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Cambridge AS & A Level

CHEMISTRY

Paper 1

Topical Past Paper Questions

+ Answer Scheme

2015 - 2021

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Chapter 11

Group 17

11.1 Physical properties of the Group 17 elements

610. 9701_s21_qp_13 Q: 15

When descending Group 17 from chlorine to iodine, which statement is correct?

A The hydrides become less thermally stable as they become weaker reducing agents.

B The hydrides become more thermally stable as the reactivity of the elements decreases.

C The volatility of the elements decreases as the van der Waals' forces increase.

D The volatility of the elements increases as the size of the molecules increases.

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611. 9701_s20_qp_12 Q: 7

When aqueous bromine is shaken with cyclohexane and allowed to stand, two layers form. The top cyclohexane layer is coloured and the bottom aqueous layer is almost colourless.

What is the most likely explanation for this observation?

A Bromine is reduced to bromide ions in the bottom layer.

B Bromine molecules are non-polar.

C Bromine reacts with water but cannot react with cyclohexane.

D The product of the reaction between bromine and cyclohexane is coloured.

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612. 9701_s20_qp_12 Q: 14

Which statement explains why iodine is less volatile than chlorine?

A Chlorine is more electronegative than iodine and so has more repulsion between its molecules.

B The greater number of electrons in iodine leads to larger temporary dipole-induced dipole forces.

C The I–I bond energy is smaller than the Cl–Cl bond energy.

D The iodine molecules have stronger permanent dipole-permanent dipole forces.

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613. 9701_s20_qp_13 Q: 13

Which property explains the trend in volatility of the elements going down Group 17?

A decreasing covalent bond strength

B decreasing van der Waals' forces

C increasing covalent bond strength

D increasing van der Waals' forces

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614. 9701_m19_qp_12 Q: 18

Under standard conditions, which statement is correct?

A Cl_2(aq) can oxidise Br^-(aq).

B Cl_2(aq) can reduce Br^-(aq).

C Cl^-(aq) can oxidise Br_2(aq).

D Cl^-(aq) can reduce Br_2(aq).

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615. 9701_w19_qp_11 Q: 16

Chlorine and bromine have different volatilities.

Which row identifies the more volatile of the two elements, and gives the correct explanation?

	identity of the more volatile element	explanation for the difference in volatility
A	bromine	instantaneous dipole-induced dipole forces are greater in bromine than they are in chlorine
B	bromine	instantaneous dipole-induced dipole forces are greater in chlorine than they are in bromine
C	chlorine	instantaneous dipole-induced dipole forces are greater in bromine than they are in chlorine
D	chlorine	instantaneous dipole-induced dipole forces are greater in chlorine than they are in bromine

---

616. 9701_s18_qp_12 Q: 14

In this question, X represents an atom of chlorine, bromine or iodine.

Which explanation for the variation in volatility down Group 17 is correct?

A Instantaneous dipole-induced dipole forces between molecules become stronger.

B Permanent dipole-permanent dipole forces between molecules become stronger.

C The bond energy of the X_2 molecules decreases.

D The first ionisation energy $X(g) \rightarrow X^+(g) + e^-$ decreases.

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617. 9701_w18_qp_11 Q: 16

Which row correctly describes the properties of the halogens as Group 17 is descended from chlorine to iodine?

	volatility	strength as oxidising agent
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

---

618. 9701_s17_qp_11 Q: 19

Redox reactions are common in the chemistry of Group 17.

Which statement is correct?

A Br^- ions will reduce Cl_2 but not I_2.

B Cl_2 will oxidise Br^- ions but not I^- ions.

C F_2 is the weakest oxidising agent out of F_2, Cl_2, Br_2 and I_2.

D I^- ions are the weakest reducing agent out of F^-, Cl^-, Br^- and I^-.

---

619. 9701_w17_qp_11 Q: 19

The strengths of the covalent bonds within halogen molecules, and the van der Waals' forces between halogen molecules, vary going down Group 17 from chlorine to bromine to iodine.

Which row shows these correctly?

	strength of covalent bonds	strength of van der Waals' forces
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

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620. 9701_s16_qp_12 Q: 19

Fluorine and iodine are Group 17 elements. Their melting points are different due to differing strengths of van der Waals' forces between molecules.

Which row is correct?

	melting point	strength of van der Waals' forces between molecules
A	$F_2 > I_2$	$F_2 > I_2$
B	$F_2 > I_2$	$F_2 < I_2$
C	$F_2 < I_2$	$F_2 < I_2$
D	$F_2 < I_2$	$F_2 > I_2$

---

621. 9701_w15_qp_11 Q: 17

Which statement about bromine is correct?

A Bromine is insoluble in non-polar solvents.

B Bromine vapour is more dense than air.

C Bromine will not vaporise significantly under normal conditions.

D Gaseous bromine is purple.

