FORMULA SHEET: This formula sheet is to be used as a reference tool. DO NOT MEMORIZE these formulas, instead, understand the concepts behind the equations and the relationships they represent.

Kinematics and Mechanics

$d = \bar{v}t$
distance

$v_f = v_0 + at$
vat

$v_f^2 = v_0^2 + 2a\Delta x$
vax

$\Delta x = v_0 t + \frac{1}{2}at^2$
tax

$a_c = \frac{v^2}{r}$, $F_c = \frac{mv^2}{r}$
centripetal motion

$F = \frac{GM_1M_2}{r^2}$
law of gravitation

$\vec{F}_{net} = m\vec{a}$
Newton's 2nd law

$F_k = \mu_k F_N$
$F_s \leq \mu_s F_N$
friction

$\tau = Fl\sin\theta$
torque

$\vec{F} = -k\vec{x}$
hooke's Law

Work, Energy, Momentum

$\text{KE} = \frac{1}{2}mv^2$
kinetic energy

$\text{PE}_{grav} = mgh$
gravitational PE

$\text{PE}_{elastic} = \frac{1}{2}kx^2$
spring PE

$P = \frac{W}{t}$
power

$W = Fd\cos\theta$
work

$\vec{p} = m\vec{v}$
momentum

$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$
conservation of momentum

Thermodynamics

$\Delta Q = mc\Delta T$
heat energy

$\Delta Q = mL$
latent heat

$\Delta U = Q - W$
first law of thermodynamics

$\Delta G = \Delta H - T\Delta S$
Gibbs free energy

$\Delta G° = -RT\ln K_{eq}$
equilibrium

Fluids and Solids

$\rho = \frac{m}{V}$
density

$s.g. = \frac{\rho_{substance}}{\rho_{water}}$
specific gravity

$F_b = \rho_{fluid}V_{submerged}g$
buoyant force

$P = \frac{F}{A}$
pressure

$\pi = MRT$
osmotic pressure

$P_{total} = P_{atm} + P_{gauge}$
total pressure on fluid

$P_{fluid} = \rho_{fluid}gh$
fluid gauge pressure

$A_1v_1 = A_2v_2$
continuity equation

$P + \frac{1}{2}\rho v^2 + \rho gh = \text{const.}$
Bernoulli's equation

$\frac{\text{rate A}}{\text{rate B}} = \sqrt{\frac{MM_B}{MM_A}}$
Graham's Law

$\Delta L = \alpha L\Delta T$
$\Delta V = \beta V\Delta T$
thermal expansion

Electricity & Magnetism

$F_e = \frac{kq_1q_2}{r^2}$
electrostatic force

$\vec{E} = \frac{\vec{F}}{q_0}$
electric field

$E = \frac{kq}{r^2}$
electric field due to point charge

$\Delta V = \frac{\Delta U}{q_0}$
electrical potential

$V = \frac{kq}{r}$
electrical potential of a point charge

$q = VC$
capacitance

$U = \frac{1}{2}CV^2$
energy stored by capacitor

$B = \frac{\mu_0 I}{2\pi r}$
magnetic field around a wire

$F = qvB\sin\theta$
$F = ILB\sin\theta$
magnetic force

$B = \frac{\mu_0 I}{2r}$
magnetic field @ center of wire loop

Electric Power & Circuits

$P = IV$
$V = IR$
electrical power & Ohm's Law

$I = \frac{\Delta q}{\Delta t}$
current

$I_{rms} = \frac{I_{\max}}{\sqrt{2}},\ V_{rms} = \frac{V_{\max}}{\sqrt{2}}$
AC circuits

$\frac{1}{C_S} = \frac{1}{C_1} + \frac{1}{C_2} + \cdots$
$C_P = C_1 + C_2 + \cdots$
capacitors in series and in parallel

$R_s = R_1 + R_2 + \cdots$
$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$
resistors in series and in parallel

Light and Optics

$n = \frac{c}{v}$
index of refraction

$E = hf = \frac{hc}{\lambda}$
photon energy

$n_1\sin\theta_1 = n_2\sin\theta_2$
Snell's Law

$\sin\theta_{crit} = \frac{n_2}{n_1},\ n_2 < n_1$
total internal reflection

$\frac{1}{f} = \frac{1}{o} + \frac{1}{i}$
lensmaker's eq.

Periodic Motion, Waves and Sound

$f = \frac{1}{T}$
wave freq., period

$\omega = 2\pi f = \sqrt{\frac{k}{m}}$
spring angular freq

$\omega = 2\pi f = \sqrt{\frac{g}{L}}$
pendulum angular freq

$v = f\lambda$
wave speed

$f' = f\left(\frac{v \mp v_D}{v \pm v_S}\right)$
Doppler effect

Atomic and Nuclear

$^{A}_{Z}X \rightarrow ^{A-4}_{Z-2}Y + \alpha$
alpha decay

$^{A}_{Z}X \rightarrow ^{A}_{Z+1}Y + ^{0}_{-1}e$
beta-minus decay

$^{A}_{Z}X \rightarrow ^{A}_{Z-1}Y + ^{0}_{+1}e$
beta-plus decay

Chemistry and Biology

$PV = nRT$
ideal gas law

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$
Charles' Law

$P_1V_1 = P_2V_2$
Boyle's Law

$\frac{n_1}{V_1} = \frac{n_2}{V_2}$
Avogadro's Law

$pH = -\log\left[H^+\right]$
pH

$M_iV_i = M_fV_f$
dilution

$\left(P + \frac{n^2a}{V^2}\right)(V - nb) = nRT$
Van der Waals equation of state

$EMF = E°_{red} + E°_{ox}$
electromotive force

$E_{cell} = E_{cathode} - E_{anode}$
EMF

$p + q = 1$
$p^2 + 2pq + q^2 = 1$
Hardy-Weinberg equations