Past-paper walk-through

Preparation of salts ▪ 7.3

eXercise

Questions in this set

- 0620/21 N25 Q21 ▪ 1 mark
- 0620/22 N25 Q20 ▪ 1 mark
- 0620/23 N25 Q11 ▪ 1 mark
- 0620/41 N25 Q3 ▪ 14 marks
- 0620/42 N25 Q3 ▪ 13 marks
- 0620/43 N25 Q5 ▪ 12 marks
- 0620/21 J25 Q19 ▪ 1 mark
- 0620/61 J25 Q1 ▪ 9 marks
- 0620/22 M25 Q24 ▪ 1 mark

Reading the mark scheme

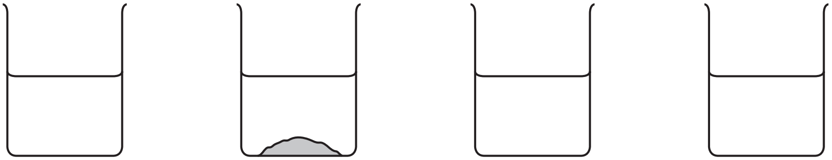
- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

Question 21

0620/21 N25 ▪ Q21 ▪ 1 mark

21 A student adds different solid salts to an excess of water. The student stirs the mixtures to determine the solubilities of the salts.

The results are shown.



Question 21

W X Y Z

What could the four different salts be?

	W	X	Y	Z
A	calcium sulfate	lead(II) chloride	ammonium nitrate	potassium sulfate
B	ammonium nitrate	sodium carbonate	calcium sulfate	lead(II) chloride
C	sodium carbonate	calcium sulfate	potassium sulfate	ammonium nitrate
D	lead(II) chloride	ammonium nitrate	sodium carbonate	calcium sulfate

Solution 21

Answer: **C**

Why

- Compare how much solid is left undissolved in each tube.
- A salt that dissolves completely is soluble; one that leaves most of the solid is insoluble.
- Then match the pattern to the standard solubility rules – all nitrates are soluble, most carbonates are not.

Question 20

0620/22 N25 ▪ Q20 ▪ 1 mark

20 Which method is used to prepare a pure, dry sample of lead(II) chloride?

A mix aqueous lead(II) nitrate and dilute hydrochloric acid → filter → crystallise and dry the filtrate

B mix aqueous lead(II) nitrate and dilute hydrochloric acid → filter → wash and dry the residue

C mix solid lead(II) hydroxide and aqueous sodium chloride → filter → crystallise and dry the filtrate

D mix solid lead(II) hydroxide and aqueous sodium chloride → filter → wash and dry the residue

Solution 20

Answer: **B**

Why

- Lead(II) chloride is insoluble, so it appears as a precipitate.
- The precipitate is the *residue* on the filter paper – it must be washed and dried.
- Crystallising the filtrate instead would give the soluble by-product, not the salt wanted.

Question 11

0620/23 N25 ▪ Q11 ▪ 1 mark

11 Which statement describes a saturated solution?

A It is a solution that contains the maximum concentration of solute.

B It is a solution that contains the maximum amount of solvent.

C It is a hydrocarbon that contains both double and single bonds.

D It is a hydrocarbon that contains only single bonds.

Solution 11

Answer: **A**

Why

- A saturated solution holds as much dissolved solute as it possibly can at that temperature.
- So it contains the maximum *concentration* of solute.
- The word “saturated” has a completely different meaning for a hydrocarbon – do not mix the two up.

Question 3

0620/41 N25 ▪ Q3 ▪ 14 marks

3 A student makes crystals of the salt sodium sulfate, Na_2SO_4. The student reacts 0.200 mol/dm^3 dilute sulfuric acid, H_2SO_4(aq), with aqueous sodium hydroxide, NaOH(aq).

The student uses the following steps.

step 1 The student places 40.0 cm^3 of NaOH(aq) into a conical flask. This volume contains 0.0100 moles of NaOH.

step 2 The student adds a few drops of methyl orange indicator to the NaOH(aq) in the conical flask.

step 3 The student adds 0.200 mol/dm^3 H_2SO_4(aq) to the flask until the end-point is reached.

step 4 The student transfers the mixture from the conical flask to an evaporating basin and obtains dry crystals.

