5. Complete the following statements:
   (a) As a solution's pOH value and $[H_3O^+]$ both decrease, the solution becomes more BASIC (acidic or basic).

   (b) As a solution's pH value and $[OH^-]$ both decrease, the solution becomes more ACIDIC (acidic or basic)

   (c) The Product (sum or product) of the $[H_3O^+]$ and $[OH^-]$ equals K_w.

   (d) The Sum (sum or product) of pH and pOH equals pK_w.

6. Complete the following table, expressing each value to the proper number of significant figures.

$[H_3O^+]$	pOH	Acidic/Basic/Neutral
0.0342 M	12.534	Acidic
2.51×10^{-6} M	8.400	Acidic
7.2×10^{-12} M	2.86	Basic
1.64×10^{-11} M	3.215	Basic

7. For pure water at 60.0°C, the value of $pK_w = 13.02$. Calculate the pH at this temperature and decide if the water is acidic, basic, or neutral.

$pKw = 13.02$

$Kw = 10^{-pKw}$

$= 9.5 \times 10^{-14}$

$Kw = [H_3O^+][OH^-]$

$[H_3O^+] = \sqrt{Kw}$

$= \sqrt{9.5 \times 10^{-14}}$

$= 3.1 \times 10^{-7}$ M

pure water is neutral

$[H_3O^+] = [OH^-]$

$pH = -\log [H_3O^+]$

$= 6.51$

8. Calculate the pH of a 0.30 M solution of $Sr(OH)_2$.

$Sr(OH)_2 \longrightarrow Sr^{2+} + 2OH^-$

$[OH^-] = 2[Sr(OH)_2]$

$= 2(0.30M)$

$= 0.60M$

$pOH = -\log [OH^-]$

$= 0.22$

$pH = 14 - pOH$

$= 14 - 0.22$

$= 13.78$

9. A 2.00 g sample of pure NaOH is dissolved in water to produce 500.0 mL of solution. Calculate the pH of this solution.

$$\frac{2.00\text{ g NaOH}}{0.5000\text{ L}} \times \frac{1\text{ mol}}{40.0\text{ g}} = 0.100M\ NaOH$$

$[OH^-] = 0.100M$

$[H_3O^+] = \frac{Kw}{[OH^-]} = \frac{1.0 \times 10^{-14}}{0.1000M} = 1.0 \times 10^{-13}$ M

$pH = -\log [H_3O^+]$

$= 13.00$

10. A sample of HI is dissolved in water to make 2.0 L of solution. The pH of this solution is found to be 2.50. Calculate the mass of HI dissolved in this solution.

$pH = 2.50$

$[H_3O^+] = 10^{-pH}$

$= 10^{-2.5}$

$= 3.16 \times 10^{-3}\ M$

$[H_3O^+] = [HI]$

$\therefore \frac{3.16 \times 10^{-3}\ mol}{L} \times 2.0\ L \times \frac{127.9\ g}{1\ mol}$

$= \boxed{0.81\ g}$

11. Complete the following table, expressing each value to the proper number of significant figures.

$[H_3O^+]$	$[OH^-]$	pOH	pH	Acidic/Basic/Neutral
5.620×10^{-5} M	1.779×10^{-10} M	9.7497	4.2502	Acidic
2.22×10^{-11} M	0.000450 M	3.347	10.653	Basic
3.2×10^{-2} M	3.2×10^{-13} M	12.50	1.50	Acidic
3×10^{-11} M	3×10^{-4} M	3.5	10.5	Basic

12. Calculate the pH resulting from mixing 75.0 mL of 0.50 M HNO_3 with 125.0 mL of a solution containing 0.20 g NaOH.

$[H_3O^+] = \frac{C_1V_1}{V_2} = \frac{(0.50\ M)(75.0\ mL)}{200.0\ mL} = 0.1875\ M$

$[OH^-] = \frac{0.20\ g}{0.2000\ L} \times \frac{1\ mol}{40.0\ g} = 0.025\ M$

$[H_3O^+]_{excess} = 0.1875\ M - 0.025\ M$

$= 0.1625\ M$

$pH = -\log[H_3O^+]$

$= \boxed{0.79}$

13. Calculate the pH of the solution that results from mixing 200.0 mL of a solution with a pH of 1.50 with 300.0 mL of a solution having a pOH of 1.50.

Solution A – Acidic

200.0 mL

$pH = 1.50$

$[H_3O^+] = 10^{-pH}$

$= 0.0316\ M$

Solution B – Basic

300.0 mL

$pOH = 1.50$

$[OH^-] = 10^{-pOH}$

$= 0.0316\ M$

$C_2 = \frac{C_1V_1}{V_2} = (0.0316)\left(\frac{200.0\ mL}{500.0\ mL}\right) = 0.0126\ M$

$C_2 = (0.0316)\left(\frac{300.0\ mL}{500.0\ mL}\right) = 0.01896\ M$

$[OH^-]_{excess} = 0.01896\ M - 0.0126\ M$

$= 6.36 \times 10^{-3}\ M$

$pOH = -\log(6.36 \times 10^{-3}\ M)$

$= 2.20$

$pH = 14 - pOH = \boxed{11.80}$

14. Calculate the pH of a solution that is produced when 3.2 g of HI is added to 500.0 mL of a solution having a pH of 13.00. Assume no volume change.

$\frac{3.2\ g\ HI}{0.5000\ L} \times \frac{1\ mol}{127.9\ g} = 0.0500\ M$

$pH = 13.00$

$pOH = 1.00$

$[OH^-] = 0.10\ M$

$[OH^-]_{excess} = 0.10\ M - 0.050\ M$

$= 0.050\ M$

$pOH = -\log[OH^-]$

$= -\log(0.050\ M)$

$= 1.30$

$pH = 12.70$

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