

Super Cram Formula Sheet

Force Cram

$F = \text{Force} = \frac{\text{kg m}}{\text{s}^2} = \text{N}$

- $F = ma = \frac{mv^2}{r} = \mu_k N = -K_{\text{spring}} x = \frac{G m_1 m_2}{r^2} = \frac{\Delta p_{\text{momentum}}}{\Delta t} = \frac{\text{kg} \cdot \text{m/s}^2}{\text{s}^2}$

- $F_{\text{buoyancy}} = m_{\text{fluid}} g = \int_{\text{fluid}} \text{density of fluid} \cdot g \cdot \text{Volume of fluid displaced} = \text{Pressure} \cdot \text{Area}$
 (Remember: $F_{\text{net}} = F_{\text{total}} = \sum F_i = F_{g \text{ gravity}} - F_{\text{buoyancy}}$)

- $F_{\text{on a particle going into a B field}} = q \text{ Velocity } B_{\text{External}} \sin \theta$

- $F_{\text{on a current carrying wire in an External B field}} = I_{\text{in wire}} L_{\text{wire}} B_{\text{External}} \sin \theta$

NOTE: $I = \frac{q}{t}$ \rightarrow q Velocity = IL
 \uparrow \uparrow \uparrow
 m/sec q/sec r m

Acceleration = m/s^2 $a = \frac{F}{m} = \frac{v^2}{r} = r\omega$	$\omega = \text{angular velocity} = \text{sec}^{-1}$ $\omega = \frac{\text{Velocity}}{r} = \frac{2\pi}{T} = 2\pi f = \sqrt{\frac{K_{\text{spring const}}}{\text{mass}}}$
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Velocity = $\text{m/s} = \frac{d}{t} = v_0 + at = r\omega = \omega A \cos \omega t = \pm \sqrt{\frac{K_{\text{spring}}}{\text{mass}} (A^2 - x^2)}$
 \uparrow \uparrow \uparrow
 max displacement \uparrow \uparrow \uparrow
 mass max displace \leftarrow displace

Velocity of Wave = $\frac{\lambda}{T} = \lambda f$

Velocity of orbiting satellite: $v^2 = \frac{GM_{\text{Earth}}}{r_{\text{center of Earth to satellite}}}$

$T = \text{Period} = \text{Sec} = 2\pi \sqrt{\frac{\text{mass}}{K_{\text{spring}}}} = 2\pi \sqrt{\frac{\text{length of string}}{g}} = \frac{1}{f} = \frac{2\pi}{\omega}$

$f = \text{frequency} = \text{sec}^{-1} = \frac{\omega}{2\pi} = \frac{1}{T}$

$\tau = \text{Torque} = \text{N} \cdot \text{m} = \text{Joule} = \text{Work} = r_{\perp} F = r F \sin \theta = r m a_{\perp}$

$\tau_{\text{coil in B field}} = N I_{\text{in loop}} A_{\text{loop}} B_{\text{Ext.}} \sin \theta$
 \uparrow \uparrow \uparrow \uparrow
 # of Turns in loop angle between normal to plane of loop + B field angle between rotational axis and line of force

Energy = Joules = N.m = $\frac{kg m^2}{s^2}$ **Energy gram** ↓ Total Energy of orbiting satellite

$$E = \Delta KE + \Delta U = \text{Work conservative forces only} = -\frac{Gm_1 m_2}{2r}$$

$$\text{Work} = F \cos \theta d = \frac{1}{2} k x^2 = \Delta KE = \Delta U = \Delta E$$

↑
Spring const

$$W_T = T = r_{\perp} F = r F \sin \theta$$

$$W_{\text{Thermo}} = (\text{Pressure Constant}) (\Delta \text{Volume}) = Q - \Delta U$$

