

## CONCEPT: CALCULATE OXIDATION NUMBERS

- The **Oxidation Number**: an element's ability to \_\_\_\_\_, \_\_\_\_\_ or \_\_\_\_\_ electrons when alone or in a compound.

### The Natural State

- For an atom in its **Natural State** (standard state), its oxidation number (oxidation state) is equal to \_\_\_\_\_.

1A (1)														2A (2)										3A (3)										4A (4)	5A (5)	6A (6)	7A (7)	8A (8)																																																																																																																																																		
1	Hydrogen														Lithium										Beryllium										Boron										Carbon	Nitrogen	Oxygen	Fluorine	Helium																																																																																																																																							
2	Li														Be																																											Ne																																																																																																																														
3	Na														Mg																																																					Ar																																																																																																																				
4	K														Ca										Sc										Ti										V										Cr										Mn										Fe										Co										Ni										Cu										Zn										Ga										Ge										As										Se										Br										Kr									
5	Rb														Sr										Y										Zr										Nb										Mo										Tc										Ru										Rh										Pd										Ag										Cd										In										Sn										Sb										Te										I										Xe									
6	Cs														Ba										La										Hf										Ta										W										Re										Os										Ir										Pt										Au										Hg										Tl										Pb										Bi										Po										At										Rn									
7	Fr														Ra										Ac										Rf										Db										Sg										Bh										Hs										Mt										Ds										Rg										Cn										Nh										Fl										Mc										Lv										Ts										Og									

**EXAMPLE:** Which of the following choices represents a natural state with an oxidation number equal to zero?

- a)  $\text{Na}_3$                                       b) Cl                                      c) He                                      d)  $\text{Mn}_4$

### Ions

- Recall, an ion is an element or compound with a \_\_\_\_\_ or \_\_\_\_\_ charge.
  - For a *monoatomic ion*, the oxidation number is \_\_\_\_\_ to its charge.

**EXAMPLE:** Which of the following elements would have the most positive oxidation number based on its ionic form?

- a) Silver, Ag                                      b) Scandium, Sc                                      c) Sodium, Na                                      d) Sulfur, S

**PRACTICE:** Which of the following elements would have the lowest oxidation number?

- a) Indium, In                                      b) Strontium, Sr                                      c) Argon, Ar                                      d) Manganese, Mn

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### Oxidation Number Rules

- *Oxidation Numbers* don't always correspond to real charges and therefore a list of rules will be necessary.
  - When different elements are in a compound these specific rules will be used to calculate oxidation numbers.

Specific Oxidation Number Rules	
Element(s)	Oxidation Number
Group 1A	_____ when connected to any other element
Group 2A	_____ when connected to any other element
Fluorine	_____ when connected to any other element
Hydrogen	_____ when connected to nonmetals Ex: _____, _____, _____ _____ when connected metals or boron Ex: _____, _____, _____
Oxygen	_____ when it is not a peroxide or superperoxide _____ when it exists as a peroxide Ex: _____, _____, _____ □ Peroxide = _____ Group 1A elements + _____ oxygens. _____ when it exists as a superoxide Ex: _____, _____, _____ □ Superoxide = _____ Group 1A elements + _____ oxygens. _____ except when they are connected to oxygen
Group 7A (Cl, Br, I)	

**EXAMPLE:** Which compound has oxygen with the lowest oxidation state?

a) NaO<sub>2</sub>

b) CO<sub>2</sub>

c) Cs<sub>2</sub>O<sub>2</sub>

d) O<sub>2</sub>

### Oxidation Number of Non-listed Elements

- When asked to determine the oxidation number of a non-listed element within a compound:

**STEP 1:** Treat the non-listed element as \_\_\_\_\_.

**STEP 2:** Use the list to WRITE the known oxidation number of the other elements.

**STEP 3:** If an element has a **subscript** then remember to distribute it.

**STEP 4:** ADD up the oxidation numbers, create an equation and make it equal to the \_\_\_\_\_ of the compound.

**EXAMPLE:** Give the oxidation number of the carbon atom in the acetate ion: C<sub>2</sub>H<sub>3</sub>O<sub>2</sub><sup>-</sup>