

Table 3.3 Solubility characteristics of ionic compounds in water at 25°C

- All alkali metal (Group 1A) compounds are soluble.
- All ammonium ( $\text{NH}_4^+$ ) compounds are soluble.
- All compounds containing nitrate ( $\text{NO}_3^-$ ), chlorate ( $\text{ClO}_3^-$ ), and perchlorate ( $\text{ClO}_4^-$ ) are soluble.
- Most hydroxides ( $\text{OH}^-$ ) are insoluble. The exceptions are the alkali metal hydroxides and barium hydroxide [ $\text{Ba}(\text{OH})_2$ ]. Calcium hydroxide [ $\text{Ca}(\text{OH})_2$ ] is slightly soluble.
- Most compounds containing chlorides ( $\text{Cl}^-$ ), bromides ( $\text{Br}^-$ ), or iodides ( $\text{I}^-$ ) are soluble. The exceptions are those containing  $\text{Ag}^+$ ,  $\text{Hg}_2^{2+}$ , and  $\text{Pb}^{2+}$ .
- All carbonates ( $\text{CO}_3^{2-}$ ), phosphates ( $\text{PO}_4^{3-}$ ), and sulfides ( $\text{S}^{2-}$ ) are insoluble; the exceptions are those of alkali metals and the ammonium ion.
- Most sulfates ( $\text{SO}_4^{2-}$ ) are soluble. Calcium sulfate ( $\text{CaSO}_4$ ) and silver sulfate ( $\text{Ag}_2\text{SO}_4$ ) are slightly soluble. Barium sulfate ( $\text{BaSO}_4$ ), mercury(II) sulfate ( $\text{HgSO}_4$ ), and lead sulfate ( $\text{PbSO}_4$ ) are insoluble.

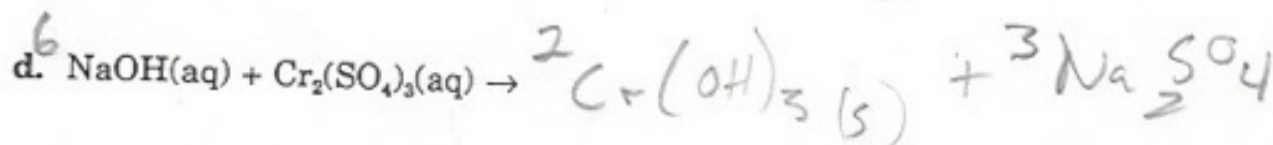
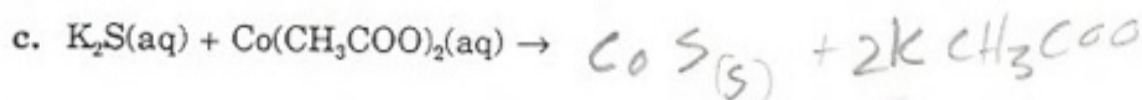
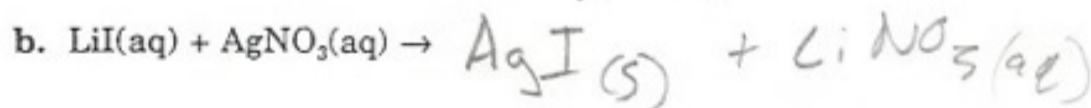
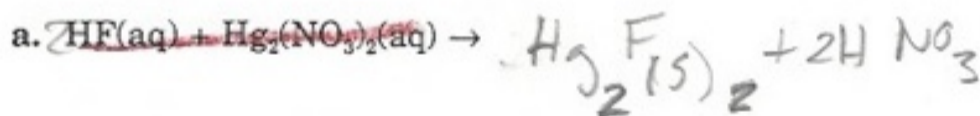
Identify each of the following substances as a strong electrolyte, a weak electrolyte, or a nonelectrolyte: (a)  $\text{H}_2\text{O}$ , (b)  $\text{KCl}$ , (c)  $\text{HNO}_3$ , (d)  $\text{CH}_3\text{COOH}$ , (e)  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ , (f)  $\text{Ba}(\text{NO}_3)_2$ , (g)  $\text{Ne}$ , (h)  $\text{NH}_3$ , (i)  $\text{NaOH}$ .

- |           |           |
|-----------|-----------|
| a) non    | e) Non    |
| b) strong | f) strong |
| c) strong | g) Non    |
| d) weak   | h) weak   |
|           | i) strong |

Characterize the following compounds as soluble or insoluble in water: (a)  $\text{Ca}_3(\text{PO}_4)_2$ , (b)  $\text{Mn}(\text{OH})_2$ , (c)  $\text{AgClO}_3$ , (d)  $\text{K}_2\text{S}$ , (e)  $\text{CaCO}_3$ , (f)  $\text{ZnSO}_4$ , (g)  $\text{Hg}(\text{NO}_3)_2$ , (h)  $\text{HgSO}_4$ , (i)  $\text{NH}_4\text{ClO}_4$ .

- |          |          |
|----------|----------|
| a) insol | d) sol   |
| b) insol | e) insol |
| c) sol   | f) sol   |
|          | g) sol   |
|          | h) insol |

Predict the result of each of the following reactions.