---

622. 9701_w15_qp_12 Q: 17

A student observed the reactions when sodium chloride and sodium iodide were each reacted separately with concentrated sulfuric acid and with concentrated phosphoric acid. Some observations are recorded in the table.

	sodium chloride	sodium iodide
conc. H_2SO_4	colourless acidic gas formed	purple vapour formed
conc. H_3PO_4	colourless acidic gas formed	colourless acidic gas formed

Which deduction can be made from these observations?

A Concentrated phosphoric acid is a stronger oxidising agent than concentrated sulfuric acid.

B Concentrated phosphoric acid is a stronger oxidising agent than iodine.

C Concentrated sulfuric acid is a stronger oxidising agent than chlorine.

D Concentrated sulfuric acid is a stronger oxidising agent than iodine.

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11.2 The chemical properties of the halogen elements and the hydrogen halides

623. 9701_m22_qp_12 Q: 6

The boiling points of some hydrogen halides are shown.

hydrogen halide	boiling point / K
H–C*l*	188
H–Br	206
H–I	238

What is the explanation for the trend in boiling point for the hydrogen halides from HC*l* to HI?

A The bond energies of the hydrogen halides increase from HC*l* to HI.

B There is an increase in the strength of the intermolecular forces of attraction from HC*l* to HI.

C The intermolecular hydrogen bonds become stronger from HC*l* to HI.

D There is an increase in the bond polarity from HC*l* to HI.

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624. 9701_s20_qp_12 Q: 18

A test-tube of HBr(g) and a separate test-tube of HI(g) are heated to the same temperature.

Which combination of observations is possible?

	test-tube of HBr(g)	test-tube of HI(g)
A	a brown vapour appears	no change
B	a purple vapour appears	no change
C	no change	a brown vapour appears
D	no change	a purple vapour appears

---

625. 9701_w19_qp_12 Q: 16

The properties of chlorine, bromine and their compounds are compared.

Which property is **smaller** for chlorine than for bromine?

A bond strength of the hydrogen-halide bond

B first ionisation energy

C solubility of the silver halide in NH_3(aq)

D strength of the van der Waals' forces between molecules of the element

---

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626. 9701_s17_qp_13 Q: 17

A test-tube of HBr(g) and a separate test-tube of HI(g) are heated to the same temperature.

Which combination of observations is possible?

	test-tube of HBr(g)	test-tube of HI(g)
A	a brown vapour appears	no change
B	a purple vapour appears	no change
C	no change	a brown vapour appears
D	no change	a purple vapour appears

---

627. 9701_m16_qp_12 Q: 16

Hydrogen chloride gas and hydrogen iodide gas have different thermal stabilities. The difference is due to a difference in the energies of some of the covalent bonds that are involved in the decomposition.

Which row identifies the more stable of the two compounds, and gives the correct explanation?

	identity of the more thermally stable compound	explanation for the difference in stability
A	hydrogen chloride	the C*l*–C*l* bond is stronger than the I–I bond
B	hydrogen chloride	the H–C*l* bond is stronger than the H–I bond
C	hydrogen iodide	the C*l*–C*l* bond is stronger than the I–I bond
D	hydrogen iodide	the H–C*l* bond is stronger than the H–I bond

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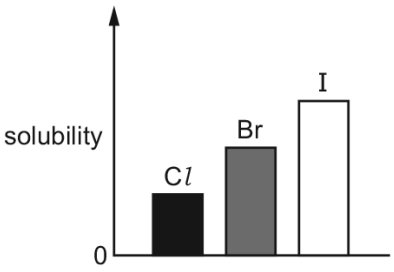
628. 9701_s16_qp_13 Q: 17

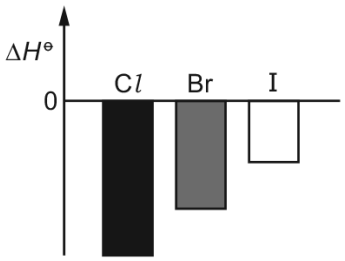
Two students, P and Q, were asked to draw bar charts to represent how some properties of the halogens and their compounds differ in magnitude. Their diagrams are shown. The bar charts show trends only and not actual values.

student P



solubility of AgX(s) in NH_3(aq)

student Q



$\Delta H^{\ominus}$ for $H_2(g) + X_2(g) \rightarrow 2HX(g)$

Which of the students have drawn bar charts which show the trends correctly?

A both P and Q

B P only

C Q only

D neither P nor Q

---

629. 9701_s16_qp_13 Q: 18

In a series of nine experiments to test the reactivity of the halogens, an aqueous solution of each halogen was added to an equal volume of an aqueous solution containing halide ions as shown in the table below.

solution	sodium chloride (aq)	sodium bromide (aq)	sodium iodide (aq)
chlorine (aq)	experiment 1	experiment 2	experiment 3
bromine (aq)	experiment 4	experiment 5	experiment 6
iodine (aq)	experiment 7	experiment 8	experiment 9

The nine resulting mixtures were then shaken with hexane. The nine tubes were corked and left to stand so that the aqueous and organic solvents could separate into layers.

