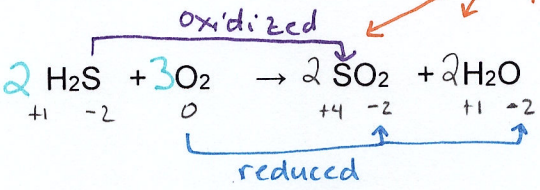
Balancing Redox Reactions with Oxidation Numbers

- So far we know how to balance redox reactions using the half-reaction method
  - This method works good in acidic conditions and for simple half reactions (ie. metal/metal ions and non-metals/ non-metal ions)
- We can also use oxidation numbers to balance redox reactions as well
- We use this method of balancing, when we need to know how many electrons are transferred per atom, per molecule, or per reaction
  - main reason to use this method of balancing.
  - can also determine this one with half-rxn method
- To balance a redox reaction using oxidation numbers, follow these steps:
  - **Step 1:** Assign oxidation numbers to all elements and identify the elements that have a change in oxidation numbers.
  - **Step 2:** Determine the number of electrons transferred *per atom* by calculating the difference between the final oxidation number and the initial oxidation number of the atom undergoing the change.
    - $\#e^- =$ final - initial
  - **Step 3:** Determine the number of electrons transferred *per molecule/reactant*. The subscript numbers in a molecule are important in this step.
  - **Step 4:** Balance the total number of electrons transferred by finding the lowest common multiple. → give e^- transferred per rxn
  - **Step 5:** Finish balancing the equation by balancing the number of atoms by inspection, just like in science 10 and chemistry 20.

EXAMPLES:

1. Use oxidation numbers to balance the following equation.

Step 5: finish balancing



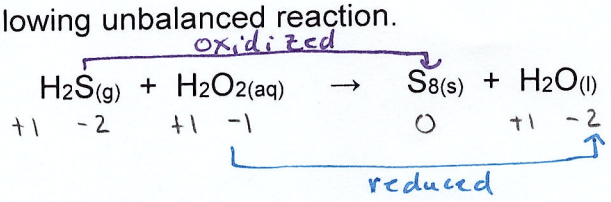
$H_2S + O_2 \longrightarrow SO_2 + H_2O$

Step 2: per atom
- $+4 - (-2) = +6e^-/S$
- $-2-0 = -2e^-/O$

Step 3: per molecule
- $6e^-/S \times (1) = 6e^-/H_2S$
- $2e^-/O \times (2) = 4e^-/O_2$

Step 4: per rxn
- $6e^-/H_2S \times (2) = 12e^-$
- $4e^-/O_2 \times (3) = 12e^-$

2. Balance the following unbalanced reaction.



Step 5: finish balancing

$8\,H_2S_{(g)} + 8\,H_2O_{2(aq)} \longrightarrow S_{8(s)} + 16\,H_2O_{(\ell)}$

Step 2: per atom
- $0-(-2) = 2e^-/S$
- $-2-(-1) = -1e^-/O$

Step 3: per molecule
- $2e^-/S \times (1) = 2e^-/H_2S$
- $1e^-/O \times (2) = 2e^-/O_2$

Step 4: per rxn
- $2e^-/H_2S \times (1) = 2e^-$
- $2e^-/O_2 \times (1)$
- $2e^-$

↙ balancing coefficients just need to be in a 1:1 ratio for H_2S & H_2O_2

*****Now try pg. 464 # 15, 16a*****