

Periodic Table with Chemistry Formulas

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CHEMISTRY FORMULAS

ATOMS AND SUBATOMIC PARTICLES

A. Atomic number: The number of protons in an atom of a given element. In the periodic table, elements are ordered by increasing atomic number.

Ex: ^{12}C $Z =$ atomic number

B. Mass number: The number of protons plus the number of neutrons in an atom of an element, measured in atomic mass units (amu). 1 amu = mass of one proton or neutron = 1.66×10^{-27} kg.

Ex: ^{12}C $12 =$ mass number

Name	Symbol	Mass	Charge
Proton	p^+	1 amu	+1
Neutron	n^0	1 amu	0
Electron	e^-	$1/1837$ amu	-1

C. Isotopes: Various atoms of an element that possess different numbers of neutrons, and therefore different mass numbers.

Ex: Boron has ^{10}B , Boron has ^{11}B

D. Calculating atomic mass: An element's atomic mass number on the periodic table is a weighted average of that element's isotopes.

Ex:

Isotope	Abundance	Mass #	Isotope Mass
Boron-10	20.26%	10	10.0129 amu
Boron-11	79.74%	11	11.0093 amu

Atomic mass = $(20.26)(10.0129 \text{ amu}) + (79.74)(11.0093 \text{ amu})$
= 10.81 amu

MOLECULAR MASS

A. Avogadro's number: 6.022×10^{23}
 6.022×10^{23} atoms or molecules = 1 mole of that element or substance.

B. The atomic mass number of an element equals the mass (in grams) of one mole of that element.
Ex: One mole of boron has a mass of 10.81 grams.

MOLECULAR FORMULA AND EMPIRICAL FORMULA

A. Molecular formula: The chemical formula of a compound that gives the actual number of atoms of each element in a molecule of the compound.

Ex: The molecular formula for glucose is $\text{C}_6\text{H}_{12}\text{O}_6$.

B. Empirical formula: A "simplified" expression of a chemical formula.

Ex: The empirical formula for glucose is $\text{C}_2\text{H}_4\text{O}$.

BALANCING CHEMICAL EQUATIONS

1. Check for diatomic molecules such as H_2 and O_2 .

2. Balance metals.

3. Balance nonmetals.

4. Balance oxygen.

5. Balance hydrogen.

6. You may change only coefficients, never the formula subscripts! Revisit all atoms to be sure you have equal numbers on both sides of the equation.

7. Revisit the equation so that coefficients are the smallest whole numbers possible.

PERCENTAGE AND PPM

A. Percentage composition: Tells how much mass any object or element contributes to a compound.

Percentage composition = $\frac{\text{mass of element}}{\text{mass of compound}} \times 100$

B. Parts per million (ppm): In a homogeneous solution, the number of grams of a

particular compound that would be present in a one million gram sample of the compound or solution.

TEMPERATURE CONVERSION

A. Converting between Fahrenheit and Celsius

$$\text{Fahrenheit} = \frac{9}{5}(\text{Celsius}) + 32^\circ\text{F}$$

$$\text{Celsius} = \frac{5}{9}(\text{Fahrenheit} - 32^\circ\text{F})$$

B. Kelvin: The temperature in K, absolute zero, is the theoretical lowest possible temperature, at which all molecular activity ceases.

$$0^\circ\text{K} = -273.15^\circ\text{C} = -459.67^\circ\text{F}$$

$$\text{K} = ^\circ\text{C} + 273.15 \quad ^\circ\text{C} = \text{K} - 273.15$$

IDEAL GAS LAWS

P = pressure

V = volume (expressed in liters)

T = temperature (expressed in Kelvin)

