

**Q8.**

The following pairs of compounds can be distinguished by simple test-tube reactions.

For each pair of compounds, give a reagent (or combination of reagents) that, when added separately to each compound, could be used to distinguish between them. State what is observed in each case.

- (a) Butan-2-ol and 2-methylpropan-2-ol (3)
- (b) Propane and propene (3)
- (c) Aqueous silver nitrate and aqueous sodium nitrate (3)
- (d) Aqueous magnesium chloride and aqueous barium chloride (3)
- (Total 12 marks)**

**Q9.**

A laboratory technician discovered four badly-labelled bottles, each containing one pure white solid. Each bottle contained a compound of a different Group 2 metal (magnesium, calcium, strontium and barium).

Some tests were carried out on the solids or, if the compound was soluble, on the aqueous solution. The results are given in the table.

Test	Compound 1	Compound 2	Compound 3	Compound 4
Added to water	Dissolves	Insoluble	Dissolves	Dissolves
Solution or solid added to HCl(aq)	Solution remains colourless	Gives off carbon dioxide gas and a colourless solution forms	Solution remains colourless	Solution remains colourless and heat released
Solution or solid added to NaOH(aq)	Solution gives a white precipitate	Solid remains insoluble	Solution gives a slight white precipitate	Solution has no visible change
Solution or solid added to H <sub>2</sub> SO <sub>4</sub> (aq)	Solution has no visible change	Gives off carbon dioxide gas and a white solid remains	Solution slowly forms a slight white precipitate	Solution forms a white precipitate

- (a) One of the bottles has a very faint label that could be read as 'Magnesium Sulfate'.

Use the information in the table to deduce which **one** of the four compounds is magnesium sulfate and explain your answer.



Compound \_\_\_\_\_

Explanation \_\_\_\_\_

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(3)

- (b) The bottle containing **Compound 2** has a 'TOXIC' hazard symbol.

Use the information in the table to identify **Compound 2**.

Explain both observations in the reaction with  $\text{H}_2\text{SO}_4(\text{aq})$ .

Identity of **Compound 2** \_\_\_\_\_

Explanation \_\_\_\_\_

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(3)

- (c) Identify the compound that is strontium hydroxide.

Give an equation for the reaction of strontium hydroxide with sulfuric acid.

Compound \_\_\_\_\_

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Equation \_\_\_\_\_

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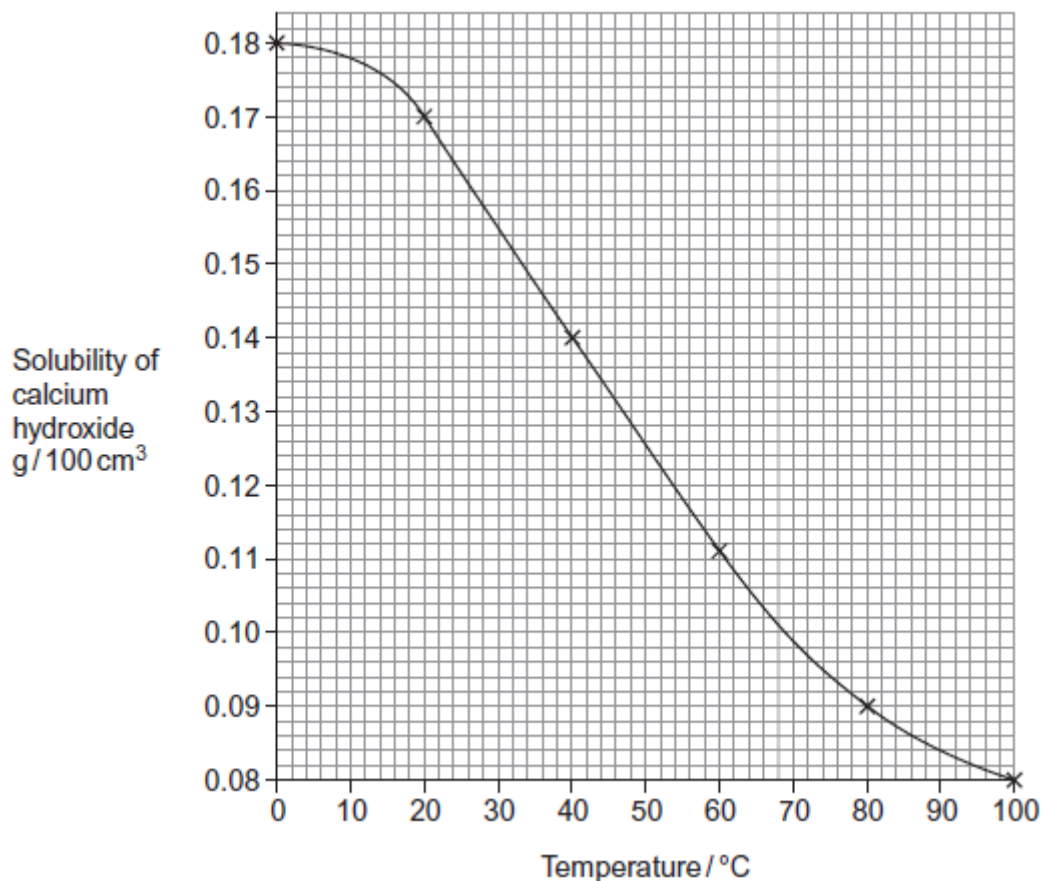
(2)

