Qual and Activity Series

Confusion and Clarification

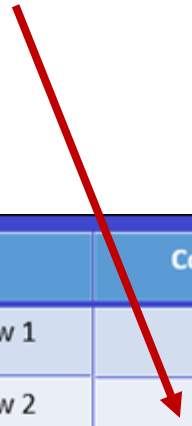
Intro to Qualitative Analysis

	Column 1 (+HCl)	Column 2 (+H_2SO_4)	Column 3 (+NaOH)	Column 4 (+NH_3)	Column 5 (+$NaHCO_3$)
Row 1	5 gtt 2% $CuSO_4$	5 gtt 2% $CuSO_4$	5 gtt 2% $CuSO_4$	5 gtt 2% $CuSO_4$	5 gtt 2% $CuSO_4$
Row 2	5 gtt $AgNO_3$	5 gtt $AgNO_3$	5 gtt $AgNO_3$	5 gtt $AgNO_3$	5 gtt $AgNO_3$
Row 3	5 gtt $FeCl_3$	5 gtt $FeCl_3$	5 gtt $FeCl_3$	5 gtt $FeCl_3$	5 gtt $FeCl_3$
Row 4	5 gtt Magnesia mixture	5 gtt Magnesia mixture	5 gtt Magnesia mixture	5 gtt Magnesia mixture	5 gtt Magnesia mixture

Intro to Qualitative Analysis – Data Analysis

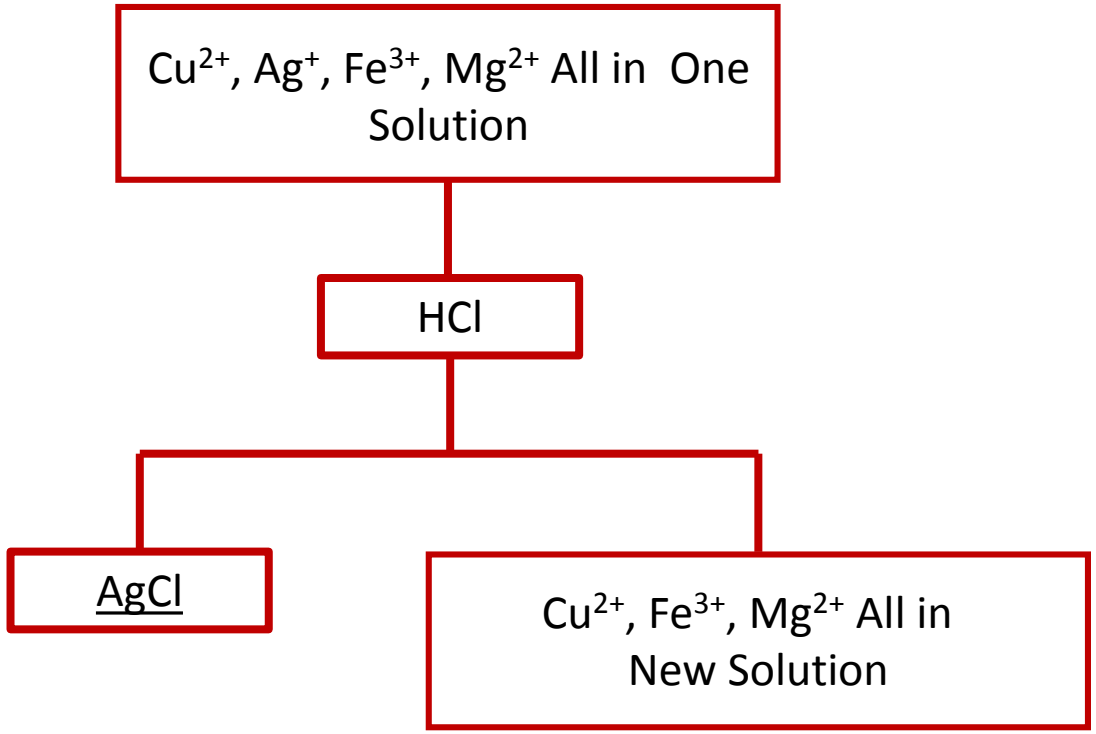
	Column 1 (+HCl)	Column 2 (+H_2SO_4)	Column 3 (+NaOH)	Column 4 (+NH_3)	Column 5 (+$NaHCO_3$)
Row 1	NR	NR	Blue ppt	Blue soln	Blue ppt
Row 2	Wht ppt	NR	Brn ppt	NR	Wht ppt
Row 3	NR	NR	Red ppt	NR	NR
Row 4	NR	NR	NR	NR	NR

