

Qualitative Analysis

1(a). This question is about chemicals used by gardeners.

A garden product contains hydrated ammonium iron(II) sulfate, $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 \cdot x\text{H}_2\text{O}$.
 $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 \cdot x\text{H}_2\text{O}$ contains 27.55% by mass of water of crystallisation.

Calculate the value of x in the formula $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 \cdot x\text{H}_2\text{O}$.

Show your working.

$x = \dots\dots\dots$ **[3]**

(b). The garden product in the previous question part is a solid mixture of the following ingredients:

- Hydrated ammonium iron(II) sulfate, $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 \cdot x\text{H}_2\text{O}$, which is soluble in water
- Crushed limestone (calcium carbonate)
- Sand.

i. Suggest why crushed limestone has been included in this garden product.

----- **[1]**

ii. *Plan a procedure on a test tube scale to show that the solid mixture contains the following ions:

- NH_4^+ , Fe^{2+} and SO_4^{2-} present in $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 \cdot x\text{H}_2\text{O}$
- CO_3^{2-} present in crushed limestone.

Show your reasoning, including relevant equations.

[6]

3. Students work together in groups to identify four different solutions.

Each solution contains one of the following compounds:

- ammonium sulfate, $(\text{NH}_4)_2\text{SO}_4$
- sodium sulfate, Na_2SO_4
- sodium chloride, NaCl
- potassium bromide, KBr .

Your group has been provided with universal indicator paper and the following test reagents:

- barium chloride solution
- silver nitrate solution
- dilute ammonia solution
- sodium hydroxide solution.

* A student in your group suggests the following plan:

- Add about 1 cm depth of each solution into separate test-tubes.
- Add a few drops of barium chloride solution to each test-tube.
- A white precipitate will show which solutions contain sulfate ions.
- Two of the solutions will form a white precipitate.

Describe how you would expand this plan so that all four solutions could be identified using a positive test result.

You should provide observations and conclusions that would enable your group to identify all four solutions.

[6]

END OF QUESTION PAPER