Group 7

Question Paper 1

Level	International A Level
Subject	Chemistry
Exam Board	Edexcel
Topic	Application of Core Principles of Chemistry
Sub Topic	Group 7
Booklet	Question Paper 1

Time Allowed: **51 minutes**

Score: **/42**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 A volume of 100 cm^3 of a solution of 0.500 mol dm^{-3} silver nitrate, $AgNO_3(aq)$, is reacted completely with excess calcium chloride solution, $CaCl_2(aq)$.

The maximum mass of precipitate that can form is

☒ **A** 7.17 g

☒ **B** 8.50 g

☒ **C** 8.95 g

☒ **D** 14.3 g

(Total for Question 1 = 1 mark)

---

2 When solutions of iodine are titrated with aqueous sodium thiosulfate solution, $Na_2S_2O_3(aq)$, the thiosulfate ions are oxidized to

☒ **A** $S_2O_4^{2-}$

☒ **B** $S_2O_6^{2-}$

☒ **C** $S_2O_8^{2-}$

☒ **D** $S_4O_6^{2-}$

(Total for Question 2 = 1 mark)

---

3 Which one of the following equations represents a halogen displacement reaction that can occur?

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

☒ **B** $2KCl(aq) + Br_2(aq) \rightarrow 2KBr(aq) + Cl_2(aq)$

☒ **C** $2KF(aq) + Cl_2(aq) \rightarrow 2KCl(aq) + F_2(aq)$

☒ **D** $2KBr(aq) + Cl_2(aq) \rightarrow 2KCl(aq) + Br_2(aq)$

(Total for Question 3 = 1 mark)

4 The silver halide which is insoluble in water but soluble in dilute aqueous ammonia is

- ☒ **A** AgCl
- ☒ **B** AgBr
- ☒ **C** AgI
- ☒ **D** AgAt

(Total for Question 4 = 1 mark)

5 The equation for the reaction of chlorine with water is shown below.

$$Cl_2 + H_2O \rightleftharpoons HCl + HClO$$

This reaction is an example of

- ☒ **A** decomposition.
- ☒ **B** displacement.
- ☒ **C** disproportionation.
- ☒ **D** neutralization.

(Total for Question 5 = 1 mark)

6 An iodine-thiosulfate titration is carried out with the thiosulfate solution in the burette and the iodine solution in the conical flask.

If an indicator is **not** used, then the colour change at the end-point is

☒ **A** pale yellow to colourless.

☒ **B** pale yellow to clear.

☒ **C** blue-black to colourless.

☒ **D** brown to clear.

(Total for Question 6 = 1 mark)

---

7 Which of the following is **not** true of the hydrogen halides, HCl, HBr and HI? These hydrogen halides

☒ **A** form white smoke when in contact with ammonia vapour.

☒ **B** dissolve in water to form strong acids.

☒ **C** are usually prepared by the action of sulfuric acid on the sodium halide.

☒ **D** produce steamy fumes in moist air.

(Total for Question 7 = 1 mark)

---

8 What is observed when a mixture of bromoethane and aqueous silver nitrate is warmed?

☒ **A** Brown solution

☒ **B** Cream precipitate

☒ **C** Decolorisation

☒ **D** Silver precipitate

(Total for Question 8 = 1 mark)

---

9 What is the colour of iodine in the non-polar solvent, cyclohexane?

- ☒ **A** Black
- ☒ **B** Brown
- ☒ **C** Purple
- ☒ **D** Yellow

(Total for Question 9 = 1 mark)

---

10 In the reaction of concentrated sulfuric acid with solid sodium iodide, the sulfur is **finally** reduced to

- ☒ **A** hydrogen sulfide.
- ☒ **B** hydrogen sulfate.
- ☒ **C** sulfur dioxide.
- ☒ **D** sulfur trioxide.

(Total for Question 10 = 1 mark)

11 This question concerns the halogens and some of their compounds.

(a) A halogen dissolves in water to form a yellow solution, and in cyclohexane to form a purple solution.

Name the halogen.

(1)

.....

(b) Oxygen difluoride, OF_2, is produced in the reaction between fluorine and cold, dilute sodium hydroxide solution.

$$2F_2 + 2OH^- \rightarrow OF_2 + 2F^- + H_2O$$

....

Give the oxidation numbers of fluorine and oxygen in all of the species in the equation above and use them to explain why this is a redox reaction.

(3)

.....

.....

.....

.....

.....

.....

(c) Chlorine oxidises thiosulfate ions, $S_2O_3^{2-}$, to sulfate(VI) ions.

The ionic half-equations for the reaction are

$$Cl_2 + 2e^- \rightarrow 2Cl^-$$

$$S_2O_3^{2-} + 5H_2O \rightarrow 2SO_4^{2-} + 10H^+ + 8e^-$$

Write the overall equation for the reaction.

(1)

(d) The boiling temperatures of the hydrogen halides are shown.

Hydrogen halide	Boiling temperature / K
HF	293
HCl	188
HBr	206
HI	238

*(i) London forces are present in **all** of these compounds.

Describe how these forces arise.

(2)

(ii) State why the London forces are greater in hydrogen iodide than in hydrogen bromide.

(1)

.....

.....

