Problems on acids and bases

1. Find the concentration in mol L^{-1} when the pH is:
   (a) 2.0 (b) 3.26 (c) 4.57
   (d) 6.58 (e) 8.32 (f) 7.89
2. Find (i) the pH; (ii) the pOH of the following solutions:
   $[H^+]$ in mol L^{-1} is
   (a) 1.1×10^{-2} (b) 0.000 67
   (c) 4.8×10^{-3}
   $[OH^-]$ in mol L^{-1} is
   (d) 3.3×10^{-6} (e) 0.0053
   (f) 6.7×10^{-4}
3. Calculate the pH of the following solutions when 50 mL of the first is mixed with 50 mL of the second.
   (a) 0.2M potassium hydroxide and 0.1M hydrochloric acid;
   (b) 0.2M barium hydroxide and 0.2M hydrochloric acid;
   (c) 0.1M sodium hydroxide and 0.2M sulfuric acid;
   (d) 0.04 potassium hydroxide and 0.01M sulfuric acid.
4. Calculate the value for the pH of a solution containing 0.39 g of potassium hydroxide dissolved in 250 mL of water.

Answers to problems on Acids and Bases

1. Concentrations in mol L^{-1}:
   (a) 0.01 or 1×10^{-2} (b) 5.50×10^{-4} (c) 2.69×10^{-5}
   (d) 2.63×10^{-7} (e) 4.79×10^{-9} (f) 1.29×10^{-8}
2. (a) 1.96; 12.04 (b) 3.17; 10.83 (c) 2.32; 11.68
   (d) 9.51; 4.49 (e) 11.72; 2.28 (f) 10.38; 3.17

3. (a) Moles of KOH $= 50 \times \frac{0.2}{1000} = 0.01$ = no. of moles of OH^- ions.

   Moles of HCl $= 50 \times \frac{0.1}{1000} = 0.005$ = no. of moles of H^+ ions.

   Difference is $0.01 - 0.005 = 0.005$ moles of OH^- ions, so

   molarity $= \frac{0.005}{100 \times 10^{-3}} = 0.05M$, Final volume of solution = 100 mL.

   so pOH = 1.30; pH = 12.7.

   (b) 1 mole of $Ba(OH)_2$ produces 2 moles of OH^- ions.

   Moles of OH^- ions $= 0.4 \times \frac{50}{1000} = 0.02$ moles.

   Moles of H^+ ions $= 0.2 \times \frac{50}{1000} = 0.01$ moles.

   No. of moles of OH^- ions left $= 0.02 - 0.01 = 0.01$ moles, so

   molarity $= \frac{0.01}{100 \times 10^{-3}} = 0.1$, so pOH = 1; pH = 13.

   (c) Moles of H^+ ions $= 0.4 \times \frac{50}{1000} = 0.02$ moles, (1 mol H_2SO_4 produces 2 mol H^+ ions).

   Moles of OH^- ions $= 0.1 \times \frac{50}{1000} = 0.005$ mol.

   Excess H^+ ions $= 0.02 - 0.005 = 0.015$ mol, so

   molarity in mixed solution $= \frac{0.015}{100 \times 10^{-3}} = 0.15$, so pH = 0.82.

   (d) Moles of OH^- ions $= 0.04 \times \frac{50}{1000} = 0.002$ moles.

   Moles of H^+ ions $= 0.02 \times \frac{50}{1000} = 0.001$ moles.

   Excess OH^- ions $= 0.002 - 0.001 = 0.001$

   Molarity $= \frac{0.001}{100 \times 10^{-3}} = 0.01$, so pOH = 2; pH = 12.

4. 56 g/L = 1M KOH, so molarity of KOH solution = 0.0279M.
   pOH = 1.56, so pH = 12.44.