Step 1: Look in one **column** for only one ppt (not 2 or 3 or 4: only one ppt)

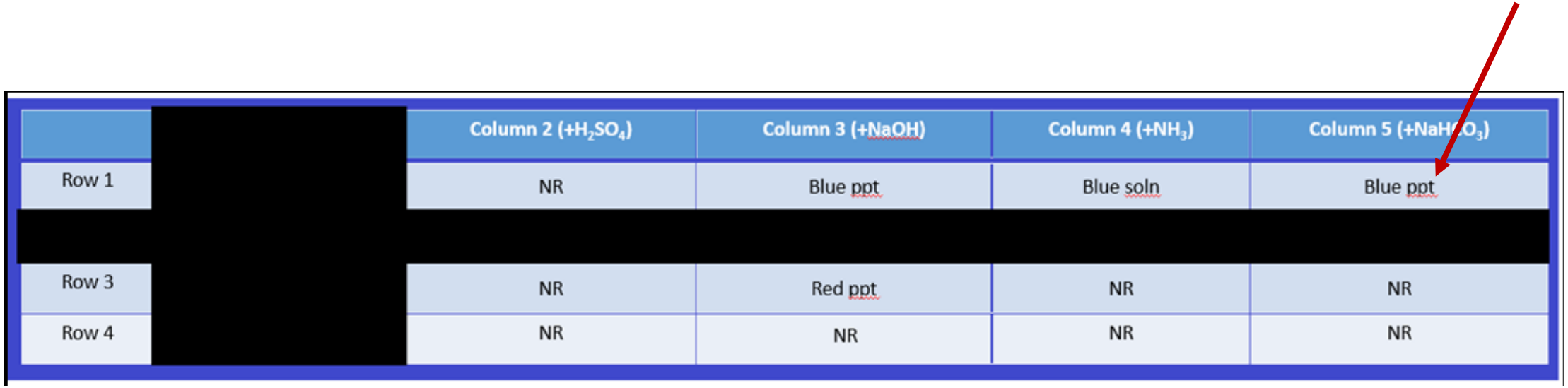


	Column 1 (+HCl)	Column 2 (+H_2SO_4)	Column 3 (+NaOH)	Column 4 (+NH_3)	Column 5 (+$NaHCO_3$)
Row 1	NR	NR	Blue ppt	Blue soln	Blue ppt
Row 2	Wht ppt	NR	Brn ppt	NR	Wht ppt
Row 3	NR	NR	Red ppt	NR	NR
Row 4	NR	NR	NR	NR	NR

Step 2: begin your flow chart (separation scheme – remember that the idea is to remove one cation at a time as an insoluble ppt from all the others