Standard temperature and pressure (STP):

$$T = 0^\circ\text{C} = 273.15\text{ K}$$

$$P = 1 \text{ atm} = 760 \text{ mmHg} = 101.3 \text{ kPa}$$

A. Boyle's law: $PV = \text{constant}$

$$P_1V_1 = P_2V_2$$

B. Charles' law: $\frac{V}{T} = \text{constant}$

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

C. Gay-Lussac's law: $\frac{P}{T} = \text{constant}$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

D. Combined gas law: $\frac{PV}{T} = \text{constant}$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

E. Ideal gas law: $PV = nRT$

$n =$ number of moles, $R =$ ideal gas constant
 $R = 8.314 \frac{\text{J}}{\text{mol}\cdot\text{K}} = 0.0821 \frac{\text{atm}\cdot\text{L}}{\text{mol}\cdot\text{K}}$

F. Dalton's law of partial pressures:

$$\frac{P_{\text{gas}}}{P_{\text{total}}} = \frac{n_{\text{gas}}}{n_{\text{total}}}$$

$$\frac{P_{\text{gas}}}{P_{\text{total}}} = \frac{V_{\text{gas}}}{V_{\text{total}}}$$

$$P_{\text{total}} = P_{\text{gas}} + P_{\text{gas}} + \dots$$

SOLUBILITY

A. Molarity (M): Measures the number of moles (n) of solute per liter of solution.

$$M = \frac{n}{V_{\text{solution}}}$$

B. Molarity (m): Measures the number of moles (n) of solute dissolved in 1 kg of solvent.

$$m = \frac{n}{\text{kg of solvent}}$$

C. Dilution: The relationship between initial volume (V_i) and final volume (V_f) is inversely proportional to the relationship between initial molarity (M_i) and final molarity (M_f):

$$\frac{V_i}{V_f} = \frac{M_f}{M_i} \quad V_iM_i = V_fM_f$$

COLLIGATIVE PROPERTIES

A. Boiling point: Original pressure. Boiling point when solute is added to pure solvent ΔT_b .

$\Delta T_b = iK_bP_m$
where P_m is the vapor pressure of A above B is added, K_b is the boiling point constant of A, and i is the van't Hoff factor of B above pure solvent A.

B. Freezing point depression:

$\Delta T_f = iK_fP_m$
where P_m is the vapor pressure of A above B is added, K_f is the freezing point constant of A, and i is the van't Hoff factor of B above pure solvent A.

C. Osmotic pressure: $\pi = iMRT$
where M is the molarity of the solution, R is the gas constant, and T is the temperature in Kelvin.

D. Vapor pressure: $P_{\text{total}} = P_A + P_B$
where P_A is the vapor pressure of A above B is added, P_B is the vapor pressure of B above pure solvent A.

E. Henry's law: $P_A = k_H \cdot C_A$
where P_A is the partial pressure of A above B is added, k_H is the Henry's law constant of A, and C_A is the concentration of A in the solution.

F. Raoult's law: $P_A = P_A^* \cdot X_A$
where P_A is the partial pressure of A above B is added, P_A^* is the vapor pressure of pure A, and X_A is the mole fraction of A in the solution.

G. Ideal gas law: $PV = nRT$
where P is the pressure, V is the volume, n is the number of moles, R is the gas constant, and T is the temperature in Kelvin.

H. Dalton's law of partial pressures: $P_{\text{total}} = P_A + P_B$
where P_A is the partial pressure of A above B is added, P_B is the partial pressure of B above pure solvent A.

I. Graham's law of effusion: $\frac{r_A}{r_B} = \sqrt{\frac{M_B}{M_A}}$
where r_A is the rate of effusion of A, r_B is the rate of effusion of B, M_A is the molar mass of A, and M_B is the molar mass of B.

$\Delta T_b = K_b \cdot m$
where ΔT_b is the amount the boiling point is lowered, K_b is a proportionality constant specific to the solvent, and m is the molality of the solution.

E. Boiling point elevation:

$\Delta T_b = K_b \cdot m$
 ΔT_b is the amount the boiling point is elevated, K_b is a proportionality constant specific to the solvent, and m is the molality of the solution.

F. Osmotic pressure:

$\pi = iMRT$
where π is the osmotic pressure, M is the molarity of the solution, R is the ideal gas constant, and T is the temperature in Kelvin.

G. Vapor pressure:

$P_{\text{total}} = P_A + P_B$
where P_A is the vapor pressure of A above B is added, P_B is the vapor pressure of B above pure solvent A.