How many test-tubes contained a purple upper layer?

A 1 **B** 2 **C** 3 **D** 5

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630. 9701_w16_qp_11 Q: 19

X, Y and Z represent different halogens. The table shows the results of nine experiments in which aqueous solutions of X_2, Y_2 and Z_2 were separately added to separate aqueous solutions containing X^-, Y^- and Z^- ions.

	$X^-(aq)$	$Y^-(aq)$	$Z^-(aq)$
$X_2(aq)$	no reaction	no reaction	no reaction
$Y_2(aq)$	X_2 formed	no reaction	Z_2 formed
$Z_2(aq)$	X_2 formed	no reaction	no reaction

Which row of the following table contains the ions X^-, Y^- and Z^- in order of their **decreasing** strength as reducing agents?

	strongest ⟶		weakest
A	X^-	Y^-	Z^-
B	X^-	Z^-	Y^-
C	Y^-	Z^-	X^-
D	Z^-	X^-	Y^-

11.3 Some reactions of the halide ions

631. 9701_m22_qp_12 Q: 11

Hydrogen peroxide, H_2O_2, decomposes to form water and oxygen.

The reaction is catalysed by bromide ions.

step 1 $2Br^-(aq) + H_2O_2(aq) + 2H^+(aq) \rightarrow 2H_2O(l) + Br_2(aq)$

step 2 $H_2O_2(aq) + Br_2(aq) \rightarrow 2Br^-(aq) + 2H^+(aq) + O_2(g)$

Which row is correct?

	type of catalyst	in step 1
A	heterogeneous	bromide ions are oxidised
B	heterogeneous	bromide ions are reduced
C	homogeneous	bromide ions are oxidised
D	homogeneous	bromide ions are reduced

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632. 9701_m22_qp_12 Q: 22

Which statement relating to the elements in Group 17 and their compounds is correct?

A Bromine will reduce KI to form iodine.

B Iodide ions react to form a white precipitate when added to silver nitrate solution.

C Bromide ions react to form a white precipitate when added to silver nitrate solution.

D Chlorine reacts with hydrogen to form a colourless gas.

---

633. 9701_m21_qp_12 Q: 17

When concentrated sulfuric acid reacts with sodium iodide the products include sulfur, iodine, hydrogen sulfide and sulfur dioxide.

Which statement is correct?

A Hydrogen sulfide is the product of a reduction reaction.

B Iodide ions are stronger oxidising agents than sulfate ions.

C Sulfur atoms from the sulfuric acid are both oxidised and reduced.

D Sulfur atoms from the sulfuric acid are oxidised to make sulfur dioxide.

---

634. 9701_s21_qp_11 Q: 16

A 5 cm^3 sample of 0.05 mol dm^{-3} sodium chloride is mixed with a 5 cm^3 sample of 0.05 mol dm^{-3} potassium iodide. 10 cm^3 of acidified 0.05 mol dm^{-3} silver nitrate is then added, followed by concentrated ammonia solution.

What is seen after the addition of an excess of concentrated ammonia solution?

A a cream precipitate

B a white precipitate

C a yellow precipitate

D no precipitate

---

635. 9701_s21_qp_12 Q: 16

Which row gives mixtures that **both** result in the oxidation of a halide ion?

	mixture 1	mixture 2
A	$AgNO_3$(aq) and NaCl(aq)	concentrated H_2SO_4(aq) and HI(aq)
B	Br_2(aq) and NaCl(aq)	concentrated H_2SO_4(aq) and HCl(aq)
C	Cl_2(aq) and NaBr(aq)	$CH_3CHBrCH_3$(l) + NaOH (ethanolic)
D	Br_2(aq) and NaI(aq)	concentrated H_2SO_4(aq) and NaBr(s)

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636. 9701_s21_qp_13 Q: 16

A powder is known to be either a single sodium halide or a mixture of two sodium halides. A sample of the powder was dissolved in water.

Aqueous silver nitrate was added, and a pale yellow precipitate was formed. When concentrated aqueous ammonia was then added, this precipitate partly dissolved leaving a darker yellow precipitate.

What could the powder be?

A sodium bromide only

B sodium iodide only

C a mixture of sodium chloride and sodium bromide

D a mixture of sodium chloride and sodium iodide

---

637. 9701_w21_qp_11 Q: 16

In a series of nine experiments, to test the reactivity of the halogens, an aqueous solution of each halogen is added to an equal volume of an aqueous solution containing halide ions, as shown in the table.

halogen solution	halide solution		
	sodium chloride (aq)	sodium bromide (aq)	sodium iodide (aq)
chlorine (aq)	experiment 1	experiment 2	experiment 3
bromine (aq)	experiment 4	experiment 5	experiment 6
iodine (aq)	experiment 7	experiment 8	experiment 9

The nine resulting mixtures are then shaken separately with an equal volume of hexane. The nine tubes are left to stand so that the aqueous and organic solvents separate into layers.

