Qualitative Analysis

1(a).	This question is about chemicals used by gardeners. A garden product contains hydrated ammonium iron(II) sulfate, (NH ₄) ₂ Fe(SO ₄) ₂ •xH ₂ O. (NH ₄) ₂ Fe(SO ₄) ₂ •xH ₂ O contains 27.55% by mass of water of crystallisation.				
	Calculate the value of x in the formula $(NH_4)_2Fe(SO_4)_2•xH_2O$. Show your working.				
		x =[3]		
(b).	The garden product in the previous question part is a solid mixture of the following ingredients:				
	•	Hydrated ammonium iron(II) sulfate, (NH ₄) ₂ Fe(SO ₄) ₂ •xH ₂ O, which is soluble in water Crushed limestone (calcium carbonate) Sand.			
	i.	Suggest why crushed limestone has been included in this garden product.			
			<u>[1]</u>		
	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 (NH ₄) ₂ Fe(SO ₄) ₂ •xH ₂ O • CO ₃ ²⁻ present in crushed limestone.			
		Show your reasoning, including relevant equations.			

2.

	[6]					
A hydrated nickel(II) complex, A , is heated in a crucible to remove the water of						
crystallisation.						
The anhydrous complex B is formed. The results are	shown below.					
Mass of crucible + hydrated complex A	= 59.554 g					
Mass of crucible + anhydrous complex B	= 58.690 g					
Mass of crucible	= 51.257 g					
The anhydrous complex B is analysed and found to l	have a molar mass of 309.7 g mol ⁻¹ and to					
contain the following percentage composition by mas	·					
,						
Ni, 18.95%; C, 23.25%; N, 27.12	%; H, 7.75%; C <i>I</i> , 22.93%.					
The anhydrous complex B contains a cation C comp	rising Ni. C. N and H only.					
Cation C is six-coordinate, contains three molecules	•					
optical isomers.						
Determine the formula of A , B , C and D and show th	e 3D structures for the ontical isomers of C					
	e 3D structures for the optical isomers of C.					
Show all your working.						

3.

[6]
Students work together in groups to identify four different solutions.
Each solution contains one of the following compounds:
Lach solution contains one of the following compounds.
 ammonium sulfate, (NH₄)₂SO₄
 sodium sulfate, Na₂SO₄ 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