GCE AS & A2 Chemistry

Acceptable Colour Changes

Effective from January 2011

Unit AS 1: Basic Concepts in Physical and Inorganic Chemistry

N.B. It should be noted that the exact colour of a solution often depends on the concentration and the following are based on solutions of normal laboratory concentration.

The following are used as standard conventions throughout this document:

1. A forward slash (/) indicates each alternative will be accepted e.g. the sodium flame colour is given as yellow/orange so either yellow or orange will be accepted.

2. A hyphen (-) indicates that both colours are required e.g. bromine liquid is described as red-brown so red or brown will not be accepted.

3. Make a solution means dissolve in water.

Content	Paragraph	Observation	
1.2 Atomic structure	1.2.16	**Flame colours:**	
		Li^+	Crimson
		Na^+	Yellow/Orange
		K^+	Lilac/Pink through cobalt glass
		Ca^{2+}	Brick red
		Ba^{2+}	Green
		Cu^{2+}	Green-blue/Blue-green
1.8 Group VII (fluorine, chlorine, bromine and iodine	1.8.1	Fluorine	Yellow gas
		Chlorine	Green/Yellow-green/Green-yellow gas
		Bromine	Red-brown liquid (and vapour)
		Iodine solid	Grey-black/Black
		Iodine vapour	Violet/Purple
	1.8.2/1.8.6	Chlorine water	pale green/colourless
		Bromine water	yellow/orange/brown
		Iodine solution	yellow/brown: polar solvents violet/purple: non-polar solvents
	1.8.7	Iron (II) solution	pale green
		Iron (III) solution	yellow/orange
		Solid halides with concentrated sulphuric acid:	
		Fluoride	steamy/misty fumes (of HF)
		Chloride	steamy/misty fumes (of HCl)
		Bromide	steamy/misty fumes (of HBr); red-brown vapour (Br_2)

		Solid halides with concentrated sulphuric acid: **(cont.)** Iodide — steamy/misty fumes (of HI); violet/purple vapour (I_2); smell of rotten eggs (H_2S); yellow solid (S); grey-black/black solid (on the sides of the test-tube) (I_2)
	1.8.11	Silver chloride — white Silver bromide — cream Silver iodide — yellow
1.9 Titrations	1.9.2	Methyl orange — Acid – red/pink; Alkali – yellow **Colour change at end-point:** adding acid to alkali — yellow to orange/red/pink adding alkali to acid — red/pink to orange/yellow Phenolphthalein — Acid – colourless; Alkali – pink/red **Colour change at end-point:** adding acid to alkali — pink to colourless adding alkali to acid — colourless to pink

Unit AS 2: Further Physical and Inorganic Chemistry and Introduction to Organic Chemistry

Content	Paragraph	Observation	
2.12 Qualitative analysis	2.12.1	**Gas tests**	
		H_2	gives a 'pop' with a burning splint
		O_2	relights a glowing splint
		Cl_2	bleaches damp litmus/universal indicator paper
		CO_2	bubble through limewater; limewater turns cloudy/milky
		SO_2	turns potassium dichromate (VI) solution from orange to green/turns potassium manganate (VII) solution form purple/pink to colourless
		HCl	white fumes/smoke with stopper from bottle of concentrated ammonia solution/glass rod dipped in concentrated ammonia solution
		NH_3	white fumes/smoke with stopper from bottle of concentrated hydrochloric acid/glass rod dipped in concentrated hydrochloric acid
	2.12.2	**Flame colours**	
		Li^+	Crimson
		Na^+	Yellow/Orange
		K^+	Lilac/Pink through cobalt glass
		Ca^{2+}	Brick red
		Ba^{2+}	Green
		Cu^{2+}	Green-blue/Blue-green
	2.12.3	SO_4^{2-}	make a solution and add dilute HCl/HNO_3 followed by a solution of Ba^{2+} ions – forms a white precipitate
		HCO_3^-/CO_3^{2-}	add dilute HCl to form colourless gas which turns lime water cloudy/milky; make a solution and add a solution of Mg^{2+} ions – CO_3^{2-} forms a white precipitate, no effect on HCO_3^-

