CHEMISTRY ONLINE
TUITION

Phone: +442081445350

www.chemistryonlinetuition.com

Email:asherrana@chemistryonlinetuition.com

CHEMISTRY

INORGANIC CHEMISTRY

Level & Board	AQA (A-LEVEL)
TOPIC:	GROUP 7 HALOGEN
PAPER TYPE:	SOLUTION - 2
TOTAL QUESTIONS	10
TOTAL MARKS	34

Group 7 the Halogens - 2

1. **B**

(1)

2.

(a)

Random movement of electrons in one molecule:

- The electrons within a chlorine molecule undergo random movement.

A (temporary) dipole is formed in one molecule / an imbalance in electron density in one molecule:

- Due to the random movement, a temporary dipole is created in one chlorine molecule, causing an imbalance in electron density.

Induces a dipole in a neighboring molecule:

- This temporary dipole induces a corresponding dipole in a nearby chlorine molecule.

Temporary dipoles attract / temporary attraction between δ+ and δ−:

- The temporary dipoles result in an attraction between the δ+ (positive end) of one molecule and the δ− (negative end) of the neighboring molecule.

So, the random movement of electrons leads to temporary dipoles, and the resulting attraction between the δ+ and δ− ends of neighboring molecules contributes to the overall weak intermolecular forces, specifically dispersion forces, in chlorine.

(3)

(b)

Equation:

$Cl_2 + H_2O \rightleftharpoons HCl + HClO$

Chlorine is added to drinking water because it kills bacteria / microbes so, it disinfect water.

(2)

(c)

Equation:

$Cl_2 + 2NaOH \rightarrow NaCl + NaClO + H_2O$

(1)

3. A

(1)

4.

(a)

The reaction of solid sodium bromide (NaBr) with concentrated sulfuric acid (H_2SO_4) to form bromine gas (Br_2) can be represented by the following chemical equation:

$2NaBr(s)+2H_2SO_4(conc) \rightarrow Br_2(g)+Na_2SO_4(aq)+H_2O+SO_2$

One observation during this reaction is the evolution of brown fumes, which indicates the formation of bromine gas. The brown color is characteristic of elemental bromine.

(2)

(b)

Dilute nitric acid is added to the solution:

HNO_3 removes (hydroxide/carbonate) ions that may give other ppts with $AgNO_3$:

Explanation: Dilute nitric acid is added to the solution to remove carbonate ions (CO_3^{2-}) that could form insoluble silver carbonate (Ag_2CO_3) upon the addition of silver nitrate.

Aqueous silver nitrate is added to the solution:

$AgNO_3$ produces ppts with chloride/iodide/halide

Explanation: Silver nitrate reacts with chloride, iodide, and other halide ions to form insoluble silver halide precipitates, such as AgCl and AgI.

$Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$

$Ag^+(aq) + I^-(aq) \rightarrow AgI(s)$

NH_3 dissolves AgCl (leaving yellow AgI):

Explanation: Excess dilute aqueous ammonia (NH_3) is added to dissolve the silver chloride ($AgCl$) precipitate, forming a soluble complex ($Ag(NH_3)_2^+$), while the yellow AgI precipitate remains.

Excess dilute aqueous ammonia is added to the mixture:

$AgCl(s) + 2NH_3(aq) \rightarrow Ag(NH_3)_2^+(aq) + Cl^-(aq)$

Explanation: This equation represents the reaction of silver chloride with excess ammonia, resulting in the formation of a soluble complex ion ($Ag(NH_3)_2^+$) and chloride ions.

(5)

5.

Reason for Water Treatment with Chlorine:

- Sterilize water / disinfect water or kill microbes.

Why Chlorine is Added to Water Despite its Toxicity:

- The health benefits of sterilizing water outweigh the risks. Chlorine is used only in small quantities or low concentrations.

Equation for the Reaction of Chlorine with Cold Water:

$Cl_2(g)+H_2O(l) \rightleftharpoons HCl(aq)+HClO(aq)$

This reversible equation represents the reaction of chlorine gas with cold water, forming hydrochloric acid (HCl) and hypochlorous acid ($HClO$). The hypochlorous acid acts as a disinfectant, providing health benefits in water treatment.

(3)

6. **B**

(1)

7.

Half-equation for the Conversion of Iodide ions to Iodine:

$2I^- \rightarrow I_2+2e^-$

Half-equation for the Conversion of Sulfuric Acid to Sulfur:

$H_2SO_4+6H^++6e^- \rightarrow S+4H_2O$

Overall Redox Reaction:

$6H^++6I^-+H_2SO_4 \rightarrow 3I_2+S+4H_2O$

Identified Sulfur-containing Reduction Product:

Sulfur (S_8) is formed as one of the reduction products when solid sodium iodide reacts with concentrated sulfuric acid.