How many test-tubes contain a purple upper hexane layer?

A 1 **B** 2 **C** 3 **D** 5

---

638. 9701_w21_qp_12 Q: 15

Redox reactions are common in the chemistry of Group 17 elements.

Which statement is correct?

A Br^- ions will reduce Cl_2 but not I_2.

B Cl_2 will oxidise Br^- ions but not I^- ions.

C F_2 is the weakest oxidising agent out of F_2, Cl_2, Br_2 and I_2.

D I^- ions are the weakest reducing agent out of F^-, Cl^-, Br^- and I^-.

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639. 9701_w21_qp_12 Q: 16

Silver chloride and silver iodide form equilibria when added to water.

$$AgCl(s) \rightleftharpoons Ag^+(aq) + Cl^-(aq) \qquad K_c = K_1$$

$$AgI(s) \rightleftharpoons Ag^+(aq) + I^-(aq) \qquad K_c = K_2$$

Each equilibrium position lies well to the **left**.

Silver iodide will not dissolve in aqueous ammonia. Silver chloride will dissolve in aqueous ammonia. Another equilibrium is formed.

$$Ag^+(aq) + 2NH_3(aq) \rightleftharpoons Ag(NH_3)_2^+(aq) \qquad K_c = K_3$$

The position of this equilibrium lies to the **right**.

What is the order of magnitude for these three equilibrium constants?

	smallest ⟶		largest
A	K_3	K_2	K_1
B	K_3	K_1	K_2
C	K_2	K_1	K_3
D	K_1	K_2	K_3

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640. 9701_w21_qp_12 Q: 17

X is the ion of a metal which burns with a red flame.

Y is an ion that reacts with concentrated H_2SO_4 to produce H_2S.

What could be the formula of a compound containing X and Y?

A $BaBr_2$ **B** BaI_2 **C** $SrBr_2$ **D** SrI_2

---

641. 9701_w21_qp_13 Q: 18

Which row is correct?

	shape		bonds present	
	ammonia molecule	ammonium ion	ammonia molecule	ammonium ion
A	pyramidal	regular tetrahedral	σ	σ
B	pyramidal	regular tetrahedral	σ	π
C	regular tetrahedral	pyramidal	σ	σ
D	regular tetrahedral	pyramidal	π	σ

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642. 9701_m20_qp_12 Q: 18

How does concentrated sulfuric acid behave when it reacts with sodium chloride?

A as an acid only

B as an acid and oxidising agent

C as an oxidising agent only

D as a reducing agent only

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643. 9701_s20_qp_11 Q: 12

A white powder is a mixture of sodium chloride and sodium iodide. It is dissolved in water in a test-tube. An excess of aqueous silver nitrate is added to the test-tube. A precipitate, X, is observed.

An excess of concentrated ammonia is then added to the test-tube containing X. After the test-tube has been shaken, a precipitate, Y, is observed.

Which statement about X or Y is correct?

A X is a pure white colour.

B X is pure silver iodide.

C Y is pure silver chloride.

D Y is yellow.

---

644. 9701_s20_qp_11 Q: 18

Astatine, At, is below iodine in Group 17 of the Periodic Table.

Which statement is most likely to be correct?

A AgAt(s) reacts with an excess of dilute aqueous ammonia to form a solution of a soluble complex.

B Astatine and KCl(aq) react to form KAt(aq) and chlorine.

C KAt(aq) and dilute sulfuric acid react to form HAt(g).

D NaAt(s) and concentrated sulfuric acid react to form astatine.

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645. 9701_s20_qp_13 Q: 17

The addition of aqueous silver nitrate to aqueous barium chloride produces a white precipitate which dissolves in an excess of dilute aqueous ammonia to form a colourless solution.

The addition of an excess of dilute nitric acid to the colourless solution produces a white precipitate, Z.

What is Z?

A AgCl **B** BaCl_2 **C** $Ba(NO_3)_2$ **D** NH_4NO_3

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646. 9701_w20_qp_11 Q: 16

With which compound does concentrated sulfuric acid react **both** as a strong acid **and** as an oxidising agent?

A magnesium carbonate

B potassium chloride

C sodium bromide

D sulfur trioxide

---

647. 9701_m19_qp_12 Q: 17

The table shows some reactions of a white compound, G.

test	observation
silver nitrate is added to a solution of G followed by aqueous ammonia	a precipitate is formed which does not dissolve when the ammonia is added
solid G is warmed with concentrated sulfuric acid	a mixture of gases is formed including hydrogen sulfide

What could be the identity of G?

A caesium chloride

B lithium bromide

C potassium sulfate

D sodium iodide

---

648. 9701_s19_qp_11 Q: 16

Concentrated sulfuric acid is added to separate solid samples of sodium chloride, sodium bromide and sodium iodide.

With which samples does sulfuric acid act as an oxidising agent?

