Chemical Reactions in Aqueous Solution

Water is unusual

O_2

H_2O

CO_2

HCN

N_2

N_2O

F_2

NO

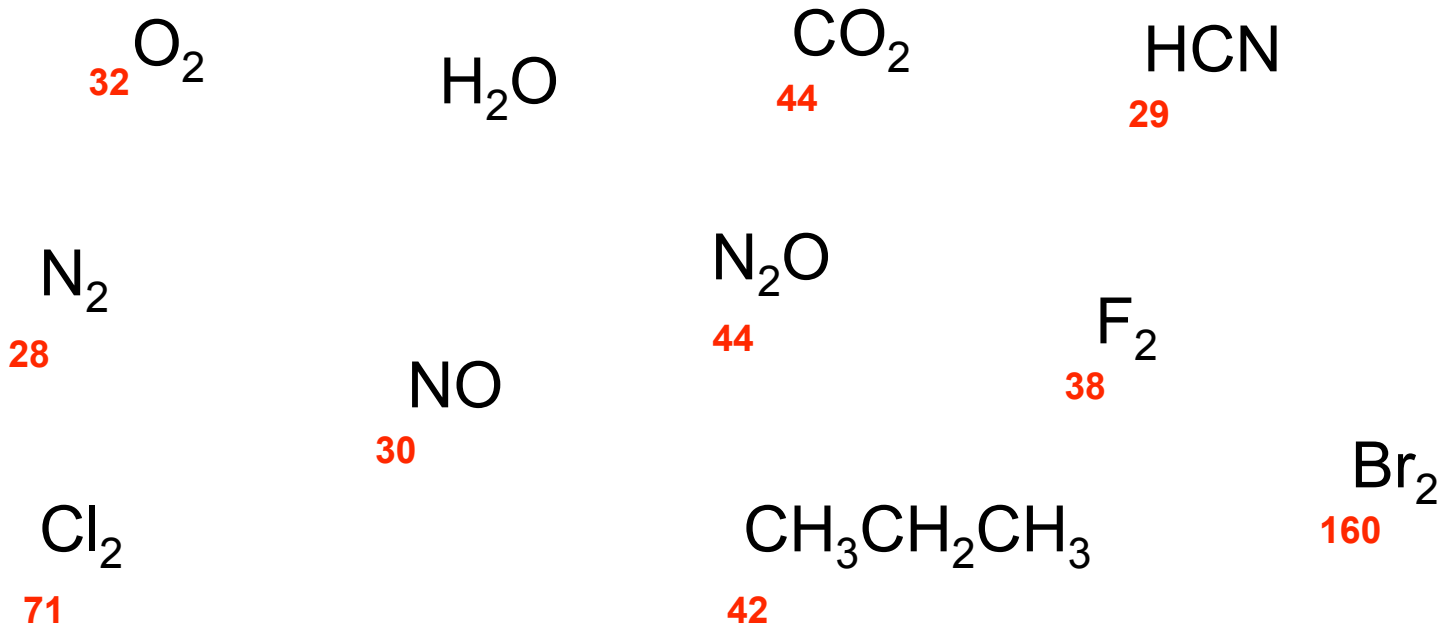
Br_2

Cl_2

$CH_3CH_2CH_3$