(Total 8 marks)

**Q10.**

Calcium hydroxide is slightly soluble in water at room temperature. As the temperature rises, the solubility decreases. When the maximum amount of solid has dissolved at a particular temperature the solution is said to be **saturated**.

In an experiment, the solubility of calcium hydroxide was measured over a range of temperatures. The results are shown in the graph.



- (a) Use data from the graph to calculate the concentration, in mol dm<sup>-3</sup>, of a saturated solution of calcium hydroxide at 30 °C. Give your answer to 3 significant figures.

Show your working.

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(3)



- (b) You are given a sample of saturated calcium hydroxide solution. Outline the practical steps that you would take to determine the solubility of calcium hydroxide in this solution.

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(3)

(Total 6 marks)

### Q11.

- (a) Strontium chloride is used in toothpaste for sensitive teeth. Both strontium carbonate and strontium sulfate are white solids that are insoluble in water.
- (i) Write an equation for the reaction between strontium chloride solution and sodium sulfate solution. Include state symbols in your equation.

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(1)

- (ii) Strontium carbonate reacts with nitric acid to produce a solution of strontium nitrate. Strontium sulfate does not react with nitric acid.

Describe briefly how you could obtain strontium sulfate from a mixture of strontium carbonate and strontium sulfate.

You are **not** required to describe the purification of the strontium sulfate.

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(2)



- (b) A solution of magnesium sulfate is sometimes given as first aid to someone who has swallowed barium chloride.

Explain why drinking magnesium sulfate solution is effective in the treatment of barium poisoning.

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(1)

- (c) Medicines for the treatment of nervous disorders often contain calcium bromide. Silver nitrate, acidified with dilute nitric acid, can be used together with another reagent to test for the presence of bromide ions in a solution of a medicine.

Describe briefly how you would carry out this test and state what you would observe.

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(3)

(Total 7 marks)

### Q12.

- (a) Anhydrous strontium chloride is not used in toothpaste because it absorbs water from the atmosphere. The hexahydrate,  $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$ , is preferred.

A chemist was asked to determine the purity of a sample of strontium chloride hexahydrate. The chemist weighed out 2.25 g of the sample and added it to 100 cm<sup>3</sup> of water. The mixture was warmed and stirred for several minutes to dissolve all of the strontium chloride in the sample. The mixture was then filtered into a conical flask. An excess of silver nitrate solution was added to the flask and the contents swirled for 1 minute to make sure that the precipitation was complete.

The silver chloride precipitate was separated from the mixture by filtration. The precipitate was washed several times with deionised water and dried carefully. The chemist weighed the dry precipitate and recorded a mass of 1.55 g.

- (i) Calculate the amount, in moles, of AgCl in 1.55 g of silver chloride ( $M_r = 143.4$ ).

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(1)



- (ii) The equation for the reaction between strontium chloride and silver nitrate is



Use your answer from part (i) and this equation to calculate the amount, in moles, of  $\text{SrCl}_2$  needed to form 1.55 g of silver chloride.

