GCE

Rewarding Learning

Revised GCE

Support Material **Chemistry**

Acceptable Colour Changes and Observations

AS and A2 Effective from September 2016

Updated: November 2021

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 either alternative will be accepted e.g. the sodium flame colour is given as yellow/orange. A candidate should provide one of these alternative options. The candidate could write yellow **or** orange. Yellow-orange will not be accepted.
2. A hyphen (-) indicates that **both** colours are required e.g. bromine liquid is described as red-brown (with or without hyphen) so red or brown alone or red/brown will not be accepted.
3. Make a solution means dissolve in water.

Unit AS 1: Basic Concepts in Physical and Inorganic Chemistry

Content	Paragraph	Observation	
1.8 Halogens	1.8.1	fluorine	yellow gas
		chlorine	green/yellow-green/green-yellow gas
		bromine	red-brown/brown-red liquid (and vapour)
		iodine solid	grey-black/black-grey
		iodine vapour	violet/purple
1.8 Halogens	1.8.2	chlorine water	green/colourless
		bromine water	yellow/orange/brown
		iodine solution	yellow/brown: polar solvents violet/purple: non-polar solvents
1.Halogens	1.8.6	**Solid halides with concentrated sulfuric acid**	
		fluoride	steamy/misty fumes (of HF)
		chloride	steamy/misty fumes (of HCl)
		bromide	steamy/misty fumes (of HBr) red-brown vapour (Br_2)
		iodide	steamy/misty fumes (of HI) violet/purple vapour (I_2) smell of rotten eggs (H_2S) yellow solid (S) grey-black solid (on the sides of the test-tube) (I_2)

Content	Paragraph	Observation	
		Solid halides with concentrated phosphoric acid	
		fluoride	steamy/misty fumes (of HF)
		chloride	steamy/misty fumes (of HCl)
		bromide	steamy/misty fumes (of HBr)
		iodide	steamy/misty fumes (of HI)
1.9 Titrations	1.9.3	**methyl orange**	
		Colour change at endpoint:	
		adding acid to alkali	yellow to red
		adding alkali to acid	red to yellow
		phenolphthalein	
		Colour change at endpoint:	
		adding acid to alkali	pink to colourless
		adding alkali to acid	colourless to pink
1.10 Qualitative tests	1.10.1	**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 milky
		HCl	white fumes/smoke/solid with stopper from bottle of concentrated ammonia solution/glass rod dipped in concentrated ammonia solution
		NH_3	white fumes/smoke/solid with stopper from bottle of concentrated hydrochloric acid/glass rod dipped in concentrated hydrochloric acid

Content	Paragraph	Observation	
1.10 Qualitative tests	1.10.2	**Flame Colours**	
		Li^+	crimson
		Na^+	yellow/orange
		K^+	lilac pink through cobalt glass
		Ca^{2+}	brick red/red
		Ba^{2+}	green/apple green
		Cu^{2+}	green-blue/blue-green
		Test for NH_4^+	warm with a solution of sodium hydroxide. A pungent smell will be observed (see 1.10 to **test** for this gas)
1.10 Qualitative tests	1.10.4	Test for SO_4^{2-}	make a solution and add a solution of barium chloride or barium nitrate – forms a white precipitate
		Test for halide ions	
		Hal^-	make a solution in dilute nitric acid and add 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
		Test for carbonate ion	Add dilute acid to form colourless gas which turns limewater milky
1.10 Qualitative tests	1.10.5	Test for iodine	Add a few drops of starch to the solution, the solution will turn blue-black/black-blue

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

Content	Paragraph	Observation	
2.3 Alkanes	2.3.4	Burning of hydrocarbons	a smoky/sooty flame is indicative of a high carbon content and for incomplete combustion
2.4 Alkenes	2.4.2	Test for alkenes	add a few cm^3 of bromine water. After shaking the aqueous layer will decolourise. (see also 1.8.2 for bromine water colours)
2.6 Alcohols	2.6.4	Burning of alcohols	a non-smoky/non-sooty/clean blue flame is indicative of complete combustion/low carbon content. A sooty/smoky flame is indicative of incomplete combustion/high carbon content
2.6 Alcohols	2.6.5	Reactions of alcohols	with sodium – solid disappears, fizzing, mixture warms up with phosphorus pentachloride – solid disappears, steamy/misty fumes, mixture warms up, hissing noise
2.6 Alcohols	2.6.6	Oxidation of alcohols	primary and secondary alcohols with acidified potassium dichromate (VI) solution changes from orange to green when heated, change in smell