Chemical Reactions in Aqueous Solution

Water is unusual



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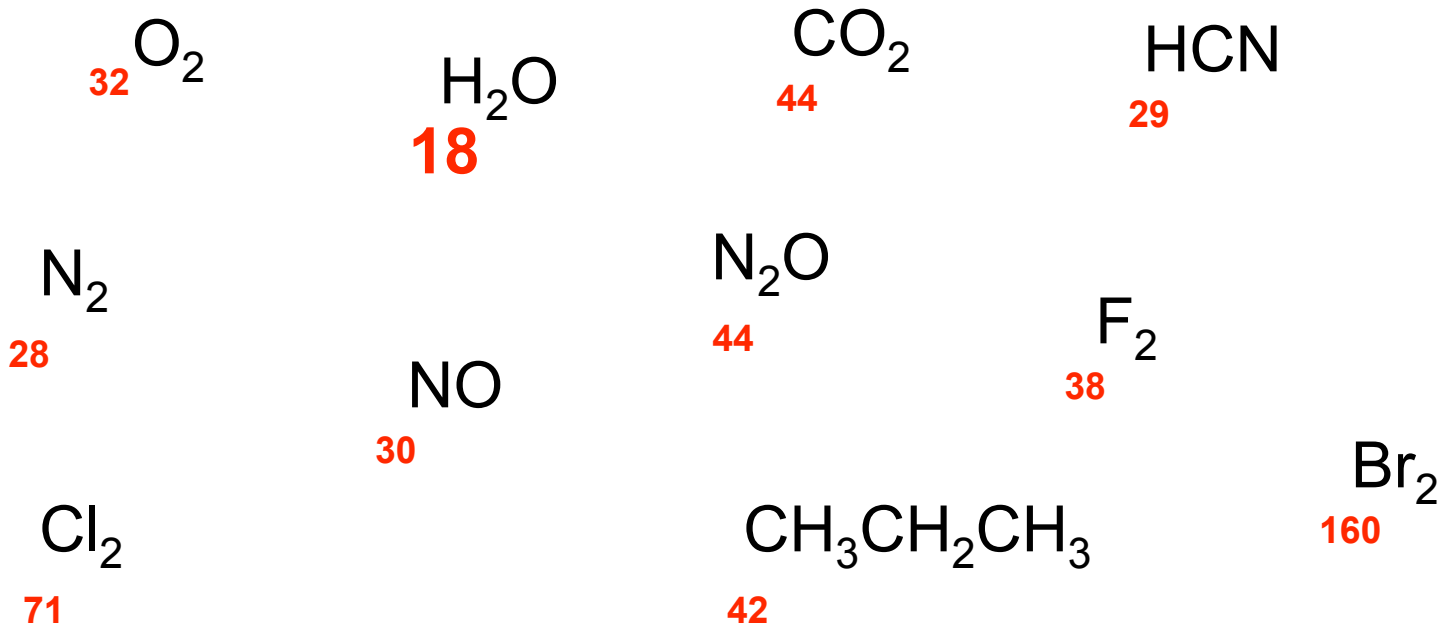
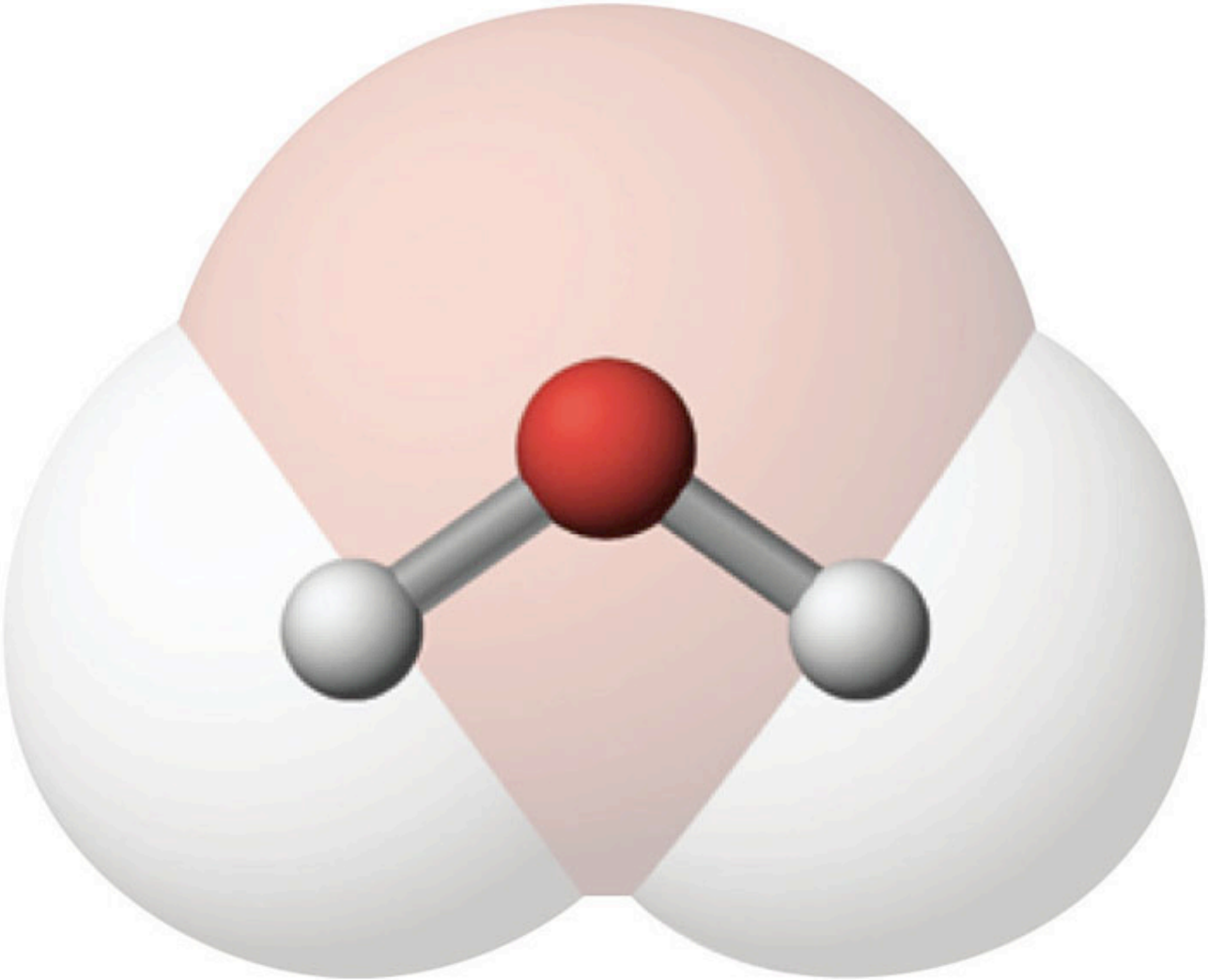