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(1)

- (iii) Use data from the Periodic Table to calculate the  $M_r$  of strontium chloride hexahydrate. Give your answer to 1 decimal place.

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(1)

- (iv) Use your answers from parts (a)(ii) and (a)(iii) to calculate the percentage by mass of strontium chloride hexahydrate in the sample. Show your working. Give your answer to the appropriate precision.

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(2)

- (v) Several steps in the practical procedure were designed to ensure an accurate value for the percentage by mass of strontium chloride hexahydrate in the sample.

1 Explain why the solution of strontium chloride was filtered to remove insoluble impurities before the addition of silver nitrate.

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(1)

2 Explain why the precipitate of silver chloride was washed several times with deionised water.

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(1)



(b) Magnesium hydroxide and magnesium carbonate are used to reduce acidity in the stomach. Magnesium hydroxide can be prepared by the reaction of solutions of magnesium chloride and sodium hydroxide.

(i) Write the **simplest ionic** equation for the reaction that occurs between magnesium chloride and sodium hydroxide.  
Include state symbols in your equation.

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(1)

(ii) Other than cost, explain one advantage of using magnesium hydroxide rather than magnesium carbonate to reduce acidity in the stomach.

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(1)

(c) Calcium ethanoate,  $(\text{CH}_3\text{COO})_2\text{Ca}$ , is used in the treatment of kidney disease. Thermal decomposition of calcium ethanoate under certain conditions gives propanone and **one** other product.

Write an equation for the thermal decomposition of calcium ethanoate.

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(1)

(d) Salts containing the chromate(VI) ion are usually yellow in colour.  
Calcium chromate(VI) is soluble in water.  
Strontium chromate(VI) is insoluble in water, but will dissolve in a solution of ethanoic acid.  
Barium chromate(VI) is insoluble in water and is also insoluble in a solution of ethanoic acid.

Describe a series of tests using solutions of sodium chromate(VI) and ethanoic acid that would allow you to distinguish between separate solutions of calcium chloride, strontium chloride and barium chloride.

State what you would observe in each test.

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(3)



- (e) The strontium salt of ranelic acid is used to promote bone growth. Analysis of a pure sample of ranelic acid showed that it contained 42.09% of carbon, 2.92% of hydrogen, 8.18% of nitrogen, 37.42% of oxygen and 9.39% of sulfur by mass.

Use these data to calculate the empirical formula of ranelic acid.  
Show your working.

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(2)  
(Total 15 marks)

### Q13.

A student investigated how the initial rate of reaction between sulfuric acid and magnesium at 20 °C is affected by the concentration of the acid.

The equation for the reaction is



- (a) The student made measurements every 20 seconds for 5 minutes. The student then repeated the experiment using double the concentration of sulfuric acid.

State a measurement that the student should make every 20 seconds. Identify the apparatus that the student could use to make this measurement.

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(2)

- (b) State **one** condition, other than temperature and pressure, that would need to be kept constant in this investigation.

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(1)



(c) When the student had finished the investigation, an excess of sodium hydroxide solution was added to the reaction mixture. This was to neutralise any unreacted sulfuric acid. The student found that a further reaction took place, producing magnesium hydroxide.

(i) Draw a diagram to show how the student could separate the magnesium hydroxide from the reaction mixture.

(2)

(ii) Suggest **one** method the student could use for removing soluble impurities from the sample of magnesium hydroxide that has been separated.

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(1)

(Total 6 marks)

#### Q14.

Barium chloride solution was added, dropwise, to magnesium sulfate solution until no more white precipitate was formed. The mixture was filtered.

Give the formulae of the **two** main ions in the filtrate.

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(Total 1 mark)

**Q15.**

- (a) Some scientists thought that the waste water from a waste disposal factory contained **two** sodium halides.

They tested a sample of the waste water.

They added three reagents, one after the other, to the same test tube containing the waste water.

The table below shows their results.

Reagent added	Observations
1. Silver nitrate solution (acidified with dilute nitric acid)	A cream precipitate formed
2. Dilute ammonia solution	A yellow precipitate remained
3. Concentrated ammonia solution	The yellow precipitate did not dissolve

- (i) Identify the yellow precipitate that did **not** dissolve in concentrated ammonia solution.  
Write the **simplest** ionic equation for the formation of this precipitate from silver ions and the correct halide ion.  
Identify the other sodium halide that must be present in this mixture of two sodium halides.