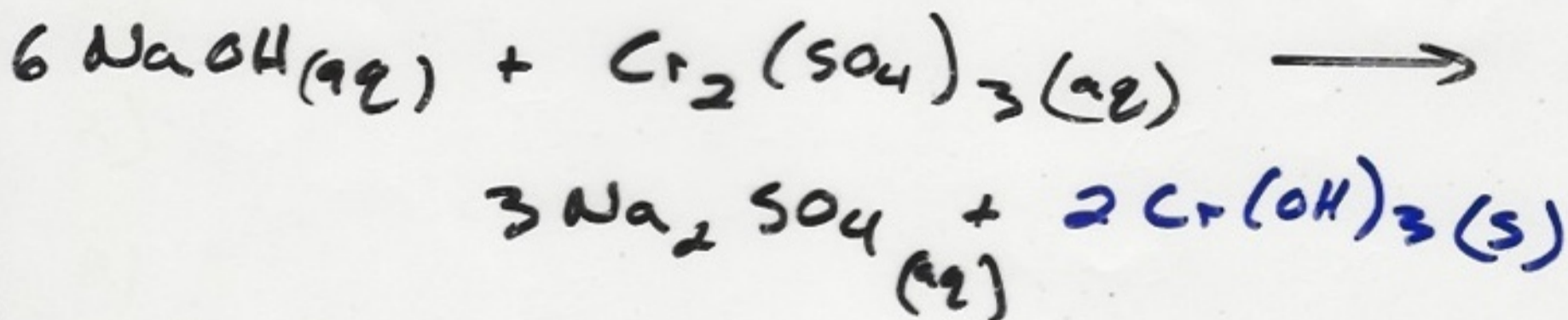
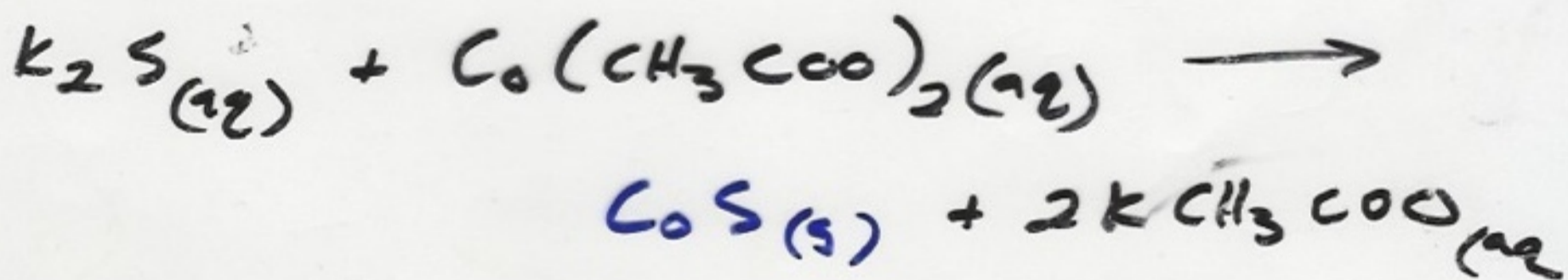
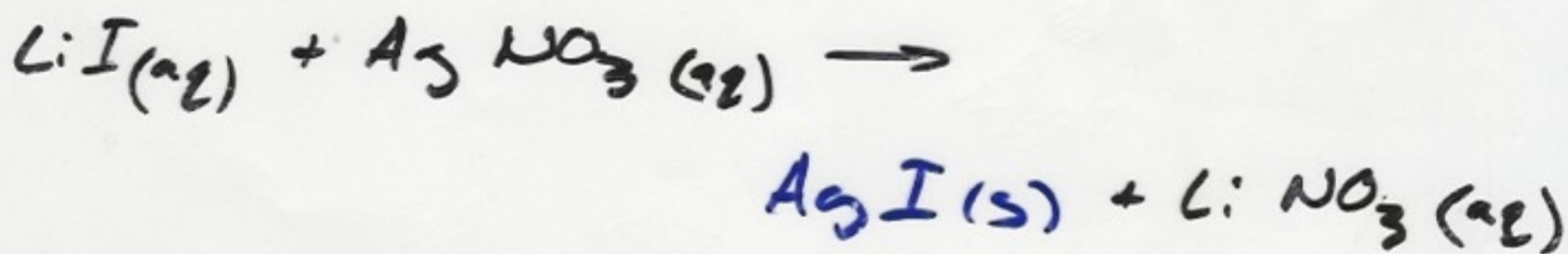
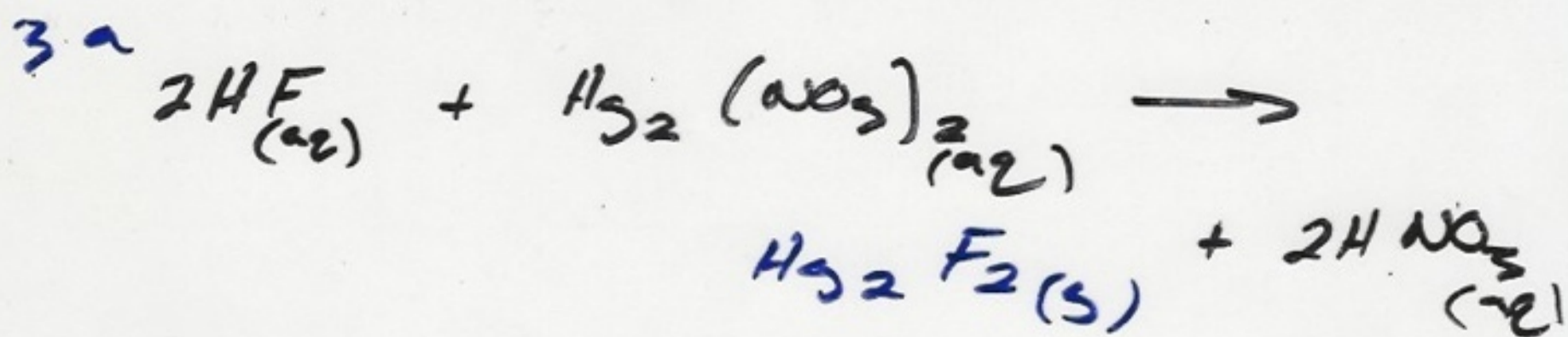


