CALCULATING THE pH OF ACID/ALKALI MIXTURES

The method used depends on whether there are weak or strong acids and alkalis and which is in excess

STRONG ACID
STRONG BASE

1. Calculate initial moles of H^+ and OH^-
2. Calculate which one is in excess
3. Calculate its concentration in the combined solution
4. Convert concentration to pH

Calculate the pH after 20cm³ of 0.1M HCl is added to 25cm³ of 0.1M NaOH

1	*original moles of* H^+	=	$0.1 \times 20/1000$	=	2×10^{-3} moles
2	*original moles of* OH^-	=	$0.1 \times 25/1000$	=	2.5×10^{-3} moles
	moles of excess OH^-	=	5×10^{-4}		
3	*final volume (20 + 25)*	=	$45cm^3$	=	$0.045dm^3$
4	$[OH^-]$	=	$5 \times 10^{-4} / 0.045$	=	0.0111 mol dm^{-3}
	pOH	=	1.95		
	pH	**=**	***14 - 1.95***	**=**	***12.05***

WEAK ACID
EXCESS
STRONG BASE

1. Calculate initial moles of acid and alkali
2. Calculate the excess moles of OH^-
3. Calculate the OH^- concentration in the combined solution
4. Convert concentration to pH

Calculate the pH after 22cm³ of 0.1M CH_3COOH is added to 25cm³ of 0.1M NaOH

1	*original moles of* H^+	=	$0.1 \times 22/1000$	=	2.2×10^{-3} moles
2	*original moles of* OH^-	=	$0.1 \times 25/1000$	=	2.5×10^{-3} moles
	moles of excess OH^-	=	3×10^{-4}		
3	*final volume (22 + 25)*	=	$47cm^3$	=	$0.047dm^3$
4	$[OH^-]$	=	$3 \times 10^{-4} / 0.047$	=	6.38×10^{-3} mol dm^{-3}
	pOH	=	2.20		
	pH	**=**	***14 - 2.20***	**=**	***11.80***

IF THE MIXTURE CONTAINS EXCESS WEAK ACID, A DIFFERENT APPROACH IS NEEDED

EXCESS
WEAK ACID
STRONG BASE

1. Calculate initial moles of acid and alkali
2. Calculate the excess moles of acid
3. Calculate the moles of anion formed (same as the alkali used up)
4. Use the value of K_a for the weak acid to calculate the value of $[H^+]$
5. Convert concentration to pH

Calculate the pH after 20cm³ of 0.1M KOH is added to 25cm³ of 0.1M CH_3COOH

1	*original moles of* CH_3COOH	=	$0.1 \times 25/1000$	=	2.5×10^{-3} moles
	original moles of KOH	=	$0.1 \times 20/1000$	=	2.0×10^{-3} moles
2	excess *moles* CH_3COOH	=	5.0×10^{-4}		
3	*moles of* CH_3COO^-	=	*moles of* H^+ *removed*	=	2.0×10^{-3}
4	K_a *for* CH_3COOH	=	$\frac{[H^+][CH_3COO^-]}{[CH_3COOH]}$	=	1.7×10^{-5} at 25°C

YOU ONLY NEED TO PUT IN THE MOLAR RATIO (NOT THE CONCENTRATIONS) BECAUSE THE VOLUME IS THE SAME FOR BOTH SPECIES

$$[H^+] = \frac{1.7 \times 10^{-5} \times 5 \times 10^{-4}}{2.0 \times 10^{-3} \text{ moles}} = 4.25 \times 10^{-6} \text{ mol dm}^{-3}$$

5 ***pH*** **=** ***-log [H⁺]*** **=** ***5.37***