Reactants			Products			
SOLID SODIUM	**LIQUID WATER**		SODIUM HYDROXIDE in solution		HYDROGEN GAS	
Na (s)	**H_2O (l)**		NaOH (aq)		H_2 (g)	
What kind of particles? atoms	Molecules (atoms in)		ions		molecules	
# protons in each _11__ # electrons in each _11__ net charge _0__	H atom __1__ protons __1__electrons _0__ net chg	O atom _8_ protons _8__electrons _0_ net chg	Na^+ ion 11_ protons 10_electrons _+1_ net chg	OH^- ion O atom 8 p 8 e- H atom 1 p 1 e- Plus 1 extra e- Net chg -1	H atom __1__ protons __1__electrons _0__ net chg	H atom __1__ protons __1__electrons _0__ net chg
Arrangement Atoms are as close as they can get in fixed positions	Water molecules as close as they can get and free to move		Ions in solution – Na+ ions are dissociated (split) from OH- ions moving freely in the water.		Molecules are far apart and free to move in the gas.	
Attractions **Metallic bond** Sea of free moving electrons charged by all the atoms	Hydrogen atom shares unequally electrons with oxygen atoms in **polar covalent bonds** Water molecules are attracted to each other's oppositely charged ends- **dipole-dipole attractions**		The Na+ ion is attracted to negative-end (oxygen end) of water molecules by **ion-dipole attractions.** The OH- ion is attracted to positive-end (hydrogen end) of water molecules by **ion-dipole attractions.**		Hydrogen atoms are ___**nonpolar covalently** _ bonded to hydrogen atoms to make hydrogen H_2 molecules. Hydrogen molecules are far apart due to their weak attractions – since they have NO oppositely charged ends (**induced dipole-induced dipole attractions**).	

ANALYSIS OF THE REACTION OF SODIUM WITH WATER

THE CHANGES
SODIUM

SODIUM before	SODIUM after	Notes-
What kind of particle? Atom – neutral Charge = 0	What kind of particle? Ion - charged Charge = +1	What happened to the sodium? Sodium atom **LOST ELECTRON** to become a sodium ion
How many protons? 11	How many protons? 11	
How many electrons? 11	How many electrons? 10	
Na (s) →	**Na^+ (aq) + 1 e-**	Chemistry term for this change **oxidation**

WATER MOLECULES

water before	water after	Notes-
H_2O molecules (H-O-H)	H_2 molecules (H-H) And OH- ions (O-H-)	What happened to the water? The water molecules broke apart – the bond between H-O must have broken to separate the H from O-H

The ionization of water occurs in water all the time as a reversible reaction.

$$H_2O(l) \leftrightarrows H^+(aq) + OH^-(aq)$$

Every once in a while two water molecules collide with enough kinetic energy to break the polar covalent bond between the O-H. When this happens the oxygen (who was pulling harder on e- pair so e- pair spent more time there) keeps the e-pair. This forms an OH- ion. Meanwhile, the hydrogen is left with no electrons forming a hydrogen ion (H+)

This reaction is **reversible** – it goes both ways. At ***equilibrium***
the rate of forward reaction (ionization of the water)
is equal to
the rate of the reverse reaction (the ions getting together to make water molecules).
So conditions remain constant – the number of ions and molecules stays the same.

HYDROGEN IONS

hydrogen before	hydrogen after	Notes-
What kind of particle? **Ions** in equilibrium with water	What kind of particle? H_2 **molecules** in the gas	What happened to the hydrogen? Hydrogen (H+) ions become H_2 molecules
How many protons? 1 proton	How many protons? 1 proton in each H atom	
How many electrons? 0 electrons	How many electrons? 1 electron in each H atom	
2 H+ (aq) + 2e- →	H_2 (aq)	Chemistry term for this change **reduction**