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(3)

- (ii) Give **one** reason why the silver nitrate solution was acidified before it was used in this test.

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(1)



- (iii) The method that the scientists used could **not** detect one type of halide ion. Identify this halide ion.  
Give **one** reason for your answer.

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(2)

- (b) The scientists thought that the waste water also contained dissolved barium ions. An aqueous solution of sodium sulfate can be used to test for the presence of dissolved barium ions.

Write the **simplest** ionic equation for the reaction between barium ions and sulfate ions to form barium sulfate.

State what is observed in this reaction.

Give a use for barium sulfate in medicine and explain why this use is possible, given that solutions containing barium ions are poisonous.

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(4)



**Q16.**

Copper(II) sulfate solution, together with copper(II) carbonate ( $\text{CuCO}_3$ ) powder, can be used to determine the identity of three solutions **A**, **B** and **C**. The three solutions are known to be hydrochloric acid, barium chloride, and sodium chloride.

In **Experiment 1** a small amount of copper(II) carbonate powder was added to each of the three solutions.

In **Experiment 2** a dropping pipette was used to add  $2 \text{ cm}^3$  of copper(II) sulfate solution to each of the three solutions.

The results of these experiments are shown in the table below.

	<b>Experiment 1</b> Addition of copper(II) carbonate powder	<b>Experiment 2</b> Addition of copper(II) sulfate solution
Solution <b>A</b>	no visible change	white precipitate
Solution <b>B</b>	no visible change	no visible change
Solution <b>C</b>	effervescence (bubbles of gas)	no visible change

- (a) Use the observations in the table to deduce which of the solutions, **A**, **B** or **C** is

hydrochloric acid \_\_\_\_\_

barium chloride \_\_\_\_\_

(2)

- (b) Explain why a precipitate was formed when copper(II) sulfate solution was added to solution **A**.

Write an equation for the reaction that occurred.

Explanation \_\_\_\_\_

\_\_\_\_\_

Equation \_\_\_\_\_

(2)

- (c) Suggest the identity for the colourless gas produced when copper(II) carbonate powder was added to solution **C**.

\_\_\_\_\_

(1)



- (d) Identify the two reagents that could be used in a test to confirm that the solutions contained chloride ions, **not** bromide ions. State what would be observed on addition of each reagent.

Reagent 1 \_\_\_\_\_

Observation 1 \_\_\_\_\_

\_\_\_\_\_

Reagent 2 \_\_\_\_\_

Observation 2 \_\_\_\_\_

\_\_\_\_\_

(4)

- (e) Copper(II) sulfate is toxic. Suggest **one** safety precaution you would take to minimise this hazard when wiping up a spillage of copper(II) sulfate solution.

\_\_\_\_\_

(1)

(Total 10 marks)



## Mark Scheme

### Q8.

(a) **M1** acidified potassium dichromate or  $K_2Cr_2O_7 / H_2SO_4$

**OR**  $K_2Cr_2O_7 / H^+$  **OR** acidified  $K_2Cr_2O_7$

**M2** (orange to) green solution **OR** goes green

**M3** (solution) remains orange or no reaction or no (observed) change

*If no reagent or incorrect reagent in **M1**, **CE = 0** and no marks for **M1**, **M2** or **M3***

*If incomplete / inaccurate attempt at reagent e.g. "dichromate" or "dichromate(IV)" or incorrect formula or no acid, **penalise M1 only and mark on***

*For **M2** ignore dichromate described as "yellow" or "red"*

*For **M3** ignore "nothing (happens)" or "no observation"*

Alternative using  $KMnO_4 / H_2SO_4$

**M1** acidified potassium manganate(VII) / potassium permanganate or  $KMnO_4 / H_2SO_4$

**OR**  $KMnO_4 / H^+$  **OR** acidified  $KMnO_4$

**M2** colourless solution **OR** goes colourless

**M3** (solution) remains purple or no reaction or no (observed) change

*For **M1***

*If incomplete / inaccurate attempt at reagent e.g. "manganate" or "manganate(IV)" or incorrect formula or no acid, **penalise M1 only and mark on***