+W = Work done by system
-W = Work done on system

$$W_{\text{Electric}} = q_0 \Delta \text{Volt}$$

U = Potential Energy = Joules = Work conservative

$$U = mgh = -\frac{Gm_1 m_2}{r} \text{ (see example p. 233 7.14)}$$

Potential E is Not a Vector

$$U_{\text{Electric}} = q \Delta \text{Voltage} = \frac{1}{2} QV = \frac{1}{2} CV^2$$

For head on elastic collisions

$KE = \frac{1}{2} mv^2 = \frac{GmM}{2r} = q \Delta \text{Volt}$	<p>P momentum = m.v $\Delta P = F \Delta t = mv - mv_0$ K impulse</p>	$V_1 = \left(\frac{m_1 - m_2}{m_1 + m_2} \right) v_{1,0}$ $V_2 = \left(\frac{2m_1}{m_1 + m_2} \right) v_{1,0}$
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↖ $v_{1,0} = 0 \text{ m/s}$

$$\text{Voltage} = \frac{\Delta U}{q} = \frac{\Delta KE}{q} = \frac{qEd}{q} = \frac{Q}{C} = \frac{4\pi k Q}{A} \cdot d = E \cdot d = IR$$

$$\text{Voltage} = \frac{\text{Work}}{q_0} = \frac{Kq}{r} = -\frac{N \Delta \Phi_{\text{Flux}}}{\Delta t}$$

Units: Volt = $\frac{J}{C} = \frac{N \cdot m}{C}$

Also called Electric Potential
NOT Vector quantity

E = Electric Field = $\frac{N}{C}$

$$E = \frac{F}{q} = \frac{Kq}{r^2} = \frac{4\pi k Q}{A} = -\frac{\Delta \text{Volt}}{\Delta x}$$

↑
Parallel plates

Electric field and Force ARE Vector Quantities

Hint: If you are asked to find Electric Potential (Voltage) at the center of something, DON'T Add Vectors. Electric field or Force Do Add Vectors!

Super Crum Formula Sheet

Kinematics crum

$$x = v_{0x}t + \frac{1}{2}at^2 = A \sin(\omega t + \phi)$$

$$v = v_0 + at$$

$$v_x^2 = v_{0x}^2 + 2ax$$

↑
max displacement

↑
radians

↑
radians initial position

$$v = \frac{dx}{dt} = r\omega = \omega A \cos \omega t = \pm \sqrt{\frac{k_{\text{spring}}}{\text{mass}} (A^2 - x^2)}$$

↑
max displacement of spring/mass

↑
instant displacement

$$v = \frac{\lambda}{T} = \lambda f$$

Fluids crum

$$\rho_1 \text{ density, } A_1 \text{ Area, } v_1 \text{ Velocity, } = \rho_2 A_2 v_2 \quad (\text{note, if } \rho_1 = \rho_2 \text{ They cancel})$$

if $y_1 = y_2$, these cancel!

Bernoulli equation:

$$\text{Pressure}_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g y_2$$

$$A_1 v_1 = A_2 v_2 \quad (\text{so, if area of pipe } \downarrow, v \text{ will } \uparrow)$$

$$F_{\text{buoyancy}} = \rho_{\text{density of fluid}} g V_{\text{of fluid displaced}}$$

Super Cram Formula Sheet

Electric Cram

C = Capacitance Q = Charge V = Volt R = resistance

U = Potential Energy ρ = resistivity (a constant - heat + metal specific)

$$C \text{ units} = \text{Coulomb/volt} = \text{Farad} = \boxed{\frac{Q}{V}}$$

$$Q \text{ units} = \text{Coulomb} = \boxed{CV}$$

$$V \text{ units} = \text{volts} = \text{J/C} = \frac{\text{N}\cdot\text{m}}{C} = \boxed{\frac{Q}{C} = IR}$$

$$R \text{ units} = \text{ohms} = \Omega = \frac{\text{volt}}{\text{Amp}} = \frac{\text{J}\cdot\text{sec}}{C^2} = \boxed{\frac{V}{I} = \frac{PL}{A}}$$

