SAINT JOSEPH'S PREPARATORY SCHOOL
PHYSICS

Kinematics:

$$\mathbf{d} = \mathbf{d}_0 + \mathbf{v}_0 t + \frac{1}{2}\mathbf{a}t^2$$
$$x = x_0 + v_{0x}t + \frac{1}{2}a_x t^2$$
$$y = y_0 + v_{0y}t + \frac{1}{2}a_y t^2$$
$$v^2 = v_0^2 + 2a\Delta x$$

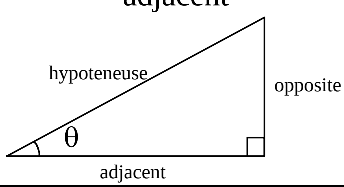
<u>Newton's Laws</u>:

$$\text{If } \sum \mathbf{F} = \mathbf{0} \text{ then } \mathbf{a} = 0$$
$$\sum \mathbf{F} = m\mathbf{a}$$

Ups = Downs + m**a**
Rights = Lefts + m**a**
Up(the plane) = Down(the plane) + ma(up the plane)
Into = OutOf
Clockwise = CounterClockwise (torque)

opposite = hypoteneuse $\times \sin\theta$
adjacent = hypoteneuse $\times \cos\theta$

$$\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$$



Parallel component of weight $= mg\sin\theta$
Perpendicular component of weight $mg\cos\theta$

Static: $F_f \le \mu_s F_N$
Kinetic: $F_f = \mu_k F_N$
Both static friction and normal forces are reactive in that they vary in magnitude depending upon the other forces that are acting.

Work:

$$W = \mathbf{F} \bullet \mathbf{d} = Fd\cos\theta$$
$$\Sigma W = \Delta K$$
$$K = \tfrac{1}{2}mv^2$$

Momentum:

$\mathbf{F}t = \Delta(m\mathbf{v})$
Elastic:
Momentum is conserved.
$m_\mathbf{A}\mathbf{v}_{\mathbf{A}1} + m_\mathbf{B}\mathbf{v}_{\mathbf{B}1} = m_\mathbf{A}\mathbf{v}_{\mathbf{A}2} + m_\mathbf{B}\mathbf{v}_{\mathbf{B}2}$
Kinetic energy is conserved.
$\frac{1}{2}m_\mathbf{A}\mathbf{v}_{\mathbf{A}1}^2 + \frac{1}{2}m_\mathbf{B}\mathbf{v}_{\mathbf{B}1}^2 = \frac{1}{2}m_\mathbf{A}\mathbf{v}_{\mathbf{A}2}^2 + \frac{1}{2}m_\mathbf{B}\mathbf{v}_{\mathbf{B}2}^2$
Relative velocity is reversed.
$\mathbf{v}_{\mathbf{A}1} - \mathbf{v}_{\mathbf{B}1} = -\left(\mathbf{v}_{\mathbf{A}2} - \mathbf{v}_{\mathbf{B}2}\right)$
Inelastic:
$m_1\mathbf{v}_1 + m_2\mathbf{v}_2 = (m_1 + m_2)\mathbf{V}$ Two objects stick together.
$(m_1 + m_2)\mathbf{v} = m_1\mathbf{V}_1 + m_2\mathbf{V}_2$ One object divides.

Waves:

$$v = f\lambda$$
$$y = A\cos(\omega t + \phi)$$

Sound:

intensity at threshold of hearing:
$1 \times 10^{-12}\ w/m^2 = I_0$
$dB = 10 \times \log(I/I_0)$
Open: $\lambda = 2L$
Closed: $\lambda = 4L$
Strings: $f_1 = \frac{v}{2L}$
Speed of sound in air: $v = 331 + 0.6C$

Periodic and Circular Motion:

$$F_c = \frac{mv^2}{r} \qquad a_c = \frac{v^2}{r}$$
$$\omega = 2\pi f \qquad T = 1/f \qquad v = r\omega$$

Gravity:

$$F = G\frac{m_1 m_2}{R^2} \qquad g_p = G\frac{m_p}{R_p^2}$$

$U = mgh$ (near surface)
$$U = -\frac{GMm}{R}$$
$$v_e = \sqrt{\frac{2GM}{R}}$$

Kepler's Laws:

$$\frac{R^3}{T^2} = \frac{G}{4\pi^2}M$$

Doppler Effect: $f' = f\left(\frac{v \pm v_0}{v \mp v_s}\right)$

Torque and Rotation:

$$\mathrm{T} = \mathbf{d} \times \mathbf{F} = dF \sin\theta$$

$$I = \sum mr^2 = \int r^2 dm$$

$$\mathbf{L} = \mathbf{r} \times \mathbf{p} = I\boldsymbol{\omega}$$

$$E_k = \frac{1}{2} I\boldsymbol{\omega}^2$$

Rotation:

$360^\circ = 2\pi$ radians

rpm/60 $= f =$ revolutions per second

$T = \frac{1}{f}; 2\pi f = \omega = \frac{2\pi}{T}$

$\alpha = \frac{\Delta\omega}{\Delta t}; \omega = \omega_0 + \alpha t$

$\theta = \theta_0 + \omega_0 + \frac{1}{2}\alpha t^2$

$s = R\theta; v = R\omega; a = R\alpha$

Periodic motion:

$T = 2\pi\sqrt{\frac{m}{k}}$

$T = 2\pi\sqrt{\frac{l}{g}}$

Temperature:

$F = 32 + \frac{9}{5}C$

$C = \frac{5}{9}(F - 32)$

$K = C + 273.15$

Heat:

$Q = cm(\Delta T)$

$Q = Lm$

Fluids: Bernouli

$$P_1 + \rho g h_1 + \tfrac{1}{2}\rho v_1^2 = P_2 + \rho g h_2 + \tfrac{1}{2}\rho v_2^2$$

Electricity:

$F = k\frac{Q_1 Q_2}{R^2}$

$C = \frac{Q}{V} = k\xi_0 \frac{A}{d}$ (k is the dielectric constant)

$E = k\frac{q}{r^2}$

U (PE) $= -qEd$

$\Delta V = -ED$

U (PE) $= \frac{1}{2}QV = \frac{1}{2}CV^2 = \frac{1}{2}\frac{Q^2}{C}$

$V = IR$

$P = VI = I^2 R = V^2/R$

$R_{\text{eq}} = \sum_{i=1}^{n} R_i$ (Series)

$R_{\text{eq}} = \frac{1}{\sum_{i=1}^{n} \frac{1}{R_i}}$ (Parallel)

Total current entering a point is zero.

Total voltage around a closed loop is zero.

Electromagnetism:

$\mathbf{F}_M = q\mathbf{v} \times \mathbf{B} = qvB\sin\theta$

$B_s = \mu_0 n I$

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

$\mathbf{F} = l\mathbf{I} \times \mathbf{B} = IlB\sin\theta$

Light:

$n_1 \sin\theta_1 = n_2 \sin\theta_2 = n_3 \sin\theta_3$

$d\sin\theta = n\lambda$

$n_m = \frac{c}{v_m}$

$c = f\lambda$ $\quad E = hf$

$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$ $\quad f = \frac{R}{2}$

Springs:

$F = kd$

$U = \frac{1}{2}kd^2$