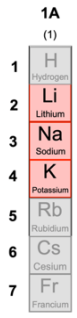
CONCEPT: METAL ION CATALYSIS: WATER ACTIVATION



Alkali Metal Reaction with H_2O

- Alkali metals react with water in a _____ displacement reaction that uses _____.

Reaction with H_2O

$$M\,(s) + H_2O\,(l) \longrightarrow H_2\,(g) + \_\_\_\_\_\,(aq)$$

EXAMPLE: Complete and balance the following reaction.

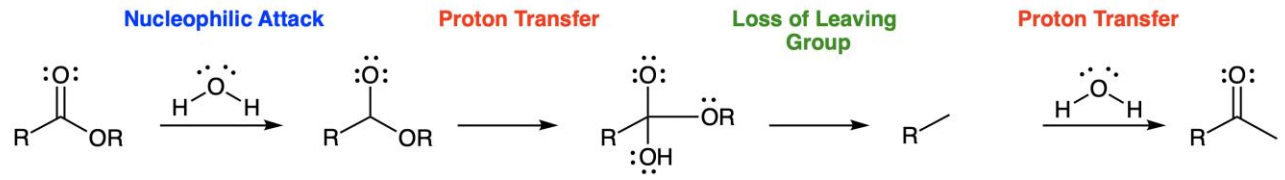
$$K\,(s) + H_2O\,(l) \longrightarrow$$

Substitution Reaction

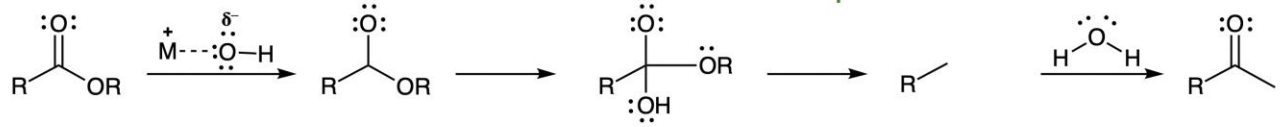
- Metals (2^+ or 3^+) form metal-hydroxide complexes when reacting with water.
  - □ The metal-hydroxide complex reacts in a similar to the _____ of carboxylic acid derivatives.
  - □ **Recall:** Carboxylic acid derivatives can react with a water molecule via a _____ Reaction.

Uncatalyzed vs Catalyzed Substitution Reactions

Uncatalyzed (Slow)



Catalyzed (Fast)



EXAMPLE: Provide the mechanism for the Zn^{2+} catalyzed hydrolysis of methyl acetate.

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PRACTICE: Name the carbonyl containing product formed when propyl-3-methylpentanoate reacts with Mg^{2+} in an aqueous solution.

a) 5-methylbutanoate b) 3-methylpentanoate c) sec-butylpentanoate d) propyl pentanoate

PRACTICE: Given below are the pK_a values of metal ions after binding to water. If the greater the acidity of a metal cation then the more easily the complex forms, which of the following ions would facilitate the fastest basic hydrolysis of ethyl propanoate?

a) Al^{3+} ($pK_a = 4.85$) b) Cu^{2+} ($pK_a = 7.52$) c) Fe^{3+} ($pK_a = 2.20$) d) Ni^{2+} ($pK_a = 10.60$)