		Hal^-	make a solution and add dilute nitric acid followed by silver nitrate solution, then note the following:
		Cl^-	white precipitate, soluble in dilute ammonia solution
		Br^-	cream precipitate, soluble in concentrated ammonia solution
		I^-	yellow precipitate, insoluble in concentrated ammonia solution
	2.12.4	Ba^{2+}	yellow precipitate with a solution of potassium chromate, soluble in hydrochloric acid to give a yellow solution
		Cu^{2+}	blue precipitate on addition of a few drops of dilute ammonia solution which dissolves in excess of the ammonia solution to form a dark/deep blue solution
		NH_4^+	heat with dilute sodium hydroxide; the gas given off gives white fumes/smoke with stopper from bottle of concentrated hydrochloric acid/glass rod dipped in concentrated hydrochloric acid
		Fe^{2+} and Fe^{3+}	add dilute sodium hydroxide solution; Fe^{2+} gives a green precipitate and Fe^{3+} gives a rust/brown precipitate
		Al^{3+}, Mg^{2+} and Zn^{2+}	1. add a few drops of dilute sodium hydroxide solution. Al^{3+}, Mg^{2+} and Zn^{2+} all form a white precipitate. The Al^{3+} and Zn^{2+} precipitates are soluble in excess of the sodium hydroxide solution; the Mg^{2+} precipitate is insoluble in excess of the sodium hydroxide solution

			2. add a few drops of dilute ammonia solution. Al^{3+}, Mg^{2+} and Zn^{2+} all form a white precipitate. The Zn^{2+} precipitate is soluble in excess of the ammonia solution; the Al^{3+} and Mg^{2+} precipitates are insoluble in excess of the ammonia solution
		Fe^{3+}	add potassium thiocyanate solution and a blood red solution is formed

Unit A2 1: Periodic Trends and Further Organic, Physical and Inorganic Chemistry

Content	Paragraph	Observation
4.7 Aldehydes and ketones	4.7.8	Aldehydes and ketones form yellow/orange precipitates in the presence of 2,4-dinitrophenylhydrazine
	4.7.10	Aldehydes can be distinguished from ketones as they: turn acidified (potassium) dichromate solution from orange to green; form a red precipitate when heated with Fehling's solution; form a silver mirror when heated with Tollen's reagent

Unit A2 2: Analytical, Transition Metals, Electrochemistry and Further Organic Chemistry

Content	Paragraph	Observation
5.3 Volumetric analysis	5.3.1	**Recall the colour of the aqueous complexes of:** Ca^{2+}/Mg^{2+} using edta: eriochrome black T turns from red to blue I_2 with $S_2O_3^{2-}$ using starch: add the thiosulphate solution until the solution is straw coloured and then add starch; turns from blue-black to colourless Fe^{2+} with MnO_4^-: no indicator required the solution changes from colourless to pink
5.8 Oxidation states	5.8.1	**Recall the colour of the aqueous complexes of:** Cr^{3+} green Cr(VI) (CrO_4^{2-}) yellow $Cr_2O_7^{2-}$ orange Mn^{2+} pink Fe^{2+} green Fe^{3+} yellow/orange Co^{2+} pink Ni^{2+} green Cu^{2+} blue V^{2+} violet V^{3+} green V(IV) (VO^{2+}) blue V(V)(VO_2^+) yellow
	5.8.2	Qualitative detection tests using the formation of precipitates of the hydroxides with NaOH(aq) and NH_3(aq) and, where appropriate, their subsequent dissolution: Cr^{3+} green-blue precipitate soluble in excess sodium hydroxide solution Mn^{2+} white precipitate slowly turning brown/black on standing; insoluble in excess sodium hydroxide/ammonia solution Fe^{2+} green precipitate; insoluble in excess sodium hydroxide/ ammonia solution Fe^{3+} rust/brown precipitate; insoluble in excess sodium hydroxide/ammonia solution

		Co^{2+}	blue precipitate; insoluble in excess sodium hydroxide solution; soluble in excess ammonia solution forming a yellow solution
		Ni^{2+}	green precipitate insoluble in excess sodium hydroxide solution; soluble in excess ammonia solution to form a blue solution
		Cu^{2+}	blue precipitate; insoluble in excess sodium hydroxide solution; soluble in excess ammonia solution to form a dark/deep blue solution
	5.8.3	V^{2+}	violet
		V^{3+}	green
		V(IV) VO^{2+})	blue
		V(V)(VO_2^+)	yellow
	5.8.5	Chrome alum	green solution; violet crystals