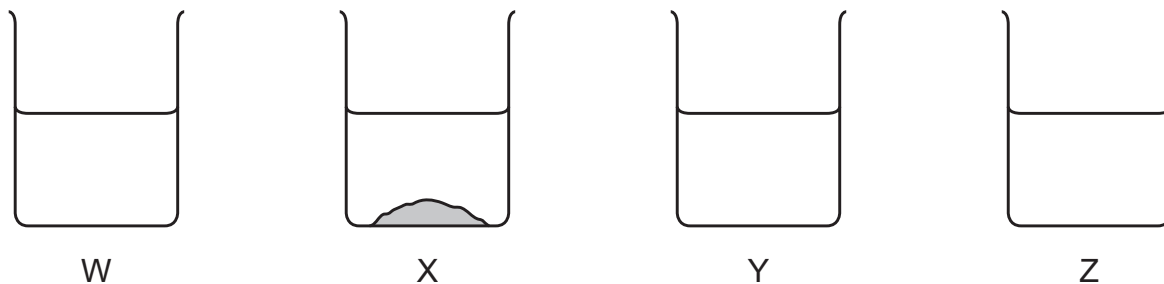


- 21** A student adds different solid salts to an excess of water. The student stirs the mixtures to determine the solubilities of the salts.

The results are shown.



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

- 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

- 11** Which statement describes a saturated solution?

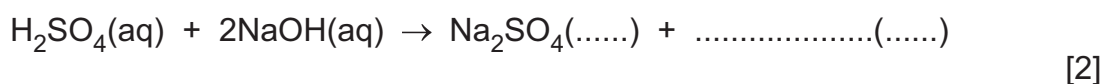
- A** It is a solution that contains the maximum concentration of solute.
- B** It is a solution that contains the maximum amount of solvent.
- C** It is a hydrocarbon that contains both double and single bonds.
- D** It is a hydrocarbon that contains only single bonds.

- 3** A student makes crystals of the salt sodium sulfate, Na_2SO_4 . The student reacts 0.200 mol/dm^3 dilute sulfuric acid, $\text{H}_2\text{SO}_4(\text{aq})$, with aqueous sodium hydroxide, $\text{NaOH}(\text{aq})$.

The student uses the following steps.

- step 1** The student places 40.0 cm^3 of $\text{NaOH}(\text{aq})$ 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 $\text{NaOH}(\text{aq})$ in the conical flask.
- step 3** The student adds 0.200 mol/dm^3 $\text{H}_2\text{SO}_4(\text{aq})$ 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.



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

..... [1]

- (c)** Calculate the concentration of $\text{NaOH}(\text{aq})$ used in **step 1**.

concentration of $\text{NaOH}(\text{aq}) = \text{..... mol/dm}^3$ [1]

- (d)** Name the item of apparatus the student uses to add $\text{H}_2\text{SO}_4(\text{aq})$ in **step 3**.

..... [1]

- (e)** Calculate the volume of $\text{H}_2\text{SO}_4(\text{aq})$, in cm^3 , added in **step 3**.

volume of $\text{H}_2\text{SO}_4(\text{aq}) = \text{..... cm}^3$ [2]

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

from to [2]

- (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.

.....
..... [1]

- (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.

.....
.....
..... [2]

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

.....
..... [1]

- (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.

..... [1]

[Total: 14]

- 3** A student prepares a sample of the insoluble salt barium sulfate, BaSO_4 .
The student adds aqueous sodium sulfate, $\text{Na}_2\text{SO}_4(\text{aq})$, to aqueous barium chloride, $\text{BaCl}_2(\text{aq})$.

The student carries out the following steps.

- step 1** Dissolve 0.100 moles of solid BaCl_2 in 100cm^3 of distilled water in a beaker to form $\text{BaCl}_2(\text{aq})$.
- step 2** Add an aqueous solution which contains 0.100 moles of $\text{Na}_2\text{SO}_4(\text{aq})$ to the beaker containing the $\text{BaCl}_2(\text{aq})$ 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.



[2]

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

mass = g [2]

- (c) The concentration of $\text{Na}_2\text{SO}_4(\text{aq})$ in **step 2** is 1.25mol/dm^3 .

Calculate the volume, in cm^3 , of 1.25mol/dm^3 $\text{Na}_2\text{SO}_4(\text{aq})$ added in **step 2** which contains 0.100 moles of Na_2SO_4 .

volume = cm^3 [1]

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

..... [1]

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

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

..... [1]

- (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.

.....
.....
.....
..... [2]

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

..... [1]

- (h) State the name of a different:

- barium salt that can be used in place of BaCl_2
- sulfate salt that can be used in place of Na_2SO_4
- barium salt that can be made by this method.

[3]

[Total: 13]

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.

..... [3]

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

..... [1]

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

..... [1]

(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.

..... [1]

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

.....

..... [2]

(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.

1

2 [2]

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

1

2 [2]

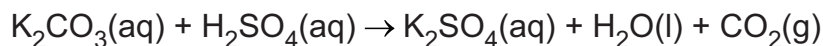
[Total: 12]

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

- 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.



The student:

- places 25.0 cm³ 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
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.

least concentrated solution

reason

[1]

- (c) Name a piece of apparatus suitable for measuring the 25.0 cm³ of aqueous potassium carbonate.

..... [1]

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

indicator

colour change at end-point to

[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.

.....

..... [1]

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

.....

.....

.....

.....

..... [3]

[Total: 9]

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.