*Credit alkaline  $KMnO_4$  for possible full marks but **M2** gives brown precipitate or solution goes green*

3

(b) **M1** (Shake with)  $Br_2$  **OR** bromine (water) **OR** bromine (in  $CCl_4$  / organic solvent)

**M2** (stays) orange / red / yellow / brown / the same

**OR** no reaction **OR** no (observed) change

**M3** decolourised / goes colourless / loses its colour / orange to colourless

*If no reagent or incorrect reagent in **M1**, **CE = 0** and no marks for **M1**, **M2** or **M3***

*If incomplete / inaccurate attempt at reagent (e.g.  $Br$ ), **penalise M1 only and mark on***

*No credit for combustion observations; **CE = 0***

*For **M2** in every case*

*Ignore "nothing (happens)"*

*Ignore "no observation"*

*Ignore "clear"*

**OR as alternatives****Use  $\text{KMnO}_4$  /  $\text{H}_2\text{SO}_4$** 

**M1** acidified potassium manganate(VII) / potassium permanganate **OR**  
 $\text{KMnO}_4$  /  $\text{H}_2\text{SO}_4$

**OR**  $\text{KMnO}_4$  /  $\text{H}^+$  **OR** acidified  $\text{KMnO}_4$

**M2** (stays) purple or no reaction or no (observed) change

**M3** decolourised / goes colourless / loses its colour

**Use iodine**

**M1 iodine** or  $\text{I}_2$  / KI or iodine solution

**M2** no change

**M3** decolourised / goes colourless / loses its colour

**Use concentrated sulfuric acid**

**M1** concentrated  $\text{H}_2\text{SO}_4$

**M2** no change

**M3** brown

*For M1, it must be a whole reagent and / or correct formula*

*For M1 penalise incorrect attempt at correct formula, but mark M2 and M3*

**With potassium manganate(VII)**

*If incomplete / inaccurate attempt at reagent e.g. "manganate" or "manganate(IV)" or incorrect formula or no acid, **penalise M1 only and mark on***

*Credit alkaline / neutral  $\text{KMnO}_4$  for possible full marks but M3 gives brown precipitate or solution goes green*

*Apply similar guidance for errors in the formula of iodine or concentrated sulfuric acid reagent as those used for other reagents.*

3

(c) **M1** Any soluble chloride including hydrochloric acid (ignore concentration)

**M2** white precipitate or white solid / white suspension

**M3** remains colourless or no reaction or no (observed) change or no precipitate or clear solution or it remains clear

**OR as an alternative**

**M1** Any soluble iodide including HI

**M2** yellow precipitate or yellow solid / yellow suspension



**M3** remains colourless or no reaction or no (observed) change or no precipitate or clear solution or it remains clear

**OR as an alternative**

**M1** Any soluble bromide including HBr

**M2** cream precipitate or cream solid / cream suspension

**M3** remains colourless or no reaction or no (observed) change or no precipitate or clear solution or it remains clear

**OR as an alternative**

**M1** NaOH or KOH or any soluble carbonate

**M2** brown precipitate or brown solid / brown suspension with NaOH / KOH  
(white precipitate / solid / suspension with carbonate)

**M3** remains colourless or no reaction or no (observed) change or no precipitate or clear solution or it remains clear

*If no reagent or incorrect reagent or insoluble chloride in **M1**, **CE = 0** and no marks for **M1**, **M2** or **M3***

*Allow chlorine water*

*If incomplete reagent (e.g. chloride ions) or inaccurate attempt at formula of chosen chloride, or chlorine, **penalise M1 only and mark on***

*For **M2** require the word "white" and some reference to a solid. Ignore "cloudy solution" OR "suspension" (similarly for the alternatives)*

*For **M3***

*Ignore "nothing (happens)"*

*Ignore "no observation"*

*Ignore "clear" on its own*

*Ignore "dissolves"*

3

(d) **M1** Any soluble sulfate including (dilute or aqueous) sulfuric acid

**M2** remains colourless or no reaction or no (observed) change or no precipitate or clear solution or it remains clear

**M3** white precipitate or white solid / white suspension

*If no reagent or incorrect reagent or insoluble sulfate in **M1**, **CE = 0** and no marks for **M1**, **M2** or **M3***

