Date: ____________

## Vectors

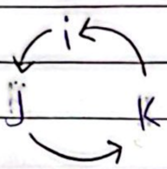
$\vec{V} = |V| \cdot \hat{V}$

$\vec{A} \cdot \vec{B} = AB\cos\theta$ or $\vec{A} \cdot B_A$

$\vec{A} \times \vec{B} = AB\sin\theta$ or $\vec{A} B_y$

$i \cdot i = j \cdot j = K \cdot K = 1$

$i \cdot j = j \cdot K = K \cdot i = 0$




$i \times j = K \quad j \times K = i \quad K \times i = j$

$$\vec{A} \times \vec{B} = \begin{vmatrix} i & j & K \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$$

$a \cdot b = b \cdot a$

$a \times b = -(b \times a)$

## Motion in 1-D

$V_f = V_i + at$

$S = V_i t + \frac{1}{2} at^2$

$2aS = V_f^2 - V_i^2$

$V_{avg} = \dfrac{x_f - x_i}{\Delta t}$

$V_{ins} = \lim_{\Delta t \to 0} \dfrac{dx}{dt}$

$\Delta x = x_f(t_f) - x_i(t_i)$

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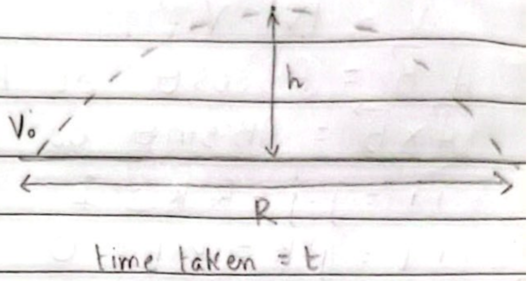
## Motion in 2D

$V_x = V_0 \cos\theta$

$V_y = V_0 \sin\theta$



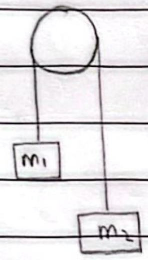

$$t = \frac{V_0 \sin\theta}{g}$$

$$R = \frac{V_0^2 \sin 2\theta}{g}$$

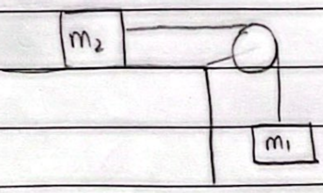
$$h = \frac{V_0^2 \sin^2\theta}{2g}$$

$$h = \frac{1}{2} g t^2 \text{ (for free falling bodies)}$$

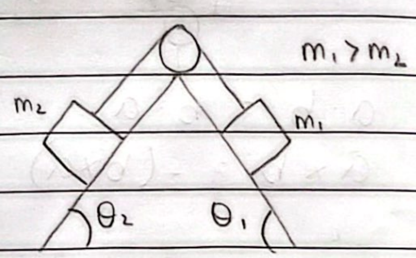
## Newton Laws of motion:-




$$T = \frac{2 m_1 m_2 g}{m_1 + m_2} \qquad a = \frac{(m_1 - m_2) g}{m_1 + m_2}$$




$$T = \frac{m_1 m_2 g}{m_1 + m_2} \qquad a = \frac{m_1 g}{m_1 + m_2}$$




let

$\theta_1 = \theta_2 = \theta$

$$T = \frac{2 m_1 m_2 g \sin\theta_2}{m_1 + m_2}$$

$$a = \frac{(m_1 - m_2) g \sin\theta}{m_1 + m_2}$$

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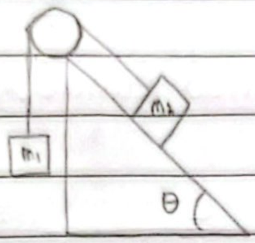
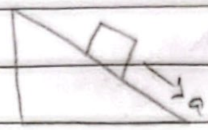


$$F = Kx$$

friction $= \mu F$



$$a = \frac{m_2 g \sin\theta - m_1 g}{m_1 + m_2}$$

$$T = \frac{m_1 m_2 g (\sin\theta + 1)}{m_1 + m_2}$$

$$a = g\sin\theta$$

## Simple harmonic motion

- $x = x_m \cos(\omega t + \phi)$
- $V = -V_m \sin(\omega t + \phi)$
- $V = \omega x_m$
- $a = \omega^2 x_m$
- $\omega = 2\pi f$
- $\omega = \sqrt{\frac{K}{m}}$
- $F = Kx$
- $K.E = \frac{1}{2} mv^2$
- $T = 2\pi \sqrt{\frac{m}{K}}$
- $\omega = \sqrt{\frac{K}{m} - \left(\frac{b}{2m}\right)^2}$
- Damp. factor $= \frac{b}{2m}$
- $P.E = \frac{1}{2} Kx^2$
- $E = K.E + P.E$ or $\frac{1}{2} K x_m^2$

$$x = x_m e^{-\frac{bt}{2m}} \cos(\omega t + \phi)$$

## Waves

$$y(x,t) = y_m \sin(Kx - \omega t)$$

$$K = \frac{2\pi}{\lambda}$$

$$\omega = \frac{2\pi}{t}$$

$$V = \sqrt{\frac{T \to \text{Tension}}{\mu \to \text{linear density}}}$$

$$\mu = \frac{m}{L}$$

$$V = f\lambda$$

$$V = A\omega \text{ or } x_m \omega$$

$$V = \frac{\omega}{K}$$

Date:

