Q1.

This question is about chlorine.

(a) Chlorine has a low boiling point because the forces between the molecules are weak.

Explain how these forces arise between molecules of chlorine.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(b) Give an equation for the reaction of chlorine with water.

Give a reason why chlorine is added to drinking water.

Equation

_____

Reason _____

_____

(2)

(c) Chlorine reacts with cold, aqueous sodium hydroxide in the manufacture of bleach.

Give an equation for this reaction.

_____

(1)

(Total 6 marks)

Q2.

Which pair of solutions, when mixed, reacts to form a dark brown solution?

A NaF(aq) + Cl_2(aq) ⬭

B NaCl(aq) + Br_2(aq) ⬭

C NaBr(aq) + Cl_2(aq) ⬭

D NaI(aq) + Br_2(aq) ⬭

(Total 1 mark)

Q3.

Some solid sodium halides are reacted with concentrated sulfuric acid.

Which solid sodium halide does **not** produce a sulfur-containing gas as one of the products?

A NaCl ⬭

B NaBr ⬭

C NaI ⬭

D NaAt ⬭

(Total 1 mark)

Q4.

This question is about Group 7 chemistry.

(a) Give an equation for the reaction of solid sodium bromide with concentrated sulfuric acid to form bromine.

State **one** observation made during this reaction.

Equation

_____

Observation _____

_____

_____

(2)

(b) A solution that is thought to contain chloride ions and iodide ions is tested.

1. Dilute nitric acid is added to the solution.
2. Aqueous silver nitrate is added to the solution.
3. A pale yellow precipitate forms.
4. Excess dilute aqueous ammonia is added to the mixture.
5. Some of the precipitate dissolves and a darker yellow precipitate remains.

Give a reason for the use of each reagent.

Explain the observations.

Give ionic equations for any reactions.

(5)

(Total 7 marks)

Q5.

This question is about Group 7 elements and their compounds.

(a) Chlorine is used to treat water even though it is toxic to humans.

Give **one** reason why water is treated with chlorine.

Explain why chlorine is added to water even though it is toxic.

Give an equation for the reaction of chlorine with cold water.

Reason

_____

_____

Explanation

_____

_____

_____

Equation

_____

(3)

(b) Solid sodium iodide reacts with concentrated sulfuric acid to form iodine and sulfur in a redox reaction.

Give a half-equation to show the conversion of iodide ions to iodine.

Give a half-equation to show the conversion of sulfuric acid to sulfur.

Give an overall equation for this redox reaction.

Identify one other sulfur-containing reduction product formed when solid sodium iodide reacts with concentrated sulfuric acid.

Half-equation for the conversion of iodide ions to iodine

_____

Half-equation for the conversion of sulfuric acid to sulfur

_____

Overall equation

_____

Other sulfur-containing reduction product

_____

(4)

A student completes an experiment to determine the percentage by mass of sodium chloride in a mixture of sodium chloride and sodium iodide.

The student uses this method.

- 600 mg of the mixture are dissolved in water to form a solution.
- An excess of aqueous silver nitrate is added to the solution. This forms a precipitate containing silver chloride and silver iodide.
- Excess dilute ammonia solution is then added to the precipitate. The silver chloride dissolves.
- The silver iodide is filtered off from the solution, and is then washed and dried.

The mass of the silver iodide obtained is 315 mg

(c) Silver nitrate is added to the solution.

Suggest why an excess is used.

_____

_____

_____

(1)

(d) Calculate the amount, in moles, of silver iodide obtained.

M_r (AgI) = 234.8

Amount of silver iodide _____ mol

(1)

(e) Calculate, using your answer to part (d), the mass, in grams, of sodium iodide in the mixture.

M_r (NaI) = 149.9

Mass of sodium iodide _____ g

(1)

(f) Calculate, using your answer to part (e), the percentage by mass of sodium chloride in the mixture.

Percentage of sodium chloride _____

(2)

(Total 12 marks)

Q6.

Which property increases down Group 7?

A ability to oxidise a given reducing agent ⬭

B boiling point ⬭

C electronegativity ⬭

D first ionisation energy ⬭

(Total 1 mark)

Q7.

Which equation shows a redox reaction that does **not** occur?