(4)

8. D

(1)

9.

(a)

When silver nitrate solution is added to sodium fluoride the solution becomes Colourless i.e. no visible change.

$AgNO_3(aq)+NaF(aq)\rightarrow AgF(s)+NaNO_3(aq)$

(1)

(b)

Observation:

Misty or steamy or white fumes/gas are observed.

Equation for the Reaction:

$2NaCl(s)+H_2SO_4(conc)\rightarrow Na_2SO_4(aq)+2HCl(g)$

Role of Chloride Ions (Base or Proton Acceptor):

The chloride ions (Cl^-) from sodium chloride act as a base or proton acceptor. In the presence of concentrated sulfuric acid, chloride ions accept protons (H^+) to form hydrogen chloride gas (HCl). The overall reaction can be represented as:

$Cl^-(aq)+H^+(aq)\rightarrow HCl(g)$

(3)

(c)

Equation for the redox reaction between solid sodium bromide and concentrated sulfuric acid

$2NaBr + 2H_2SO_4 \rightarrow Na_2SO_4 + Br_2 + SO_2 + 2H_2O$

This is a redox reactionas:
Br changes oxidation state from −1 NaBr to 0 (Br_2)and is oxidised
S changes oxidation state from +6 (H_2SO_4) to +4 (SO_2) and is reduced

(3)

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(d)

Observation:

A yellow / orange solution is observed.

Ionic Equation for the Reaction:

$Cl_2(aq)+2Br^-(aq)\rightarrow 2Cl^-(aq)+Br_2(aq)$

(2)

10. C

(1)

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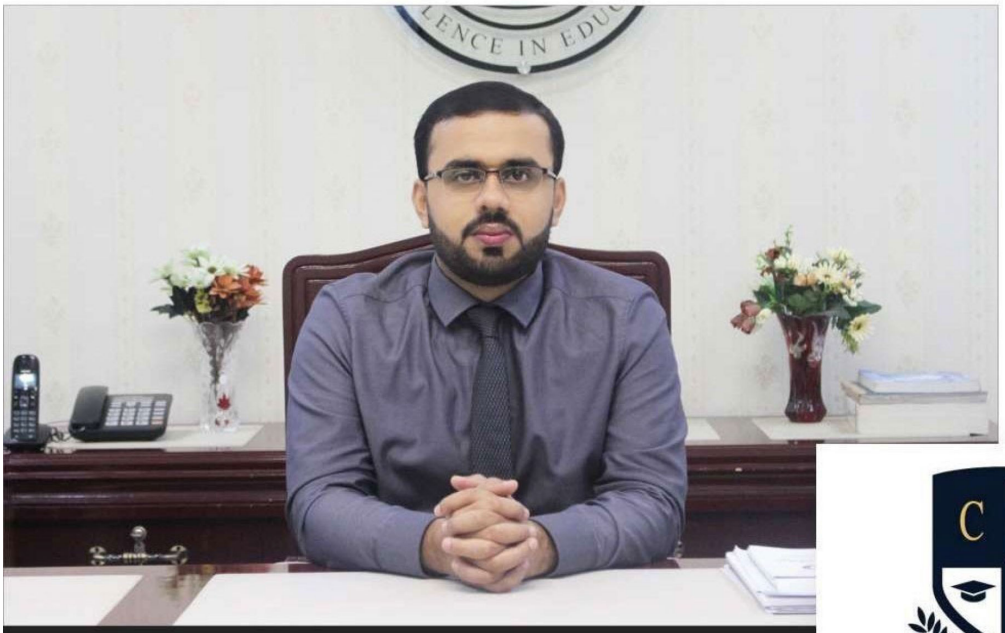

DR. ASHAR RANA

M.B.B.S / MS. CHEMISTRY

CHEMISTRY ONLINE TUITION

Phone: +442081445350
www.chemistryonlinetuition.com
Email: asherrana@chemistryonlinetuition.com

- Founder & CEO of Chemistry Online Tuition Ltd.
- Completed Medicine (M.B.B.S) in 2007
- Tutoring students in UK and worldwide since 2008
- CIE & EDEXCEL Examiner since 2015
- Chemistry, Physics, Math's and Biology Tutor

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CONTACT INFORMATION FOR
CHEMISTRY ONLINE TUITION

- UK Contact: 02081445350
- International Phone/WhatsApp: 00442081445350
- Website: www.chemistryonlinetuition.com
- Email: asherrana@chemistryonlinetuition.com

Address: 210-Old Brompton Road, London SW5 OBS, UK