









# AS PRACTICAL 8

## Equilibrium shifts (Instructions)


### REACTION 1 – Reactions of cobalt(II)

<b>Health &amp; safety</b>	  	HCl is corrosive Cobalt compounds are toxic
<b>Equation</b>	$[\text{Co}(\text{H}_2\text{O})_6]^{2+} + 4\text{Cl}^- \rightleftharpoons [\text{CoCl}_4]^{2-} + 6\text{H}_2\text{O}$	
<b>Instructions</b>	Reaction 1 Place about 1 cm depth of cobalt(II) nitrate solution into a boiling tube. Add concentrated hydrochloric acid dropwise until the colour stops changing. Reaction 2 Add water to the boiling tube until it stops changing colour.	
<b>Observations</b>	Reaction 1 colour changes from pink solution to blue solution Reaction 2 colour changes from blue solution to pink solution	
<b>Explanation</b>	Reaction 1 adding HCl increases the concentration of $\text{Cl}^-$ ions and so the equilibrium position moves right to oppose this increase in concentration Reaction 2 adding $\text{H}_2\text{O}$ increases the amount of water and so the equilibrium position moves left to oppose this increase	


### REACTION 2 – Reactions of chromate(VI)

<b>Health &amp; safety</b>	  	$\text{H}_2\text{SO}_4$ and NaOH are irritants Chromium compounds are toxic
<b>Equation</b>	$2\text{CrO}_4^{2-} + 2\text{H}^+ \rightleftharpoons \text{Cr}_2\text{O}_7^{2-} + \text{H}_2\text{O}$	
<b>Instructions</b>	Reaction 1 Place about 1 cm depth of sodium chromate(VI) solution into a boiling tube. Add dilute sulfuric dropwise until the colour stops changing. Reaction 2 Add sodium hydroxide solution to the mixture until the colour stops changing.	
<b>Observations</b>	Reaction 1 colour changes from yellow solution to orange solution Reaction 2 colour changes from orange solution to yellow solution	
<b>Explanation</b>	Reaction 1 adding $\text{H}_2\text{SO}_4$ increases the concentration of $\text{H}^+$ ions and so the equilibrium position moves right to oppose this increase in concentration Reaction 2 adding NaOH decreases the amount of $\text{H}^+$ ions (as $\text{H}^+$ reacts with $\text{OH}^-$ ) and so the equilibrium position moves left to replace $\text{H}^+$	

### REACTION 3 – Reactions of iron(III)

<b>Health &amp; safety</b>	 KSCN is harmful Iron(III) compounds are irritants
<b>Equation</b>	$\text{Fe}^{3+} + \text{SCN}^- \rightleftharpoons \text{Fe}(\text{SCN})^{2+}$
<b>Instructions</b>	Mix together one drop of iron (III) nitrate solution and one drop of potassium thiocyanate (KSCN) solution in a test tube and add about 5 cm <sup>3</sup> of distilled water to form a pale orange brown solution. Reaction 1 Take half of this solution in a test tube and place it in an ice bath. Reaction 2 Take the other half of this solution in another test tube and add one drop of potassium thiocyanate solution.
<b>Observations</b>	Reaction 1 colour changes from pale orange-brown solution to deep red solution Reaction 2 colour changes from pale orange-brown solution to deep red solution
<b>Explanation</b>	Reaction 1 adding KSCN increases the concentration of SCN <sup>-</sup> ions and so the equilibrium position moves right to oppose this increase in concentration Reaction 2 when the equilibrium is cooled, the equilibrium moves right in the exothermic direction to oppose the decrease in temperature

### REACTION 4 – Reactions of ethanoic acid

<b>Health &amp; safety</b>	 Ethanoic acid and sodium ethanoate are irritants
<b>Equation</b>	$\text{CH}_3\text{COOH} \rightleftharpoons \text{CH}_3\text{COO}^- + \text{H}^+$
<b>Instructions</b>	Place about 2 cm depth of ethanoic acid solution into a boiling tube and add a few drops of universal indicator. Add two spatula loads of sodium ethanoate and mix well.
<b>Observations</b>	colour of indicator changes from orange-red to orange
<b>Explanation</b>	adding sodium ethanoate increases the concentration of CH <sub>3</sub> COO <sup>-</sup> ions and so the equilibrium position moves left to oppose this increase in concentration but removing H <sup>+</sup> ions and so increasing the pH