# COLOUR CHANGES

Please remember that the colour change in a titration occurs at the "**end point**" but the point of exact neutralisation is called the "**equivalence point**" (EP). **(NB At a value of one-half of the EP, pKa = pH.)**

| Reaction/Identification | Colour Change |
|---|---|
| Alcohols + $PCl_5$ | White fuming HCl (no reaction with Phenol) |
| Alcohols to Carbonyl Compounds | orange —> Green<br>(orange $Cr^{6+}$ + blue $Cr^{3+}$) *looks* green |
| Methyl Ketones and Iodoform test | ppt of fine yellow $CHI_3$ crystals |
| Brady's reagent for Carbonyl compounds<br>*(2,4-DNPH + methanol + $H_2SO_4$)* | Greeny solution —> reddy/yellow/straw coloured ppt<br>*(the Carbonyl compound would be colourless). For 'A' Level purposes, assume that only Aldehydes/Ketones test positive.* |
| Tollens identification of Aldehydes | colourless —> silver ppt in colourless solution |
| Benedict's and Fehling's | cyan blue $Cu^{2+}$ —> dirty reddy/brown $Cu^{+}$ |
| Alkenes and some other unsaturated molecules. (Benzene will not react without a Friedel-Crafts' catalyst.) | brown $Br_2$ —> colourless (immediately, and in the cold and the dark therefore it **cannot** be the result of homolytic bond fission) |
| Alkene (ditto) | purple $MnO_4^-$ —> colourless but **no reaction** with Benzene |
| Phenol with $FeCl_3$ | Violet colour results, an alcohol will **not** do this |
| Phenol and diazonium salt | yellow dye produced |
| Phenol with Bromine Water<br>(Phenol has an area of high electron density above it and below it) | decolourises it even in the cold and dark<br>*(therefore not a Free Radical mechanism)* |
| Ammonia + HCl(g) —> | steamy white fumes |
| Acid | red litmus paper stays red |
| Alkali | red litmus paper turns blue |
| $NO_2$ (g) —> $N_2O_4$ (g) | reddish brown turns colourless<br>(demonstration of Le Chatelier's Principle) |
| The Iodine clock reaction<br>($I_2$ + $I^-$ + starch) when neutralised by $Na_2CO_3$<br>or when titrated against Sodium Thiosulphate | When the Thiosulphate or the Bisulphite ions are used up, then the Iodine/Iodide mixture attacks the Starch and the deep blue-black colour appears. The reaction colourless —> blue-black can be made to occur the other way round viz. blue-black to colourless. The colour change is instantaneous. Please type in "Iodine Clock Reaction, youtube" into your search engine and watch two or three of the videos. |
| Bromine/Bromate clock reaction | When the Phenol has been used, then the Bromine can attack the Methyl Orange and "bleach" it. (Orange —> colourless) |
| Acidified Propanone and Iodine | brown gradually becomes colourless as all the Iodine is used up |
| Benzene | Will **NOT** decolourise Bromine water nor $MnO_4^-$ at RTP. |
| Phenol | **WILL** decolourise Bromine Water at RTP to form 2,4,6-tribromophenol. (NO catalyst is required.) Mono-bromination and dibromination is formed if the Bromine is first dissolved in $CCl_4$. |
| Complexes | There are **many** different colour changes involved (cf. Chapter 12 Year 2, Inorganic Chemistry). |
| Alkene + hot **purple** $MnO_4^-$<br>Alkene + cold purple $MnO_4^-$ | **Colourless** $Mn^{2+}$ ion<br>**Green** $Mn^{6+}$ (and then becomes oxidised by the Oxygen in the air into browny-black $Mn^{4+}$). |
| $H_2S$ will turn white lead ethanoate/lead acetate, $Pb(C_2H_3O_2)_2$, paper black (because PbS is black). | White —> black |
| The acidified potassium dichromate, $K_2Cr_2O_7$ test for $SO_2$. | yellow $Cr^{6+}$ –> blue $Cr^{3+}$, (yellow mixed with blue **looks green** cf. footnote[1]). The examiners like you to tell them yellow –> green. |

[1] NB Yellow/orange mixed with blue gives a green colour, therefore if there is any unreduced **$Cr^{6+}$** present the mixture will look green. When there is no **$Cr^{6+}$** left, then the colour will be blue. **Please give the examiners what they want to hear.** It is they who award the marks!