

Double-replacement reactions

- synthesis
- decomposition
- combustion
- single-replacement
- double-replacement
- neutralization

1. Learn to *predict* Double-replacement reaction
If and when a reaction occurs, what are the products?
2. Learn to *write* Double-replacement reaction:
 - (i) Balanced chemical reaction
 - (ii) Net ionic reaction
 - (iii) Identify spectator ions in the reaction

Double-replacement reactions



Neutralization Reactions

- Special double-replacement reactions
- Involves acids and bases

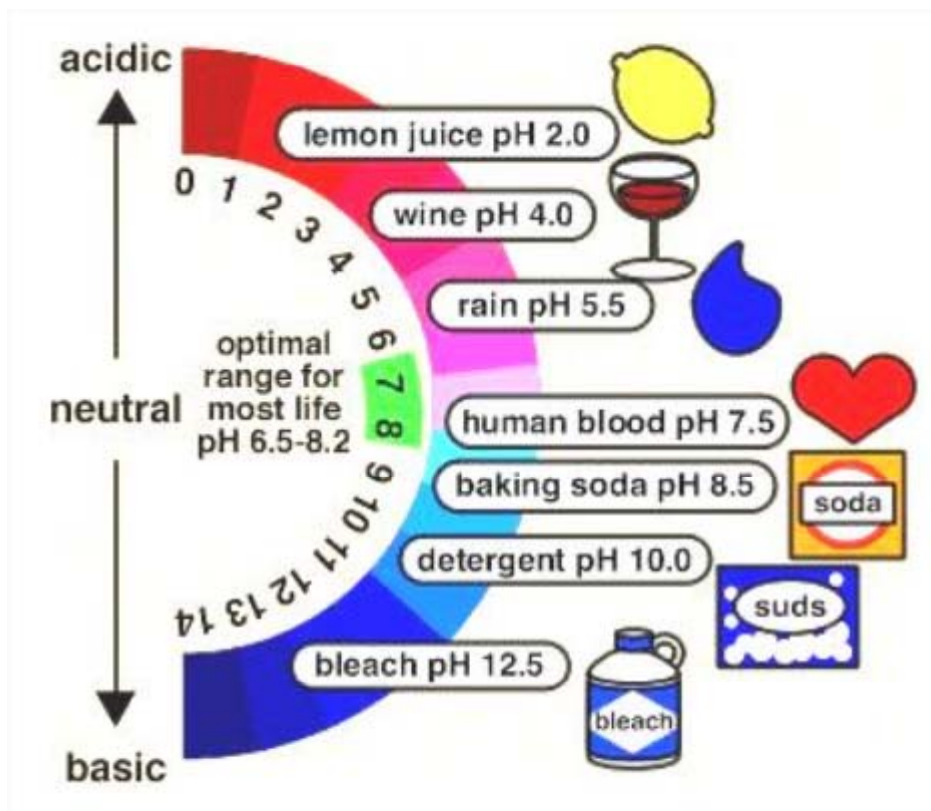


Image credit: <http://blog.tutorvista.com/2011/12/acids-and-bases/>

Double-replacement reactions



Neutralization Reactions

- Special double-replacement reactions
- Involves acids and bases

ACIDS	BASES
Common Properties:	Common Properties:
<ul style="list-style-type: none">• taste sour.• stings on a open wound.• produce H_2 gas when reacted with metals.	<ul style="list-style-type: none">• taste bitter.• give a slippery feel.
Common Examples:	Common Examples:
Lemons, oranges, vinegar, soft drink, urine, sulfuric acid, hydrochloric acid	Soap, toothpaste, bleach, cleaning agents, limewater, ammonia water, sodium hydroxide.
Other Chemical Properties:	Other Chemical Properties:
<ul style="list-style-type: none">• In acidic solution, phenolphthalein (a colour indicator) stays colourless.• Acid solution turns blue litmus paper (a pH indicator) red.• Acid solutions have a $pH < 7$.	<ul style="list-style-type: none">• In basic solution, phenolphthalein (a colour indicator) turns pink.• Basic solution turns red litmus paper (a pH indicator) blue.• Basic solutions have a $pH > 7$.

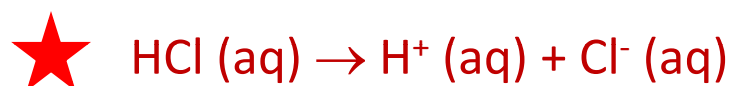
Double-replacement reactions



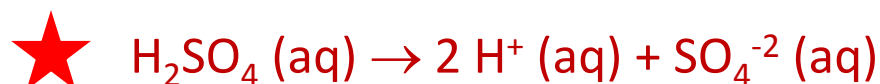
Neutralization Reactions

- Special double-replacement reactions
- Involves acids and bases
- Acidic compounds are usually H^+ ion-containing compounds. In solution, they produced H^+ ions.

