Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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Making salts

Time allowed: 1 hour 30 minutes

Subject code **0620**

Chemistry

Questions from Paper 4 and Paper 6

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.

Total marks

/ 67

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.

Information

- This paper has 9 questions worth 67 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

1 The following instructions were used to prepare magnesium sulfate crystals, $MgSO_4.7H_2O$.

Step 1 Measure 50 cm^3 of dilute sulfuric acid into a beaker and warm the solution.

Step 2 Using a spatula, add some magnesium oxide and stir the mixture. Continue adding the magnesium oxide until excess is present.

Step 3 Separate the excess magnesium oxide from the solution of magnesium sulfate.

Step 4 Heat the solution until crystals form. Obtain the crystals and dry them.

(a) Why is the sulfuric acid warmed?

..... [1]

(b) How would you know when excess magnesium oxide is present in **Step 2**?

..... [1]

(c) What method is used in **Step 3**?

..... [1]

(d) Why must care be taken when drying the crystals in **Step 4**?

..... [1]

(e) Explain how the method would differ if magnesium carbonate was used instead of magnesium oxide.

.....

..... [2]

[Total: 6]

Preparation of salts Click for more variations

1 **(a)** to speed up the reaction [1]

(b) solid visible owtte e.g. no more solid will dissolve [1]

(c) filtration / centrifuge **not** decant [1]

(d) to make sure water (of crystallisation) is not lost / stop dehydration /
so crystals do not turn into powder / does not decompose **not** crystals break [1]

(e) no heat needed / not necessary to warm acid (1)
carbonates react with acid at room temperature (1)
no bubbles would indicate that carbonate is in excess (1) [max 2]

[Total: 6]

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2 The notes below show the steps taken by a student to prepare crystals of hydrated nickel nitrate, $Ni(NO_3)_2.6H_2O$.

Step 1 Place 25 cm^3 of dilute nitric acid in a beaker.

Step 2 Add nickel carbonate powder to the beaker until it is in excess.

Step 3 Separate the solution of nickel nitrate from the mixture.

Step 4 Heat the solution to obtain crystals of hydrated nickel nitrate.

(a) (i) Name the piece of apparatus used to measure the nitric acid in **Step 1**.

..... [1]

(ii) Why is it **not** necessary to heat the dilute nitric acid before adding the nickel carbonate?

..... [1]

(b) How would the student know when excess nickel carbonate was present in **Step 2**?

..... [1]

(c) Draw a diagram to show the separation method used in **Step 3**.

[2]

(d) How could the student make sure a good sample of crystals was obtained when carrying out **Step 4**? Explain your answer.

.....

.....

..... [2]

[Total: 7]

Preparation of salts Click for more variations

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2 **(a)** **(i)** measuring cylinder [1]

(ii) reaction will happen / is fast with cold acid [1]

(b) solid / powder visible / no more solid dissolves / fizzing stops when powder added [1]
not precipitate forms, **not** stops reacting

(c) diagram of funnel (1) and filter paper within (1) [2]

(d) heat to crystallising point owtte (1) to prevent loss of water of crystallisation (1) [2]
not heat and leave to cool

[Total: 7]

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3 Potassium sulfate is the salt produced when sulfuric acid is neutralised by potassium hydroxide solution.
The correct amount of potassium hydroxide solution must be added to neutralise all of the sulfuric acid.
Plan an experiment to obtain pure crystals of potassium sulfate from sulfuric acid and potassium hydroxide solution.
You are provided with common laboratory apparatus.

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..... [6]

[Total: 6]

Preparation of salts Click for more variations

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3	**making the salt** any 4 from: • known volume sulfuric acid; • add named indicator; • add potassium hydroxide solution to the acid until the indicator changes colour / is neutralised; • note / measure the volume of potassium hydroxide solution added; • repeat without indicator **OR** add (decolourising) charcoal; **obtaining crystals** any 2 from: • heat / evaporate solution to crystallising point until half evaporated **OR** until crystals (start to) form **OR** until saturated; • leave to cool; • filter to get crystals; • dry crystals (on filter paper) / leave to dry;	**6**

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4 Solid cobalt(II) oxide is a base which is insoluble in water. It reacts very slowly with cold dilute sulfuric acid to form a solution of cobalt(II) sulfate.

Describe how to make pure, dry crystals of hydrated cobalt(II) sulfate.

You are provided with cobalt(II) oxide, dilute sulfuric acid and common laboratory apparatus.