Charge on O atom = −0.4



Charge on each H atom = +0.2

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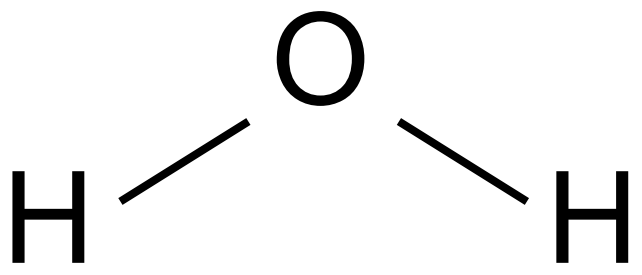

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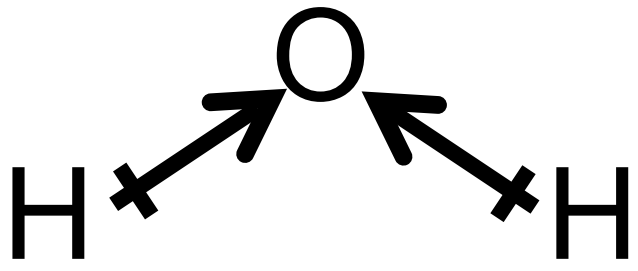

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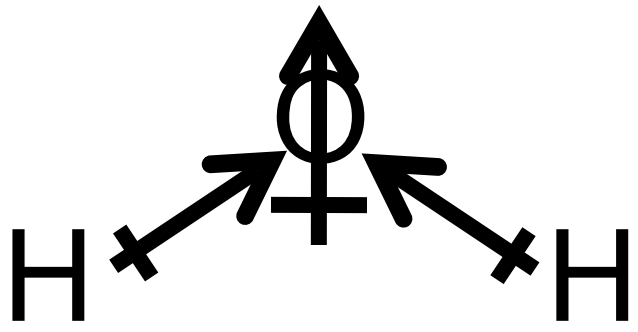

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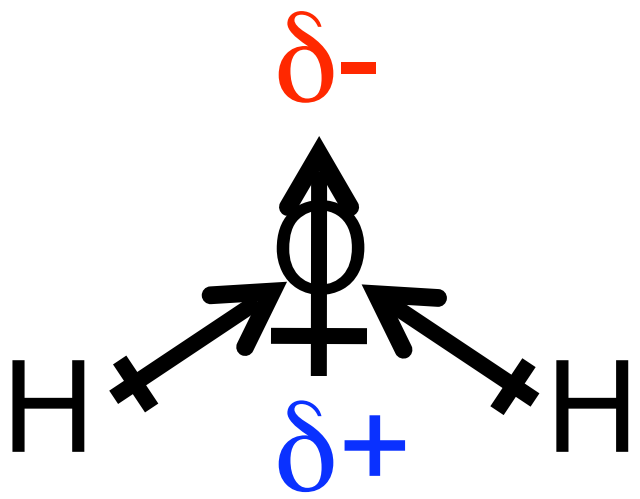

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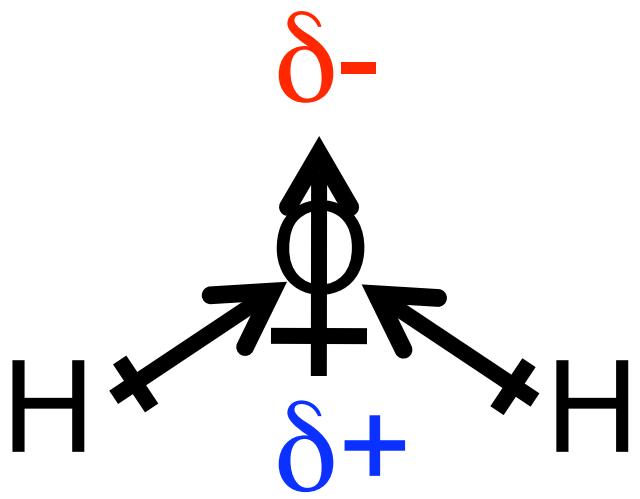