(a) Complete the symbol equation for the reaction. Include state symbols.

Question 3

Question 3

[2]

(b) State the type of exothermic reaction taking place.

Question 3

(c) Calculate the concentration of NaOH(aq) used in **step 1**.

Question 3

(d) Name the item of apparatus the student uses to add $H_2SO_4(aq)$ in **step 3**.

Question 3

(e) Calculate the volume of $H_2SO_4(aq)$, in cm^3, added in **step 3**.

Question 3

(f) State the colour change observed in **step 3**.

Question 3

(g) The dry crystals formed in **step 4** are coloured and **not** white. This is because the student should do an additional step between **step 3** and **step 4**.

Suggest what the student should do in this additional step to produce white crystals.

Question 3

(h) In **step 4**, the student gently heats the solution in the evaporating basin until the solution is saturated. The student then stops heating and leaves the hot solution to cool. Crystals start to appear.

(i) Explain the term saturated solution.

Question 3

(ii) Explain why crystals start to appear as the hot solution cools.

Question 3

(iii) Suggest the effect, if any, on the mass of crystals collected in **step 4** if the solution in the evaporating basin is allowed to dry without gentle heating.

Question 3

[Total: 14]

Solution 3

(a)

Mark scheme

- M1 2H2O M2
- state symbols (aq) and (l)
- 2

Solution 3

(b)

Mark scheme

- neutralisation
- 1

Solution 3

(c)

Mark scheme

- $0.0100 \times 1000 \div 40 = 0.25(0)$
- 1

Solution 3

(d)

Mark scheme

- burette
- 1

Solution 3

(e)

Mark scheme

- M1 mol H2SO4 needed $= 0.0100 \div 2 = 0.005(00)$ M2
- vol of H2SO4 needed $= 0.005(00) \div 0.200 \times 1000 = 25$ (cm3)
- 2

Solution 3

(f)

Mark scheme

- M1 yellow M2
- orange
- 2

Solution 3

(g)

Mark scheme

- repeat steps 1 and 3 without indicator
- 1

Solution 3

(h)(i)

Mark scheme

- M1 (a solution containing the) maximum concentration of a solute dissolved in the solvent M2
- at a specified temperature
- 2

Solution 3

(h)(ii)

Mark scheme

- solubility decreases as temperature decreases
- 1

Solution 3

(h)(iii)

Mark scheme

- none
- 1
- 0620/41
- October/November 2025

Question 3

0620/42 N25 ▪ Q3 ▪ 13 marks

3 A student prepares a sample of the insoluble salt barium sulfate, $BaSO_4$.
The student adds aqueous sodium sulfate, Na_2SO_4(aq), to aqueous barium chloride, $BaCl_2$(aq).

The student carries out the following steps.

step 1 Dissolve 0.100 moles of solid $BaCl_2$ in 100 cm^3 of distilled water in a beaker to form $BaCl_2$(aq).

step 2 Add an aqueous solution which contains 0.100 moles of Na_2SO_4(aq) to the beaker containing the $BaCl_2$(aq) from **step 1**.

step 3 Stir the mixture and then filter it.

step 4 Dry the solid left in the filter paper.

(a) Complete the symbol equation for the reaction. Include state symbols.

Question 3

[2]

(b) Calculate the mass of solid $BaCl_2$ dissolved in **step 1**.

Question 3

(c) The concentration of Na_2SO_4(aq) in **step 2** is 1.25 mol / dm^3.

Calculate the volume, in cm^3, of 1.25 mol / dm^3 Na_2SO_4(aq) added in **step 2** which contains 0.100 moles of Na_2SO_4.

Question 3

(d) State the colour of the solid formed in **step 2**.

Question 3

(e) The mixture is filtered in **step 3**.

State the general term given to a solid left in the filter paper after filtration.

Question 3

(f) The actual mass of dry $BaSO_4$ collected in **step 4** is greater than the expected mass. This is because the student should do an additional step between **step 3** and **step 4**.