# work sheet #1

1)	A	non/very weak	H <sub>2</sub> O
	B	KCl	strong
	C	HNO <sub>3</sub>	strong
	D	CH <sub>3</sub> COH	weak
	E	sugar	non
	F	Ba(NO <sub>3</sub> ) <sub>2</sub>	strong
	G	NE	non
	H	NH <sub>3</sub>	weak
	I	NaOH	strong

2	A	Ca <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub>	In sol.
	B	Mn(OH) <sub>2</sub>	In sol.
	C	AgClO <sub>3</sub>	sol.
	D	K <sub>2</sub> S	sol.
	E	CaCO <sub>3</sub>	In sol.
	F	ZnSO <sub>4</sub>	sol
	G	Hg(NO <sub>3</sub> ) <sub>2</sub>	sol.
	H	HgSO <sub>4</sub>	In sol
	I	NH <sub>4</sub> ClO <sub>4</sub>	sol





# PRACTICE PROBLEMS ON NET IONIC EQUATIONS

Show the total ionic and net ionic forms of the following equations. If all species are spectator ions, please indicate that no reaction takes place. Note! You need to make sure the original equation is balanced before proceeding! A set of solubility rules are given at the end of this document.

1.  $\text{AgNO}_3(\text{aq}) + \text{KCl}(\text{aq}) \rightarrow \text{AgCl}(\text{s}) + \text{KNO}_3(\text{aq})$
2.  $\text{Mg}(\text{NO}_3)_2(\text{aq}) + \text{Na}_2\text{CO}_3(\text{aq}) \rightarrow \text{MgCO}_3(\text{s}) + \text{NaNO}_3(\text{aq})$
3. strontium bromide(aq) + potassium sulfate(aq)  $\rightarrow$  strontium sulfate(s) + potassium bromide(aq)
4. manganese(II)chloride(aq) + ammonium carbonate(aq)  $\rightarrow$  manganese(II)carbonate(s) + ammonium chloride(aq)
5. chromium(III)nitrate(aq) + iron(II)sulfate(aq)  $\rightarrow$  chromium(III)sulfate(aq) + iron(II)nitrate(aq)