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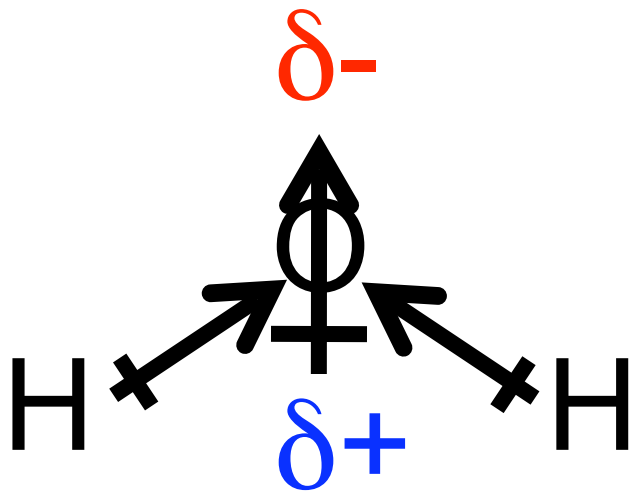
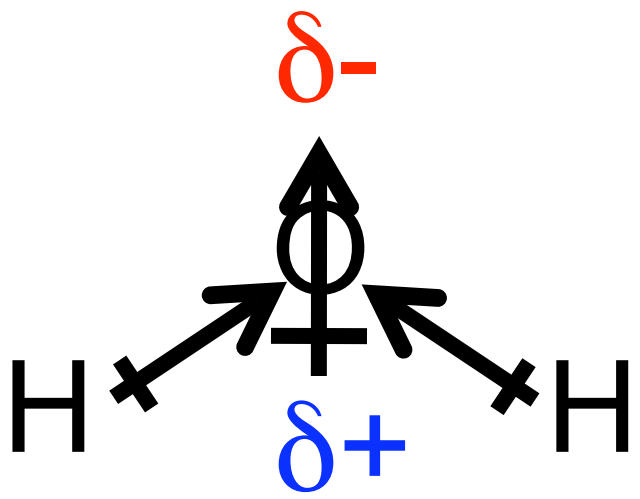
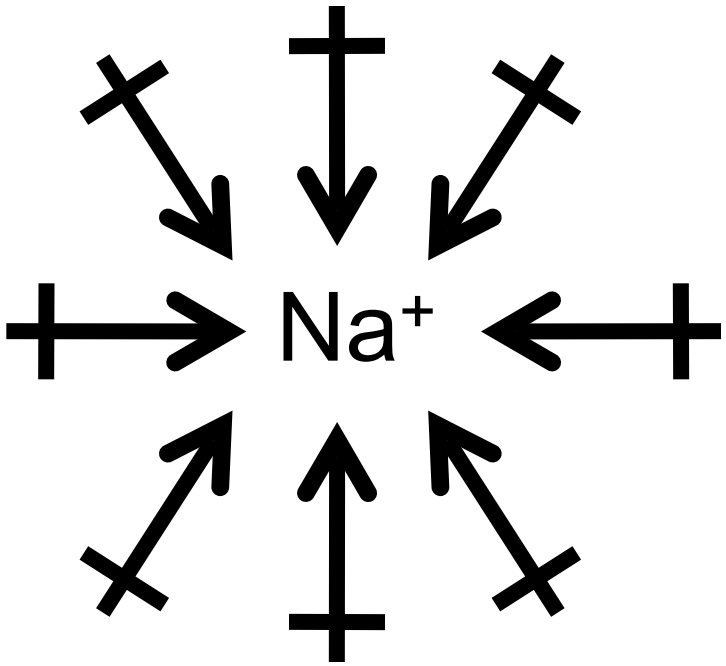


Na^+

Chemical Reactions in Aqueous Solution

Water is unusual





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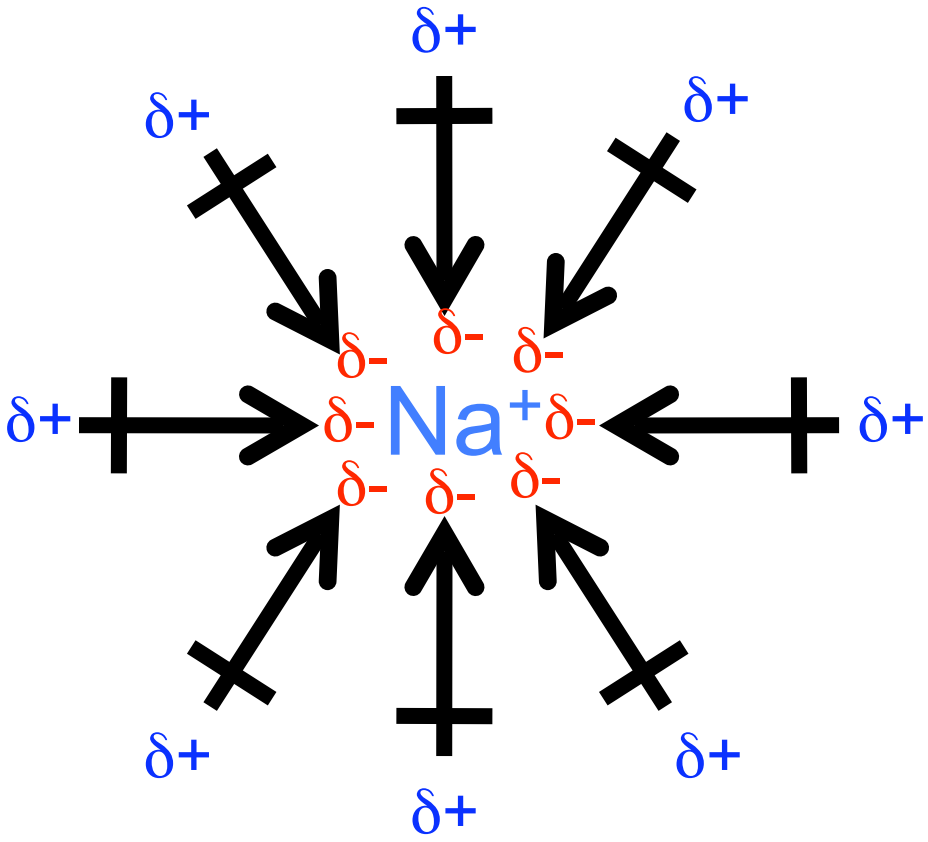

