Equations & Constants

Metrics G • • M • • k h dk b d c m • • μ • • n • • p • • f

Conversions

Mass:
1 ton = 2000 lb = 907.2 kg
1 lb = 16 oz = 0.454 kg
1 oz = 28.35 g

Length:
1 mile = 8 furlong = 1.61 km
1 furlong = 10 chain
1 chain = 22 yd
1 yd = 3 ft = 0.914 m
1 ft = 12 in
1 in = 2.54 cm

Volume:
1 barrel = 5.2 bushel
1 bushel = 8 gal
1 gal = 4 qt = 3.78 L
1 qt = 2 pt = 0.946 L
1 pt = 2 cup
1 cup = 8 fl.oz.
1 fl.oz. = 29.57 mL
1 cm^3 = 1 mL

Matter

$D = \frac{m}{v}$

$V_{box} = L \cdot W \cdot H$

$V_{cyl} = \pi r^2 h$

$V_{sph} = 4/3\pi r^3$

charge = (#p+) – (#e-)

Temperature

K = ^{0}C + 273

^{0}C = K – 273

$°F = \frac{9}{5}°C + 32$

$°C = \frac{5}{9}(°F - 32)$

Mole Conversions

1 mole = 6.02 x 10^{23} particles
1 mole = 22.4 L (at STP)
1 mole = (molar mass) g
F = 96,500 C/mol e-
1 e- = 1.6 x 10^{-19} C

Light & Energy

Speed of light (c) = 3.0 x 10^8 m/s

Planck's constant (h) = 6.63 x 10^{-34} J•s

$c = \lambda\nu$

$E = h\nu$

$\Delta E = (-2.18 \times 10^{-18}\ J)\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$

$\lambda = \frac{h}{mv}$

Concentrations

$Molarity(M) = \frac{mol\ solute}{liters\ solution}$

$molality\ (m) = \frac{mol\ solute}{kg\ solvent}$

$mole\ fraction\ (X) = \frac{mol\ component}{total\ moles}$

$pph = \frac{mass\ solute}{mass\ solution}\ x100$

Gas Laws

1 atm = 101,325 Pa = 101.325 kPa
= 760 mmHg = 760 torr = 14.7 psi

PV=nRT

$R = 0.0821\ \frac{atm \cdot L}{mol \cdot K} = 8.314\frac{Pa \cdot m^3}{mol \cdot K} = 62.38\frac{mmHg \cdot L}{mol \cdot K}$
$= 8.314\frac{J}{mol \cdot K}$

$P_1V_1 = P_2V_2$ $\quad \frac{P_1}{T_1} = \frac{P_2}{T_2}$

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\quad \frac{V_1}{n_1} = \frac{V_2}{n_2}$

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $\quad P_T = P_1 + P_2 + P_3 + \ldots$

$D = \frac{P\mathcal{M}}{RT}$ $\quad \mathcal{M} = \frac{DRT}{P}$

$u_{rms} = \sqrt{\frac{3RT}{\mathcal{M}}}$ $\quad \frac{r_1}{r_2} = \sqrt{\frac{\mathcal{M}_2}{\mathcal{M}_1}}$

$\left(P + \frac{n^2a}{V^2}\right)(V - nb) = nRT$

Acids and Bases

pH = -log [H^+]
pOH = -log [OH^-]
pH + pOH = 14
$M_aV_a = M_bV_b$

$pH = pKa + log\frac{[base]}{[acid]}$

$K_w = [H^+]\ [OH^-]$

$K_a = \frac{[H^+][A^-]}{[HA]}$

$K_b = \frac{[HB^+][OH^-]}{[B]}$

$K_a \cdot K_b = 1.0 \times 10^{-14}$
$pK_a + pK_b = 14$
$pK_a = -\log K_a$
$pK_b = -\log K_b$