H. Raoult's law: $P_A = P_A^* \cdot X_A$
where P_A is the partial pressure of A above B is added, P_A^* is the vapor pressure of pure A, and X_A is the mole fraction of A in the solution.

CHEMICAL EQUILIBRIA

A. Equilibrium constant expression:

Method using molar concentration:
For the reaction: $aA + bB \rightleftharpoons cC + dD$

$$\text{Equilibrium constant } K_c = \frac{[C]^c [D]^d}{[A]^a [B]^b}$$

Method using gas partial pressures:
For the reaction:
 $aA(g) + bB(g) \rightleftharpoons cC(g) + dD(g)$

$$\text{Equilibrium constant } K_p = \frac{(P_C)^c (P_D)^d}{(P_A)^a (P_B)^b}$$

B. Acid-base equilibrium:

1. Acid dissociation reactions: The reaction of a weak acid with H_2O .



Acid dissociation constant (equilibrium constant for the reaction):

$$K_a = \frac{[\text{H}_3\text{O}^+][\text{A}^-]}{[\text{HA}]}$$

The greater the K_a value, the stronger the acid.

2. Base dissociation reactions: The reaction of a weak base with H_2O .



Base dissociation constant (equilibrium constant for the reaction):

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

The greater the K_b value, the stronger the base.

3. Dissociation of water: The self-ionization of water:



$$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1.0 \times 10^{-14}$$

4. Conjugate acid-base pair:



5. pH and pOH: pH measures $10^{-\text{pH}} \geq \text{pOH}$ measures $10^{-\text{pOH}}$

$\text{pH} = -\log[\text{H}^+]$ and $\text{pOH} = -\log[\text{OH}^-]$

$\text{pH} + \text{pOH} = 14$

6. Buffer solutions: A solution that resists changes in pH when small amounts of acid or base are added.

7. Henderson-Hasselbalch equation:

$$\text{pH} = \text{pK}_a + \log\left(\frac{[\text{A}^-]}{[\text{HA}]}\right)$$

where pH is the pH of the solution, pK_a is the negative logarithm of the acid dissociation constant, $[\text{A}^-]$ is the concentration of the conjugate base, and $[\text{HA}]$ is the concentration of the weak acid.

8. Le Chatelier's principle: If a system at equilibrium is subjected to a change in concentration, temperature, or pressure, the system will shift in the direction that relieves the stress.

concentration with respect to A, assuming the reaction rate is independent of A.

THEORETICAL AND PERCENTAGE YIELD

Theoretical yield: $\text{Theoretical yield} = \frac{\text{mass of product}}{\text{molar mass of product}} \times \text{molar mass of reactant}$

THERMODYNAMICS

A. Specific heat:

$q = mc\Delta T$
where q is the heat absorbed by the object, m is the mass of the object, ΔT is the change in temperature, and c is the specific heat of the substance.

B. Enthalpy (ΔH): In kJ/mol

$\Delta H = H_{\text{products}} - H_{\text{reactants}}$
 $\Delta H < 0$ for exothermic reactions
 $\Delta H > 0$ for endothermic reactions

C. Entropy (ΔS): In J/mol \cdot K

$\Delta S = S_{\text{products}} - S_{\text{reactants}}$
 $\Delta S > 0$ for spontaneous reactions
 $\Delta S < 0$ for non-spontaneous reactions

D. Gibbs free energy (ΔG): In kJ/mol

$\Delta G = \Delta H - T\Delta S$
 $\Delta G < 0$ when forward reaction is spontaneous
 $\Delta G > 0$ when reverse reaction is spontaneous

E. Equilibrium constant (K): In kJ/mol

$K = \frac{[\text{products}]}{[\text{reactants}]}$
The greater the K value, the stronger the reaction.

REDOX REACTIONS AND ELECTROCHEMISTRY

A. Standard reduction potential of a cell:

$$E_{\text{cell}} = E_{\text{cathode}} - E_{\text{anode}}$$

B. Normal equation:

$$\Delta G = -nFE_{\text{cell}}$$

where ΔG is the Gibbs free energy change, n is the number of electrons transferred in the half-reaction, F (Faraday's constant) = 96485 C/mol , and E_{cell} is the cell potential.

