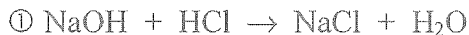


**g) Advanced pH and pOH Calculations**

- i) Example: 50.0ml of 0.200 M NaOH is reacted with 30.0ml of 0.250 M HCl. What is the pH of the resulting solution?**



moles of acid or base in *excess* will determine the pH

② moles NaOH present =  $0.200\text{M} \times 0.0500\text{L} = 0.0100$  moles

moles HCl present =  $0.250\text{M} \times 0.0300\text{L} = 0.00750$  moles

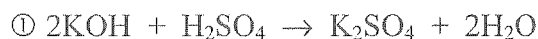
③ NaOH is in excess by:  $0.0100 - 0.00750 = 0.00250$  moles

④  $[\text{NaOH}] = [\text{OH}^-] = 0.00250 \text{ moles} / (0.0300\text{L} + 0.0500\text{L}) = 0.0312 \text{ M}$

⑤  $\text{pOH} = -\log[0.0312\text{M}] = 1.506$

⑥  $\text{pH} = 14 - \text{pOH} = 14 - 1.506 = 12.494$

- ii) Example: Calculate the pH if 1.25 L of 0.300 M KOH is added to 0.500 L of 0.0900 M H<sub>2</sub>SO<sub>4</sub>.**



moles of acid or base in *excess* will determine the pH

② moles  $[\text{OH}^-]$  present =  $0.300\text{M} \times 1.25\text{L} = 0.375$  moles

moles  $[\text{H}_3\text{O}^+]$  present =  $0.0900\text{M} \times 0.500\text{L} \times 2 = 0.0900$  moles



cause each H<sub>2</sub>SO<sub>4</sub>  
produces two H<sub>3</sub>O<sup>+</sup>'s

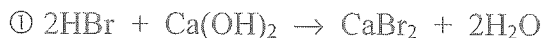
③  $[\text{OH}^-]$  is in excess by:  $0.375 - 0.0900 = 0.285$  moles

④  $[\text{OH}^-] = 0.285 \text{ moles} / (1.25\text{L} + 0.500\text{L}) = 0.163 \text{ M}$

⑤  $\text{pOH} = -\log[0.163\text{M}] = 0.788$

⑥  $\text{pH} = 14 - 0.788 = 13.212$

iii) **Example: Calculate the pOH if 0.0300 L of 0.400 M Ca(OH)<sub>2</sub> is added to 0.250 L of 0.125 M HBr.**



moles of acid or base in *excess* will determine the pH

② moles  $[\text{OH}^-]$  present =  $0.400\text{M} \times 0.0300\text{L} \times 2 = 0.0240$  moles  
moles  $[\text{H}_3\text{O}^+]$  present =  $0.125\text{M} \times 0.250\text{L} = 0.0312$  moles

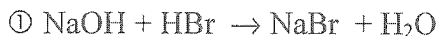
③  $[\text{H}_3\text{O}^+]$  is in excess by:  $0.0312 - 0.0240 = 0.00720$  moles

④  $[\text{H}_3\text{O}^+] = 0.00720 \text{ moles} / (0.250\text{L} + 0.0300\text{L}) = 0.0257 \text{ M}$

⑤  $\text{pH} = -\log[0.0257\text{M}] = 1.590$

⑥  $\text{pOH} = 14 - 1.590 = 12.410$

iv) **Example: How many grams of NaOH must be added to 0.800 L of 0.0400 M HBr to change the pH to 7.00? (Assume no volume change from adding NaOH)**



② want  $[\text{H}_3\text{O}^+] = 10^{-7} = 0.0000001 \text{ M}$

③ current  $[\text{H}_3\text{O}^+] = 0.0400 \text{ M}$

④ change in  $[\text{H}_3\text{O}^+] = 0.0400 - 0.0000001 = 0.0399 \text{ M}$

⑤  $[\text{H}_3\text{O}^+] = [\text{OH}^-] = 0.0399 \text{ M}$

⑥  $0.0399 \text{ M} \times 0.800 \text{ L} = 0.0320 \text{ moles NaOH}$

⑦  $0.0320 \text{ moles} \times 40 \text{ g/mol} = 1.28 \text{ g NaOH}$