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.... [6]

Preparation of salts Click for more variations

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4	**any 6 from** **MP1** adds cobalt(II) oxide to (dilute) sulfuric acid in a suitable container	6
	MP2 cobalt(II) oxide is in excess	
	MP3 the mixture is stirred / mixed	
	MP4 the acid / mixture is heated/warmed	
	MP5 filter (to remove (excess) cobalt(II) oxide)	
	MP6 heat filtrate / solution / leave to evaporate (reject heat to dryness)	
	MP7 filter out crystals / **description** of drying crystals	

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5 Lead(II) chloride, $PbCl_2$, is an insoluble salt. Solid lead(II) chloride can be made by reacting aqueous sodium chloride with aqueous lead(II) nitrate.

$$2NaCl(aq) + Pb(NO_3)_2(aq) \rightarrow 2NaNO_3(aq) + PbCl_2(s)$$

Describe how to make a pure, dry sample of solid lead(II) chloride.

You are provided with solid sodium chloride, solid lead(II) nitrate, distilled water and common laboratory apparatus.

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.... [6]

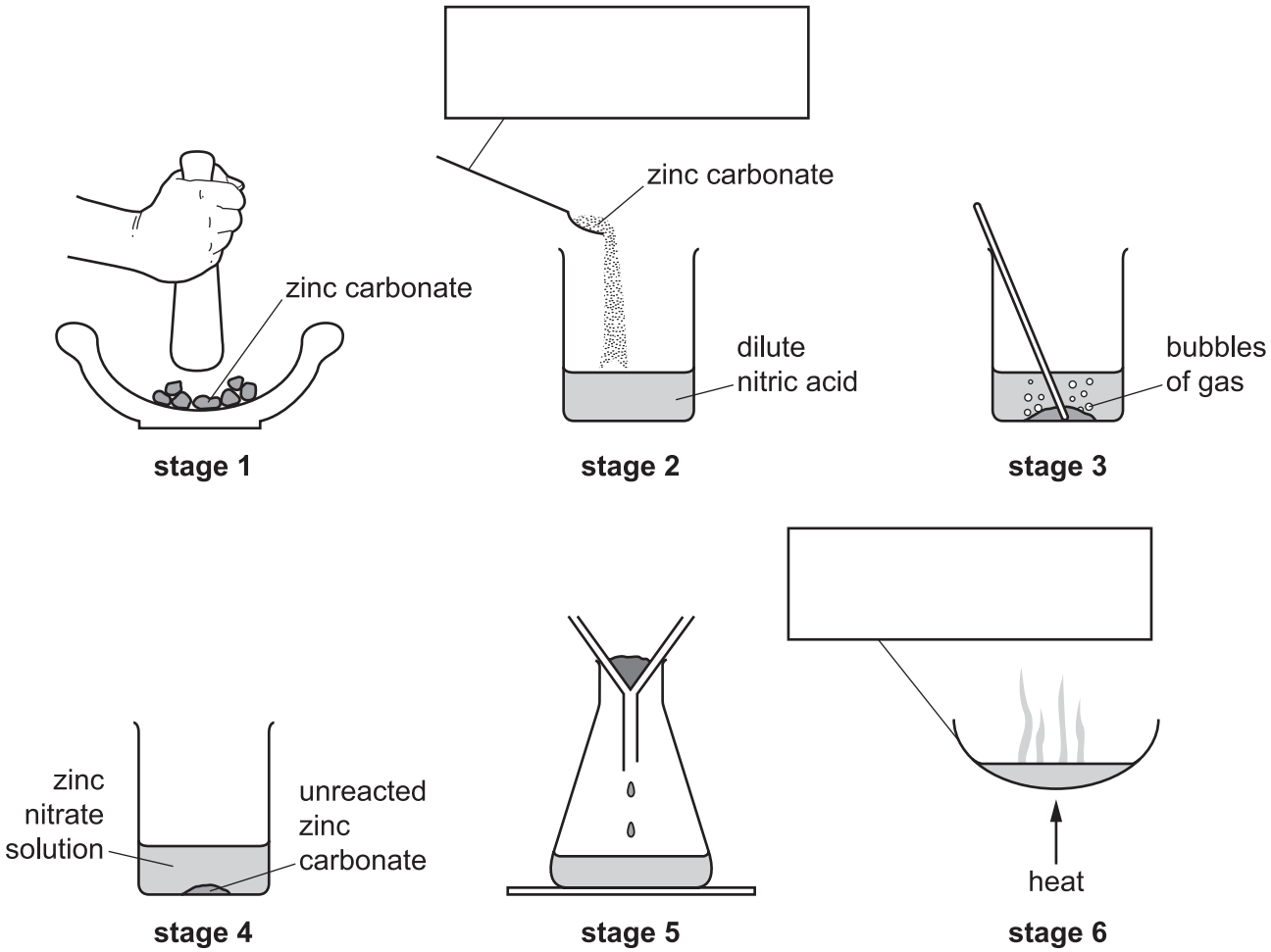
Preparation of salts Click for more variations