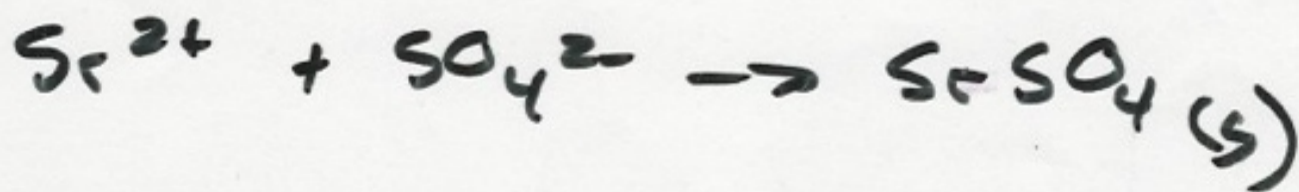
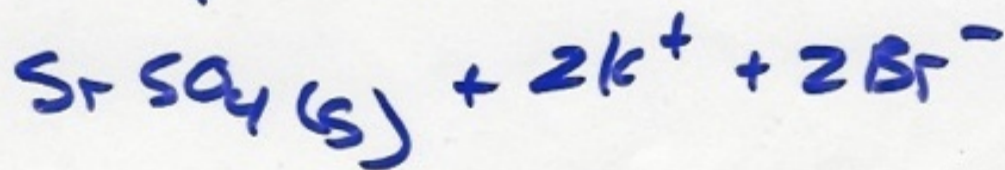
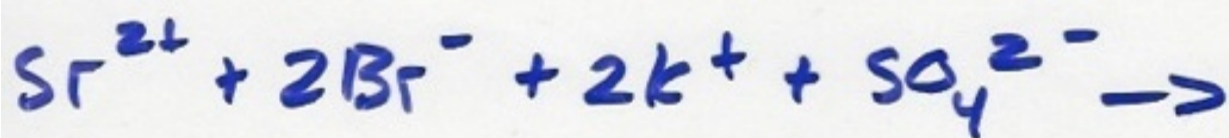
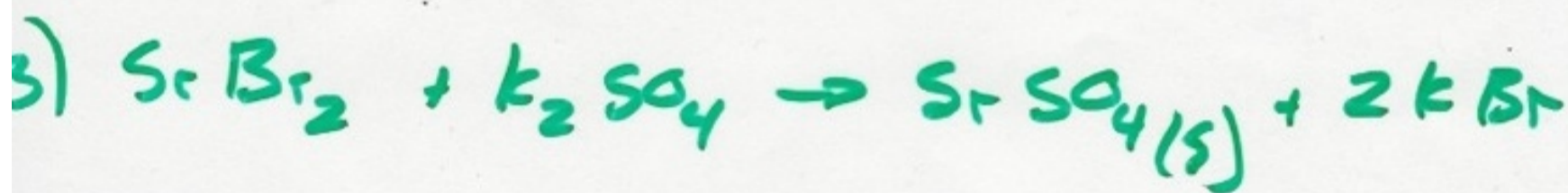
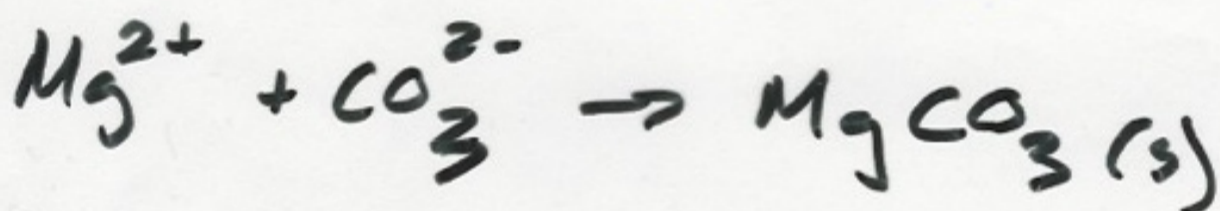
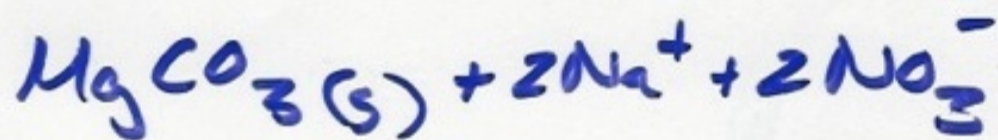
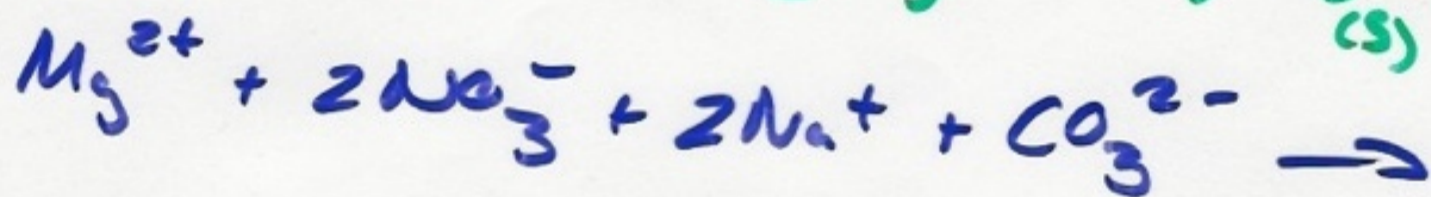
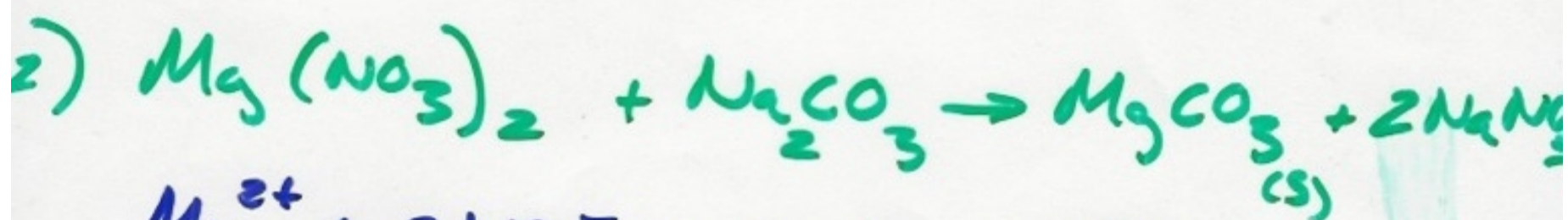
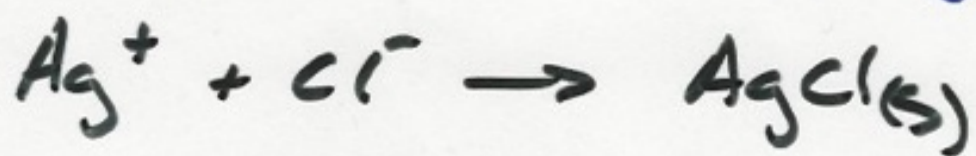
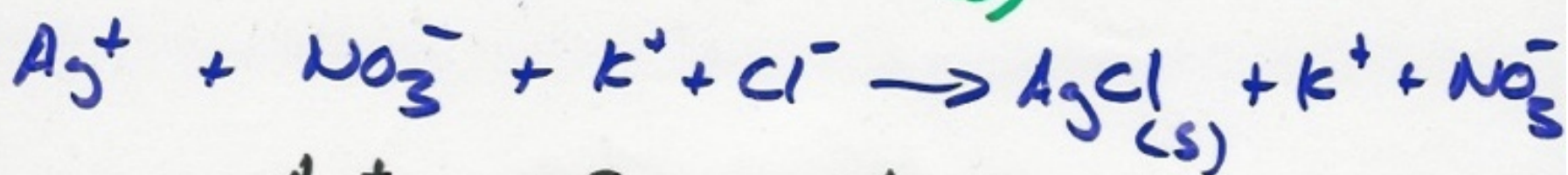
Please complete the following reactions, and show the total ionic and net ionic forms of the equation:

6.  $\text{K}_3\text{PO}_4(\text{aq}) + \text{Al}(\text{NO}_3)_3(\text{aq}) \rightarrow$
7.  $\text{BeI}_2(\text{aq}) + \text{Cu}_2\text{SO}_4(\text{aq}) \rightarrow$
8.  $\text{Ni}(\text{NO}_3)_2(\text{aq}) + \text{KBr}(\text{aq}) \rightarrow$
9. cobalt(III)bromide + potassium sulfide  $\rightarrow$
10. barium nitrate + ammonium phosphate  $\rightarrow$
11. calcium hydroxide + iron(III)chloride  $\rightarrow$
12. rubidium fluoride + copper(II)sulfate  $\rightarrow$