## Electrostatics

$Q = nE$

$F = \frac{K q_1 q_2}{r^2}$

$K = \frac{1}{4\pi\epsilon_0}$

$E = \frac{F}{q}$

## Capacitors

$q = Cv$

$V = \frac{E_p}{q}$

$W = -\Delta V q$

$C = \frac{\epsilon_0 A}{d}$ (without dielectric)

$C = \frac{K \epsilon_0 A}{d}$ (with dielectric)

$U_E = \frac{1}{2} \epsilon_0 E^2$ (Energy stored in Capacitor)

$E = \frac{v}{d}$

$E = \frac{\sigma}{\epsilon_0}$

$\sigma = \frac{q}{A}$

$E = \frac{\sigma r}{3\epsilon_0}$

## Cylinderical Capacitor

$C = \frac{L}{2K_e \ln(b/a)}$

## Spherical Capacitor

$C = \frac{ab}{K_e(b-a)}$

## Parallel capacitors

$C = C_1 + C_2 \cdots C_n$

$V =$ constant

## Series Capacitors

$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} \cdots \frac{1}{C_n}$

$V = V_1 + V_2 \cdots V_n$

$q =$ constant

$J = \frac{I}{L}$

$R = \frac{\rho L}{A}$

$I = nAqV_D$

$V = IR$ P = power

$P = IV$

$P = I^2R$

$P = \frac{V^2}{R}$

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Gauss's Law and electric field -

$$\phi = \vec{E} \cdot \vec{\Delta A}$$

$$\phi = E \Delta A \cos\theta$$

$\vec{A}$ = surface area

$\phi$ = flux

$$\phi_{net} = \frac{Q}{\epsilon_0}$$

Q = charge enclosed in a surface

$$V = \frac{W}{q}$$

$E = \frac{\sigma}{2\epsilon_0}$ (electric field produced by infinite charge sheet)

$E = \frac{\sigma}{\epsilon_0}$ (electric field between two oppositely charged sheets)

$E = 0$ (inside the sphere)

$E = \frac{KQ}{r^2}$ (outside the sphere)

$E = \frac{\sigma}{\epsilon_0}$ (at surface of sphere)

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# Electric current and resistance

$$I = \frac{Q}{\Delta t}$$

$$I = nAqV_d$$

$$\frac{Q}{\Delta t} = nAqV_d$$

$$\bar{J} = \frac{I}{A} = nqV_d$$

$\bar{J}$ = current density

$$V = IR$$

$$R = \frac{\rho L}{A}$$

$$\rho_T = \rho_0[1 + \alpha(T - T_0)]$$

(Relation of resistance and temperature -)

$$R_T = R_0[1 + \alpha(T - T_0)]$$

$$P = IV$$

$$P = I^2R$$

$$P = \frac{V^2}{R}$$

$$\rho = \frac{E}{J}$$

$\sigma$ = conductivity

$$\sigma = \frac{1}{\rho}$$

$$\bar{J} = \sigma E$$

$$V = EL$$

$$\bar{J} = \frac{\sigma V}{L}$$

$$V = \frac{\bar{J}L}{\sigma}$$

$$\boxed{\because \bar{J} = \frac{I}{A}}$$

$$V = \frac{L}{A\sigma} \cdot I$$

$$\boxed{\because V = IR}$$

$$IR = \frac{L}{A\sigma} \cdot I$$

$$\boxed{R = \frac{\rho L}{A}}$$

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# Magnetic field

force on charge

$F = qVB\sin\theta$

$r = \frac{mV}{qB}$

$V = r\omega$

$\omega$ = angular velocity

$\omega = \frac{V}{r} = \frac{V \cdot q \cdot B}{mV}$

$$\boxed{\omega = \frac{qB}{m}}$$

$B = \frac{\mu_0 I}{2\pi r}$

Solenoid

$\vec{B} = \mu_0 n I$ $\quad n = \frac{N}{L}$

n = turn density

Toroid

$\vec{B} = \frac{\mu_0 N I}{2\pi r}$

$r = \frac{r_i + r_o}{2}$

$T = \frac{2\pi r}{V} = \frac{2\pi r}{r\omega} = \frac{2\pi}{\omega} = \frac{2\pi m}{qB}$

lorentz force

$\vec{F}_{Net} = \vec{F}_m + \vec{F}_e$

$= q(\vec{V} \times \vec{B}) + q\vec{E}$

$\frac{q}{m} = \frac{V}{Br}$

$q\cancel{V}B_o = \frac{mV^{\cancel{2}}}{r}$

$\frac{q}{m} = \frac{V}{B_o r}$

$qE = qVB$

$E = VB$

$V = \frac{E}{B}$

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$$\frac{m}{q} = \frac{r B_0}{V} = r B_0 \cdot \frac{B}{E}$$

$$\boxed{\frac{m}{q} = \frac{r B_0 B}{E}}$$

Hall effect:-

$$q V_d B = q E_H$$

$$E_H = V_d B$$

$$\Delta V_H = E_H L$$

$$\Delta V_H = V_d B L$$

$$\boxed{\because I = n A q V_d}$$

$$\Delta V_H = \frac{IBL}{nAq}$$

A = lenght × width = L × w

$$\Delta V_H = \frac{IB}{nwq}$$

$$R_H = \frac{1}{nq} = \text{Hall coeffecient}$$

$$\boxed{\Delta V_H = \frac{R_H I B}{w}}$$

Force on wire carrying current

$$F = BIL\sin\theta$$