

CHALLENGE PROBLEM ON UNKNOWN SALT IDENTIFICATION

You are given a salt, MX_2 , whose cation is an alkaline earth metal ion, and whose anion is a halide. (1) Using the information given in the table below, deduce the identity of the salt. You must show your reasoning clearly. (2) What is the minimum number of tests that must be performed to determine the identity of the salt? (3) How many salts are possible? (4) Construct a procedure that will allow you to determine the identity of any of the possible salts. (5) Write molecular, total ionic and net ionic equations for all of the insoluble salts found in both information tables.

Data Table for Cation Analysis

Cation Reagents	Anion Reagents			
	$(\text{NH}_4)_2\text{SO}_4$	Na_2CO_3	$\text{K}_2\text{C}_2\text{O}_4$	Na_2CrO_4
$\text{Mg}(\text{NO}_3)_2$	soluble	insoluble	soluble	soluble
$\text{Ca}(\text{NO}_3)_2$	soluble	insoluble	insoluble	soluble
$\text{Sr}(\text{NO}_3)_2$	insoluble	insoluble	insoluble	soluble
$\text{Ba}(\text{NO}_3)_2$	insoluble	insoluble	insoluble	insoluble
Unknown Cation, M^{2+}	insoluble	insoluble	insoluble	soluble

Data Table for Anion Analysis

Anion Reagent	Test Reagent	Color of Precipitate
NaCl	AgNO_3	white
NaBr	AgNO_3	cream
NaI	AgNO_3	pale yellow green
Unknown Anion, X^-	AgNO_3	pale yellow green

Comments to instructor: This challenge problem requires critical thinking skills, reinforces net ionic equations and the formula writing associated with writing chemical equations. It also reinforces solubility rules.