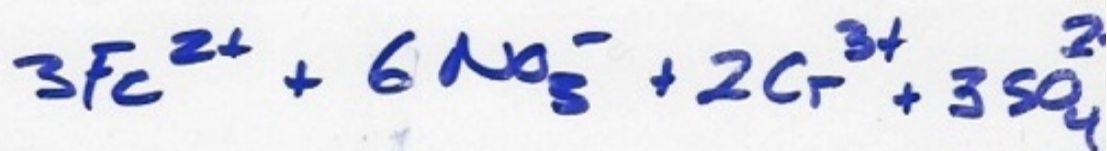
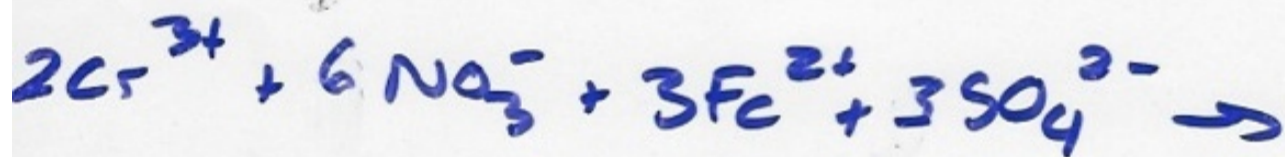
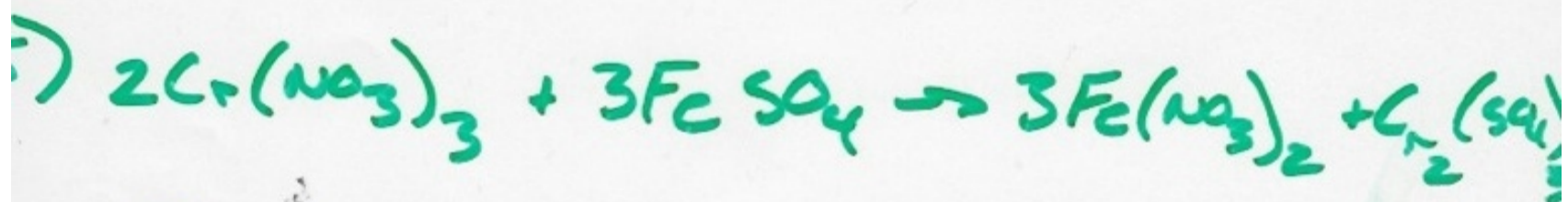
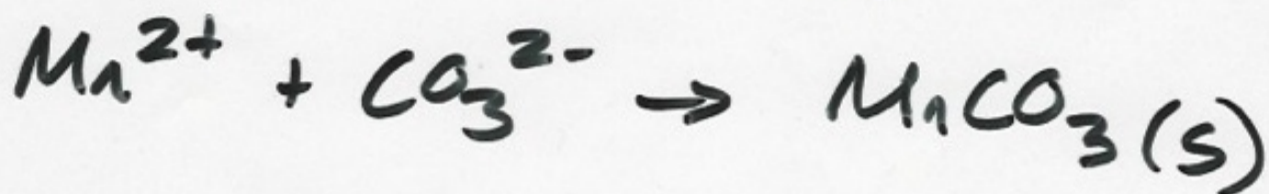
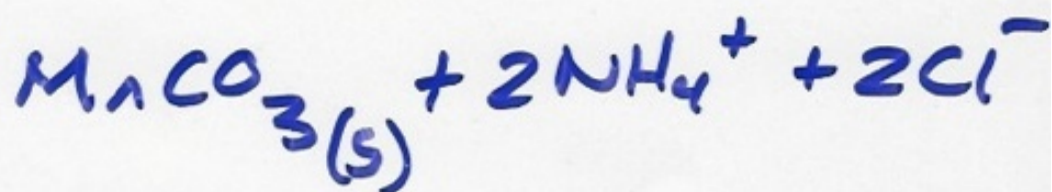
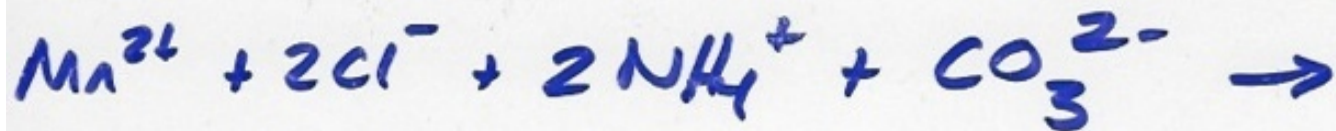
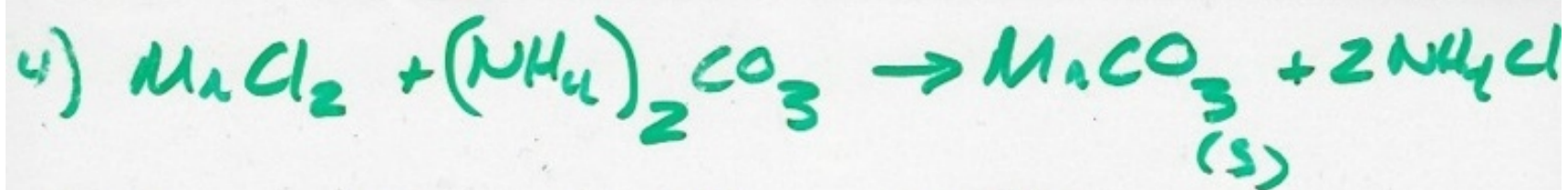
## Solubility Rules

1. All salts of Group IA, and ammonium are soluble.
2. All salts of nitrates, chlorates and acetates are soluble.
3. All salts of halides are soluble except those of silver(I), copper(I), lead(II), and mercury(I).
4. All salts of sulfate are soluble except for barium sulfate, lead(II) sulfate, and strontium sulfate.
5. All salts of carbonate, phosphate and sulfite are insoluble, except for those of group IA and ammonium.
6. All oxides and hydroxides are insoluble except for those of group IA, calcium, strontium and barium.
7. All salts of sulfides are insoluble except for those of Group IA and IIA elements and of ammonium.