A sodium chloride only

B sodium chloride and sodium bromide

C sodium bromide and sodium iodide

D sodium iodide only

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649. 9701_s19_qp_13 Q: 16

The solids sodium chloride and sodium iodide both react with concentrated sulfuric acid at room temperature.

With NaCl, the products are $NaHSO_4$ and HCl.
With NaI, the products are $NaHSO_4$, HI, I_2, SO_2, H_2O, S and H_2S.

What is the explanation for this difference in products?

A Chloride ions will displace iodine from solution.

B Hydrogen chloride is more volatile than hydrogen iodide.

C Iodide ions are better reducing agents than chloride ions.

D Sulfuric acid is able to act as a dehydrating agent with NaI.

---

650. 9701_s19_qp_13 Q: 17

An aqueous solution of a calcium compound is treated with a mixture of dilute aqueous nitric acid and aqueous silver nitrate. The resulting white precipitate dissolves when dilute aqueous ammonia is added.

What is the relative molecular mass, M_r, of the calcium compound?

A 54.0 **B** 75.6 **C** 111.1 **D** 199.9

---

651. 9701_w19_qp_11 Q: 17

Sodium azide, NaN_3, is dissolved in water. Acidified silver nitrate is added to the solution and a white precipitate forms. Aqueous ammonia is then added to the white precipitate.

The azide ion, N_3^-, has similar chemical properties to the Cl^- ion.

Which row of the table can be predicted from this information?

	formula of white precipitate	observation on adding aqueous ammonia
A	AgN_3	colourless solution formed
B	AgN_3	precipitate remains
C	Ag_3N	colourless solution formed
D	Ag_3N	precipitate remains

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652. 9701_w19_qp_12 Q: 17

Solid sodium iodide reacts with concentrated sulfuric acid to form more than one product that contains sulfur.

What is the lowest oxidation number of sulfur in these products?

A –2 **B** 0 **C** +4 **D** +6

---

653. 9701_s18_qp_11 Q: 16

Aqueous silver nitrate is added to a solution of potassium iodide.

Aqueous ammonia is then added.

What would be observed?

A a cream precipitate that dissolves on addition of aqueous ammonia

B a cream precipitate that does not dissolve on addition of aqueous ammonia

C a yellow precipitate that dissolves on addition of aqueous ammonia

D a yellow precipitate that does not dissolve on addition of aqueous ammonia

---

654. 9701_s18_qp_12 Q: 17

When concentrated sulfuric acid is added to solid sodium bromide, bromine gas is produced, along with a number of other products. However when concentrated sulfuric acid is added to solid sodium chloride **only** hydrogen chloride and sodium hydrogensulfate are produced.

What is the reason for this difference?

A Bromine is less volatile than chlorine.

B Hydrochloric acid is a weak acid.

C Sulfuric acid is not an oxidising agent.

D The bromide ion is a stronger reducing agent than the chloride ion.

---

655. 9701_s18_qp_13 Q: 16

When concentrated sulfuric acid is added to solid sodium chloride, HCl is formed but not Cl_2.

When concentrated sulfuric acid is added to solid sodium iodide, I_2 is formed.

Which statement explains these observations?

A Sulfuric acid is an oxidising agent and chloride ions are more easily oxidised.

B Sulfuric acid is an oxidising agent and iodide ions are more easily oxidised.

C Sulfuric acid is a reducing agent and chloride ions are more easily reduced.

D Sulfuric acid is a reducing agent and iodide ions are more easily reduced.

---

656. 9701_w18_qp_12 Q: 16

Which statement about the halogens is correct?

A Iodine cannot behave as an oxidising agent.

B The volatility of the elements increases from chlorine to iodine because of the increase in molecular size down the group.

C When an equimolar mixture of chlorine and hydrogen is exploded, only one product is formed.

D When concentrated sulfuric acid is added to solid sodium bromide, hydrogen sulfide is one of the products.

---

657. 9701_s17_qp_11 Q: 17

When concentrated sulfuric acid reacts with sodium iodide the products include sulfur, iodine, hydrogen sulfide and sulfur dioxide.

Which statement is correct?

A Hydrogen sulfide is the product of a reduction reaction.

B Iodide ions are stronger oxidising agents than sulfate ions.

C Sulfur atoms from the sulfuric acid are both oxidised and reduced.

D Sulfur atoms from the sulfuric acid are oxidised to make sulfur dioxide.

---

658. 9701_s17_qp_12 Q: 17

A powder is known to be either a single sodium halide or a mixture of two sodium halides. A sample of the powder was dissolved in water.

Aqueous silver nitrate was added, and a pale yellow precipitate was formed. When concentrated aqueous ammonia was then added, this precipitate partly dissolved leaving a darker yellow precipitate.

What might the powder be?

A sodium bromide only

B sodium iodide only

C a mixture of sodium chloride and sodium bromide

D a mixture of sodium chloride and sodium iodide

---

659. 9701_w17_qp_11 Q: 18

Compound Q is a white crystalline solid which dissolves easily in water. When concentrated sulfuric acid is added to a dry sample of Q steamy white fumes are formed which, when passed through aqueous silver nitrate solution, form a white precipitate. This precipitate is soluble in dilute ammonia solution.