Equilibrium

$K_C = \frac{[C]^c[D]^d}{[A]^a[B]^b}$ for aA + bB <==> cC + dD

$K_p = K_c(RT)^{\Delta n}$

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Constants for water

Solid: c = 2.09 J/g^{o}C
Liquid: c = 4.184 J/g^{o}C
Gas: c = 1.88 J/g^{o}C
H_f = 334 J/g = 6.01 kJ/mol
H_v = 2260 J/g = 44.0 kJ/mol
K_f = 1.86 ^{o}C/m
K_b = 0.52 ^{o}C/m
K_w = 1.0 x 10^{-14}

Colligative Properties

$\Delta T_f = iK_fm$
$\Delta T_b = iK_bm$
$\pi = iMRT$
$P_A = X_A P_A^O$

Rates

$\ln[A]_t = -kt + \ln[A]_0$

$$\frac{1}{[A]_t} = kt + \frac{1}{[A]_0}$$

$$t_{\frac{1}{2}} = \frac{0.693}{k}$$

$$t_{\frac{1}{2}} = \frac{1}{k[A]_0}$$

$$ln\frac{k_1}{k_2} = \frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

Calorimetry

q=mcΔT
1 calorie = 4.184 J

Thermodynamics

$\Delta H = H_{products} - H_{reactants}$
$\Delta S = S_{products} - S_{reactants}$
$\Delta G = G_{products} - G_{reactants}$
$\Delta G = \Delta H - T\Delta S$
$\Delta G = \Delta G^{o} + RT\ \ln Q$
$\Delta G^{o} = -\ RT\ \ln K$

Electrochemistry

$E^o_{cell} = E^o_{red}(cathode) - E^o_{red}(anode)$
$\Delta G = -\ nFE$

$$E = E^o - \frac{0.0592}{n}\log Q$$

$$I = \frac{q}{t}$$

Solubility Rules

Compounds that contain the following ions are generally *soluble* in water:
1) alkali metals and ammonium ions: Li^+, Na^+, K^+, Rb^+, Cs^+, NH_4^+
2) acetate ion: $C_2H_3O_2^-$
3) nitrate ion: NO_3^-
4) halide ions (X): Cl^-, Br^-, I^- (Insoluble exceptions: AgX, Hg_2X_2, PbX_2)
5) sulfate ion: SO_4^{-2} (Insoluble exceptions $SrSO_4$, $BaSO_4$, $PbSO_4$)

Compounds that contain the following ions are generally *insoluble* in water:
6) carbonate ion: CO_3^{-2} (Soluble exceptions: see rule 1)
7) chromate ion: CrO_4^{-2} (Soluble exceptions: rule 1)
8) phosphate ion: PO_4^{-3} (Soluble exceptions: rule 1)
9) sulfide ion: S^{-2} (Soluble exceptions: rule 1, CaS, SrS, BaS)
10) hydroxide ion: OH^- (Soluble exceptions: rule 1, $Ca(OH)_2$, $Sr(OH)_2$, $Ba(OH)_2$,)

Activity Series for Metals

Li
K
Ba
Ca
Na
Mg
Al
Mn
Zn
Cr
Fe
Cd
Co
Ni
Sn
Pb
H
Cu
Ag
Hg
Pt
Au

Experiments:

Dilution: $M_1V_1 = M_2V_2$

$$\%\ error = \frac{(experimental\ value - accepted\ value)}{accepted\ value}\ x\ 100$$

$$\%\ yield = \frac{experimental\ value}{accepted\ value}\ x\ 100$$

Water Vapor Pressures

T (^{o}C)	P (mmHg)	T (^{o}C)	P (mmHg)	T (^{o}C)	P (mmHg)	T (^{o}C)	P (mmHg)
0	4.6	21	18.7	35	42.2	92	567.0
5	6.5	22	19.8	40	55.3	94	610.9
10	9.2	23	21.1	45	71.9	96	657.6
12	10.5	24	22.4	50	92.5	98	707.3
14	12.0	25	23.8	55	118.0	100	760.0
16	13.6	26	25.2	60	149.4	102	815.9
17	14.5	27	26.7	65	187.5	104	875.1
18	15.5	28	28.4	70	233.7	106	937.9
19	16.5	29	30.0	80	355.1	108	1004.4
20	17.5	30	31.8	90	525.8	110	1074.6

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