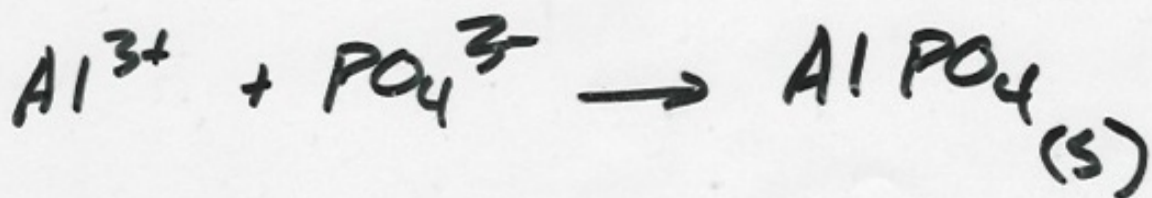
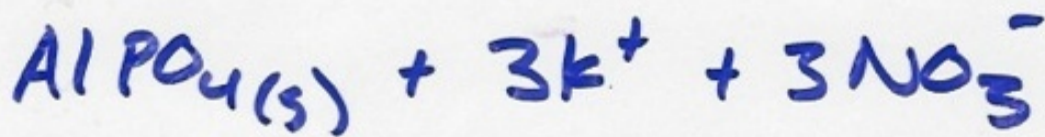
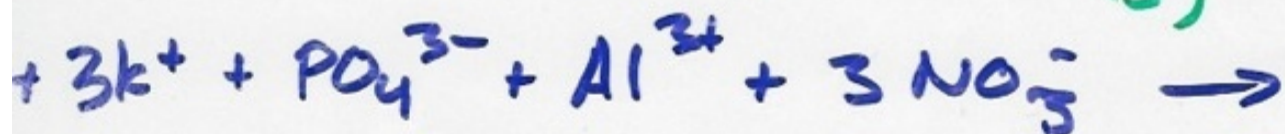
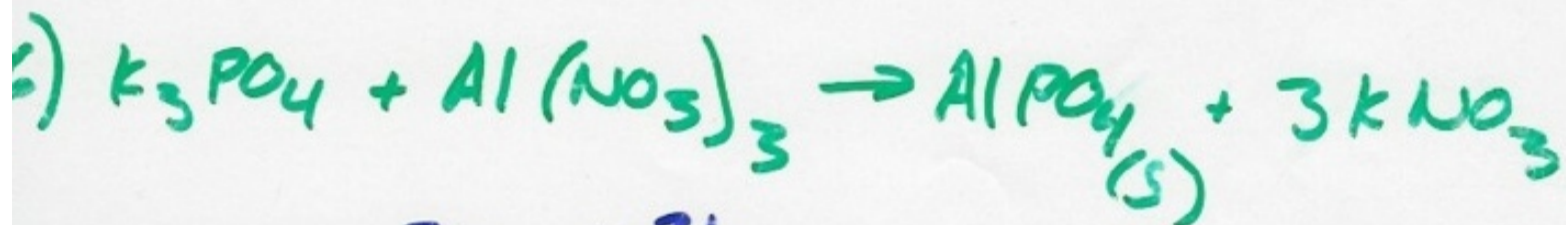




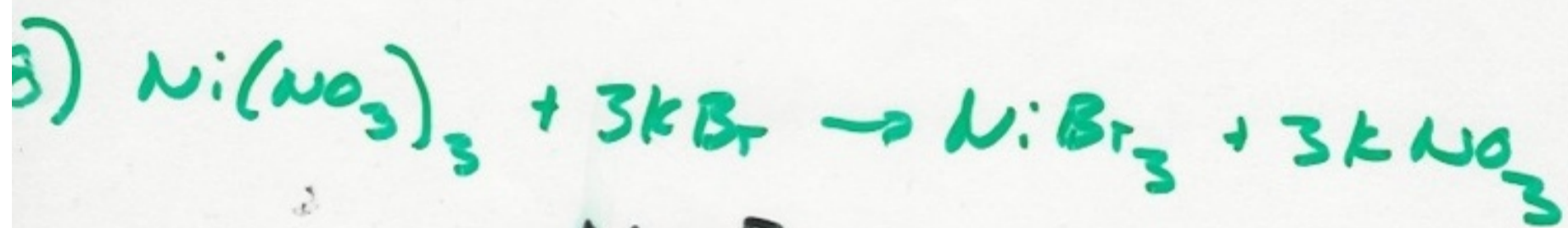
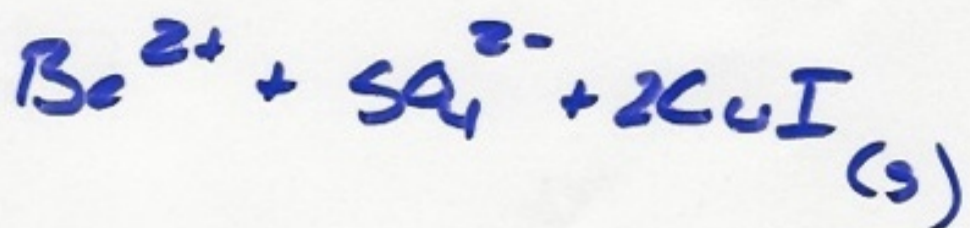
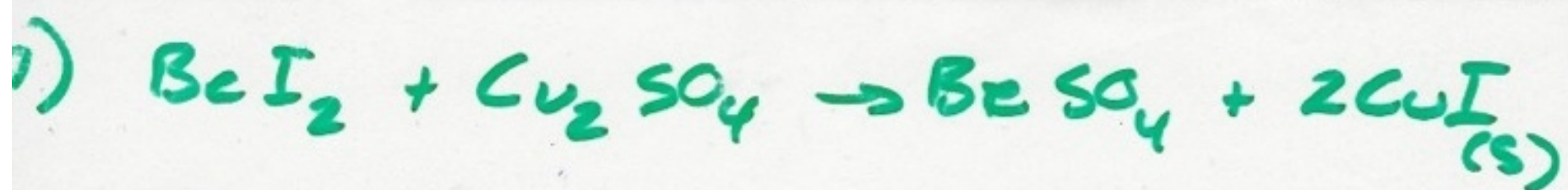