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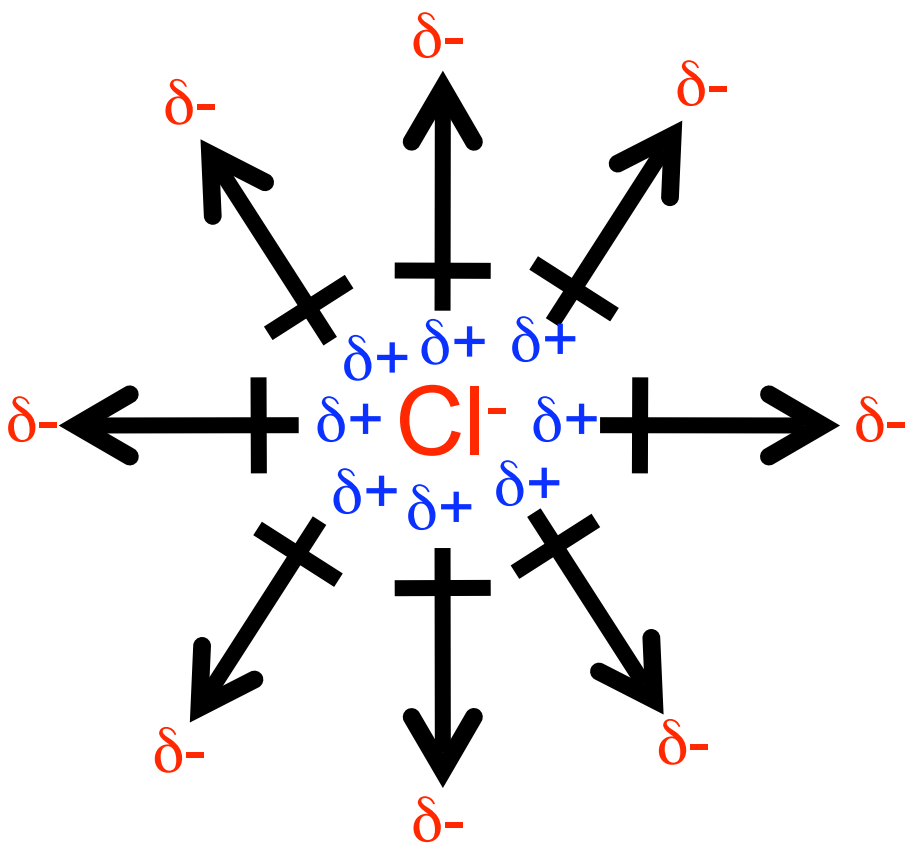
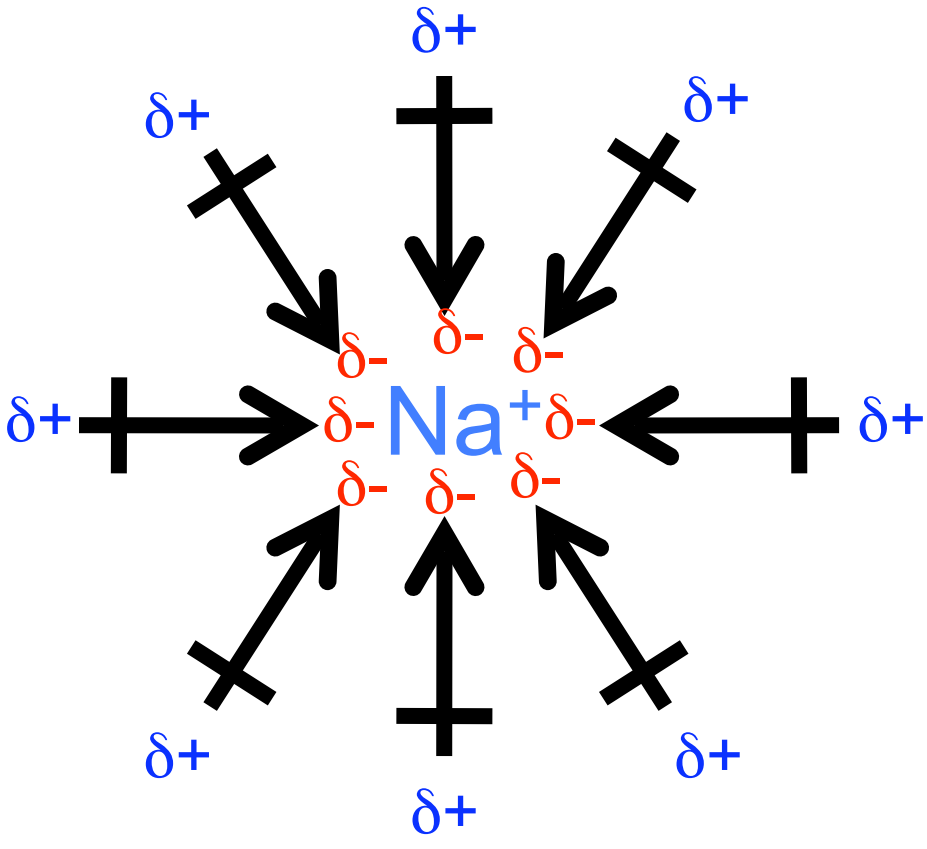
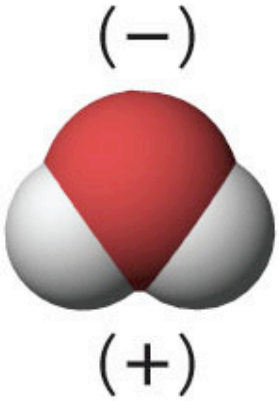
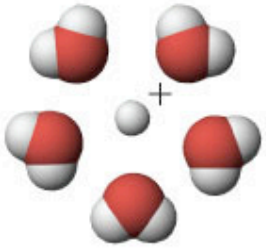




