Group 1 & 2

Question Paper 1

Level	International A Level
Subject	Chemistry
Exam Board	Edexcel
Topic	Application of Core Principles of Chemistry
Sub Topic	Group 1 & 2
Booklet	Question Paper 1

Time Allowed: **59 minutes**

Score: **/49**

Percentage: **/100**

Grade Boundaries:

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

1 Which shows the trend in solubility of the hydroxides and sulfates of the Group 2 elements going **up** the group from barium to magnesium?

	Solubility of Group 2 hydroxides	Solubility of Group 2 sulfates
☒ **A**	decreases	decreases
☒ **B**	decreases	increases
☒ **C**	increases	decreases
☒ **D**	increases	increases

(Total for Question 1 = 1 mark)

2 Which of these metal salts gives a lilac colour during a flame test?

☒ **A** Sodium chloride

☒ **B** Potassium chloride

☒ **C** Barium chloride

☒ **D** Magnesium chloride

(Total for Question 2 = 1 mark)

3 What volume of 0.200 mol dm^{-3} potassium sulfate solution is required to make, by dilution with water, 1.00 dm^3 of a solution with a **potassium** ion concentration of 0.100 mol dm^{-3}?

☒ **A** 100 cm^3

☒ **B** 250 cm^3

☒ **C** 400 cm^3

☒ **D** 500 cm^3

(Total for Question 3 = 1 mark)

4 Which trends are correct as Group 2 is descended?

		Solubility of sulfates	Solubility of hydroxides
☒	**A**	decreases	eases
☒	**B**	decreases	eases
☒	**C**	increases	eases
☒	**D**	increases	eases

(Total for Question 4 = 1 mark)

5 A flame test was carried out on a mixture of magnesium chloride and potassium chloride.

The flame colour observed was

☒ **A** white and lilac.

☒ **B** orange.

☒ **C** lilac.

☒ **D** bright white, which masks any other colour.

(Total for Question 5 = 1 mark)

6 The equation for the reaction of lithium with excess water is

☒ **A** $2Li(s) + 2H_2O(l) \rightarrow Li_2O_2(s) + 2H_2(g)$

☒ **B** $2Li(s) + H_2O(l) \rightarrow Li_2O(s) + H_2(g)$

☒ **C** $Li(s) + H_2O(l) \rightarrow LiOH(s) + \frac{1}{2}H_2(g)$

☒ **D** $2Li(s) + 2H_2O(l) \rightarrow 2LiOH(aq) + H_2(g)$

(Total for Question 6 = 1 mark)

7 Solid sodium is reacted with chlorine gas and the product of this reaction is added to water. This gives

- ☒ **A** an insoluble white crystalline solid.
- ☒ **B** a colourless solution.
- ☒ **C** a pale green solution.
- ☒ **D** a cloudy white mixture.

(Total for Question 7 = 1 mark)

8 The solids barium hydroxide and barium sulfate are similar in

- ☒ **A** their colours.
- ☒ **B** the pH of their solutions.
- ☒ **C** their reactions with hydrochloric acid.
- ☒ **D** their solubility in water.

(Total for Question 8 = 1 mark)

9 The solids magnesium carbonate and magnesium nitrate are identical in

- ☒ **A** the gas released on heating the solids.
- ☒ **B** their reaction with hydrochloric acid.
- ☒ **C** the solid product of their thermal decomposition.
- ☒ **D** their solubility in water.

(Total for Question 9 = 1 mark)

10 Flame colours can be used to detect some metal ions. The **emission** of these flame colours arises when electrons

- ☒ **A** are lost from the ions.
- ☒ **B** absorb light energy.
- ☒ **C** are excited to higher energy levels.
- ☒ **D** drop back down to lower energy levels.

(Total for Question 10 = 1 mark)

11 When lithium chloride is heated in a Bunsen flame, the colour of the flame is

- ☒ **A** lilac.
- ☒ **B** bright yellow.
- ☒ **C** bright red.
- ☒ **D** pale green.

(Total for Question 11 = 1 mark)

12 Which of the following is the equation for the reaction of calcium with excess water?

- ☒ **A** $Ca(s) + 2H_2O(l) \rightarrow Ca(OH)_2(aq) + H_2(g)$
- ☒ **B** $Ca(s) + H_2O(l) \rightarrow CaO(s) + {}_2(g)$
- ☒ **C** $Ca(s) + H_2O(l) \rightarrow CaOH(aq) + ½H_2(g)$
- ☒ **D** $Ca(s) + 2H_2O(l) \rightarrow CaO_2(s) + 2\ {}_2(g)$

(Total for Question 12 = 1 mark)

13 The thermal stability of the Group 2 carbonates, $MgCO_3$ to $BaCO_3$, increases down the group because

- ☒ **A** the charge on the cation increases.
- ☒ **B** the charge density of the ions increases.
- ☒ **C** the cation is less able to polarize the anion.
- ☒ **D** the anion is less reactive than the cation.

(Total for Question 13 = 1 mark)

14 This question is about the carbonates and nitrates of elements in Group 1 and Group 2 of the Periodic Table.

(a) Many of the metal ions of Group 1 and Group 2 can be identified using flame tests.

(i) State the colour given to a flame by barium nitrate.

(1)

.....

(ii) Explain the origin of the flame colour.

(3)

.....

.....

.....

.....