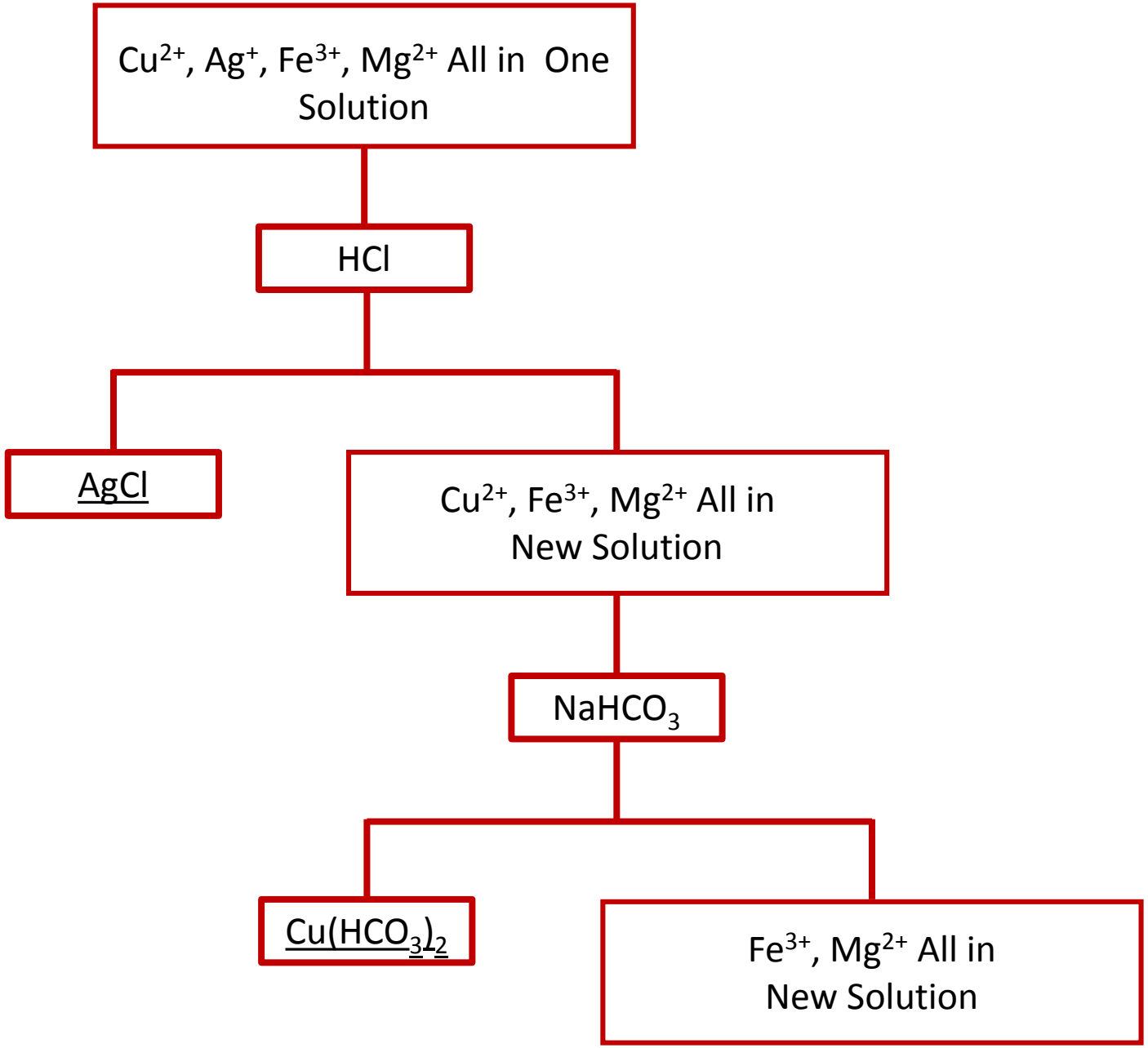

Cu^{2+}, Ag^{+}, Fe^{3+}, Mg^{2+} All in One Solution
HCl
AgCl
Cu^{2+}, Fe^{3+}, Mg^{2+} All in New Solution

Step 3: DONE with Column 1, Row 2: All of the Ag^+ is gone.

