**CEE111 First Midterm Review Sheet**

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| Air quality engineering issues* Acid deposition – economic and ecosystem damage
* Stratospheric ozone depletion - CFCs
* Hazardous air pollutants
* Biomass cookstoves
 | Hazardous wastes* Corrosivity (high or low pH)
* Ignitability
* Reactivity
* Toxicity
 |

Concentration

* %: percent, 1 parts species per 100 parts solution
* ‰: per mil, 1 parts species per 1000 parts solution
* ppm: parts per million, 1 parts species per 106 parts solution
* ppb: parts per billion, 1 parts species per 109 parts solution
* ppt: parts per trillion, 1 parts species per 1012 parts solution

molar concentration of i molar mass of i mass concentration of i

 mass fraction of i density of solution mass concentration of i

Mass balance

**Accuracy** describes the relationship between the average of several repeated determinations and the goal.

**Precision** describes the level of variability within several repeated determinations.

Density of water is greatest at 4°C, at . Density of water is higher in liquid than in solid.

Composition of dry air

N2 ~ 78.08%

O2 ~ 20.95%

Argon ~ 0.93 %

CO2 ~ 0.035 ppm

Electroneutrality, Ionic strength,

**Hardness**, the sum of the normalities of all multivalent cations. Main cations,

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| --- | --- | --- |
| Classification | Hardness (meq/L) | Hardness (mg/L as CaCO3) |
| Soft | <1.5 | <75 |
| Moderately hard | 1.5~3 | 75~150 |
| Hard  | 3~6 | 150~300 |
| Very hard | >6 | >300 |

Compute total harness (TH), compute

If CH = Nc NCH = TH-CH

If CH = TH NCH = 0

Alkalinity,

|  |  |
| --- | --- |
| **Organic compounds of environmental concern**FormaldehydeCHC-12BenzenePerchloroethylene2,3,7,8-TCDD (dioxin)Benzo(a)pyrene | **Toxic metals**CadmiumChromiumLeadMercury |
|  |  |

If, elementary reaction

Zero order First order

Second order

A system is at equilibrium:

1. does not vary in time
2. is internally uniform
3. has no net flows of mass, heat, or species within the system and its surroundings
4. net rate of chemical reactions equal to 0

The equilibrium partial pressure of species i is equal to vapor pressure equilibrium constant at T.

**Adsorption**- surface uptake

**Absorption**- distributed uptake

**Sorption**- either one or both

Equilibrium sorption described by sorption isotherms

Equations you need for the dissociation of weak acic HA

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| --- | --- |
| Carbonate system carbon dioxide gas dissolved carbon dioxide  carbonic acid bicarbonate ion  carbonate ion  calcium carbonate |  |
| pH of water in a limestone aquifer | pH of pristine rainwater |