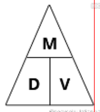
chemistry equations

1. introduction to chemistry

d = density; m = mass in g; v = volume in mL

$$d = \frac{m}{V}$$



SI unit prefixes

giga	billion (10^9)
mega	million (10^6)
kilo	thousand (10^3)
deka	ten (10^0)
deci	tenth (10^{-1})
centi	hundredth (10^{-2})
milli	thousandth (10^{-3})
micro	millionth (10^{-6})
nano	billionth (10^{-9})
pico	trillionth (10^{-12})

2. data

$$\% \text{ yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100$$

$$\% \text{ error} = \frac{\text{error}}{\text{accepted valued}} \times 100$$

temperature: K = °C + 273.15

$$°C = (°F - 32) \times \frac{5}{9} \qquad °F = \frac{9}{5}°C + 32$$

3. matter, 4. atom: no formulas

5. electrons

s = wf e = hf e = hs/w w = hs/e

s = the speed of light = 3×10^8 m/s

w = wavelength in meters

f = frequency, per second.

e = energy in joules

h = Plancks constant = 6.626×10^{-34} j sec

Balmer formula :

$$w_{nm} = \frac{1}{0.01097\left(\frac{1}{inner^2} - \frac{1}{outer^2}\right)}$$

w = wavelength in nanometers

inner = inner shell #; outer = outer shell #.

similarly:

$$E = 2.18 \times 10^{-18} \text{joules}\left(\frac{1}{inner^2} - \frac{1}{outer^2}\right)$$

9. the mole: is an amount! = 6.02×10^{23}

mol-mol conversions: $$\text{mol A} \times \frac{\text{mol B}}{\text{mol A}} = \text{mol B}$$

gram – mol conversions: $$\text{gA} \times \frac{\text{mol A}}{\text{gA}} \times \frac{\text{mol B}}{\text{mol A}} = \text{mol B}$$

mol – g conversions: $$\text{mol A} \times \frac{\text{mol B}}{\text{mol A}} \times \frac{\text{g B}}{\text{mol B}} = \text{g B}$$

g– g conversions: $$\text{g A} \times \frac{\text{mol A}}{\text{g A}} \times \frac{\text{molB}}{\text{mol A}} \times \frac{\text{gB}}{\text{molB}} = \text{gB}$$

10. gas laws

units

P pressure

V = volume (L)

T = Kelvin Temp (K)

n = # of moles (mol)

R = 0.0821 L atm/mol K

M = molar masses (g/mol)

d = density

1 atm = 14.7 psi = 760 mm Hg or Torr = 101 3 kPa

STP = standard temp and pressure = 1 atm, 273.15 K

formulas

boyles: $P_1V_1 = P_2V_2$

charles: $\frac{T_1}{V_1} = \frac{T_2}{V_2}$

gay-lussac: $\frac{T_1}{P_1} = \frac{T_2}{P_2}$

combined: $\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$

must use K for temperature; other units must cancel

ideal gas law:

PV = nRT must use L atm mol K

avogadro's law: 22.4 L = 1 mole gas at STP

density formula: $d = \frac{PM}{RT}$

graham's law: $\frac{rate_1}{rate_2} = \sqrt{\frac{M_2}{M_1}}$

partial pressure

$$\text{partial pressure of gas a} = \frac{\text{moles of gas a}}{\text{total moles of gas}} \times \text{total pressure}$$

6. periodic table; 7. bonding 8. reactions: no formulas ☺

11. energy:

q = mcΔT

q = heat, m = mass, c = specific heat (J/g°C), ΔT = temp change in °C.

$c_{water(l)}$ = 4.184 J/g °C

$c_{water(s)}$ = 2.03 J/g°C

$c_{water(g)}$ = 2.01 J/g°C

energy needed to melt and boil water:

$\Delta H_{fus\ water}$ = 334 J/g

$\Delta H_{vap\ water}$ = 2260 J/g

$\Delta H_{vap\ water}$ = 2260 J/g; $\Delta H_{fus\ water}$ = 334 J/g

water boils/condenses at 100°C

water melts/freezes at 0°C

1 Nutritional Calorie = 4184 Joules = 4 BTU = 1000 calories = 0.0016 kilowatt hours

ΔG = ΔH–TΔS

ΔG = change in free energy

ΔH = change in enthalpy

T = temperature

ΔS = change in entropy

15. acids and bases

K_a for example of HCl = $[H+][Cl^-]/[HCl]$

$K_w = [H+][OH^-] = 10^{-14}$

titration:

pH = –log[H+]

10^{-pH} = $[H^+]$

pOH = –log$[OH^-]$

10^{-pOH} = $[OH^-]$

pH + pOH = 14

$$\text{molarity}_{\text{unknown}} = \frac{(\text{volume}_{\text{standard}})(\text{molarity}_{\text{standard}})}{\text{volume}_{\text{unknown}}}$$

14. equilibrium

for:

$$aA + bB \rightleftarrows cC + dD$$

$$K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

omit liquids and solids

13. rates

reaction rate = $\Delta_{concentration}/\Delta_{time}$

M = Molarity = moles per liter = moles/liter

$$\Delta_{concentration}^{\ order} = \Delta_{rate}$$

$$E_a = \frac{(\ln\frac{K_1}{K_2})R}{\frac{1}{T_2} - \frac{1}{T_1}}$$

E_a = activation energy (j/mol)

K_1, K_2 =rate constants

T_1, T_2, = temperatures (K)

R = 8.314 j/k mol

12. solutions

1. percent concentration by volume (%v/v)

$$= \frac{\text{volume of solute}}{\text{volume of solution}} \times 100$$

2. percent concentration by mass (%m/m)

$$= \frac{\text{mass of solute}}{\text{mass of solution}} \times 100$$

3. Molarity (M)

$$= \frac{\text{moles of solute}}{\text{Liters of solution}}$$

4. molality (m)

$$= \frac{\text{moles of solute}}{\text{Kilograms of solvent}}$$

5. mole fraction (X)

$$= \frac{\text{moles of solute}}{\text{moles of solution}}$$

6. concentration and dilution

6. $C_1V_1 = C_2V_2$

where C_1 and C_2 are concentrations; and V_1 and V_2 are volumes

7. Henry's Law:

Solubility is proportional to Pressure

$S_1/P_1 = S_2/P_2$

8. pressure and volume units units:

1 atm = 760 mm Hg = 14.7 psi = 101.3 KPa

1 L = 1000 mL

9. boiling point elevation (ΔT_b) and freezing point depression (ΔT_f) of solutions

$\Delta T_f = K_f m \cdot pm$

$\Delta T_b = k_b m \cdot pm$

ΔT_f = change in freezing temp; ΔT_b = change in boiling temperature; K_f = freezing point constant; K_b = boiling point constant; m = molality; pm = particle molality (ion count) (K_f is for the solvent; pm is for the solute)