$$I \text{ units} = \frac{\text{Coulombs}}{\text{sec}} = \text{Amp} = \frac{\text{volt}}{\text{ohm}} = \boxed{q/t = \frac{V}{R}}$$

$$U \text{ units} = \text{J} = \boxed{\frac{1}{2} QV = \frac{1}{2} CV^2 = q\Delta V}$$

$$C_{\text{Series}} = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}}$$

$$C_{\text{parallel}} = C_1 + C_2 + C_3$$

$$R_{\text{Series}} = R_1 + R_2 + R_3$$

$$R_{\text{parallel}} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$$

Note: Long wire has big resistance. Thick wire has low resistance

POWER CORNER

$$P \text{ units} = \text{Power} = \frac{\text{J}}{\text{sec}} = \boxed{\frac{\text{Work}}{t} = IV = \frac{V^2}{R} = I^2 R}$$

$$\text{Power Thermo} = \boxed{\frac{\Delta Q(\text{heat})}{\Delta t}}$$

$$\text{Power Torque} = \boxed{\frac{\tau}{t} = \tau \omega (\text{angular speed})}$$

Time constant for an RC circuit = $\tau = RC = \text{ohm} \cdot \text{Farads} = \text{sec}$
 Ohms Times Farads = Seconds! cool!

Super Cram Formula Sheet

Magnetism Cram

ϕ = Flux B = Magnetic field μ_0 = Permativity of free space

$$B = \frac{N}{C \cdot m/sec} = \frac{N}{Amp \cdot m} = \text{Tesla} = T$$

$$\phi = T \cdot m^2 = \text{Weber} = Wb = \frac{N \cdot m}{Amp} = \frac{J}{Amp}$$

$$B_{\text{created by long wire}} = \frac{\mu_0 I_{\text{in wire}}}{2\pi d_{\text{distance from wire}}}$$

$$\phi = N B A_{\text{area of loop}} \cos \theta \leftarrow \begin{array}{l} \text{Angle between normal to plane} \\ \text{of loop and B field} \end{array}$$

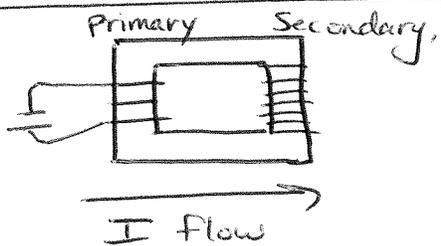
\uparrow
of loops

$\therefore \phi_{\text{max}}$ when loop is \perp to B field

$$F_{\text{on particle}} = qvB \sin \theta$$

$$F_{\text{on wire}} = ILB \sin \theta$$

Transformer:



If Primary has less coils than Secondary, This is a step up Transformer (V will \uparrow and I will \downarrow)

$$\frac{I_P}{I_S} = \frac{V_S}{V_P} = \frac{N_S}{N_P}$$

$$\text{Voltage} = - \frac{N \Delta \phi}{\Delta t}$$

Remember, you must have a change in flux in order to induce a current/voltage.

Super Crum Formula Sheet

Thermo Crum

Q = heat in Joules W = Work in Joules U = Potential in Joules
 C_p = Specific Heat

Isothermal - const. Temp ($\Delta U = 0$)

Isobaric - const. Pressure

Isometric - const. Volume ($W = 0$)

Adiabatic - const. Heat ($Q = 0$)

$$Q = \Delta U + W$$

$$Q = (\text{mass}) C_p \Delta T = \Delta U + W$$

$$W = Q - \Delta U = \text{constant Pressure } \Delta \text{Volume}$$

isothermal: $\frac{Q}{W = P\Delta V}$

$$\frac{W}{Q}$$

isobaric: $\Delta U + W$

$$Q - \Delta U$$

isometric: ΔU

$$0$$

Adiabatic 0

$$\Delta U$$

$+Q$ = heat added to system
(Endothermic)

$-Q$ = heat removed from system
(Exothermic)

$+W$ = work done by system

$-W$ = work done on system