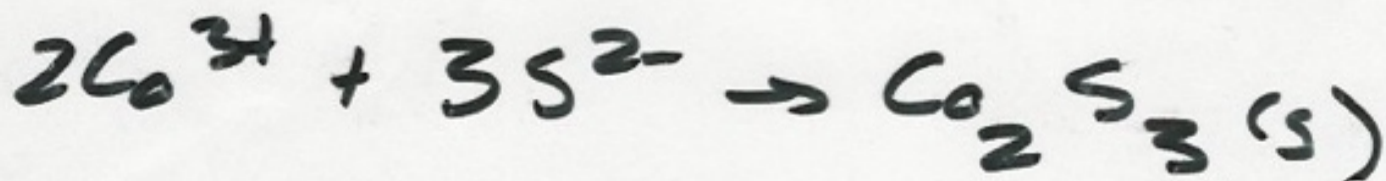
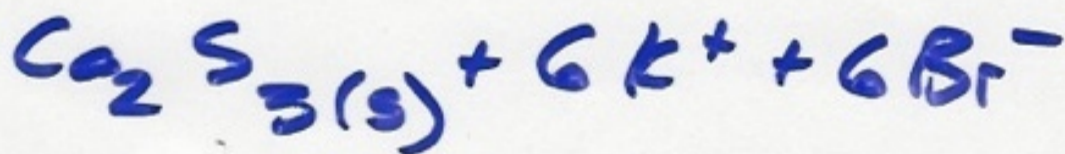
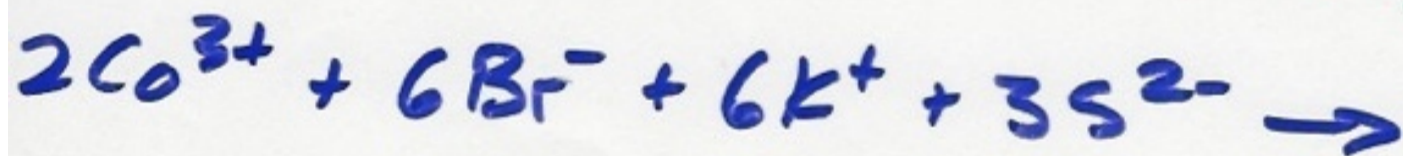
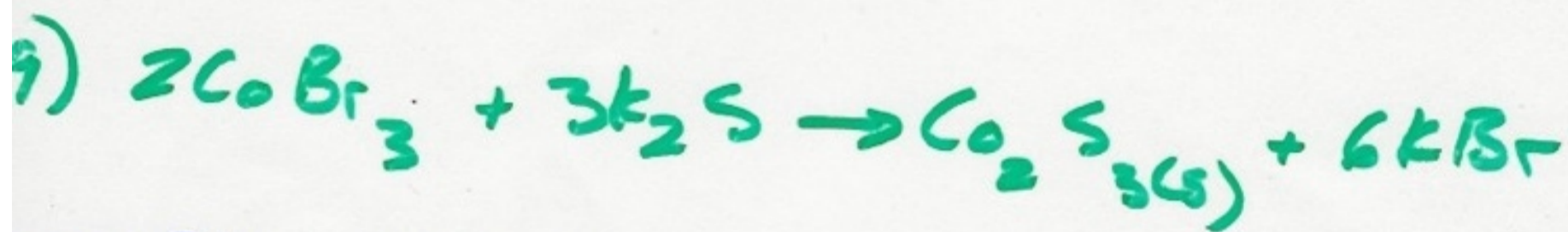
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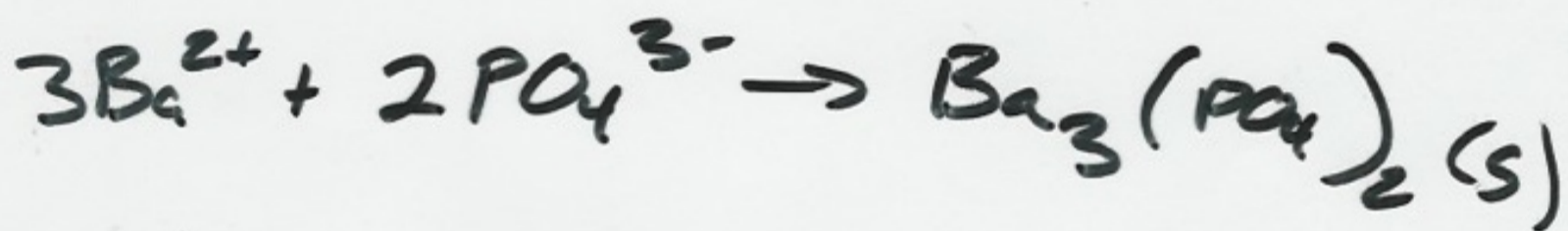
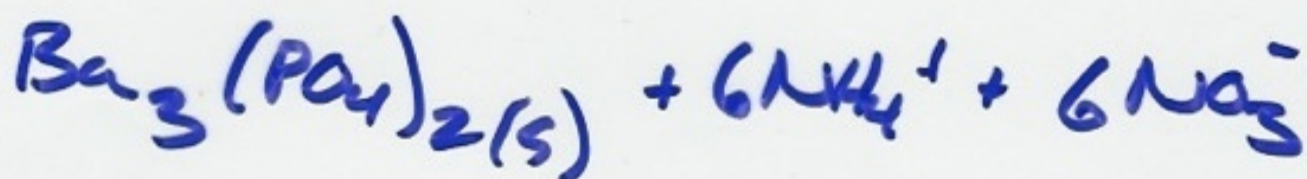
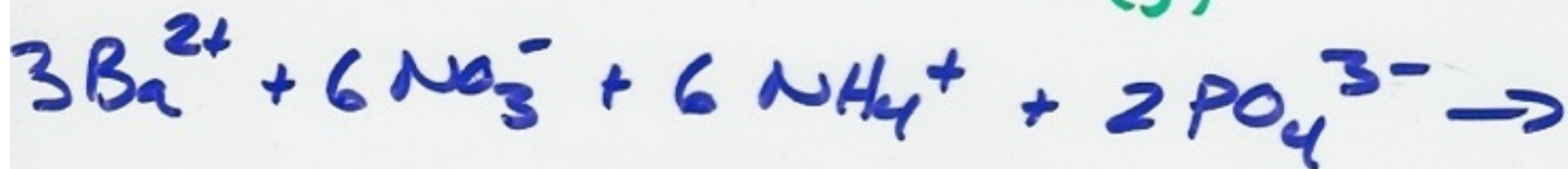
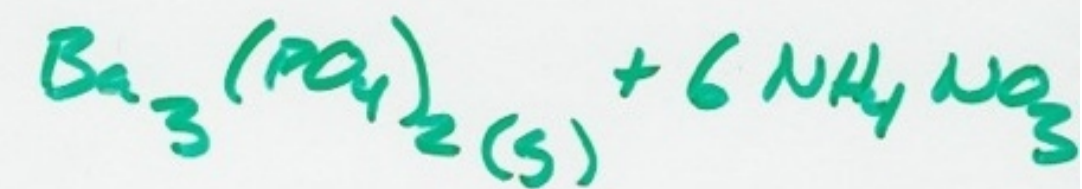
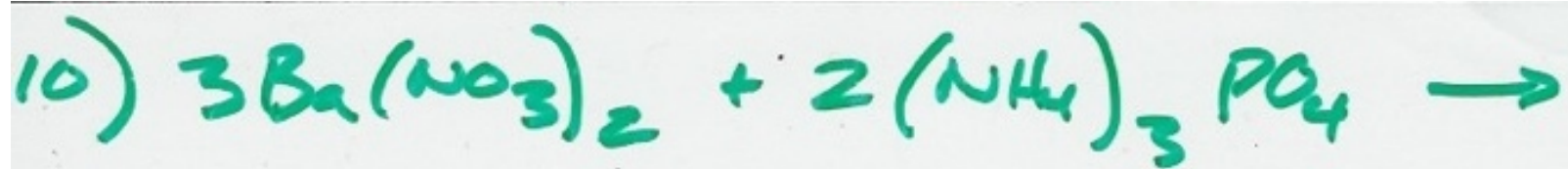






