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AP Chem
May 2003

AP TOPIC: Equation Writing

Introduction

Question 4 in Section B, Part II of the AP Chemistry examination requires the candidates to write five chemical equations from a choice of eight sentences that describe chemical reactions in words.
In general, it is worth noting the following points.

- Learn inorganic nomenclature rules. Without knowledge of these rules this question is almost impossible.
- Where appropriate all compounds that produce ions in solution should be written in their ionic form and spectator ions should be ignored, i.e. where appropriate, write the net-ionic equation.
- There are no reactions in the question that do not occur.
- There is no requirement to balance the equations you write, however, it may be helpful to do so.
- It is possible to get partial credit by writing reactants carefully and guessing products.

Double Replacement (Metathesis).

These reactions involve two reactants forming two products. They usually involve acids, bases and salts.

- **Acids**

Formulae begin with H and have a hydrogen ion (H^+) that they donate in reactions.

Organic acids often have ionizable hydrogen ions written at the end of their formulae and include the -COOH or -CO_2H group. E.g. ethanoic acid CH_3COOH. Organic acids are weak.

Learn the strong acids. HCl, HBr, HI and acids where the number of oxygen's present exceeds the number of hydrogen's by two or more, e.g. HNO_3, H_2SO_4.

Sulfuric acid, H_2SO_4, is more accurately represented as only losing one H^+ ion, i.e. as $H^+ + HSO_4^-$, rather than $2H^+ + SO_4^{2-}$, since the second dissociation of the HSO_4^- ions is only very slight in comparison to the loss of one H^+ from H_2SO_4 to form H^+ and HSO_4^-.

Carbonic acid, H_2CO_3, is weak not very stable and is better represented as $CO_2 + H_2O$. If it were to be represented as an acid it should be shown as a monoprotic acid, forming H^+ and HCO_3^-.

Sulfurous acid, H_2SO_3, is generally thought of as being a monoprotic acid forming H^+ and HSO_3^-, or alternatively, if a product, as a weak acid and not dissociating at all.

- **Bases**

Formulae end in OH (hydroxide ions, OH^- present) except for ammonia and organic bases that contain Nitrogen that has a lone pair of electrons allowing it to act as a base. Do not confuse organic alcohols that also have formulae ending in OH as hydroxide ions. An alcohol can be recognized as having a carbon chain preceding the –OH group, e.g. C_2H_5OH or $CH_3CH_2CH_2OH$, for ethanol and propan-1-ol respectively.

Learn the strong bases. Confined to Group I & II hydroxides and ammonium hydroxide, i.e. LiOH, NaOH, KOH, $Ca(OH)_2$, $Sr(OH)_2$, $Ba(OH)_2$ and NH_4OH.
Ammonium hydroxide, NH_4OH, is not very stable and is better represented as $NH_3 + H_2O$.

- **Salts**

A salt is a compound where the hydrogen ion(s) in an acid have been replaced by metal ions or the ammonium (NH_4^+) ion.
Learn the solubility rules for salts.

ACID + BASE ➔ SALT + WATER (NEUTRALIZATION)
ACID + CARBONATE ➔ SALT + WATER + CARBON DIOXIDE
ACID + METAL ➔ SALT + HYDROGEN

Equimolar means the reactants react in a 1:1 ratio and is often a clue to only some of the ionizable hydrogen's in an acid being replaced.