$H^+(aq) + Cl^-(aq) + Na^+(aq) + OH^-(aq) \rightarrow H_2O + Na^+(aq) + Cl^-(aq)$ …(i)

Equation (i) is more simply written as **net ionic equation**, as

$$H^+(aq) + OH^-(aq) \rightarrow H_2O \qquad \text{…(ii)}$$

For reactions between strong acids and bases the net ionic equation is always given by Eqn (ii). For such reactions, heat of neutralization is constant (– 56.1 kJ/mol H_2O formed).

A reaction between a **weak acid** (say, acetic acid) **and a strong base** (say, NaOH) is,

$$CH_3COOH + OH^- \rightarrow H_2O + CH_3COO^-$$

NaOH is almost completely dissociated whereas CH_3COOH is present mainly as undissociated molecule.

Limitations of Arrhenius's Theory

One of the most glaring limitations of this theory is in its treatment of the weak base ammonia, NH_3. According to Arrhenius, a substance must contain OH^- in order to be a base. Where is the OH^- in NH_3?

BRONSTED- LOWRY THEORY OF ACIDS AND BASES

According to Bronsted- Lowry, an acid is a **proton (H^+) donor** and a base is a **proton (H^+) acceptor.**

To describe the basic behaviuor of ammonia which we had difficulty doiung with Atthenius theory, we can write

$$\underset{\text{acid}}{H_2O} + \underset{\text{base}}{NH_3} \rightleftharpoons NH_4^+ + OH^- \qquad \text{..(1)}$$

H_2O acts as an acid. It donates a proton (H^+) which is gained by NH_3, a base. As a result of this transfer, the ions NH_4^+ and OH^- are formed.

The above reaction, when written in reverse order:

$$\underset{\text{acid}}{NH_4^+} + \underset{\text{base}}{OH^-} \rightleftharpoons H_2O + NH_3 \qquad \text{..(2)}$$