Suggest what the student should do in this additional step, and explain why the actual mass collected is greater than the expected mass.

Question 3

(g) State the name of this method of salt preparation.

Question 3

(h) State the name of a different:

Question 3

[3]

[Total: 13]

Solution 3

(a)

Mark scheme

- $\rightarrow$ BaSO4(s) + 2NaCl(aq) **M1**
- 2NaCl (only) **M2**
- (s) and (aq)
- 2

Solution 3

(b)

Mark scheme

- M1 Mr $BaCl2 = 208$ M2
- $208 \times 0.1 = 20.8$
- 2

Solution 3

(c)

Mark scheme

- $0.100 \div 1.25\ (\times\ 1000) = 80\,(\mathrm{cm3})$
- 1

Solution 3

(d)

Mark scheme

- white
- 1

Solution 3

(e)

Mark scheme

- residue
- 1

Solution 3

(f)

Mark scheme

- M1 rinsing the residue (with water) M2
- (mass was greater) because (dry) residue contains solid sodium chloride / NaCl adds to the mass (of residue)
- 2

Solution 3

(g)

Mark scheme

- precipitation
- 1

Solution 3

(h)

Mark scheme

- M1 named soluble barium salt other than barium chloride e.g. (barium) nitrate M2
- named soluble sulfate salt other than sodium sulphate e.g. potassium (sulfate) / ammonium (sulfate) M3
- named insoluble barium salt other than barium sulfate e.g. (barium) carbonate
- 3

Question 5

0620/43 N25 ▪ Q5 ▪ 12 marks

5 This question is about metallic compounds.

(a) Insoluble metal salts, such as lead(II) sulfate, are made by precipitation.

When aqueous lead(II) ions react with aqueous sulfate ions, a precipitate of lead(II) sulfate forms.

A sample of pure lead(II) sulfate can be obtained from the precipitate formed.

(i) Write an ionic equation for this precipitation reaction. Include state symbols.

Question 5

(ii) State the name of an aqueous solution containing lead(II) ions.

Question 5

(iii) State the name of an aqueous solution containing sulfate ions.

Question 5

(iv) The lead(II) sulfate precipitate is separated from the rest of the reaction mixture by filtration. The impure lead(II) sulfate remains on the filter paper.

State the general term given to an insoluble substance that remains on the filter paper during filtration.

Question 5

(v) Describe how the lead(II) sulfate is purified after filtration.

Question 5

(b) Copper is a transition element.

A list of properties of copper is shown.

- It has good electrical conductivity.
- It has variable oxidation states.
- It forms soluble salts.
- It forms coloured compounds.
- It forms basic oxides.
- It acts as a catalyst.

(i) Give **two** properties from the list that show how copper is similar to metals in Group I of the Periodic Table.

Question 5

Question 5

[2]

(ii) Give **two** properties from the list that show how copper is different from metals in Group I of the Periodic Table.

Question 5

Question 5

[2]

[Total: 12]

Solution 5

(a)(i)

Mark scheme

- Pb2+(aq) + SO42– (aq) $\rightarrow$ PbSO4(s) M1
- PbSO4 as the ONLY formula on the right M2
- ONLY Pb2+ and SO42– on the left M3
- state symbols
- 3

Solution 5

(a)(ii)

Mark scheme

- lead(II) nitrate
- 1

(a)(iii)

Mark scheme

- sodium sulfate / potassium sulfate / ammonium sulfate
- 1

Solution 5

(a)(iv)

Mark scheme

- residue
- 1

Solution 5

(a)(v)

Mark scheme

- M1 wash with distilled water M2
- suitable method of drying
- 2

Solution 5

(b)(i) Mark scheme

- any two from:
- ▪
- good conductor of electricity
- ▪
- soluble salts
- ▪
- basic oxides
- 2

Solution 5

(b)(ii) Mark scheme

- any two from:
- ▪
- variable oxidation states
- ▪
- coloured compounds
- ▪
- catalyst
- 2

Solution 5

- 0620/43
- October/November 2025

Question 19

0620/21 J25 ▪ Q19 ▪ 1 mark

19 Lead(II) sulfate is an insoluble salt.

Which process is **not** used to prepare a pure sample of this salt?