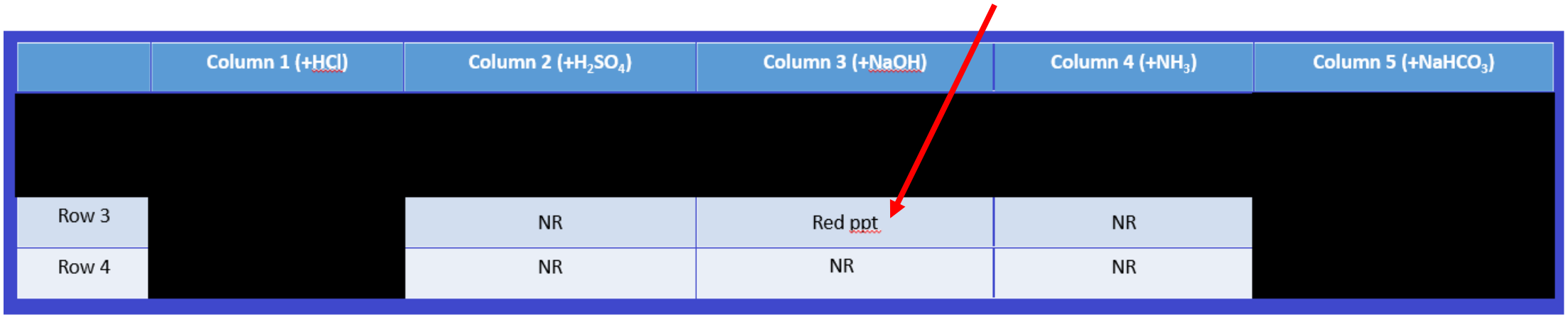


	[redacted]	Column 2 ($+H_2SO_4$)	Column 3 ($+NaOH$)	Column 4 ($+NH_3$)	Column 5 ($+NaHCO_3$)
Row 1		NR	Blue ppt	Blue soln	Blue ppt
[redacted]					
Row 3		NR	Red ppt	NR	NR
Row 4		NR	NR	NR	NR

Step 4: Look for another column with only ONE ppt in it – and continue flow chart

