

CHEMISTRY 301 - FORMULA SHEET

General Formulas

$$\tau = \frac{M}{F} = \frac{1}{k}$$

$$\alpha_i = \frac{[X_i]}{\sum [X_i]}$$

$$\text{pH} + \text{pOH} = \text{pK}_w$$

$$\text{pH} = -\log \{H^+\} \approx -\log [H^+]$$

$$\text{pe} = -\log \{e^-\} = E/0.0591 \text{ at } 25^\circ\text{C}$$

$$\log \gamma_{DH} = -A z^2 I^{1/2}, \text{ where } A = 0.51 \text{ at } 25^\circ\text{C}$$

$$I = 0.5 \sum c_i z_i^2$$

Fundamental Thermodynamic Relations

$$\Delta G^\circ_{\text{rxn}} = \sum \Delta G^\circ_f(\text{products}) - \sum \Delta G^\circ_f(\text{reactants})$$

$$\Delta G_{\text{rxn}} = -n F E$$

$$\Delta G_{\text{rxn}} = \Delta G^\circ_{\text{rxn}} + 2.303 RT \log Q$$

$$\text{pe}^\circ = \left(\frac{1}{n}\right) \log K$$

$$\text{pe}^\circ = \left(\frac{1}{n}\right) \frac{-\Delta G^\circ}{2.303 R T}$$

$$\text{pe}^\circ = \frac{E^\circ}{0.0591}$$

$$\log K = \frac{-\Delta G^\circ}{2.303 RT}$$

$$E = E^\circ - \frac{2.303 R T}{n F} \log Q$$

$$\text{pe} = \text{pe}^\circ - \left(\frac{1}{n_e}\right) \log Q$$

$$\text{pe} = \text{pe}^\circ - \frac{n_H}{n_e} \text{pH} - \frac{1}{n_e} \log \frac{\{\text{reduced}\}}{\{\text{oxidized}\}}$$

CHEMISTRY 301 - INFORMATION SHEET

Abbreviations:

ABS – alkyl benzene sulfonates
AOP – advanced oxidation process
BOD – biochemical oxygen demand
CEC – cation exchange capacity
COD – chemical oxygen demand
DO – dissolved oxygen
DDM – dimethyl mercury
EDTA – ethylenediamine tetraacetate
LAS – linear alkyl sulfonates
NTA – nitrilotriacetate
ORP – oxidation reduction potential
PCB – polychlorinated biphenyl
PCDD – polychlorinated dibenzodioxin
PCDF – polychlorinated dibenzofuran
SCE – saturated calomel electrode
SHE – standard hydrogen electrode
SSCE – saturated silver/silver chloride electrode
STP – sodium tripolyphosphate
TEL – tetraethyl lead
TOC – total organic carbon
ZPC – zero point charge

Conversions:

$$1 \text{ ppm} = \frac{1 \text{ mg}}{\text{kg}} = \frac{1 \mu\text{g}}{\text{g}} = \frac{1 \text{ ng}}{\text{mg}}$$

$$1 \text{ ppb} = \frac{1 \mu\text{g}}{\text{kg}} = \frac{1 \text{ ng}}{\text{g}}$$

$$1.00 \text{ atm} = 101,300 \text{ Pa}$$

$$1 \text{ km}^3 = 10^9 \text{ m}^3 = 10^{12} \text{ L}$$

$$\text{Kelvin Temperature} = 273.2 + ^\circ\text{C}$$

$$E_h = E_{\text{SCE}} + 0.241 \text{ V}$$

or

$$E_h = E_{\text{SSCE}} + 0.220 \text{ V}$$

typical humics: ~ 60% C (by mass)

$$C_{\text{FACo}_2^-} \sim 5 \text{ mmol/g}$$

Gas Composition of Dry Atmosphere

N ₂	0.7801
O ₂	0.2095
He	0.00980
CO ₂	0.000365

CHEMISTRY 301 - DATA SHEET

Universal Constants

$$R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1} = 0.08206 \text{ L atm mol}^{-1} \text{ K}^{-1}$$

$$F = 96,480 \text{ C mol}^{-1} \quad \text{where, } 1 \text{ C} = 1 \text{ J/V} \quad \text{and } 1 \text{ J} = 1 \text{ kg m}^2 \text{ s}^{-2}$$

Specific Constants

Autodissociation of water

$$K_w = 1.0 \times 10^{-14}$$

Henry's Law Constants

$$K_H(\text{O}_2) = 1.3 \times 10^{-8} \text{ mol L}^{-1} \text{ Pa}^{-1}$$

$$K_H(\text{CO}_2) = 3.3 \times 10^{-7} \text{ mol L}^{-1} \text{ Pa}^{-1}$$

$$K_H(\text{NH}_3) = 5.7 \times 10^{-4} \text{ mol L}^{-1} \text{ Pa}^{-1}$$

$$K_H(\text{O}_3) = 1.3 \times 10^{-7} \text{ mol L}^{-1} \text{ Pa}^{-1}$$

Acid Dissociation Constants

$$\text{H}_3\text{PO}_4 \quad K_{a1} = 7.1 \times 10^{-3} \quad K_{a2} = 6.3 \times 10^{-8} \quad K_{a3} = 4.2 \times 10^{-13}$$

$$\text{H}_3\text{T} \quad K_{a1} = 2.2 \times 10^{-2} \quad K_{a2} = 1.1 \times 10^{-3} \quad K_{a3} = 5.2 \times 10^{-11}$$

$$\text{H}_2\text{CO}_3 \quad K_{a1} = 4.5 \times 10^{-7} \quad K_{a2} = 4.7 \times 10^{-11}$$

$$\text{H}_2\text{S} \quad K_{a1} = 1.0 \times 10^{-7} \quad K_{a2} = 1.1 \times 10^{-12}$$

$$\text{NH}_4^+ \quad K_a = 5.6 \times 10^{-10}$$

$$\text{HOCl} \quad K_a = 3.0 \times 10^{-8}$$

Solubility Product Constants

$$K_{sp}(\text{Ca}_5(\text{PO}_4)_3\text{OH}) = 1.0 \times 10^{-56}$$

$$K_{sp}(\text{Ca}_3(\text{PO}_4)_2) = 2.2 \times 10^{-33}$$

$$K_{sp}(\text{CaCO}_3) = 6.0 \times 10^{-9}$$

$$K_{sp}(\text{Fe}(\text{OH})_2) = 4.8 \times 10^{-17}$$

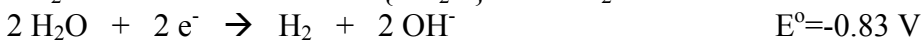
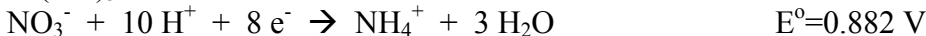
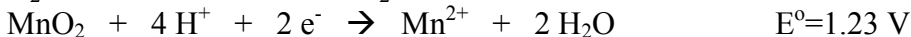
$$K_{sp}(\text{Fe}(\text{OH})_3) = 1.0 \times 10^{-38}$$

$$K_{sp}(\text{FePO}_4) = 2.3 \times 10^{-18}$$

$$K_{sp}(\text{Zn}(\text{OH})_2) = 1.2 \times 10^{-17}$$

$$K_{sp}(\text{AlPO}_4) = 1.0 \times 10^{-21}$$

Standard Reduction Potentials



Equilibrium constants are supplied at 25°C unless otherwise noted