Content	Paragraph	Observation	
2.11 Group II	2.11.3	Reactions of Group II elements	with water: Mg – few bubbles produced slowly, metal dulls Ca – fizzing, mixture warms up, metal rises and falls, metal disappears, white solid produced with HCl(aq) metal disappears, fizzing, mixture warms up with H_2SO_4 (aq) Mg – metal disappears, fizzing, mixture warms up Ca – fizzing initially but reaction stops (due to formation of insoluble calcium sulfate) with oxygen Mg – bright white light to form a white powder Ca – brick red/red flame to form a white powder.

Unit A2 1: Further Physical and Organic Chemistry

Content	Paragraph	Observation	
4.7 Aldehydes and ketones	4.7.9	Distinguishing between aldehydes and ketones	aldehydes can be distinguished from ketones as they: change acidified potassium dichromate(VI) solution from orange to green; form a red precipitate when heated with Fehling's solution; form a silver mirror when heated with Tollens' reagent
4.8 Carboxylic acids	4.8.5	Reactions of carboxylic acids	with sodium carbonate – solid disappears, fizzing with sodium hydroxide solution the mixture warms up with aqueous ammonia – smell disappears
4.8 Carboxylic acids	4.8.6	Reactions of carboxylic acids	with alcohols – sweet smell detected with phosphorus pentachloride – solid disappears, steamy/misty fumes, mixture warms up
4.9 Derivatives of Carboxylic Acids	4.9.9	Acyl Chlorides	with water steamy/misty fumes, mixture warms up with alcohols same reaction with water but less vigourous
4.10 Aromatic Chemistry	4.10.5	Preparation of methyl-3-nitrobenzoate	product is a cream solid

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

Content	Paragraph	Observation	
5.3 Volumetric analysis	5.3.1	titrations	I_2 with $S_2O_3^{2-}$ using starch: add the thiosulphate solution until the solution is straw/yellow coloured and then add starch; turns from blue-black to colourless at endpoint
5.3 Volumetric analysis	5.3.2	titrations	Fe^{2+} with MnO_4^-: no indicator required as the acidified solution changes from colourless to pink
5.5 Transition metals	5.5.9	Ligand replacement reactions for hexaaquacopper(II) ions	with ammonia solution – blue precipitate forms. Upon addition of excess ammonia solution a dark blue/deep blue solution forms with concentrated HCl – blue solution changes to yellow
5.5 Transition metals	5.5.11	Recall the colour of the aqueous complexes of:	
		Cr^{3+}	green
		$Cr_2O_7^{2-}$	orange
		CrO_4^{2-}	yellow
		Mn^{2+}	pink
		Fe^{2+}	green
		Fe^{3+}	orange/yellow
		Co^{2+}	pink
		Ni^{2+}	green
		Cu^{2+}	blue
		V^{2+}	violet
		V^{3+}	green
		VO^{2+}	blue
		VO_2^+	yellow

Content	Paragraph	Observation	
5.5 Transition metals	5.5.12	Qualitative detection tests:	
		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 solution/ ammonia solution
		Fe^{2+}	green precipitate; insoluble in excess sodium hydroxide solution/ ammonia solution
		Fe^{3+}	brown precipitate; insoluble in excess sodium hydroxide solution/ammonia solution
		Co^{2+}	blue precipitate; insoluble in excess sodium hydroxide solution; soluble in excess ammonia solution forming a yellow solution which changes to brown on standing
		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 blue/deep blue solution
5.5 Transition metals	5.5.13	Colours of vanadium oxidation states	
		V^{2+}	violet
		V^{3+}	green
		VO^{2+}	blue
		VO_2^{+}	yellow
5.7 Amines	5.7.8	Coupling of phenol/phenylamine with benzenediazonium chloride	produces a yellow precipitate

Content	Paragraph	Observation	
5.9 Amino acids	5.9.5	Reactions of amino acids	with sodium carbonate – fizzing, solid disappears with copper(II) sulfate solution – solution turns dark blue with nitrous acid – bubbles given off
5.11 Medicinal Chemistry	5.11.7	Preparation of aspirin	product appears as white crystals

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