(iii) Explain why the boiling temperature of hydrogen fluoride is higher than that of hydrogen chloride.

(2)

.....

.....

.....

.....

.....

(e) In the solid state, phosphorus(V) chloride exists as $[PCl_4]^+$ and $[PCl_6]^-$ ions.

Predict the shapes of these ions. Fully justify your answers.

(4)

Shape $[PCl_4]^+$ .....

Shape $[PCl_6]^-$ .....

Justification

.....

.....

.....

.....

.....

.....

.....

.....

(Total for Question 11 = 14 marks)

12 When concentrated sulfuric acid is added to solid sodium chloride, the gas hydrogen chloride is produced.

(a) Write an equation for this reaction. State symbols are not required.

(1)

(b) Fumes of hydrogen chloride gas can be identified by bringing the fumes into contact with another gas, **X**. Identify gas **X** and state the observation you would make.

(2)

Gas **X** .....

Observation .....

(c) Chloride ions in solution can be distinguished from other halide ions by the addition of silver nitrate solution followed by dilute, aqueous ammonia.

State what you would see when silver nitrate solution is added to chloride ions, followed by dilute aqueous ammonia.

Suggest why concentrated ammonia should not be used to confirm that silver chloride has been formed.

(3)

Observation on addition of $AgNO_3$ .....

Observation on addition of dilute NH_3 .....

Reason why concentrated NH_3 should **not** be used .....

.....

.....

(Total for Question 12 = 6 marks)

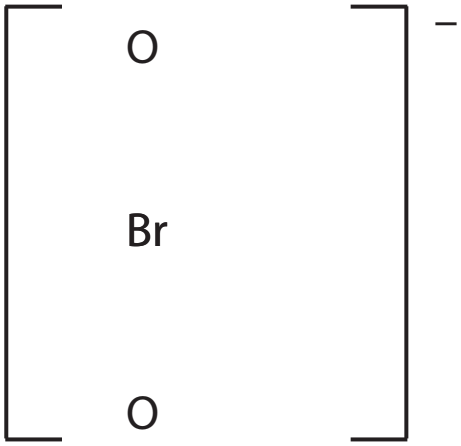
13 Potassium bromate(V), $KBrO_3$, is a primary standard, meaning that it can be obtained as a pure substance and used to accurately determine the concentrations of solutions of other chemicals, such as sodium thiosulfate, $Na_2S_2O_3$.

(a) (i) Complete the dot and cross diagram for the bromate(V) ion. Show only the outer shell electrons.

In this ion, the bromine expands its outer shell to accommodate 12 electrons.

Use **x** for bromine electrons and • for oxygen electrons. The symbol * on the diagram represents the extra electron which gives the ion its charge.

(2)



(ii) Suggest how elements in Period 3 and higher can accommodate more than eight electrons in their outer shell.

(1)

.....

.....

(b) Four chemistry students were given a solution of sodium thiosulfate with a concentration of **approximately** 0.1 mol dm^{-3} and asked to determine its **exact** concentration.

They were each given separate tasks to carry out, as described below.

(i) The first student was given the task of making up a potassium bromate(V) solution. A mass of 8.35 g of $KBrO_3$ was weighed out, dissolved in deionized water, the volume made up to 250 cm^3 in a volumetric flask and the mixture shaken.

Calculate the concentration of this potassium bromate(V) solution, in mol dm^{-3}.

(2)

(ii) The second student was asked to determine a suitable mass of potassium iodide to add to 0.0025 mol of potassium bromate(V) to ensure complete reaction. The equation for the reaction is

$$BrO_3^-(aq) + 6H^+(aq) + 6I^-(aq) \rightarrow Br^-(aq) + 3I_2(aq) + 3H_2O(l)$$

Calculate the minimum mass of potassium iodide, KI, required and hence suggest a suitable mass to use if the potassium iodide is to be in excess.

You **must** show your working and your mass should be reasonable.

(3)

Minimum mass required ..... g

Suitable mass to use ..... g

(iii) The third student was given the following equation.

$$I_2(aq) + 2S_2O_3^{2-}(aq) \rightarrow 2I^-(aq) + S_4O_6^{2-}(aq)$$

This student was asked to estimate the titration reading.

Calculate the volume of 0.1 mol dm^{-3} of sodium thiosulfate solution, in cm^3, that would be needed to react with 0.00100 mol of iodine present in the conical flask.

(2)

(iv) The fourth student carried out an alternative method for determining the concentration of the sodium thiosulfate solution. A known mass of solid potassium bromate(V) was dissolved in water in a conical flask. An excess of potassium iodide and acid were added and the mixture titrated with the sodium thiosulfate solution. The following measurements were obtained.

Mass of $KBrO_3$	0.07 g
Volume of water	25 cm^3
Volume of $Na_2S_2O_3(aq)$	26.85 cm^3

The student calculated the concentration of the sodium thiosulfate, $Na_2S_2O_3$, to be 0.0937 mol dm^{-3}.

There is uncertainty in the value of the calculated concentration of the sodium thiosulfate. Which measurement, given in the table, has the greatest effect on the uncertainty of this value? Justify your answer.

No calculation is required for this answer.

(2)

.....

.....

.....

.....

.....

.....

(Total for Question 13 = 12 marks)