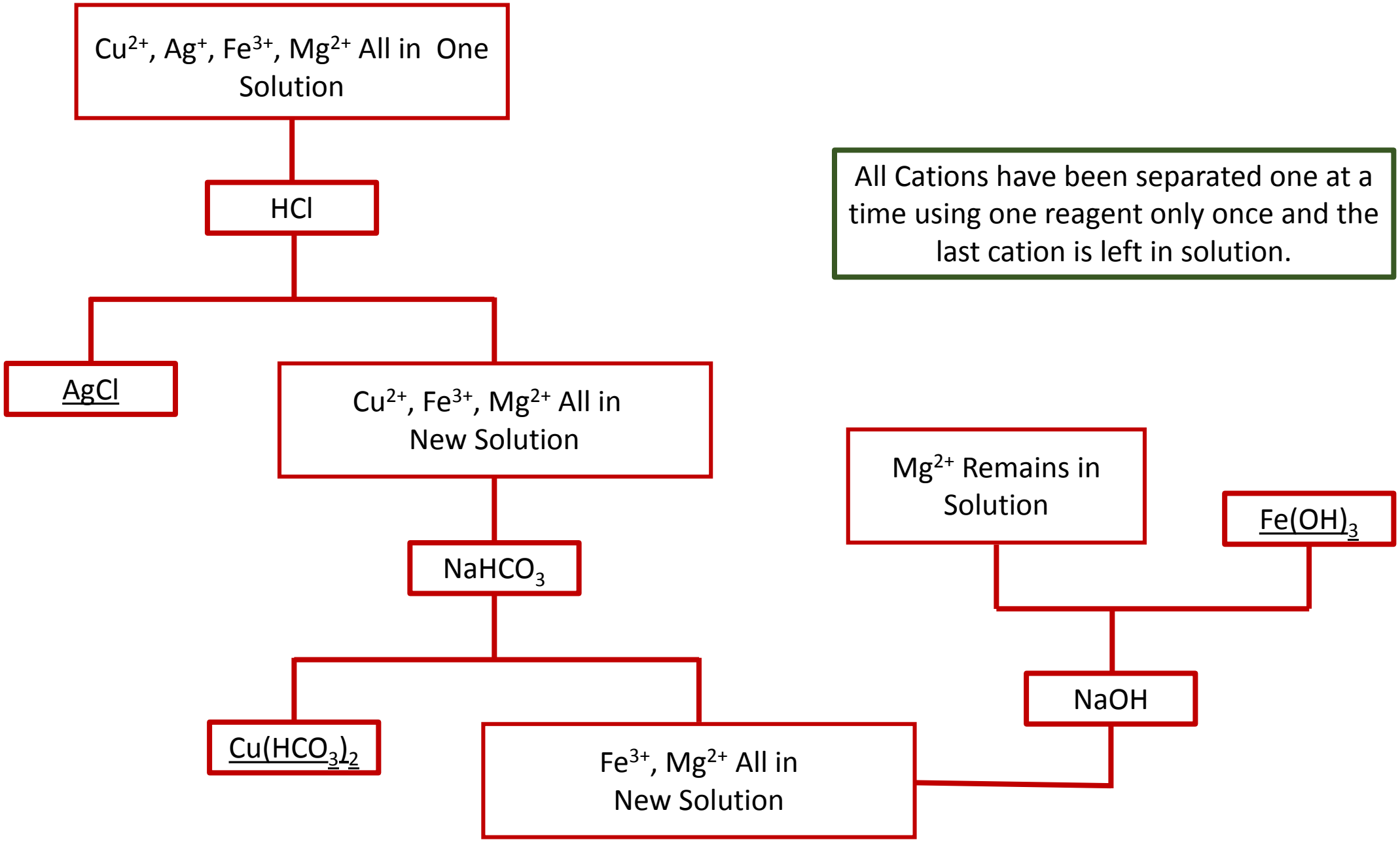

Cu^{2+}, Ag^{+}, Fe^{3+}, Mg^{2+} All in One Solution
HCl
AgCl
Cu^{2+}, Fe^{3+}, Mg^{2+} All in New Solution
$NaHCO_3$
$Cu(HCO_3)_2$
Fe^{3+}, Mg^{2+} All in New Solution

Step 3: DONE with Column 5, Row 1: All of the Cu^{+2} is gone.



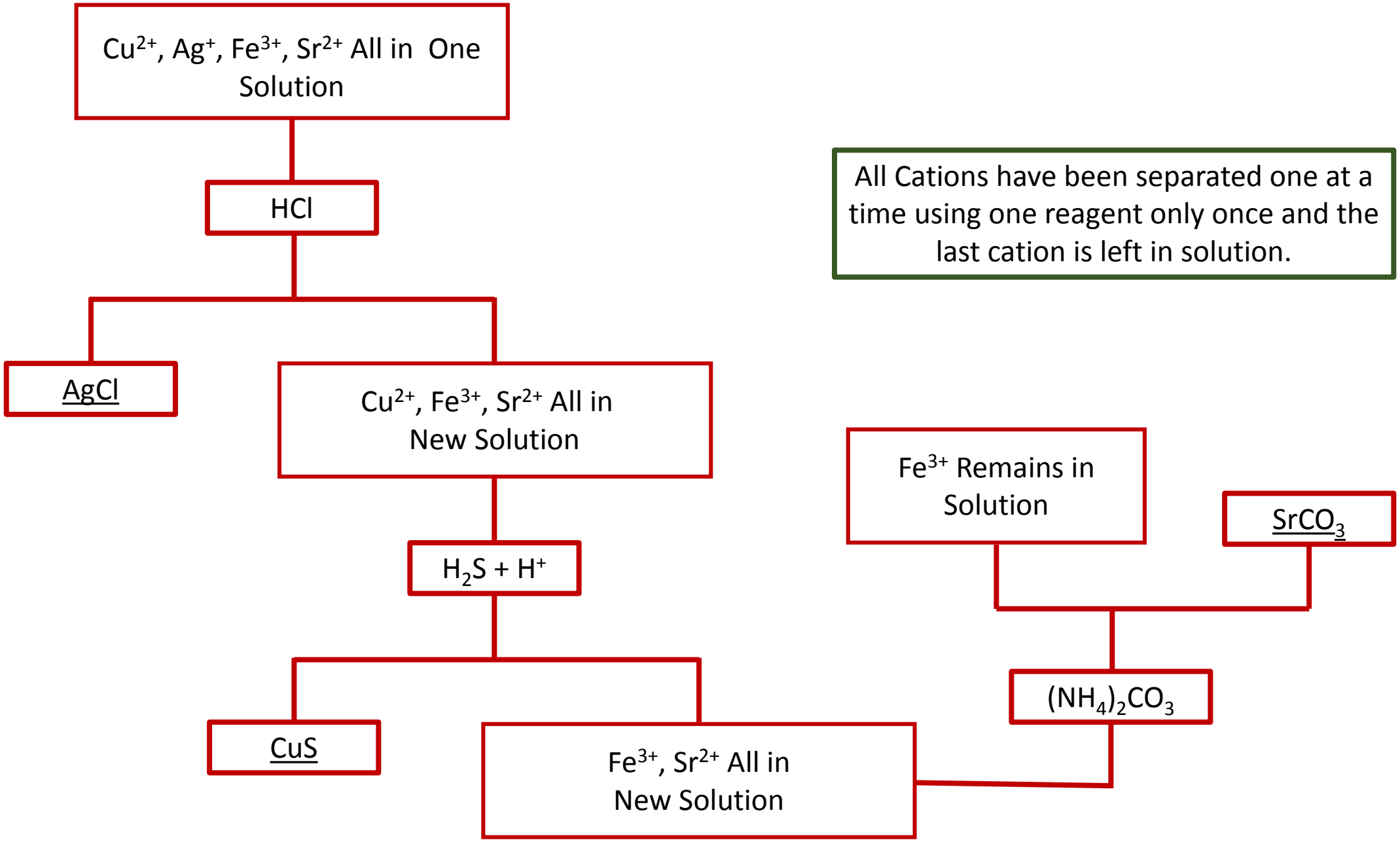
	Column 1 (+HCl)	Column 2 (+H_2SO_4)	Column 3 (+NaOH)	Column 4 (+NH_3)	Column 5 (+$NaHCO_3$)
Row 3		NR	Red ppt	NR	
Row 4		NR	NR	NR	

