PrepPals

PrepPals | CSCA Physics Formula Sheet

Complete · Systematic · High-Frequency · Syllabus-Aligned

How to Use

Welcome to the CSCA Physics 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 $q \neq 1$, $|q|<1$, and $a>0$ with $a \neq 1$.
- In multiple-choice questions, the most common traps are units, signs, domains, and special cases.

Key Constants

Useful values

- $g \approx 9.8\ m/s^2$; $G \approx 6.67 \times 10^{-11}\ N \cdot m^2/kg^2$; $k \approx 9.0 \times 10^9\ N \cdot m^2/C^2$
- $e \approx 1.60 \times 10^{-19}\ C$; $h \approx 6.63 \times 10^{-34}\ J \cdot s$; $c \approx 3.00 \times 10^8\ m/s$
- $R \approx 8.314\ J \cdot mol^{-1} \cdot K^{-1}$; $k_B \approx 1.38 \times 10^{-23}\ J/K$

MODULE 1 | Kinematics and Newton's Laws

Linear motion

- Average velocity: $\bar{v}=\Delta x/\Delta t$; average acceleration: $\bar{a}=\Delta v/\Delta t$
- Uniform acceleration: $v=v_0+at$; $x=x_0+v_0t+1/2\ at^2$
- Velocity-displacement relation: $v^2-v_0^2=2a(x-x_0)$; average velocity: $\bar{v}=(v_0+v)/2$
- Free fall: $v=gt$; $h=1/2\ gt^2$; $v^2=2gh$ (air resistance ignored)

Forces and equilibrium

- Newton's second law: $\Sigma F=ma$; weight: $G=mg$
- Kinetic friction: $f=\mu N$; maximum static friction: $f_{max}=\mu_s N$
- Spring force: $F=kx$ (Hooke's law)
- Equilibrium: $\Sigma F_x=0$, $\Sigma F_\gamma=0$; inclined plane components: $mg\sin\theta$, $mg\cos\theta$

MODULE 2 | Momentum, Work, and Energy

Momentum and impulse

- Momentum: $p=mv$; impulse: $I=F\Delta t=\Delta p$
- Impulse-momentum theorem: $\Sigma F\Delta t=m\ v-m\ v_0$
- Conservation of momentum: $m_1v_1+m_2v_2=m_1v_1'+m_2v_2'$ when external force is zero
- Perfectly inelastic collision: $m_1v_1+m_2v_2=(m_1+m_2)v'$

Work, energy, and power

- Work: $W=Fs\cos\theta$; kinetic energy: $K=1/2\ mv^2$
- Gravitational potential energy: $U=mgh$; elastic potential energy: $U=1/2\ kx^2$
- Work-energy theorem: $W_{net}=\Delta K$; mechanical energy conservation: $K_1+U_1=K_2+U_2$

- Power: $P=W/t=Fv\cos\theta$; efficiency: $\eta=W_{useful}/W_{input}\times100\%$

MODULE 3 | Circular Motion, Gravitation, Oscillations, and Waves

Circular motion and gravitation

- Angular speed: $\omega=2\pi/T=2\pi f$; linear speed: $v=\omega r=2\pi r/T$
- Centripetal acceleration: $a_c=v^2/r=\omega^2 r$; centripetal force: $F_c=mv^2/r=m\omega^2 r$
- Universal gravitation: $F=Gm_1m_2/r^2$; gravitational field strength: $g=GM/r^2$
- Circular-orbit speed: $v=\sqrt{(GM/r)}$; period: $T=2\pi\sqrt{(r^3/GM)}$

Simple harmonic motion and waves

- SHM: $x=A\cos(\omega t+\varphi)$; $a=-\omega^2 x$
- Mass-spring oscillator: $T=2\pi\sqrt{(m/k)}$; simple pendulum: $T=2\pi\sqrt{(l/g)}$
- Wave speed: $v=f\lambda=\lambda/T$; frequency: $f=1/T$
- Approximate wave intensity: $I=P/A$; spherical wave area $A=4\pi r^2$

MODULE 4 | Electrostatics and DC Circuits

Electric fields and potential

- Coulomb's law: $F=kq_1q_2/r^2$, $k=9.0\times10^9\ N\cdot m^2/C^2$
- Electric field: $E=F/q$; point-charge field: $E=kQ/r^2$
- Electric potential: $V=U/q$; point-charge potential: $V=kQ/r$
- Uniform field: $E=U/d$; work by electric force: $W=qU=qEd$

Circuit basics

- Current: $I=Q/t$; Ohm's law: $U=IR$
- Resistance: $R=\rho L/A$; series: $R=R_1+R_2+...$; parallel: $1/R=1/R_1+1/R_2+...$
- Electric power: $P=UI=I^2R=U^2/R$; electrical energy: $W=UIt=Pt$
- Complete circuit: $I=E/(R+r)$; terminal voltage: $U=E-Ir$

MODULE 5 | Magnetic Fields and Electromagnetic Induction

Magnetic forces

- Magnetic flux: $\Phi=BA\cos\theta$
- Ampere force: $F=BIL\sin\theta$; direction by the left-hand rule
- Lorentz force: $F=qvB\sin\theta$; circular radius of charged particle: $r=mv/(qB)$
- Period: $T=2\pi m/(qB)$; magnetic force does no work on a moving charge

Electromagnetic induction

- Faraday's law: $\varepsilon=-N\Delta\Phi/\Delta t$
- Motional emf: $\varepsilon=BLv$ when B, L, and v are mutually perpendicular
- Lenz's law: induced current opposes the change in magnetic flux

- Induced current: $I=\varepsilon/R$; induced charge approximately $q=\Delta\Phi/R$ for one loop

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MODULE 6 | Thermodynamics, Optics, and Modern Physics

Thermodynamics

- Ideal gas law: $PV=nRT$; Boyle's, Charles's, and Gay-Lussac's laws follow from it
- Heat: $Q=mc\Delta T$; latent heat: $Q=mL$
- First law of thermodynamics: $\Delta U=Q-W$, where W is work done by the gas
- Average molecular kinetic energy: $\bar{E}_k=3/2\ kT$; $pV=NkT$

Optics and modern physics

- Reflection: angle of incidence = angle of reflection; refraction: $n_1\sin\theta_1=n_2\sin\theta_2$
- Thin lens: $1/f=1/u+1/v$; magnification: $m=v/u=h'/h$
- Double-slit spacing: $\Delta x=\lambda L/d$; diffraction grating: $d\sin\theta=m\lambda$
- Photoelectric effect: $h\nu=\varphi+K_{max}$; photon energy: $E=h\nu=hc/\lambda$
- Matter wave: $\lambda=h/p$; mass-energy relation: $E=mc^2$; half-life: $N=N_0(1/2)^{(t/T_{1/2})}$

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.