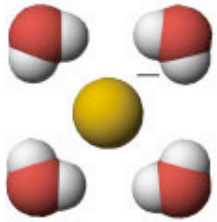
$CuCl_2\ (s) \rightarrow Cu^{2+}\ (aq) + 2Cl^{-}\ (aq)$

A water molecule is electrically positive on one side (the H atoms) and electrically negative on the other (the O atom). These charges enable water to interact with negative and positive ions in aqueous solution.





Water surrounding a cation



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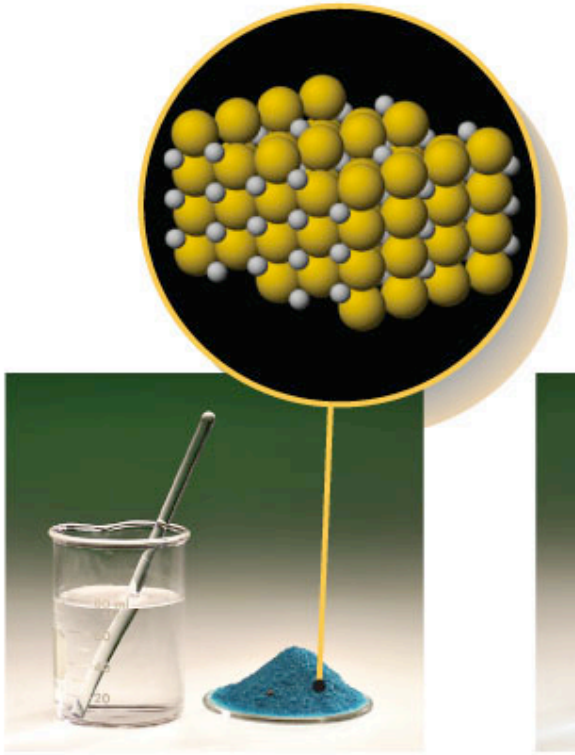

Copper chloride is added to water. Interactions between water and the Cu^{2+} and Cl^{-} ions allow the solid to dissolve.

The ions are now sheathed in water molecules.

Sodium in Water (H_2O)

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What will happen?

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What will happen?

Na O H

Sodium in Water (H_2O)

What will happen?

Na O H

3.5

Sodium in Water (H_2O)

What will happen?

Na	O	H
	3.5	**2.2**

Sodium in Water (H_2O)

What will happen?

Na	O	H
0.9	**3.5**	**2.2**

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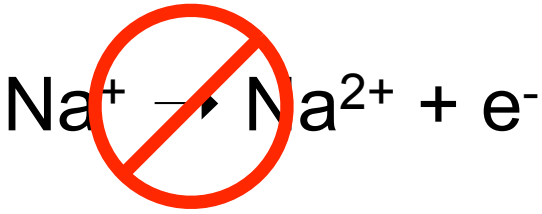

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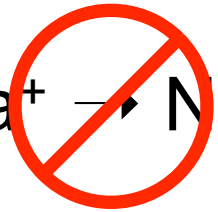

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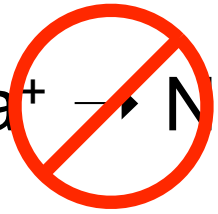

$O + e^- \rightarrow O^-$

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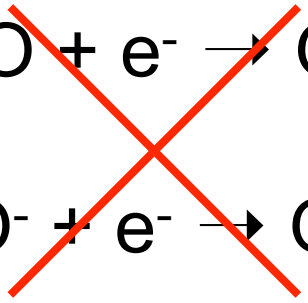

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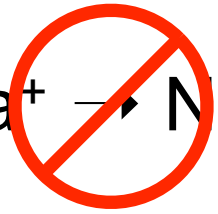

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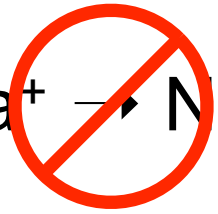

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-2

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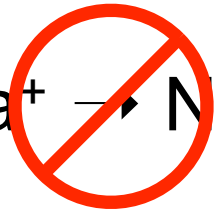

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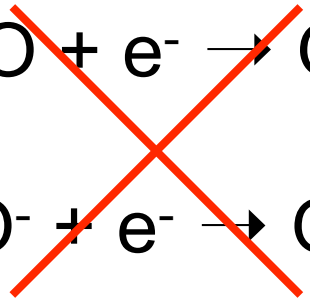

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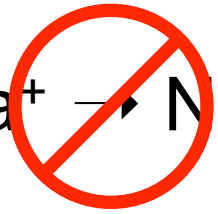