Step 4: Look for another column with only ONE ppt in it – and continue flow chart


Cu^{2+}, Ag^{+}, Fe^{3+}, Mg^{2+} All in One Solution
HCl
AgCl
Cu^{2+}, Fe^{3+}, Mg^{2+} All in New Solution
$NaHCO_3$
$Cu(HCO_3)_2$
Fe^{3+}, Mg^{2+} All in New Solution
NaOH
Mg^{2+} Remains in Solution
$Fe(OH)_3$
All Cations have been separated one at a time using one reagent only once and the last cation is left in solution.

Students Complete a Flow Chart to Separate the Cations – 10 minutes

Cation →	Ag^{+1}	Cu^{2+}	Fe^{3+}	Sr^{2+}
Reagent 1	HCl	HCl	HCl	HCl
Result	White ppt	No reaction (NR)	Yellow solution	NR
Reagent 2	NaOH	NaOH	NaOH	NaOH
Result	Brown ppt	Powder blue ppt	Red ppt	NR
Reagent 3	$(NH_4)_2CO_3$	$(NH_4)_2CO_3$	$(NH_4)_2CO_3$	$(NH_4)_2CO_3$
Result	NR	NR	NR	White ppt
Reagent 4	H_2S with acid	H_2S with acid	H_2S with acid	H_2S with acid
Result	Black ppt	Brown ppt	NR	NR
Reagent 5	H_2SO_4	H_2SO_4	H_2SO_4	H_2SO_4
Result	NR	White ppt	NR	White ppt


Cu^{2+}, Ag^{+}, Fe^{3+}, Sr^{2+} All in One Solution
HCl
AgCl
Cu^{2+}, Fe^{3+}, Sr^{2+} All in New Solution
$H_2S + H^{+}$
CuS
Fe^{3+}, Sr^{2+} All in New Solution
Fe^{3+} Remains in Solution
$SrCO_3$
$(NH_4)_2CO_3$
All Cations have been separated one at a time using one reagent only once and the last cation is left in solution.

Activity Series

Activity Series Key: Metals higher up in the activity table ought to reduce metal ions below that metallic element

(e.g., $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$)

Example – CONCEPT!!!!!!

Given the following series of " reactions", create an activity se
reactive and ending with the least reactive "element" -- NOTE: th
this is a concept question. Remember that elements higher in the
in the series.