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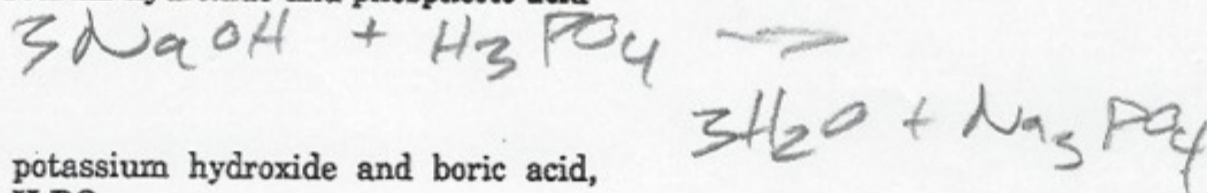


- 1) Balance the following equations and write the corresponding ionic and net ionic equations (if appropriate):
- $\text{HBr}(aq) + \text{NH}_3(aq) \longrightarrow \text{NH}_4\text{Br}^-$   
 (HBr is a strong acid)
- (b)  $\text{Ba}(\text{OH})_2(aq) + \text{H}_2\text{PO}_4(aq) \longrightarrow$
- (c)  $\text{HClO}_3(aq) + \text{Mg}(\text{OH})_2(s) \longrightarrow$

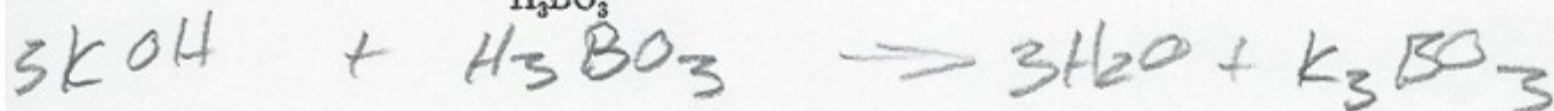
- 2) Balance the following equations and write the corresponding ionic and net ionic equations (if appropriate):
- (a)  $\text{CH}_3\text{COOH}(aq) + \text{KOH}(aq) \longrightarrow$
- (b)  $\text{H}_2\text{CO}_3(aq) + \text{NaOH}(aq) \longrightarrow$
- (c)  $\text{HNO}_3(aq) + \text{Ba}(\text{OH})_2(aq) \longrightarrow$

- 3) Give the names and formulas of the salts obtained from complete neutralization reactions between the following acid-base pairs.

a. sodium hydroxide and phosphoric acid



b. potassium hydroxide and boric acid,  $\text{H}_3\text{BO}_3$



c. cadmium hydroxide and hydrobromic acid



d. lithium hydroxide and silicic acid,  $\text{H}_4\text{SiO}_4$



e. barium hydroxide and sulfurous acid

