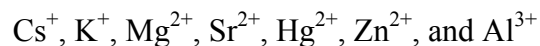


Reaction of Anions with Cations

This exercise will investigate what happens when cations of varying acidity are combined with oxo anions of varying basicity. The cations to be studied are:



- Using the principles that you already know, predict the category of acidity for each cation.

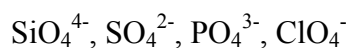
Cs^+	
K^+	
Mg^{2+}	
Sr^{2+}	
Hg^{2+}	
Zn^{2+}	
Al^{3+}	

Arrange the ions within each category in order of increasing acidity to get a list of the cations in order of increasing acidity.

_____ < _____ < _____ < _____ _____ < _____ < _____
_____ _____ _____ _____ _____ _____ _____ pK_a

Check your answer by listing the pK_a values for the ions. NOTE: You might have to make some adjustments because our rules of thumb are not perfect.

- The following four oxo anions will be reacted with the cations:



List these four in order of increasing basicity and give the category of basicity and approximate pK_b for each.

SiO_4^{4-}	
SO_4^{2-}	
PO_4^{3-}	
ClO_4^-	

_____ < _____ < _____ < _____

_____ _____ _____ _____ pK_b

3. Test the reactions of each of the eight cations with each of the four anions. For each test, combine equal volumes of the two solutions, mix well and allow one minute to ensure that any reaction is complete. Note any temperature change that occurs. List your observations in tabular form. Develop your table with the cations listed vertically in a logical order and the anions across the top in a logical order.

4. How does the tendency for the precipitation reaction appear to relate to the acidity and basicity of the cations and anions involved?

5. Predict which categories of metal cations would give insoluble salts with each of the following anions:

selenate, permanganate, chromate, carbonate, nitrate

Check your answers by looking up the solubilities of the salts in the *Handbook of Chemistry and Physics* (CRC)

6. The perbromate ion was first synthesized in the 1960s in minute quantities by the radioactive decay of $^{82}\text{BrO}_4^{2-}$. How would you separate the BrO_4^- ion from the selenate ion?