*Accept  $MgSO_4$  and  $CaSO_4$  but not barium, lead or silver sulfates*

*If concentrated sulfuric acid or incomplete reagent (e.g. sulfate ions) or inaccurate attempt at formula of chosen sulfate, **penalise M1 only and mark on***

*For **M3** (or **M2 in the alternative**) require the word "white" and some reference to a solid.*

*Ignore "cloudy solution" OR "suspension"*

*For **M2** (or **M3 in the alternative**)*



*Ignore "nothing (happens)"*

*Ignore "no observation"*

*Ignore "clear" on its own*

*Ignore "dissolves"*

**OR as an alternative**

**M1** NaOH or KOH

**M2** white precipitate or white solid / white suspension

**M3** remains colourless or no reaction or no (observed) change or no precipitate or clear solution or it remains clear

*If incomplete reagent (e.g. hydroxide ions) or inaccurate attempt at formula of chosen hydroxide, **penalise M1 only and mark on***

*If **M1** uses  $NH_3$  (dilute or concentrated) **penalise M1 only and mark on***

3

[12]

**Q9.**

(a) Compound 1

*If M1 incorrect, CE = 0*

**M1**  
1

No visible change with  $H_2SO_4$

**M2**  
1

Gives white ppt with NaOH

**M3**  
1

(b)  $BaCO_3$

1

The carbonate ion releases  $CO_2$

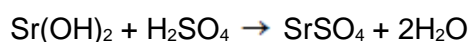
1

but the  $BaSO_4$  formed is highly insoluble.

1

(c) Compound 4

1



*Allow ionic equation; ignore state symbols*

1

[8]

**Q10.**



(a) 0.155 g per 100 cm<sup>3</sup>

**M1**

*Allow 0.153 – 0.157*

1

$(0.155 / 74.1) \times 10 = 0.0209 \text{ mol dm}^{-3}$

**M2**

*Allow 0.0206 – 0.0212*

1

Answer to 3 significant figures

**M3**

*The correct answer only loses M1*

1

(b) Take a known volume of the saturated solution

1

Evaporate the filtrate to dryness

*Allow titrate with dilute HCl or HNO<sub>3</sub> .....*

1

Weigh the residue

*.....of known / specified concentration*

*Ignore any references to indicators*

1

**[6]**

### Q11.

(a) (i)  $\text{SrCl}_2(\text{aq}) + \text{Na}_2\text{SO}_4(\text{aq}) \rightarrow \text{SrSO}_4(\text{s}) + 2\text{NaCl}(\text{aq})$

*Allow multiples, including fractions.*

*Allow ionic equations.*

*Lose this mark if any of the state symbols are missing or incorrect.*

1

(ii) Add nitric acid to the mixture (until in excess)

*Do not allow any suggestion that the solution is an emetic.*

1

Filter (to isolate strontium sulfate)

1

(b) Insoluble barium sulfate is formed

*Allow 'removes barium ions as a precipitate'.*

1

(c) Add silver nitrate, then dilute ammonia (solution) **M1**

*Do not allow answers which imply silver nitrate and ammonia are added at the same time.*

*Allow 'add silver nitrate, then concentrated ammonia (solution)'.*



Can score **M1** in the answer for **M3**

1

Cream precipitate **M2**

Allow 'off white precipitate'.

1

No visible change or precipitate dissolves slightly in dilute ammonia **M3**

Allow 'soluble / colourless solution / precipitate dissolves in concentrated ammonia'.

Allow 3 marks for:

Add dilute ammonia (solution), then silver nitrate **M1**

No visible change **M2**

Cream / off white precipitate with silver nitrate **M3**

1

[7]

### Q12.

(a) (i)  $1.08 \times 10^{-2}$

Do not penalise precision but must be to at least 2 significant figures.

Do not accept  $1 \times 10^{-2}$

1

(ii)  $5.4(0) \times 10^{-3}$

Allow (i) / 2

Do not penalise precision but must be to at least 2 significant figures.