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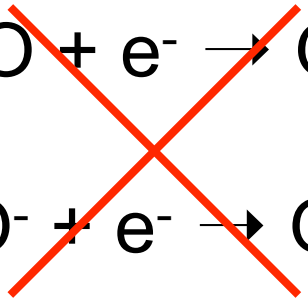

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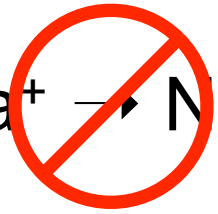

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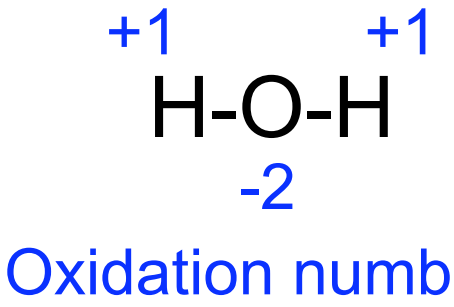

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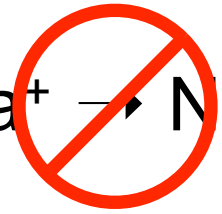

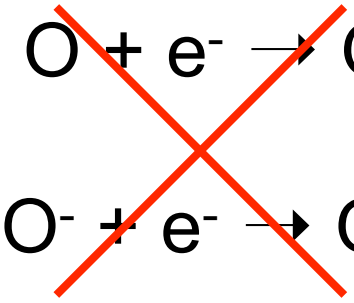

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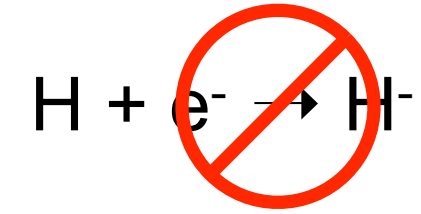

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$H\cdot + H\cdot \rightarrow H_2$

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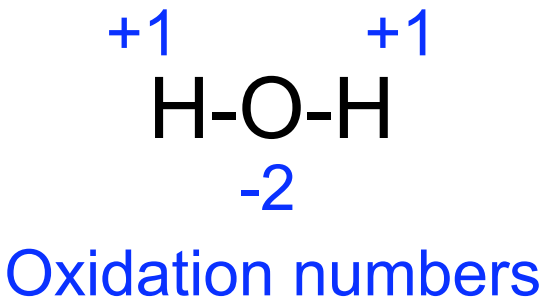

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Knowing where electrons want to go!

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Stoichiometry!

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Stoichiometry!

Balanced, reasonable equation!

What just happened?

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$$2Na\ (s) + 2H_2O\ (l) \rightarrow 2Na^+\ (aq) + 2OH^-\ (aq) + H_2\ (g)$$

What just happened?

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- Fire erupted occasionally
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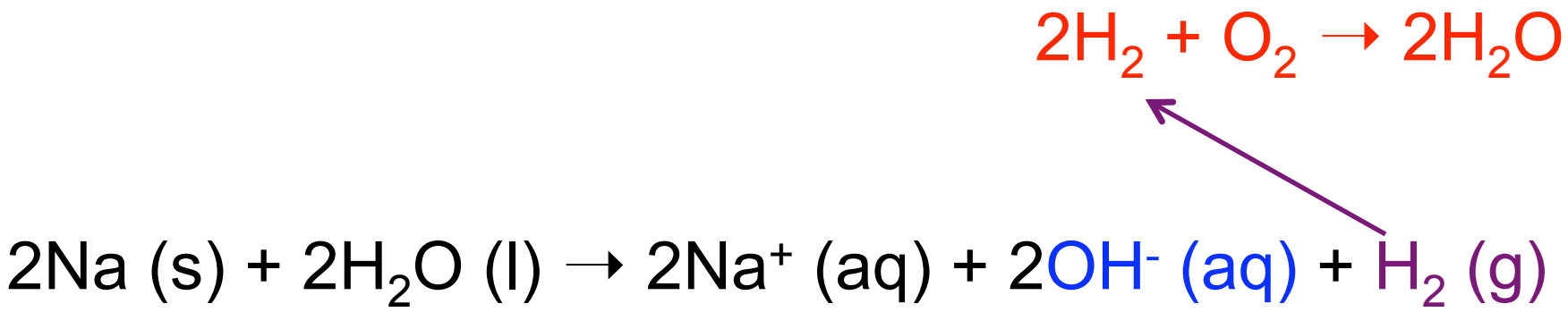

Back to NaCl

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$$NaCl\ (s) \rightarrow Na^{+}\ (aq) + Cl^{-}\ (aq)$$

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a ***strong*** electrolyte

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a ***very weak*** electrolyte

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Electricity – movement of charge

