PrepPals | CSCA Chemistry Formula Sheet

Complete · Systematic · High-Frequency · Syllabus-Aligned

How to Use

Welcome to the CSCA Chemistry Formula Sheet! 🎉

This resource reorganizes the formulas most likely to be useful for revision according to the CSCA syllabus and the PrepPals 21-day study plan.

After finishing each topic, spend 10-15 minutes with this sheet: cover the explanation, recall when the formula applies, then return to practice questions to use it actively.

Do not memorize formulas in isolation. Learn the meaning of each variable, the unit, the domain or condition, and the common traps.

PrepPals will help you move from “I recognize it” to “I can use it accurately.” 🚀 💙

Formula Quick-Check Checklist

- Review by module first, then use your mistakes to decide which formulas to revisit.
- Memorize conditions together with formulas, such as $q\neq1$, $|q|<1$, and $a>0$ with $a\neq1$.
- In multiple-choice questions, the most common traps are units, signs, domains, and special cases.

Key Constants

Useful values

- $N\_A=6.02\times10^{23}$ mol^{-1}; at STP, $V\_m\approx22.4$ $L\cdot mol^{-1}$
- $R=8.314$ $J\cdot mol^{-1}\cdot K^{-1}=0.0821$ $L\cdot atm\cdot mol^{-1}\cdot K^{-1}$
- $F\approx96485$ $C\cdot mol^{-1}$; at 25°C, $K\_w=1.0\times10^{-14}$

MODULE 1 | Amount of Substance, Equations, and Gases

Mole concept and conservation:

- □ Amount of substance: $n=m/M$; number of particles: $N=nN\_A$, $N\_A=6.02\times10^{23}$ mol^{-1}
- □ Molar gas volume: $V=nV\_m$; at STP, $V\_m\approx22.4$ $L\cdot mol^{-1}$
- □ Stoichiometry: coefficient ratio = mole ratio = gas volume ratio at the same T and P
- □ Conservation of mass: total mass before reaction = total mass after reaction; atoms of each element are conserved

Ideal gases

- □ Ideal gas law: $PV=nRT$
- □ Combined gas law: $P_1V_1/T_1=P_2V_2/T_2$ when n is constant
- □ Gas density: $\rho=PM/RT$; molar mass: $M=\rho RT/P$
- □ Useful R values: 8.314 $J\cdot mol^{-1}\cdot K^{-1}$ or 0.0821 $L\cdot atm\cdot mol^{-1}\cdot K^{-1}$

MODULE 2 | Solutions, Concentration, and pH

Concentration calculations:

- □ Mass percent: $w=m(solute)/m(solution)\times100\%$
- □ Molar concentration: $c=n/V$, where V is in liters
- □ Dilution: $c_1V_1=c_2V_2$; moles of solute stay constant during dilution
- □ Solubility: $S=m(solute)/m(water)\times100$ g for a saturated solution at a given temperature

Acids, bases, and pH:

- □ $pH=-\log[H^+]$; $pOH=-\log[OH^-]$; at 25°C, $pH+pOH=14$

- □ $K_w=[H^+][OH^-]=1.0\times10^{-14}$ at 25°C
- □ Strong acid/base neutralization: $n(H^+)=n(OH^-)$
- □ Monoprotic strong acid: pH≈-log c; monobasic strong base: pOH≈-log c

---

MODULE 3 | Atomic Structure, Periodic Trends, and Bonding

Atoms and periodic trends:

- □ Mass number: A=Z+N; atomic number Z=number of protons=nuclear charge
- □ Neutral atom: electrons=protons; ionic charge=protons-electrons
- □ Maximum electrons in shell n: $2n^2$ as a useful high-school rule
- □ Across a period: atomic radius generally decreases, electronegativity/ionization energy generally increases; down a group radius increases

Chemical bonds and intermolecular forces:

- □ Large electronegativity difference suggests ionic bonding; small difference suggests covalent bonding
- □ Bond polarity depends on electronegativity difference; molecular polarity also depends on geometry
- □ Common strength order: hydrogen bonding > dipole-dipole forces > dispersion forces
- □ Higher boiling/melting points usually indicate stronger intermolecular forces

---

MODULE 4 | Redox, Ionic Reactions, and Electrochemistry

Redox:

- □ Oxidation number increases = oxidation = reducing agent; oxidation number decreases = reduction = oxidizing agent
- □ Common rules: elemental substance 0; O usually -2; H usually +1; main-group metals usually positive
- □ Redox balancing: total increase in oxidation number = total decrease; electrons lost = electrons gained
- □ Net ionic equations: remove spectator ions and keep only the reacting particles

Galvanic cells and electrolysis:

- □ Galvanic cell: oxidation at anode/negative electrode, reduction at cathode/positive electrode; electrons flow from anode to cathode
- □ Charge: Q=It; Faraday relation: $n(e^-)=Q/F$, $F\approx96485\ C\cdot mol^{-1}$
- □ Electrolysis products: check ion discharge order, then check whether the electrode material reacts

- □ Activity series: more active metals lose electrons more easily and can displace less active metals

---

MODULE 5 | Reaction Rate, Equilibrium, and Thermochemistry

Rate and equilibrium:

- □ Reaction rate: $v=\Delta c/\Delta t$, usually reported as a positive value
- □ Equilibrium constant: K_c=Π[products]^{coef} / Π[reactants]^{coef}; pure solids/liquids are omitted
- □ Reaction quotient Q vs K: $Q<K$ shifts forward; $Q>K$ shifts backward; $Q=K$ at equilibrium
- □ Le Chatelier's principle: a system shifts to reduce the imposed change

Energy changes:

- □ Endothermic: $\Delta H>0$; exothermic: $\Delta H<0$
- □ State changes: melting/vaporization/sublimation absorb heat; freezing/condensation/deposition release heat
- □ Catalysts lower activation energy and speed up reactions, but do not change K
- □ Increasing temperature usually increases reaction rate and may change K

MODULE 6 | Inorganic, Organic, and Experimental Calculations

Common tests and calculations:

- □ Precipitation: $Ag^{+}+Cl^{-}\rightarrow AgCl\downarrow$; $Ba^{2+}+SO_4^{2-}\rightarrow BaSO_4\downarrow$
- □ NH_4^+ test: add base and heat to produce NH_3, which turns moist red litmus paper blue
- □ CO_2 test: turns limewater cloudy, $Ca(OH)_2+CO_2\rightarrow CaCO_3\downarrow+H_2O$
- □ Percent yield: actual yield/theoretical yield×100%; purity: pure substance mass/sample mass×100%

Organic basics:

- □ Alkanes: C_nH_{2n+2}; alkenes: C_nH_{2n}; alkynes: C_nH_{2n-2}
- □ Alcohol: R-OH; aldehyde: R-CHO; carboxylic acid: R-COOH; ester: R-COOR′
- □ Esterification: acid + alcohol ⇌ ester + water, usually with concentrated H_2SO_4 and heat
- □ Addition commonly occurs at C=C/C≡C; substitution is common in alkanes, aromatics, and alcohols

---

Closing Note

You have now reviewed the core formulas for this subject. Score improvement comes not only from memorizing formulas, but from quickly deciding which formula fits the question and whether its conditions are satisfied.

PrepPals wishes you a calm, confident, and successful exam performance.

📍 Prepare with Pals, Power your Progress.