1

(iii) 266.6

Lose this mark if answer not given to 1 decimal place.

1

(iv) mass =  $5.4(0) \times 10^{-3} \times 266.6 = 1.44 \text{ g}$  **M1**

Allow (ii)  $\times$  (iii).

1

percentage =  $1.44 \times 100 / 2.25 = 64.0$  **M2**

Allow consequential answer from **M1**

Lose this mark if answer not given to 3 significant figures.

Correct answer with no working scores **M2** only.

1

(v) 1 Would give an incorrect / too large mass (of silver chloride)  
Do not allow 'to get an accurate result' without qualification.

1

2 To remove soluble impurities / excess silver nitrate (solution) / strontium nitrate (solution)

Do not allow 'to remove impurities'.

Do not allow 'to remove excess strontium chloride solution'.



(b) (i)  $\text{Mg}^{2+}(\text{aq}) + 2\text{OH}^{-}(\text{aq}) \rightarrow \text{Mg}(\text{OH})_2(\text{s})$   
 Allow  $\text{Mg}^{2+}(\text{aq}) + 2\text{OH}^{-}(\text{aq}) \rightarrow \text{Mg}^{2+}(\text{OH})_2(\text{s})$   
 Allow multiples, including fractions.  
 Lose mark if state symbols are missing or incorrect.  
 Lose mark if incorrect charge on an ion.

1

(ii) Does not produce  $\text{CO}_2$  / gas which distends stomach / does not produce wind / does not increase pressure in stomach  
 Allow 'prevents flatulence' and 'prevents burping'.  
 Do not allow 'gas' without qualification.

1

(c)  $(\text{CH}_3\text{COO})_2\text{Ca} \rightarrow \text{CH}_3\text{COCH}_3 + \text{CaCO}_3$   
 Allow multiples.  
 Allow propanone as  $\text{C}_3\text{H}_6\text{O}$   
 Allow  $(\text{CH}_3\text{COO}^{-})_2\text{Ca}^{2+} \rightarrow \text{CH}_3\text{COCH}_3 + \text{Ca}^{2+}\text{CO}_3^{2-}$

1

(d) Ca (salt) - no visible change with sodium chromate(VI) **M1**  
 Allow 'yellow solution formed' or 'no ppt. forms'.  
 Allow **M1** and **M2** in any order.

1

Sr and Ba (salts) give (yellow) precipitate with sodium chromate(VI) **M2**  
 Lose this mark if precipitate has an incorrect colour.

1

Sr precipitate (chromate(VI)) dissolves in ethanoic acid / Ba precipitate (chromate(VI)) does not dissolve in ethanoic acid **M3**  
 If ethanoic acid is added first, allow access to **M1** and **M3**.

1

(e) C 42.09 / 12, H 2.92 / 1, N 8.18 / 14, O 37.42 / 16 and S 9.39 / 32.1  
 Accept any other correct method of working.  
 If relative atomic mass has been divided by the percentage composition is used then CE = 0 / 2

1

$\text{C}_{12}\text{H}_{10}\text{N}_2\text{O}_8\text{S}$   
 Correct answer with no working scores 1 mark only.

1

[15]

**Q13.**

(a) (Measure the) volume of gas / mass of the container + contents

1

Suitable named piece of equipment

Gas syringe (or inverted burette or measuring cylinder, as long as



*student has referred to the cylinder being filled with water) / balance.*

*Equipment must be correct for the measurement stated.*

1

(b) Any **one** of:

- Mass of magnesium  
*Allow amount of magnesium.*
- Surface area of magnesium

1

(c) (i) Gravity: Conical flask or beaker and funnel /

Vacuum: Sealed container with a side arm and Buchner or Hirsch funnel  
*Must be either gravity filtration (with a V-shaped funnel) or vacuum filtration (with a side-arm conical flask) appropriately drawn.*

1

Filter paper

*Must show filter paper as at least two sides of a triangle (V-shaped) for gravity filtration or horizontal filter paper for vacuum filtration.*

1

- (ii) Wash with / add (a small amount of cold) water  
*Ignore filtering.*

1

[6]

### Q14.

Mg<sup>2+</sup> and Cl<sup>-</sup>

*Do not allow names.*

[1]