A $Br_2(aq) + 2\ KI(aq) \rightarrow I_2(aq) + 2\ KBr(aq)$ ⬭

B $Cl_2(g) + 2\ KI(aq) \rightarrow I_2(aq) + 2\ KCl(aq)$ ⬭

C $Cl_2(g) + 2\ KBr(aq) \rightarrow Br_2(aq) + 2\ KCl(aq)$ ⬭

D $I_2(aq) + 2\ KBr(aq) \rightarrow Br_2(aq) + 2\ KI(aq)$ ⬭

(Total 1 mark)

Q8.

This question is about sodium halides.

(a) State what is observed when silver nitrate solution is added to sodium fluoride solution.

_____

(1)

(b) State **one** observation when solid sodium chloride reacts with concentrated sulfuric acid.

Give an equation for the reaction.

State the role of the chloride ions in the reaction.

Observation

_____

Equation

_____

Role

_____

(3)

(c) Give an equation for the redox reaction between solid sodium bromide and concentrated sulfuric acid.

Explain, using oxidation states, why this is a redox reaction.

Equation

_____

Explanation

_____

_____

_____

_____

(3)

(d) State what is observed when aqueous chlorine is added to sodium bromide solution.

Give an ionic equation for the reaction.

Observation

_____

Ionic equation

_____

(2)

(Total 9 marks)

Q9.

Which shows the major product(s) formed when chlorine reacts with cold, dilute, aqueous sodium hydroxide?

A NaCl only ⬭

B NaClO only ⬭

C NaCl and NaClO ⬭

D NaCl and $NaClO_3$ ⬭

(Total 1 mark)

Q10.

What is the best oxidising agent?

A F_2 ⬭

B F^- ⬭

C I_2 ⬭

D I^- ⬭

(Total 1 mark)

Q11.

Which statement is correct about reactions involving halide ions?

A Sodium chloride forms chlorine when added to concentrated sulfuric acid. ⬭

B Sodium chloride forms chlorine when added to bromine. ⬭

C Sodium bromide forms bromine when added to concentrated sulfuric acid. ⬭

D Sodium bromide forms bromine when added to iodine. ⬭

(Total 1 mark)

Q12.

Which statement is **not** correct about the trends in properties of the hydrogen halides from HCl to HI ?

A The boiling points decrease. ⬭

B The bond dissociation energy of H−X decreases. ⬭

C The polarity of the H−X bond decreases. ⬭

D They are more easily oxidised in aqueous solutions. ⬭

(Total 1 mark)

Q13.

This question is about some Group 7 compounds.

(a) Solid sodium chloride reacts with concentrated sulfuric acid.

Give an equation for this reaction.
State the role of the sulfuric acid in this reaction.

Equation

_____

Role

_____

(2)

(b) Fumes of sulfur dioxide are formed when sodium bromide reacts with concentrated sulfuric acid.

For **this** reaction
- give an equation
- give **one** other observation
- state the role of the sulfuric acid.

Equation

_____

Observation

_____

_____

Role

_____

(3)

(c) Chlorine reacts with hot aqueous sodium hydroxide as shown in the equation.

$$3\ Cl_2 + 6\ NaOH \rightarrow NaClO_3 + 5\ NaCl + 3\ H_2O$$

Give the oxidation state of chlorine in $NaClO_3$ and in NaCl

$NaClO_3$ _____

NaCl _____

(1)

(d) State, in terms of redox, what happens to chlorine in the reaction in part **(c)**.

_____

_____

(1)

(e) Solution **Y** contains **two** different negative ions.

To a sample of solution **Y** in a test tube a student adds
- silver nitrate solution
- then an excess of dilute nitric acid
- finally an excess of concentrated ammonia solution.

The observations after each addition are recorded in the table.

Reagent added to solution Y	**Observation**
silver nitrate solution	cream precipitate containing compound **D** and compound **E**
excess dilute nitric acid	cream precipitate **D** and bubbles of gas **F**
excess concentrated ammonia solution	colourless solution containing complex ion **G**

Give the formulas of **D**, **E** and **F**.
Give an **ionic** equation to show the formation of **E**.
Give an equation to show the conversion of **D** into **G**.

Formula of **D** _____

Formula of **E** _____

Formula of **F** _____

Ionic equation to form **E**

_____

Equation to show the conversion of **D** into **G**

_____

(6)

(Total 13 marks)

Q14.

Separate unlabelled solid samples of three anhydrous sodium compounds are provided for a student to identify.
These compounds are known to be sodium carbonate, sodium fluoride and sodium chloride but it is not known which sample is which.