.....

.....

(b) Sodium nitrate and magnesium nitrate decompose when they are heated.

Write equations to show the thermal decomposition of each of these nitrates. State symbols are not required.

(i) Sodium nitrate

(1)

(ii) Magnesium nitrate

(1)

(c) Magnesium carbonate decomposes readily when heated but sodium carbonate does not.

Explain this observation by including reference to the charge and size of the cations.

(4)

(d) Hydrated sodium carbonate has the formula $Na_2CO_3.xH_2O$.

A student determined the value of x in the formula of a sample of hydrated sodium carbonate. The following procedure was used.

- Use 2.50 g of hydrated sodium carbonate to prepare 250 cm^3 of solution.
- Use a pipette to transfer 25.0 cm^3 of the sodium carbonate solution to a conical flask.
- Add a few drops of methyl orange indicator to the conical flask.
- Titrate the solution with 0.105 mol dm^{-3} hydrochloric acid until concordant results are obtained.

The student's mean titre was 16.65 cm^3.

The equation for the reaction is

$$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$$

*(i) Calculate the amount, in moles, of sodium carbonate, Na_2CO_3, in the 250 cm^3 of solution in the volumetric flask.

(3)

amount Na_2CO_3 in 250 cm^3 = ... mol

(ii) Calculate the molar mass of $Na_2CO_3.xH_2O$ and hence the value of x. **(2)**

(iii) Another student carried out the same experiment but obtained a different answer. The method this student used for preparing the sodium carbonate solution is shown.

> I weighed 2.50 g of hydrated sodium carbonate in a weighing bottle and then tipped the solid into a 250 cm^3 volumetric flask.
>
> I dissolved the solid in a small amount of distilled water and then added distilled water up to the mark.
>
> I then carried out a series of titrations.

Identify **two** errors that the student made in preparing this solution and explain the effect these errors will have on the titration volumes.

(4)

Error 1 .....

.....

Effect on the titration volumes .....

.....

.....

Error 2 .....

.....

Effect on the titration volumes .....

.....

.....

(Total for Question 14 = 19 marks)

15 This is a question about an acid-base titration.

Potassium hydroxide, KOH, is used to assist in the removal of hair. For example, it is present in some pre-shave products and used in solutions for soaking animal skins prior to the removal of the animal hair.

The skin of a red-brown cow was soaked in a solution of potassium hydroxide containing 226.8 g of potassium hydroxide in 45.0 dm^3 of solution. After several hours, the skin was removed.

The residual solution, **R**, contained unreacted potassium hydroxide. In order to determine the potassium hydroxide concentration in **R**, 25.00 cm^3 samples of the solution were titrated with 0.0500 mol dm^{-3} sulfuric acid.

Titration	Trial	1	2	3
Final volume / cm^3	5.00	9.50	14.10	18.55
Initial volume / cm^3	0.00	5.00	9.55	14.10
Volume added / cm^3	5.00	4.50	4.55	4.45

Mean titre = 4.50 cm^3

The equation for the reaction is:

$$2KOH(aq) \quad {}_2SO_4(aq) \rightarrow K_2SO_4(aq) + 2H_2O(l)$$

(a) (i) Calculate the number of moles of sulfuric acid that react with 25.00 cm^3 of the potassium hydroxide solution **R**.

(1)

(ii) From your answer to (a)(i), deduce the number of moles of potassium hydroxide in the 25.00 cm^3 of solution **R**.

(1)

(iii) Calculate the concentration, in mol dm^{-3}, of potassium hydroxide in the solution **R**.

(1)

(iv) Calculate the **difference** between the initial concentration of the potassium hydroxide used to soak the animal skin and the concentration of solution **R**, which you have calculated in (a)(iii).

Relative Atomic Masses: K = 39.1; O = 16; H = 1

(3)

Initial KOH Concentration .....

KOH concentration in solution **R** .....

Difference .....

(v) Calculate the total mass of potassium hydroxide used up in the soaking process. Give your answer to **three** significant figures.

(2)

(b) The indicator phenolphthalein could have been used for this titration.

(i) State the colour change you would expect at the end-point of a titration when sulfuric acid is added to potassium hydroxide using phenolphthalein.

(2)

From ..... to .....

(ii) Suggest why the particular skin used might make it difficult to accurately judge the end-point of the titration.

(1)

.....

.....

(iii) Phenolphthalein is used as a solution in ethanol which is highly flammable. A student suggested that for safety reasons there should be no naked flames present during this titration.

Is this an appropriate suggestion? Justify your answer.

(1)

.....

.....

.....

(c) Titration experiments use equipment with a measurement uncertainty. For a pipette, the uncertainty is ±0.06 cm^3 on the volume measured. For each burette reading, the uncertainty is ±0.05 cm^3.

(i) By calculating the percentage error for the burette titre value of 4.50 cm^3, and for the pipette volume of 25.00 cm^3, show that in this case the burette error is greater than the pipette error.

(2)

Burette titre % error .....

Pipette volume % error .....

(ii) Suggest **two** ways by which the percentage error for the burette titre could be reduced, without changing the apparatus.

(2)

1 .....

.....

2 .....

.....

(iii) The trial titre value was not included in the calculation of the mean.

In what circumstances could the trial value be used in the calculation of the mean?

(1)

.....

.....

(Total for Question 15 = 17 marks)