### Q15.

- (a) (i) **M1** (yellow precipitate is) silver iodide OR AgI (which may be awarded from the equation)

**M2** Ag<sup>+</sup> + I<sup>-</sup> → AgI (Also scores M1 unless contradicted)

**M3** sodium chloride OR NaCl

*For M2*

*Accept multiples*

*Ignore state symbols*

*Allow crossed out nitrate ions, but penalise if not crossed out*

3

- (ii) The silver nitrate is acidified to



- react with / remove ions that would interfere with the test
- prevent the formation of other silver precipitates / insoluble silver compounds that would interfere with the test
- remove (other) ions that react with the silver nitrate
- react with / remove carbonate / hydroxide / sulfite (ions)  
*Ignore reference to “false positive”*

1

(iii) **M1 and M2 in either order****M1** Fluoride (ion) OR F

- M2**
- Silver fluoride / AgF is soluble / dissolves (in water)
  - no precipitate would form / no visible / observable change  
*Do not penalise the spelling “fluoride”,  
Penalise “fluride” once only  
Mark M1 and M2 independently*

2

(b) **M1**  $\text{Ba}^{2+} + \text{SO}_4^{2-} \rightarrow \text{BaSO}_4$ 

(or the ions together)

**M2** white precipitate / white solid / white suspension**M3** Barium meal or ( internal ) X-ray or to block X-rays**M4** BaSO<sub>4</sub> / barium sulfate is insoluble (and therefore not toxic)*For M1, ignore state symbols**Allow crossed out sodium ions, but penalise if not crossed out**For M2, ignore “milky”**If BaSO<sub>3</sub> OR BaS used in M1 and M4, penalise once only**For M3 Ignore radio-tracing**For M4 NOT barium ions**NOT barium**NOT barium meal**NOT “It” unless clearly BaSO<sub>4</sub>*

4

(c) **M1** 2(12.00000) + 4(1.00794) = 28.03176**M2** Ethene and CO or “they” have an imprecise **M<sub>r</sub>** of 28.0 / 28

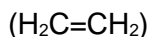
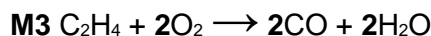
OR

Ethene and CO or “they” have the same M<sub>r</sub> to one d.p.

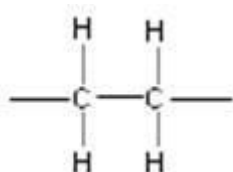
OR



These may be shown by two clear, simple sums identifying both compounds



**M4** Displayed formula



**M5** Type of polymer = Addition (polymer)

*M1 must show working using 5 d.p. for hydrogen*

*Penalise "similar" or "close to", if this refers to the imprecise value in M2, since this does not mean "the same"*

*For M3, accept  $CH_2=CH_2$  OR  $CH_2CH_2$*

*For M4, all bonds must be drawn out including those on either side of the unit.*

*Penalise "sticks"*

*Ignore brackets around **correct** repeating unit but penalise "n"*

*Penalise "additional"*

5

[15]

**Q16.**

(a) Hydrochloric acid = **C**

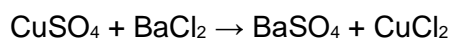
1

Barium chloride = **A**

1

(b) Barium sulfate is insoluble

1



*Accept multiples.*

*Accept ionic equation.*

*Do not penalise lack of state symbols, but if used they must be correct.*

1

(c)  $CO_2$  / Carbon dioxide

1

(d) Reagent 1 silver nitrate (solution)

*Ignore lack of reference to acidifying prior to addition of silver nitrate solution.*

1



Observation 1 <u>White precipitate</u>	1
Reagent 2 (dilute) ammonia solution / aqueous ammonia <i>Do not accept addition of <b>ammonia</b> only.</i>	1
Observation 2 (Colourless) solution <i>Allow ppt dissolves. Do not allow 'goes colourless' or 'goes clear'. Chlorine and no visible change or solution does not become orange scores M3 and M4.</i>	1
(e) Gloves / wash hands after use <i>Ignore 'eye protection'. Do not accept 'do not ingest the chemicals', 'wipe up spillages', 'use a fume cupboard', 'wear a lab coat' (list principle).</i>	1
	<b>[10]</b>