***Chemistry***

**14: Acid-Base Equilibria**

**14.2: pH and pOH**

15. Explain why a sample of pure water at 40 °C is neutral even though  = 1.7 × 10–7 *M*. *K*w is 2.9 × 10–14 at 40 °C.

Solution

In a neutral solution  = [OH–]. At 40 °C, .

17. The ionization constant for water (*K*w) is 9.311 × 10–14 at 60 °C. Calculate , [OH–], pH, and pOH for pure water at 60 °C.

Solution

For water,  = [OH–] = *x*.

*K*w = 9.311 × 10–14 = *x*2

*x* = 3.051 × 10–7*M* =  = [OH–]

pH = –log 3.051 × 10–7 = –(–6.5156) = 6.5156

pOH = pH = 6.5156

19. Calculate the pH and the pOH of each of the following solutions at 25 °C for which the substances ionize completely:

(a) 0.000259 *M* HClO4

(b) 0.21 *M* NaOH

(c) 0.000071 *M* Ba(OH)2

(d) 2.5 *M* KOH

Solution

(a) pH = –log(0.000259) = –(–3.5867) = 3.587; pOH = 14.0000 – 3.5867 = 10.4133 = 10.413; (b) pH = –log(0.21) = –(–0.678) = 0.68; pOH = 14.000 – 0.678 = 13.322 = 13.32; (c) since [OH–] = 2(0.000071) = 0.000142 *M*; pOH = –log(0.000142) = –(–3.848) = 3.85; pH = 14.000 – 3.848 = 10.152 = 10.15;(d) pH = –log(2.5) = –(0.398) = –0.40; pOH = 14.000 – (–0.398) = 14.398 = 14.4

21. What are the hydronium and hydroxide ion concentrations in a solution whose pH is 6.52?

Solution

 = 10–6.52 = 3.0 × 10–7 *M*; pOH = 14.00 – pH; pOH = 14.00 – 6.52 = 7.48; [OH–] = 10–7.48 = 3.3 × 10–8 *M*

23. Calculate the hydronium ion concentration and the hydroxide ion concentration in lime juice from its pH. See Figure 14.2 for useful information.

Solution

From Figure 14.2 the pH of lime juice is equal to 2. The hydronium ion concentration is pH = 2 = –log;  = 1 × 10–2 *M*; pH + pOH = 14; pOH = 14 – 2 = 12; [OH–] = 1 × 10–12 *M*

25. The hydroxide ion concentration in household ammonia is 3.2 × 10–3 *M* at 25 °C. What is the concentration of hydronium ions in the solution?

Solution

[OH–] = 1.0 × 10–14; [3.2 × 10–3] = 1.0 × 10–14; 

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