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Conducts electricity well

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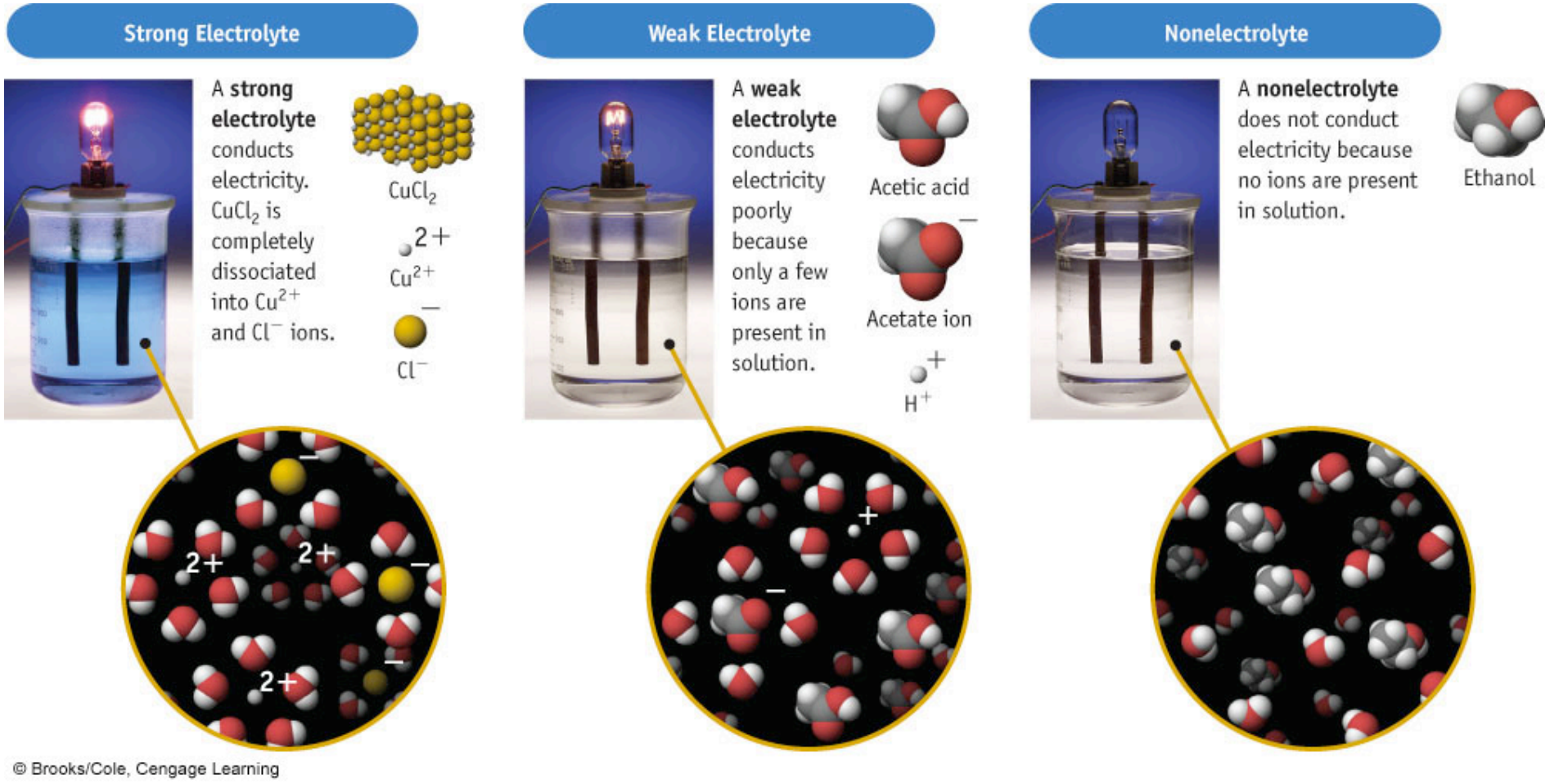


Fig. 3-9, p. 124

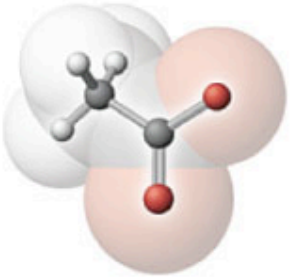
$CH_3CO_2H(aq) + H_2O(\ell) \rightleftharpoons CH_3CO_2^-(aq) + H_3O^+(aq)$

acetic acid

$<$ 1% ionized

$=$ weak electrolyte

water



acetate ion

hydronium ion

SOLUBLE COMPOUNDS	EXCEPTIONS
Almost all salts of Na^+, K^+, NH_4^+	
Salts of nitrate, NO_3^- chlorate, ClO_3^- perchlorate, ClO_4^- acetate, $CH_3CO_2^-$	
Almost all salts of Cl^-, Br^-, I^-	Halides of Ag^+, Hg_2^{2+}, Pb^{2+}
Salts containing F^-	Fluorides of Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Pb^{2+}
Salts of sulfate, SO_4^{2-}	Sulfates of Ca^{2+}, Sr^{2+}, Ba^{2+}, Pb^{2+}

INSOLUBLE COMPOUNDS	EXCEPTIONS
Most salts of carbonate, CO_3^{2-} phosphate, PO_4^{3-} oxalate, $C_2O_4^{2-}$ chromate, CrO_4^{2-} sulfide, S^{2-}	Salts of NH_4^+ and the alkali metal cations
Most metal hydroxides and oxides	Alkali metal hydroxides and $Ba(OH)_2$

Fig. 3-10, p. 126