A crystallisation

B drying

C filtration

D precipitation

Solution 19

Answer: **A**

Why

- An insoluble salt is made by precipitation, then filtered, washed and dried.
- Crystallisation is for a *soluble* salt, where the solvent is evaporated to grow crystals.
- So crystallisation is the one process not needed here.

Question 1

0620/61 J25 ▪ Q1 ▪ 9 marks

1 A student prepares some crystals of pure potassium sulfate by reacting aqueous potassium carbonate with dilute sulfuric acid. The equation for the reaction is shown.

$$K_2CO_3(aq) + H_2SO_4(aq) \rightarrow K_2SO_4(aq) + H_2O(l) + CO_2(g)$$

The student:

- places 25.0 cm^3 of aqueous potassium carbonate in a conical flask
- adds a few drops of a suitable indicator to the conical flask
- uses a burette to add dilute sulfuric acid to the conical flask until the end-point is reached and the indicator changes colour.

Table 1.1 shows the burette readings the student obtains.

Table 1.1

final burette reading / cm^3	18.8
initial burette reading / cm^3	4.2

Question 1

volume of dilute sulfuric acid added / cm^3	

(a) Complete Table 1.1 by calculating the volume of dilute sulfuric acid added to the conical flask. [1]

(b) State which solution, aqueous potassium carbonate or dilute sulfuric acid, is the **least** concentrated. Give a reason for your answer.

Question 1

Question 1

[1]

(c) Name a piece of apparatus suitable for measuring the $25.0\,cm^3$ of aqueous potassium carbonate.

Question 1

(d) Name a suitable indicator and give the colour change of this indicator at the end-point.

Question 1

[2]

(e) As the student added the dilute sulfuric acid to the aqueous potassium carbonate they looked for a colour change.

State what the student should do as they add the dilute sulfuric acid to the aqueous potassium carbonate in the conical flask. Do **not** include observations in your answer.

Question 1

(f) Describe what the student should now do to obtain crystals of pure potassium sulfate.

Question 1

[Total: 9]

Solution 1

(a)

Mark scheme

- 14.6
- 1

Solution 1

(b)

Mark scheme

- (least concentrated solution) potassium carbonate
- and
- (because) a larger volume of potassium carbonate was used
- 1

Solution 1

(c)

Mark scheme

- (volumetric) pipette / burette
- 1

Solution 1

(d)

Mark scheme

- M1 methyl orange
- 1 M2
- yellow to orange
- 1

Solution 1

(e)

Mark scheme

- swirl / mix (the contents of the flask)
- 1

Solution 1

(f) Mark scheme

- M1 mix / add / combine together 25.0 cm3 aqueous potassium carbonate and 14.6 cm3 dilute sulfuric acid (without indicator)
- 1 M2
- (place in an evaporating basin) and warm until crystals start to form / warm until crystalising point / warm until
- saturated / half / most water gone
- 1 M3
- cool (solution) (so that crystals form) / leave solution from M2 so that crystals form
- 1

Question 24

0620/22 M25 ▪ Q24 ▪ 1 mark

24 Lead(II) sulfate is an insoluble salt.

Which method is suitable for obtaining pure solid lead(II) sulfate?

A Mix aqueous lead(II) nitrate and aqueous potassium sulfate, heat to evaporate all of the water, collect the solid and then wash and dry it.

B Mix aqueous lead(II) nitrate and aqueous potassium sulfate, filter, collect the filtrate, crystallise, then wash and dry the crystals.

C Mix aqueous lead(II) nitrate and dilute sulfuric acid, filter, then wash and dry the residue.

D Titrate aqueous lead(II) hydroxide with dilute sulfuric acid, crystallise, then wash and dry the crystals.

Solution 24

Answer: **C**

Why

- An insoluble salt is made by precipitation, so mix two soluble solutions.
- Filter off the precipitate – evaporating instead would leave the soluble by-product behind too.
- Then wash the residue with distilled water and dry it.