What could be the identity of compound Q?

A AgCl **B** NaBr **C** NaCl **D** $PbBr_2$

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660. 9701_w17_qp_12 Q: 17

Sodium bromide reacts with concentrated sulfuric acid.

Which observation will be made?

A A coloured vapour is produced.

B A purple solid is formed.

C A strong smell of H_2S is detected.

D Yellow sulfur is formed.

---

661. 9701_s16_qp_11 Q: 15

The solids sodium chloride and sodium iodide both react with concentrated sulfuric acid at room temperature.

With NaCl, the products are $NaHSO_4$ and HCl.
With NaI, the products are $NaHSO_4$, HI, I_2, SO_2, H_2O, S and H_2S.

What is the best explanation for this difference in products?

A Chloride ions will displace iodine from solution.

B Hydrogen chloride is more volatile than hydrogen iodide.

C Iodide ions are better reducing agents than chloride ions.

D Sulfuric acid is able to act as a dehydrating agent with NaI.

---

662. 9701_w16_qp_11 Q: 14

The properties of chlorine, bromine and their compounds are compared.

Which property is **smaller** for chlorine than for bromine?

A bond strength of the hydrogen-halide bond

B first ionisation energy

C solubility of the silver halide in NH_3(aq)

D strength of the van der Waals' forces between molecules of the element

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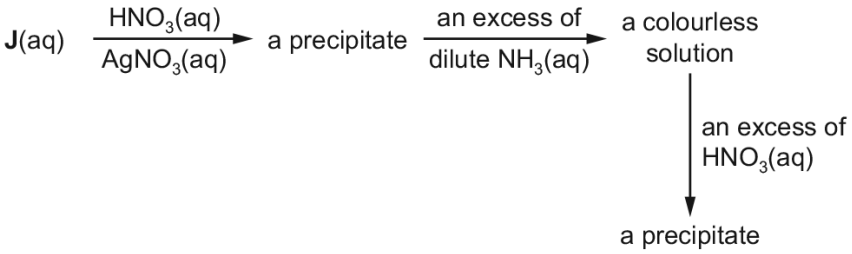
663. 9701_w16_qp_12 Q: 16

J is a salt of one of the halogens chlorine, bromine, iodine or astatine.

The reaction scheme shows a series of reactions using a solution of **J** as the starting reagent.



What could **J** be?

A sodium chloride

B sodium bromide

C potassium iodide

D potassium astatide

---

664. 9701_s15_qp_11 Q: 17

Astatine, At, is below iodine in Group VII of the Periodic Table.

Which statement is most likely to be correct?

A AgAt(s) reacts with excess dilute aqueous ammonia to form a solution of a soluble complex.

B Astatine and KC*l*(aq) react to form KAt(aq) and chlorine.

C KAt(aq) and dilute sulfuric acid react to form white fumes of HAt(g).

D NaAt(s) and concentrated sulfuric acid react to form astatine.

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665. 9701_s15_qp_13 Q: 19

Two separate tests were carried out on an aqueous solution of a salt which contains only two ions.

In each test, the resulting mixtures were filtered and the filtrate solution was collected.

	reagent	result	filtrate collected
test 1	aqueous silver nitrate acidified with dilute nitric acid	yellow precipitate forms	solution P
test 2	dilute sulfuric acid	white precipitate forms	solution Q

Which ions are present in the filtrates?

	solution P	solution Q
A	$Ba^{2+}(aq)$	$Cl^{-}(aq)$
B	$Ba^{2+}(aq)$	$I^{-}(aq)$
C	$Mg^{2+}(aq)$	$Cl^{-}(aq)$
D	$Mg^{2+}(aq)$	$I^{-}(aq)$

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666. 9701_w15_qp_11 Q: 18

The addition of aqueous silver nitrate to aqueous barium chloride produces a white precipitate which dissolves in excess dilute aqueous ammonia to form a colourless solution.

The addition of excess dilute nitric acid to the colourless solution produces a white precipitate, **Z**.

What is **Z**?

A $AgCl$ **B** $BaCl_2$ **C** $Ba(NO_3)_2$ **D** NH_4NO_3

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667. 9701_w15_qp_12 Q: 18

A white powder is a mixture of sodium chloride and sodium iodide. It is dissolved in water in a test-tube. Excess aqueous silver nitrate is added to the test-tube. A precipitate, X, is observed.

Excess concentrated ammonia is then added to the test-tube containing X. After the test-tube has been shaken, a precipitate, Y, is observed.

Which statement about X or Y is correct?

A X is a pure white colour.

B X is pure silver iodide.

C Y is pure silver chloride.

D Y is yellow.

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11.4 The reactions of chlorine

668. 9701_m22_qp_12 Q: 23

An excess of chlorine was bubbled into 100 cm^3 of hot 6.0 mol dm^{-3} sodium hydroxide.