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5	any 6 points from: • add sodium chloride / lead nitrate to water • stir / mix / shake (to dissolve) • add / combine / mix the two reactants together • use of a suitable container • filter (to obtain lead(II) chloride as residue) • pour water over the residue (in the funnel) • description of how to dry the solid	**6**

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6 The diagrams show the stages in the preparation of zinc nitrate crystals from lumps of zinc carbonate.



(a) Complete the boxes to show the apparatus used. [2]

(b) Use the diagrams to write a list of instructions for the stages of this preparation.

(i) stages 1, 2, 3 and 4

.....

.....

..... [3]

(ii) stage 5

..... [1]

(iii) stage 6

.....

..... [2]

[Total: 8]

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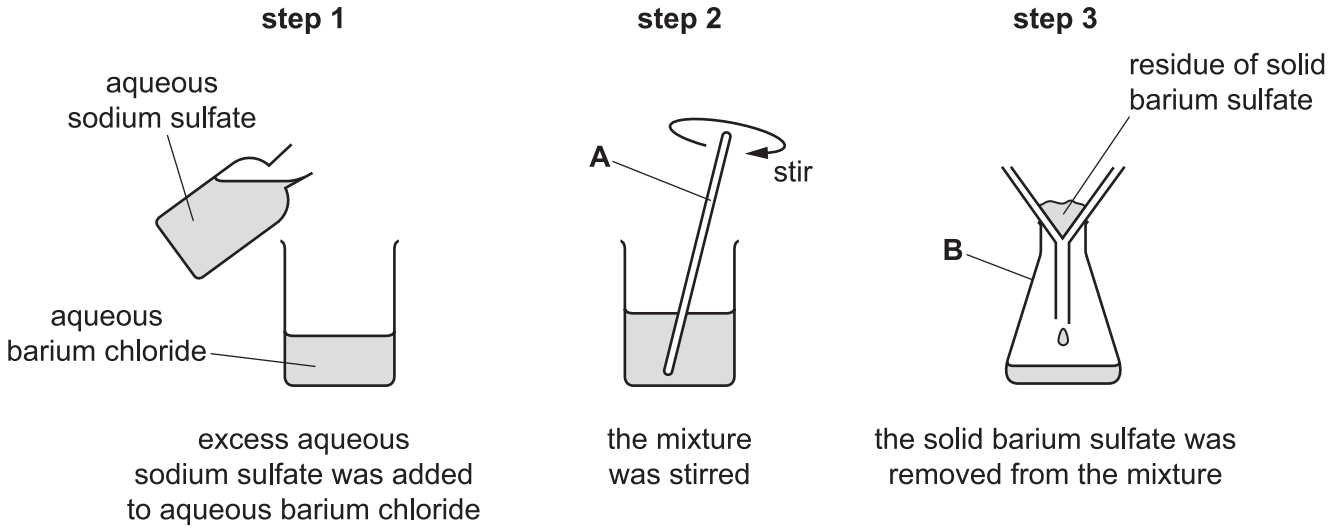
Preparation of salts Click for more variations

6(a)	spatula; evaporating dish / basin;	1 1	**A:** spoon **R:** watch glass / clock glass / crucible / petri dish
6(b)(i)	crush / powder / grind / pound zinc carbonate; add to acid **and** stir / mix; (until) no more bubbles / excess carbonate / solid remains;	1 1 1	**I:** reaction is over
6(b)(ii)	filter / filtration etc.;	1	**R:** 'filter funnel' / 'filter paper' only
6(b)(iii)	2 from: • evaporate; • until crystallisation point / crystals (start to) form / saturated; • leave to cool;	1	**I:** heat or evaporating basin (in diagram) **R:** 'to dryness'

7 Barium sulfate is an insoluble salt. Barium sulfate can be made by reacting excess aqueous sodium sulfate with aqueous barium chloride.

sodium sulfate + barium chloride → sodium chloride + barium sulfate

A student made a sample of barium sulfate using the following steps.



(a) Name the items of apparatus labelled **A** and **B**.

A .....

B .....

[2]

(b) Name the process shown in **step 3**.

