

# APES Chemistry Review

## Basics

→ Neutrons, protons, and electrons are the components of atoms, which combine to form molecules.

→ The basic unit of all chemical compounds, whether natural or man-made, is the molecule.

## Abbreviations

C ≡ carbon

S ≡ sulfur

U ≡ uranium

Cl<sub>2</sub> ≡ chlorine

O<sub>2</sub> ≡ oxygen

N<sub>2</sub> ≡ nitrogen

H<sub>2</sub> ≡ hydrogen

P ≡ phosphorus

NO<sub>2</sub><sup>-1</sup> ≡ nitrite

NO<sub>3</sub><sup>-1</sup> ≡ nitrate

SO<sub>4</sub><sup>-2</sup> ≡ sulfate

NH<sub>3</sub> ≡ ammonia

NO<sub>x</sub> ≡ oxides of nitrogen or nitrogen oxides (NO, NO<sub>2</sub>)

SO<sub>x</sub> ≡ oxides of sulfur or sulfur oxides (SO<sub>2</sub>, SO<sub>3</sub>)

VOC ≡ volatile organic compounds (compounds containing carbon which readily evaporate, ex. methane, benzene)

PAN ≡ peroxyacyl nitrates

## pH

→ pH is the negative log of the hydrogen ion concentration (sometimes called the potential of hydrogen ion).

→ Mathematically it is represented by the equation:  $\text{pH} = -\log[\text{H}^+]$  or  $\text{pH} = -\log[\text{H}_3\text{O}^+]$

→ [H<sup>+</sup>] is the molarity (# of moles per liter) of H<sup>+</sup> ions

→ [H<sup>+</sup>] and [H<sub>3</sub>O<sup>+</sup>] are essentially the same. H<sub>3</sub>O<sup>+</sup> is called the hydronium ion, it results when H<sup>+</sup> are in water.

→ Low pH corresponds to being more acidic. High pH corresponds to being more basic.

→ The opposite of acidic is basic.

→ The range of pH is from 0 to 14.

pH=1 ∴ [H<sup>+</sup>]=1 x 10<sup>-1</sup> moles/liter (very acidic)

pH=4 ∴ [H<sup>+</sup>]=1 x 10<sup>-4</sup> moles/liter (acidic)

pH=6 ∴ [H<sup>+</sup>]=1 x 10<sup>-6</sup> moles/liter (slightly acidic)

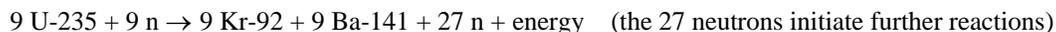
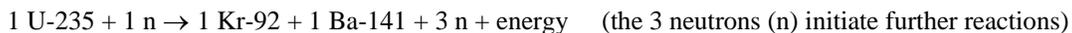
pH=7 ∴ [H<sup>+</sup>]=1 x 10<sup>-7</sup> moles/liter (neutral)

pH=8 ∴ [H<sup>+</sup>]=1 x 10<sup>-8</sup> moles/liter (slightly basic)

pH = 13 ∴ [H<sup>+</sup>]=1 x 10<sup>-13</sup> moles/liter (very basic)

## Nuclear Fission

→ Nuclear fission (splitting atoms) is the source of energy in today's nuclear power plants. The reactions used are chain reactions, in which one neutron initiates the reaction of millions of Uranium nuclei.

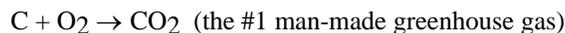


This continues until there are millions of neutrons being produced and millions of times more energy, as well.

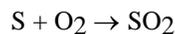
→ A moderator and control rods are used to absorb neutrons to prevent the chain reaction from getting out of control which would result in a meltdown.

## Air Pollution in the Troposphere

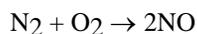
→ All fossil fuels contain large amounts of carbon (from the molecules of decomposed lifeforms). The combustion of fossil fuels (reaction with oxygen) produces carbon dioxide and carbon monoxide:



→ Coal may also contain sulfur which reacts during combustion:



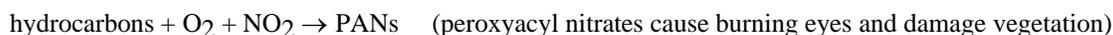
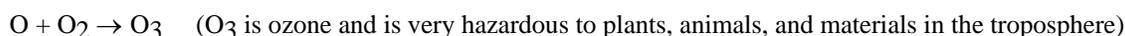
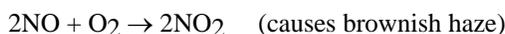
→ During combustion, the nitrogen that composes 80% of the air in the troposphere reacts:



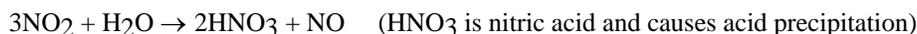
→ The reactions above all show the formation of primary air pollutants

→ Primary air pollutants undergo reactions in the atmosphere to form secondary air pollutants.

### Photochemical Smog



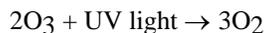
### Acid Precipitation



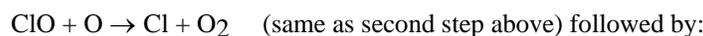
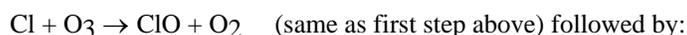
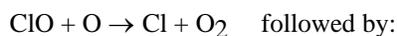
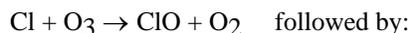
→ Acid deposition can be neutralized by the addition of lime ( $\text{CaCO}_3$ ) which is a base (a base will neutralize an acid)

## Air Pollution in the Stratosphere

### The reaction that is supposed to happen, which protects the Earth from UV light



### The destruction of ozone by CFCs



(these reactions are repeated thousands of times to destroy thousands of ozone molecules)