How many moles of sodium chloride would be produced in the reaction?

A 0.30 **B** 0.50 **C** 0.60 **D** 0.72

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669. 9701_m21_qp_12 Q: 16

Chlorine gas is reacted with aqueous sodium hydroxide. The oxidation number of chlorine changes from 0 to –1 and also from 0 to +1.

Under which conditions does this reaction occur and what is the colour of the solid silver salt with chlorine in the oxidation state –1?

	reaction conditions	colour of silver salt
A	cold, dilute alkali	white
B	cold, dilute alkali	yellow
C	hot, concentrated alkali	white
D	hot, concentrated alkali	yellow

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670. 9701_s21_qp_12 Q: 17

Chlorine gas is widely used to treat contaminated water.

When chlorine is added to water, which chemical species present is responsible for killing bacteria?

A ClO_2^- **B** Cl^- **C** HCl **D** ClO^-

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671. 9701_w21_qp_11 Q: 17

Z is a compound of sodium, chlorine and oxygen.

It contains 45.1% by mass of oxygen.

Z is prepared by reacting sodium hydroxide with chlorine.

Which row shows the conditions used for the reaction and the oxidation state of chlorine in Z?

	reaction conditions	oxidation state of Cl in Z
A	cold dilute NaOH	+1
B	cold dilute NaOH	+5
C	hot concentrated NaOH	+1
D	hot concentrated NaOH	+5

672. 9701_m20_qp_12 Q: 14

Hot aqueous sodium hydroxide reacts with chlorine.

$$6NaOH(aq) + 3Cl_2(g) \rightarrow 5NaCl(aq) + NaClO_3(aq) + 3H_2O(l)$$

Which statement is correct?

A The oxidation numbers of chlorine and hydrogen both change in the reaction.

B The oxidation numbers of chlorine in the products are –1 and +1.

C If the aqueous sodium hydroxide is cold the reaction produces NaClO instead of NaClO$_3$.

D Sodium undergoes disproportionation in this reaction.

673. 9701_w20_qp_12 Q: 17

Which statement about Group 17 elements and their compounds is correct?

A Chlorine reacts with cold concentrated sodium hydroxide to form NaCl and NaClO$_3$.

B HCl is more thermally stable than HBr because chlorine is less electronegative than bromine.

C Iodide ions are oxidised to iodine by concentrated sulfuric acid.

D Silver iodide is soluble in dilute aqueous ammonia.

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674. 9701_s19_qp_11 Q: 17

The reaction of bromine with warm NaOH(aq) produces products with the same oxidation numbers, in the same ratios, as the reaction of chlorine with hot NaOH(aq).

In one reaction between bromine and warm NaOH(aq), 30.2 g of a product containing sodium, bromine and oxygen is produced.

Which mass of NaOH has reacted?

A 8.00 g **B** 10.2 g **C** 20.3 g **D** 48.0 g

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675. 9701_s19_qp_12 Q: 17

An excess of chlorine was bubbled into 100 cm^3 of hot 6.0 mol dm^{-3} sodium hydroxide.

How many moles of sodium chloride would be produced in the reaction?

A 0.3 **B** 0.5 **C** 0.6 **D** 1.2

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676. 9701_m18_qp_12 Q: 24

Structural isomerism and stereoisomerism should be considered when answering this question.

The molecular formula of compound X is $C_5H_{12}O$.

Compound X:

- reacts with alkaline aqueous iodine
- can be dehydrated to form two alkenes only.

What could be the identity of compound X?

A $CH_3CH_2CH(CH_3)CH_2OH$

B $CH_3CH_2CH(OH)CH_2CH_3$

C $(CH_3)_2CHCH(OH)CH_3$

D $CH_3CH_2CH_2CH(OH)CH_3$

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677. 9701_s18_qp_11 Q: 14

Chlorine reacts with **cold** aqueous sodium hydroxide to produce sodium chloride, water and compound X.

Chlorine reacts with **hot** aqueous sodium hydroxide to produce sodium chloride, water and compound Y.

What are the oxidation states of chlorine in compound X and compound Y?

	X	Y
A	–1	–5
B	–1	+5
C	+1	–5
D	+1	+5

---

678. 9701_w18_qp_11 Q: 17

Reaction 1: chlorine reacts with cold aqueous sodium hydroxide to form solution Z.

Reaction 2: solution Z is heated and forms ClO_3^-(aq) and Cl^-(aq).

Which equations represent reaction 1 and reaction 2?

