AP Physics B Formula Study Sheet

NEWTONIAN MECHANICS

Kinematics	Δx = area under v-t graph Δv = area under a-t graph
Net Force	$F_{net} = ma$
Friction force	$F_f = \mu N$
centripetal acceleration	$a_c = \frac{v^2}{r}$
torque	$\tau = rF$
momentum	$p = mv$
impulse	$J = F\Delta t = m\Delta v$
kinetic energy	$K = \frac{1}{2}mv^2$
gravitational potential energy	$U_g = mgh$
mechanical work	$W = F\Delta x$
power (general definition)	$P = \frac{W_{net}}{\Delta t}$
power in terms of velocity	$P = Fv$
spring force	$F_s = kx$
spring potential energy	$U_s = \frac{1}{2}kx^2$
period of a spring	$T_s = 2\pi\sqrt{\frac{m}{k}}$
period of a pendulum	$T_p = 2\pi\sqrt{\frac{l}{g}}$
relationship between period and frequency	$T = \frac{1}{f}$
gravitational force in terms of Newton's law of universal gravitation	$F_G = \frac{Gm_1m_2}{r^2}$
gravitational potential energy in terms of Newton's law of universal gravitation	$U_G = \frac{Gm_1m_2}{r}$

FLUID MECHANICS AND THERMAL PHYSICS

absolute pressure in a fluid	$P = P_0 + \rho gh$
gage pressure	$P = \rho gh$
buoyant force	$F_{bouy} = \rho Vg$
fluid flow continuity	$A_1v_1 = A_2v_2$
volume flow rate	A_1v_1
Bernoulli's principle	$P + \rho gy + \frac{1}{2}\rho v^2 = \text{constant}$
pressure (general definition)	$P = \frac{F}{A}$
ideal gas law	$PV = nRT = Nk_BT$
internal energy in a gas	$K_{avg} = \frac{3}{2}k_BT$
velocity of a gas molecule	$v_{rms} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3k_BT}{\mu}}$
thermal work	$W = P\Delta V$ or area under graph
change in internal energy	$\Delta U = Q + W$
efficiency (general)	$e = \left\lvert\frac{W_{net}}{Q_{in}}\right\rvert$
ideal (Carnot) efficiency	$e_c = \frac{T_H - T_C}{T_H}$

ELECTRICITY AND MAGNETISM

Electrostatic force	$F_e = \frac{kq_1q_2}{r^2}$
Electrostatic field	$E = \frac{kq_1}{r^2}$
Electrostatic potential energy	$U_e = \frac{kq_1q_2}{r}$
Electrostatic potential	$V = \frac{kq_1}{r}$
Charge on a capacitor	$Q = VC$
Capacitance	$C = \frac{\varepsilon_0 A}{d}$
Energy stored in a capacitor	$U_C = ½\ QV = ½\ CV^2$
Current (definition)	$I = \frac{\Delta Q}{\Delta t}$
Resistance of a wire	$R = \frac{\rho l}{A}$
Ohm's Law	$V = IR$
Power in a circuit	$P = IV = \frac{V^2}{R} = I^2R$
Equivalent resistor for series	$R_{eq} = R_1 + R_2 + \ldots$
Equivalent resistor for parallel	$R_{eq} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \ldots\right)^{-1}$
Equivalent capacitance for series	$C_{eq} = \left(\frac{1}{C_1} + \frac{1}{C_2} + \ldots\right)^{-1}$
Equivalent capacitance for parallel	$C_{eq} = C_1 + C_2 + \ldots$

Magnetic force on a moving charge in a magnetic field	$F_B = qvB\sin\theta$
Magnetic force on a current carrying wire in a magnetic field	$F_B = BIl\sin\theta$
Magnetic field around a current carrying wire	$B = \frac{\mu_0 I}{2\pi r}$
Magnetic flux	$\Phi_m = BA\cos\theta$
Average EMF generated by a changing magnetic field	$\varepsilon_{avg} = -\frac{\Delta \Phi_m}{\Delta t}$
EMF generated by a loop moving into or out of a magnetic field	$\varepsilon = Blv$

Force **BIl**'s **qvB**

Take **ε**ast **Blv**d when the flux is changing.

WAVES AND OPTICS

Velocity of a wave	$v = f\lambda$
Index of refraction	$n = \frac{c}{v}$
Snell's Law	$n_1 \sin\theta_1 = n_2 \sin\theta_2$
Critical angle	$n_1 \sin\theta_1 = n_2 \sin 90$ or $\sin\theta_c = \frac{n_2}{n_1}$
Mirror & lens equation	$\frac{1}{s_i} + \frac{1}{s_o} = \frac{1}{f}$
Magnification	$M = \frac{h_i}{h_o} = -\frac{s_i}{s_o}$
Focal length in terms of radius of curvature	$f = \frac{R}{2}$
Diffraction pattern path difference	$m\lambda = d\sin\theta$
Diffraction pattern spacing	$x_m = \frac{m\lambda L}{d}$

ATOMIC AND NUCLEAR PHYSICS

Energy of a photon	$E = hf = pc$
Maximum kinetic energy of an emitted electron	$-\varphi + hf = K_{max}$
deBroglie wavelength of an emitted electron	$\lambda = \frac{h}{p}$
Rest energy of a mass	$\Delta E = (\Delta m)c^2$