Outline a logical sequence of test-tube reactions that the student could carry out to identify each of these compounds.
Include the observations the student would expect to make.
Give equations, including **state symbols**, for any reactions that would take place.

(Total 6 marks)

Q15.

Which statement is correct about the reaction between concentrated sulfuric acid and solid sodium bromide?

A Bromide ions are reduced. ⬭

B Hydrogen bromide and sulfur are formed. ⬭

C Sulfuric acid acts as an oxidising agent. ⬭

D Bromine and hydrogen sulfide are formed. ⬭

(Total 1 mark)

Q16.

Which is the best technique to remove the silver chloride that forms when aqueous solutions of silver nitrate and sodium chloride react?

A Refluxing ○

B Evaporation ○

C Filtration ○

D Distillation ○

(Total 1 mark)

Q17.

Which statement about astatine is correct?

A Astatine has a greater electronegativity than bromine ○

B Astatine is a better oxidising agent than bromine ○

C Astatine has a greater boiling point than bromine ○

D Astatine has a greater first ionisation energy than bromine ○

(Total 1 mark)

Q18.

Which species is **not** produced by a redox reaction between solid sodium iodide and concentrated sulfuric acid?

A Na_2SO_4 ○

B H_2S ○

C S ○

D SO_2 ○

(Total 1 mark)

Q19.

A student was given a 50.0 g sample of solid silver chloride contaminated with solid silver carbonate.
The student suggested the following method to obtain the maximum amount of pure dry silver chloride from the sample:

1. Tip the solid into a boiling tube.

2. Add dilute nitric acid.

3. Allow the remaining solid to settle.

4. Decant off the liquid.

5. Leave the sample to dry on a shelf.

Identify any faults or omissions in the method suggested by the student.
Suggest improvements to the method, using commonly available laboratory equipment.

The following chemicals are also available:
distilled water, dilute solutions of NaOH, NH_3, HCl, H_2SO_4

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(Total 6 marks)

Q20.

This question is about elements in Group 7 of the Periodic Table and their compounds.

(a) Bromine (Br_2), strontium chloride ($SrCl_2$) and iodine monochloride (ICl) all have similar M_r values.

Suggest, with reasons, the order of melting points for these three substances.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

(b) Write an equation for the reaction of chlorine with cold water.

State a reason why chlorine is added to drinking water, and suggest a disadvantage of treating water in this way.

Equation

_____

Reason

_____

_____

Disadvantage _____

_____

_____

(3)

(c) Bromine reacts with phosphorus to form phosphorus tribromide.

Write an equation for this reaction and draw the shape of the phosphorus tribromide molecule formed.

Suggest the bond angle in phosphorus tribromide.

Equation

_____

Shape

Bond angle

_____

(3)

(d) Phosphorus pentabromide in the solid state consists of PBr_4^+ and Br^- ions.

Draw the shape of the PBr_4^+ ion and suggest its bond angle.

Shape

Bond angle

_____

(2)

(Total 14 marks)

Q21.

Which equation represents a reaction that does take place?

A $Cl_2 + 2NaI \longrightarrow 2NaCl + I_2$ ⬭

B $Br_2 + 2NaCl \longrightarrow 2NaBr + Cl_2$ ⬭

C $NaCl + H_2O \longrightarrow HCl + NaOH$ ⬭

D $2HCl + H_2SO_4 \longrightarrow Cl_2 + SO_2 + 2H_2O$ ⬭

(Total 1 mark)

Q22.

Which species is the best oxidising agent?

A Cl_2 ⬭

B Cl^- ⬭

C Br_2 ⬭

D Br^- ⬭

(Total 1 mark)

Q23.

This question is about the chemical properties of chlorine, sodium chloride and sodium bromide.

(a) Sodium bromide reacts with concentrated sulfuric acid in a different way from sodium chloride.

Write an equation for this reaction of sodium bromide and explain why bromide ions react differently from chloride ions.

Equation

_____

Explanation

_____

_____

_____

_____

(3)

(b) A colourless solution contains a mixture of sodium chloride and sodium bromide.

Using aqueous silver nitrate and any other reagents of your choice, develop a procedure to prepare a pure sample of silver bromide from this mixture.
Explain each step in the procedure and illustrate your explanations with equations, where appropriate.

(6)

(c) Write an ionic equation for the reaction between chlorine and cold dilute sodium hydroxide solution.
Give the oxidation state of chlorine in each of the chlorine-containing ions formed.

(2)

(Total 11 marks)