Example: HCl, hydrochloric acid. In solution, H^+ ions are produced.



Example: H_2SO_4 , sulfuric acid. In solution, H^+ ions are produced.



Example: CH_3COOH , acetic acid. In solution, H^+ ions are produced.



★ **STRONG ACID** - In solution, the acid is 100% dissociated into its ions.
(Note: 'Strong' has no association with the acid's concentration.)

★ **WEAK ACID** - In solution, the acid is **NOT** 100% dissociated into its ions, as indicated by the \rightleftharpoons (Note: 'Weak' has no association with the acid's concentration.)

Double-replacement reactions



Neutralization Reactions

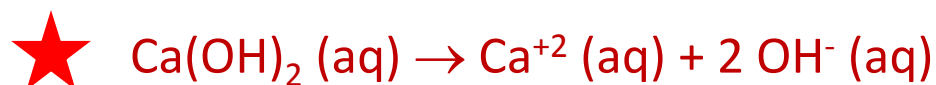
- Special double-replacement reactions
- Involves acids and bases
- Basic compounds are usually OH^- ion-containing compounds.

In solution, they produced OH^- ions.

Example: NaOH , sodium hydroxide. In solution, OH^- ions are produced.



Example: Ca(OH)_2 , calcium hydroxide. In solution, OH^- ions are produced.



Example: NH_4OH , ammonium hydroxide. In solution, OH^- ions are produced.



★ **STRONG BASE** - In solution, the base is 100% dissociated into its ions.
(Note: 'Strong' has no association with the base's concentration.)

★ **WEAK BASE** - In solution, the base is **NOT** 100% dissociated into its ions, as indicated by the \rightleftharpoons (Note: 'Weak' has no association with the base's concentration.)

Double-replacement reactions



Neutralization Reactions

- The word "neutralization" is used because the acid and base properties of H^+ and OH^- are destroyed or neutralized.
- In the reaction, H^+ and OH^- ions combine to form **HOH** (i.e. H_2O) or water molecules.
- The other product is the formation of a *salt*, which is a broad term for an ionic chemical compound.

Examples: $NaCl$, $CaCl_2$, etc.

Recall:

Formation of water is one of the driving force of a double-replacement reaction. Neutralization reaction will always occur!



Neutralization Reaction: Acid + Base \rightarrow Salt + Water

Double-replacement reactions



Neutralization Reactions

Let's consider if the following reaction will occur:



Step 1: What are the potential products formed?

Potential products would be: H_2O and NaCl .

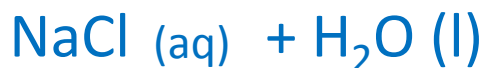
Make sure
the formulae
are chemically
correct.

Step 2: Determine the physical states of the products.

Check to see whether the products would be:

(i) A solid (i.e. precipitate), (ii) A liquid, water (iii) A gas, H_2S (g)

	Soluble	Not soluble
Chlorides, Cl^-	ALL, except	AgCl , Hg_2Cl_2 , PbCl_2 .



Formation of H_2O (l),
Reaction occurs!

Double-replacement reactions



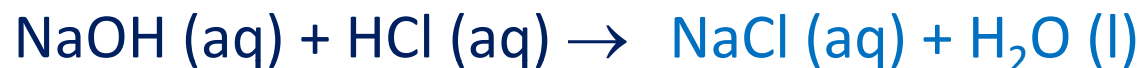
Neutralization Reactions

Let's consider if the following reaction will occur:

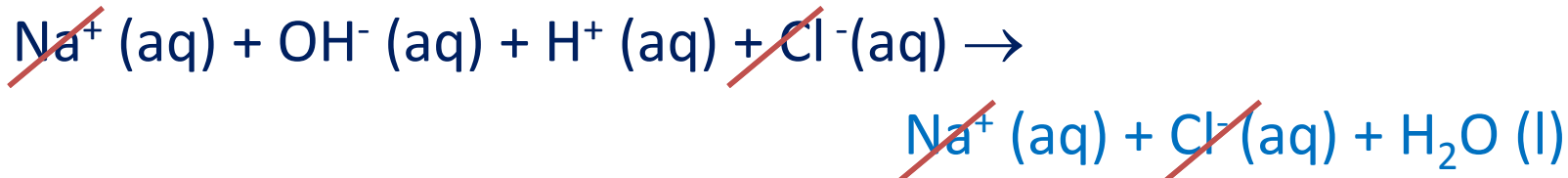


Make sure
the reaction is
balanced.

Step 3: Write the balanced chemical reaction.



Step 4: Write the net ionic reaction.



Step 5: Identify the spectator ions.



For neutralization reactions,
this is ALWAYS the net ionic
reaction.

Try some practice problems in Maple TA.

Use Dimensional Analysis in ALL your
calculations!!