..... [1]

(c) The general name for the solid in **step 3** is residue.

State the general name for the solution obtained from the process in **step 3**.

..... [1]

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(d) Two more steps, **step 4** and **step 5**, are needed to obtain a pure sample of barium sulfate. In each of these steps something is removed from the residue.

State what is done in each of **step 4** and **step 5** and identify the substance removed from the barium sulfate.

step 4 .....

.....

substance removed .....

step 5 .....

.....

substance removed .....

[4]

[Total: 8]

Preparation of salts Click for more variations

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7(a)	**A** glass / stirring rod	**1**
	B (conical) flask	**1**
7(b)	filtration	**1**
7(c)	filtrate	**1**
7(d)	step 4: wash / rinse (with water)	**1**
	to remove sodium sulfate / sodium chloride	**1**
	step 5: dry	**1**
	water	**1**

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8 Three common methods of preparing salts are shown below.

method **A** adding an excess of an insoluble base or carbonate or metal to a dilute acid and removing excess by filtration

method **B** using a burette and indicator

method **C** mixing two solutions to obtain the salt by precipitation

For each of the following salt preparations, choose a method, **A**, **B** or **C**. Name any additional reagent which is needed and complete the equation.

(a) the soluble salt, nickel chloride, from the insoluble compound nickel carbonate

method .....

reagent .....

word equation .....

[3]

(b) the insoluble salt, lead(II) bromide, from aqueous lead(II) nitrate

method .....

reagent .....

ionic equation ..... + ... → $PbBr_2$

[3]

(c) the soluble salt, lithium sulfate, from the soluble base lithium hydroxide

method .....

reagent .....

equation .....

[4]

[Total: 10]

Preparation of salts Click for more variations

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8(a)	method A; hydrochloric acid / HC*l* / hydrogen chloride solution; nickel carbonate + hydrochloric acid → nickel chloride + water + carbon dioxide;	3	hydrochloric acid / HC*l* can only score if written in the reagent space i.e. **R** hydrochloric acid / HC*l* in equation if reagent space is blank **I** hydrogen chloride (therefore 'hydrogen chloride + HC*l*' would get mark 2 BOD) **I** nickel carbonate **A** fully correct balanced chemical equation i.e. $NiCO_3 + 2HCl \rightarrow NiCl_2 + CO_2 + H_2O$ for the third mark **R** combination of words and formulae in the same equation for the third mark **I** concentration of acid for marks 2 and 3
8(b)	method C; any (aqueous / dilute / solution of soluble) bromide including potassium bromide / KBr, hydrogen bromide / HBr i.e. all bromides except silver, lead and mercury; $Pb^{2+} + 2Br^- \rightarrow PbBr_2$;	3	**A correct** formula of soluble bromide **I** lead nitrate **I** state symbols **A** multiples

8(c)	method B; sulfuric acid / hydrogen sulfate / H_2SO_4 ; $2LiOH + H_2SO_4 \rightarrow Li_2SO_4 + 2H_2O$ species; balancing;	4	**I** concentration of acid for mark 2 **I** indicators / lithium hydroxide **I** state symbols **A** multiples

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9 Three ways of making salts are

- titration using a soluble base or carbonate
- neutralisation using an insoluble base or carbonate
- precipitation.

(a) Complete the following table of salt preparations.

method	reagent 1	reagent 2	salt
titration	....	....	sodium nitrate
neutralisation	nitric acid	....	copper(II) nitrate
precipitation	....	....	silver(I) chloride
neutralisation	sulfuric acid	zinc(II) carbonate	....

[6]

(b) (i) Write an ionic equation with state symbols for the preparation of silver(I) chloride.

..... [2]

(ii) Complete the following equation.

$ZnCO_3 + H_2SO_4 \rightarrow$ ..... + ... + ...

[2]

[Total: 10]

Preparation of salts Click for more variations

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9 **(a)** nitric acid; [1]
sodium hydroxide / carbonate / hydrogen carbonate; [1]

copper(II) oxide / hydroxide / carbonate; [1]

any named soluble chloride; [1]
accept: *hydrochloric acid* / *hydrogen chloride*
silver(I) nitrate / ethanoate / sulfate; [1]
must be soluble silver salt **not** *silver oxide* / *carbonate*

zinc(II) sulfate [1]

(b) **(i)** $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$ [2]
equation correct state symbols missing [1]

(ii) $ZnCO_3 + H_2SO_4 \rightarrow ZnSO_4 + CO_2 + H_2O$ [2]
correct formula for zinc sulfate = 1

[Total: 10]

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