

← strong acid

1. 0.38 g of HI is dissolved in 500. mL of water. What is the pH of the solution?

Logic: grams & volume \Rightarrow [HI] = [H₃O⁺] \Rightarrow pH
 using molecular weight because HI is a strong acid

$$\text{mw of HI} = 1.008 \text{ g/mol} + 126.90 = 127.91 \text{ g/mol}$$

$$\frac{\text{amount}}{\text{volume}} = \frac{0.38 \text{ g HI}}{500. \text{ mL}} \times \frac{\text{mole HI}}{127.91 \text{ g HI}} \times \frac{1000. \text{ mL}}{\text{L}} = 5.942 \times 10^{-3} \frac{\text{mol}}{\text{L}} = \text{M} = [\text{HI}] = [\text{H}_3\text{O}^+]$$

$$\text{pH} = -\log(\text{H}_3\text{O}^+) = -\log(5.942 \times 10^{-3}) = 2.2261$$

↑ 2 sig figs ↑ = 2.23

← strong base

2. 4.25 g of NaOH is dissolved in 1.00 L of water. What is the pH of the solution?

Logic: grams & volume \Rightarrow [NaOH] = [OH⁻] \Rightarrow pOH \Rightarrow pH
 using molecular wt because NaOH is a strong base w/ 1 OH⁻ per NaOH

$$\text{mw of NaOH} = 22.99 + 16.00 + 1.008 = 40.00 \text{ g/mol}$$

$$\frac{\text{amount}}{\text{volume}} = \frac{4.25 \text{ g}}{1.00 \text{ L}} \times \frac{\text{mole}}{40.00 \text{ g}} = 0.10625 \frac{\text{mol}}{\text{L}} = \text{M} = [\text{NaOH}] = [\text{OH}^-]$$

$$\text{pOH} = -\log(\text{OH}^-) = -\log(0.10625) = 0.97367$$

↑ 3 sig figs ↑ = 13.023

$$\text{pH} + \text{pOH} = 13.9965 \Rightarrow \text{pH} = 13.9965 - \text{pOH} = 13.9965 - 0.97367 = 13.0228$$

* See F06 quiz 3 forms C & D, S06 quiz 2 for additional problems like questions 1 & 2.

3. 10.0 mL of a 0.10 M NaOH solution is diluted to 500. mL. What is the pH of the final solution?

Logic: orig. conc & dilution info \Rightarrow [NaOH] = [OH⁻] \Rightarrow pOH \Rightarrow pH

for dilution: moles dil = mol conc

$$C_{\text{dil}} V_{\text{dil}} = C_{\text{conc}} V_{\text{conc}}$$

$$C_{\text{dil}} = \frac{C_{\text{conc}} V_{\text{conc}}}{V_{\text{dil}}} = 0.10 \text{ NaOH} \left(\frac{10.0 \text{ mL}}{500. \text{ mL}} \right) = 2.0 \times 10^{-3} \text{ M}$$

$$= [\text{NaOH}] = [\text{OH}^-]$$

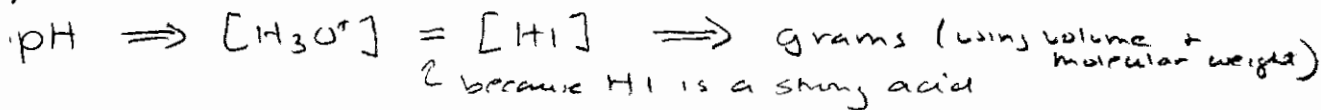
$$\text{pOH} = -\log(\text{OH}^-) = -\log(2.0 \times 10^{-3}) = 2.6990$$

$$\text{pH} = 13.9965 - 2.6990 = 11.2975 = \span style="border: 1px solid black; padding: 2px;">11.30$$

* See F06 quiz 3 for additional practice on questions like this

4. You want to make 250. mL of a pH 2.50 HI solution. How many grams of HI will you need to weigh out?

Logic:



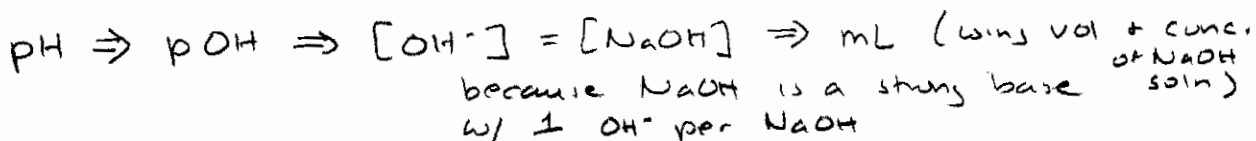
$$[\text{H}_3\text{O}^+] = 10^{-\text{pH}} = 10^{-2.50} = 3.162 \times 10^{-3} \text{ M} = [\text{HI}]$$

$$250. \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{3.162 \times 10^{-3} \text{ mol HI}}{\text{L}} \times \frac{127.91 \text{ g HI}}{\text{mole}} = 0.10111 \text{ g} = \boxed{0.10 \text{ g}}$$

* See 507 Quiz 3 for other questions like this.

5. How many mL of a 0.10 M NaOH(aq) solution, will you need to use to make 250. mL of a pH 12.50 solution?

Logic:



$$\text{pH} + \text{pOH} = 13.9965$$

$$\text{pOH} = 13.9965 - \text{pH} = 13.9965 - 12.50 = 1.4965$$

$$[\text{OH}^-] = 10^{-\text{pOH}} = 10^{-1.4965} = 3.188 \times 10^{-2} \text{ M} = [\text{NaOH}]$$

$$250. \text{ mL} \times \frac{\text{L}}{1000 \text{ mL}} \times \frac{3.188 \times 10^{-2} \text{ mol NaOH}}{\text{L}} = 7.970 \times 10^{-3} \text{ mol NaOH}$$

needed for final solution

Obtain moles of NaOH for final solution from the 0.10 M NaOH solution

$$7.970 \times 10^{-3} \text{ mol NaOH}_{\text{final soln}} \times \frac{\text{L}}{0.1 \text{ mol NaOH}} \times \frac{1000 \text{ mL}}{\text{L}} = 79.70 \text{ mL} = \boxed{80. \text{ mL}}$$

Note - could also solve the last part of ^{the} problem by thinking of it as a dilution problem

$\text{mol dil} = \text{mol conc}$
 $C_{\text{dil}} V_{\text{dil}} = C_{\text{conc}} V_{\text{conc}}$

$$V_{\text{conc}} = \frac{C_{\text{dil}} V_{\text{dil}}}{C_{\text{conc}}} = \frac{(3.188 \times 10^{-2} \text{ M})(250. \text{ mL})}{(0.10 \text{ M})} = 79.7 \text{ mL} = \boxed{80. \text{ mL}}$$