, O2–; (b) , OH–; (c) H2CO3, ; (d) , ; (e) H2SO4, ; (f) , ; (g) H2S; S2–; (h) , H4N2

9. Identify and label the Brønsted-Lowry acid, its conjugate base, the Brønsted-Lowry base, and its conjugate acid in each of the following equations:

(a) 

(b) 

(c) 

(d) 

(e) 

(f) 

(g) 

Solution

The labels are Brønsted-Lowry acid = BA; its conjugate base = CB; Brønsted-Lowry base = BB; its conjugate acid = CA. (a) HNO3(BA), H2O(BB), ,; (b) CN–(BB), H2O(BA), HCN(CA), OH–(CB); (c) H2SO4(BA), Cl–(BB), HCl(CA), ; (d) , OH–(BB), , H2O(CA); (e) O2–(BB), H2O(BA) OH–(CB and CA); (f) , , , ; (g) H2S(BA), , HS–(CB), NH3(CA)

11. What are amphiprotic species? Illustrate with suitable equations.

Solution

Amphiprotic species may either gain or lose a proton in a chemical reaction, thus acting as a base or an acid. An example is H2O. As an acid: . As a base: 

13. State which of the following species are amphiprotic and write chemical equations illustrating the amphiprotic character of these species.

(a) NH3

(b) 

(c) Br–

(d) 

(e) 

Solution

(a) , ; (b) , ;

not amphiprotic: (c) Br –; (d) ; (e) 

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