C. Standard cell voltage at equilibrium:

$$E_{\text{cell}} = \frac{RT}{nF} \ln K$$

where n is the total number of electrons transferred in the redox reaction.

D. Thermodynamics:

$$\Delta G = -nFE_{\text{cell}}$$

where ΔG is the Gibbs free energy change, n is the number of electrons transferred in the half-reaction, F (Faraday's constant) = 96485 C/mol , and E_{cell} is the cell potential.

RADIOACTIVE DECAY

A. Particle types:

Alpha	Beta	Gamma	Positron	Neutron
α	β^-	γ	β^+	n

B. Alpha decay:

$${}^A_Z\text{X} \rightarrow {}^{A-4}_{Z-2}\text{Y} + {}^4_2\text{He}$$

where A is the mass number, Z is the atomic number, X is the parent nucleus, and Y is the daughter nucleus.

C. Beta decay:

$${}^A_Z\text{X} \rightarrow {}^A_{Z+1}\text{Y} + e^- + \bar{\nu}_e$$

where A is the mass number, Z is the atomic number, X is the parent nucleus, Y is the daughter nucleus, e^- is the electron, and $\bar{\nu}_e$ is the antineutrino.

D. Positron decay:

$${}^A_Z\text{X} \rightarrow {}^A_{Z-1}\text{Y} + e^+ + \nu_e$$

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Periodic Table With Chemistry Formulas Sparkcharts: Bestsellers in 2023 The year 2023 has witnessed a noteworthy surge in literary brilliance, with numerous captivating novels captivating the hearts of readers worldwide. Lets delve into the realm of top-selling books, exploring the captivating narratives that have captivated audiences this year. Periodic Table With Chemistry Formulas Sparkcharts : Colleen Hoover "It Ends with Us" This heartfelt tale of love, loss, and resilience has captivated readers with its raw and emotional exploration of domestic abuse. Hoover masterfully weaves a story of hope and healing, reminding us that even in the darkest of times, the human spirit can prevail. Uncover the Best : Taylor Jenkins Reids "The Seven Husbands of Evelyn Hugo" This intriguing historical fiction novel unravels the life of Evelyn Hugo, a Hollywood icon who defies expectations and societal norms to pursue her dreams. Reids compelling storytelling and compelling characters transport readers to a bygone era, immersing them in a world of glamour, ambition, and self-discovery. Periodic Table With Chemistry Formulas Sparkcharts : Delia Owens "Where the Crawdads Sing" This mesmerizing coming-of-age story follows Kya Clark, a young woman who grows up alone in the marshes of North Carolina. Owens spins a tale of resilience, survival, and the transformative power of nature, captivating readers with its evocative prose and mesmerizing setting. These popular novels represent just a fraction of the literary treasures that have emerged in 2023. Whether you seek tales of romance, adventure, or personal growth, the world of literature offers an abundance of captivating stories waiting to be discovered. The novel begins with Richard Papen, a bright but troubled young man, arriving at Hampden College. Richard is immediately drawn to the group of students who call themselves the Classics Club. The club is led by Henry Winter, a brilliant and charismatic young man. Henry is obsessed with Greek mythology and philosophy, and he quickly draws Richard into his world. The other members of the Classics Club are equally as fascinating. Bunny Corcoran is a wealthy and spoiled young man who is always looking for a good time. Charles Tavis is a quiet and reserved young man who is deeply in love with Henry. Camilla Macaulay is a beautiful and intelligent young woman who is drawn to the power and danger of the Classics Club. The students are all deeply in love with Morrow, and they are willing to do anything to please him. Morrow is a complex and mysterious figure, and he seems to be manipulating the students for his own purposes. As the students become more involved with Morrow, they begin to commit increasingly dangerous acts. The Secret History is a brilliant and thrilling novel that will keep you wondering until the very end. The novel is a warning tale about the dangers of obsession and the power of evil.

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