A reaction 1 $2Cl_2 + 4OH^- \rightarrow ClO_2^- + 3Cl^- + 2H_2O$
reaction 2 $3ClO_2^- \rightarrow 2ClO_3^- + Cl^-$

B reaction 1 $2Cl_2 + 4OH^- \rightarrow ClO_2^- + 3Cl^- + 2H_2O$
reaction 2 $3ClO^- \rightarrow ClO_3^- + 2Cl^-$

C reaction 1 $Cl_2 + 2OH^- \rightarrow ClO^- + Cl^- + H_2O$
reaction 2 $2ClO^- + 2OH^- \rightarrow ClO_3^- + Cl^- + H_2O$

D reaction 1 $Cl_2 + 2OH^- \rightarrow ClO^- + Cl^- + H_2O$
reaction 2 $3ClO^- \rightarrow ClO_3^- + 2Cl^-$

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679. 9701_w18_qp_12 Q: 17

Chlorine reacts with both hot and cold sodium hydroxide to form products containing chlorine.

Cold sodium hydroxide forms sodium chlorate(X) and hot sodium hydroxide forms sodium chlorate(Y). X and Y are oxidation numbers.

Which equation is correct?

A Y = X – 6 **B** Y = X – 4 **C** Y = X + 4 **D** Y = X + 6

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680. 9701_m17_qp_12 Q: 16

Some uses of chlorine and bromine are given.

Which is a use of bromine?

A making bleaches for textiles and the paper industry

B making CFCs

C making flame retardants and fire extinguishers

D making the polymer PVC

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681. 9701_m17_qp_12 Q: 17

In an experiment, 0.600 mol of chlorine gas, Cl_2, is reacted with an excess of hot aqueous sodium hydroxide. One of the products is $NaClO_3$.

Which mass of $NaClO_3$ is formed?

A 21.3 g **B** 44.7 g **C** 63.9 g **D** 128 g

---

682. 9701_s17_qp_11 Q: 18

A solution of sodium hydroxide reacts with 3 mol of chlorine under certain conditions. The reaction produces 5 mol of sodium chloride and 1 mol of **X**, the only other chlorine-containing product.

What is the formula of compound **X**?

A $NaClO$ **B** $NaClO_2$ **C** $NaClO_3$ **D** $NaClO_4$

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683. 9701_s17_qp_12 Q: 16

Element X reacts with cold, dilute, aqueous sodium hydroxide to form two different chlorine-containing products, Y and Z.

What are the oxidation states of chlorine in Y and Z?

	Y	Z
A	0	+1
B	0	+5
C	–1	+1
D	–1	+5

---

684. 9701_s17_qp_13 Q: 16

Chlorine gas is added to cold, aqueous sodium hydroxide.

In a separate experiment, chlorine gas is added to hot, aqueous sodium hydroxide.

Which oxidation states of chlorine are found in the reactants and products of the two reactions that take place?

A 0, –1, +1 and +5

B 0, –1 and +1 only

C 0, –1 and +5 only

D 0, +1 and +5 only

---

685. 9701_w17_qp_11 Q: 17

71.0 g of chlorine, Cl_2, react with an excess of sodium hydroxide solution at a particular temperature. The reaction produces exactly 35.5 g of product **X**.

What is product **X**?

A H_2O **B** $NaCl$ **C** $NaClO$ **D** $NaClO_3$

---

686. 9701_w17_qp_12 Q: 16

In an experiment, 0.125 mol of chlorine gas, Cl_2, is reacted with an excess of cold, aqueous sodium hydroxide. One of the products is a compound of sodium, oxygen and chlorine.

Which mass of this product is formed?

A 9.31 g **B** 13.3 g **C** 18.6 g **D** 26.6 g

---

687. 9701_m16_qp_12 Q: 14

Chlorine gas is widely used to treat contaminated water.

Which species present in water when chlorine gas has been added is responsible for killing bacteria?

A ClO_2^- **B** Cl^- **C** HCl **D** OCl^-

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688. 9701_s16_qp_12 Q: 18

An excess of chlorine gas, Cl_2, is passed through 60 cm^3 of cold aqueous 0.1 mol dm^{-3} sodium hydroxide. In a separate experiment an excess of chlorine gas is passed through 60 cm^3 of hot aqueous 0.1 mol dm^{-3} sodium hydroxide until no further reaction takes place.

How much **more** sodium chloride will be produced by the reaction with hot NaOH than with cold NaOH?

A 0.002 moles

B 0.003 moles

C 0.005 moles

D 0.006 moles

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689. 9701_w16_qp_12 Q: 15

When chlorine reacts with hot aqueous sodium hydroxide, two chlorine-containing ions are formed. One of these is the chloride ion, Cl^-.

What is the other ion?

A ClO^- **B** ClO_2^- **C** ClO_3^- **D** ClO_4^-

---

690. 9701_s15_qp_11 Q: 16

Chlorine is widely used in water treatment plants.

Which reaction takes place when chlorine dissolves in water?

A $Cl_2 + H_2O \rightarrow HCl + HClO$

B $2Cl_2 + 2H_2O \rightarrow 3HCl + HClO_2$

C $3Cl_2 + 3H_2O \rightarrow 5HCl + HClO_3$

D $4Cl_2 + 4H_2O \rightarrow 7HCl + HClO_4$

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