FREE AP PHYSICS 2 FORMULA SHEET
All the Essential Formulas You Need for Test Day

Unit 9: Thermodynamics

- Ideal Gas Law: $PV = nRT$
- Average Kinetic Energy of a Gas Molecule: $KE_{avg} = (3/2)\, k_B\, T$
- Internal Energy of an Ideal Monatomic Gas: $U = (3/2)\, nRT$
- Heat Transfer (temperature change): $Q = mc\Delta T$
- Heat Transfer (phase change): $Q = mL$
- First Law of Thermodynamics: $\Delta U = Q - W$
- Work Done by a Gas (isobaric process): $W = P\,\Delta V$

Unit 10: Electric Force, Field, and Potential

- Coulomb's Law: $F = k\,(q_1\,q_2)\,/\,r^2$
- Electric Field (point charge): $E = k\,q\,/\,r^2$
- Electric Force (field form): $F = q\,E$
- Electric Potential Energy (two charges): $U = k\,(q_1\,q_2)\,/\,r$
- Electric Potential (point charge): $V = k\,q\,/\,r$
- Potential Difference (work per charge): $\Delta V = W\,/\,q$
- Relationship between field and potential: $E = -\Delta V\,/\,\Delta x$

Unit 11: Electric Circuits

- Ohm's Law: $V = I\,R$
- Electric Power: $P = IV = I^2 R = V^2\,/\,R$
- Series Resistors: $R_{eq} = R_1 + R_2 + \ldots$
- Parallel Resistors: $1\,/\,R_{eq} = 1\,/\,R_1 + 1\,/\,R_2 + \ldots$
- Capacitance: $C = Q\,/\,V$
- Parallel-Plate Capacitor: $C = \varepsilon_0\,A\,/\,d$
- Energy Stored in a Capacitor: $U = \frac{1}{2}\,C\,V^2$
- Current Definition: $I = \Delta Q\,/\,\Delta t$

Constants

- $g = 9.8$ m/s^2
- $G = 6.67 \times 10^{-11}$ N·m^2/kg^2
- $\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/(N·m^2)
- $\mu_0 = 4\pi \times 10^{-7}$ T·m/A
- $e = 1.60 \times 10^{-19}$ C
- $h = 6.63 \times 10^{-34}$ J·s
- $k_B = 1.38 \times 10^{-23}$ J/K
- $c = 3.0 \times 10^8$ m/s
- $N_A = 6.02 \times 10^{23}$ mol^{-1}
- $R = 8.31$ J/(mol·K)

Unit 12: Magnetism and Electromagnetism

- Magnetic Force on a Moving Charge: $F = q\,v\,B\,\sin\theta$
- Magnetic Force on a Current-Carrying Wire: $F = I\,L\,B\,\sin\theta$
- Magnetic Field Around a Long Straight Wire: $B = \mu_0\,I\,/\,(2\pi r)$
- Magnetic Flux: $\Phi_B = B\,A\,\cos\theta$
- Faraday's Law of Induction: $\varepsilon = -\,d\Phi_B\,/\,dt$
- Induced emf in a Moving Conductor: $\varepsilon = B\,L\,v$
- Ampère's Law (straight wire): $\oint B \cdot dl = \mu_0\,I_{enclosed}$

Unit 13: Geometric Optics

- Index of Refraction: $n = c\,/\,v$
- Snell's Law: $n_1\,\sin\theta_1 = n_2\,\sin\theta_2$
- Mirror/Lens Equation: $1/f = 1/do + 1/di$
- Magnification: $M = -\,di\,/\,do$
- Critical Angle (for total internal reflection): $\sin\theta_c = n_2\,/\,n_1$

Unit 14: Waves, Sound, and Physical Optics

- Wave Speed: $v = f\,\lambda$
- Frequency and Period: $f = 1\,/\,T$
- Sound Intensity Level (decibels): $\beta = 10\,\log(I\,/\,I_0)$
- Doppler Effect: $f' = f\,(\,(v \pm v_0)\,/\,(v \mp v_s)\,)$
- Double-Slit Interference: $d\,\sin\theta = m\,\lambda$
- Thin Film Interference (path difference): $2t = m\,\lambda\,/\,n$
- Diffraction Grating: $d\,\sin\theta = m\,\lambda$

Unit 15: Modern Physics

- Photon Energy: $E = h\,f = h\,c\,/\,\lambda$
- Photoelectric Effect: $K_{max} = h\,f - \varphi$
- De Broglie Wavelength: $\lambda = h\,/\,p$
- Mass–Energy Equivalence: $E = m\,c^2$
- Time Dilation: $t' = t\,/\,\sqrt{(1 - v^2\,/\,c^2)}$
- Length Contraction: $L = L_0\,\sqrt{(1 - v^2\,/\,c^2)}$

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