$C + H^+ \rightarrow C^+ + H^\circ$

$C + E^+ \rightarrow C^+ + E^\circ$

$C + I^+ \rightarrow C^+ + I^\circ$

$C + T^+ \rightarrow C^+ + T^\circ$

$C + Y^+ \rightarrow C^+ + Y^\circ$

$H + E^+ \rightarrow H^+ + E^\circ$

$I + S^+ \rightarrow I^+ + S^\circ$

$M + I^+ \rightarrow M^+ + I^\circ$

$M + S^+ \rightarrow M^+ + S^\circ$

$E + M^+ \rightarrow E^+ + M^\circ$

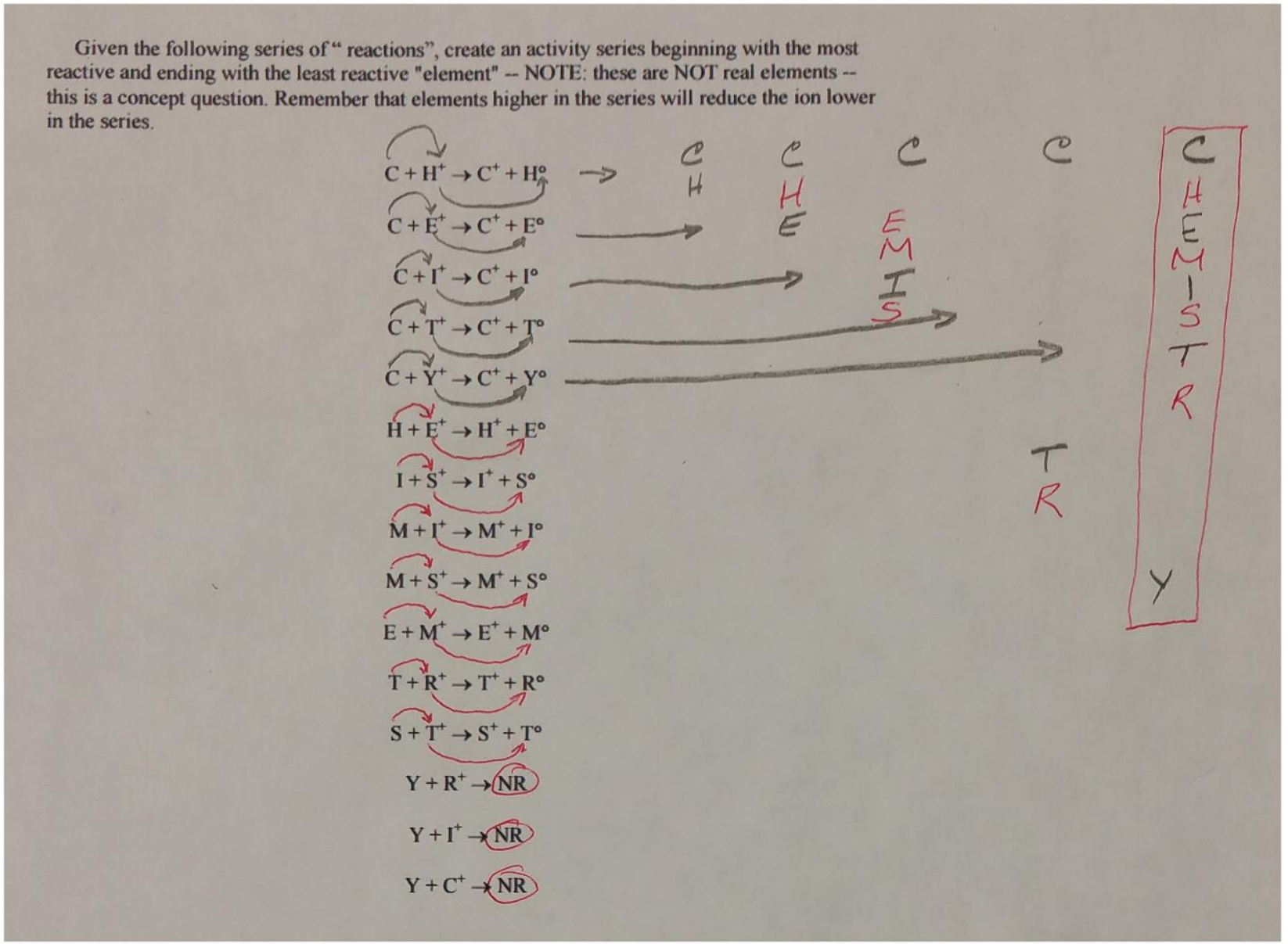
$T + R^+ \rightarrow T^+ + R^\circ$

$S + T^+ \rightarrow S^+ + T^\circ$

$Y + R^+ \rightarrow NR$

$Y + I^+ \rightarrow NR$

$Y + C^+ \rightarrow NR$



Student Example – 10 Minutes

Refer to the following activity series' data – these are NOT real elements, they are being used as in the lab experiment to determine if you've got the concept.

$R + E^+ \rightarrow R^+ + E$

$R + A^+ \rightarrow R^+ + A$

$R + D^+ \rightarrow R^+ + D$

$A + D^+ \rightarrow A^+ + D$

$E + D^+ \rightarrow E^+ + D$

$E + A^+ \rightarrow E^+ + A$

$D + R^+ \rightarrow NR$