Vectors: $\vec{A} = A_x\hat{x} + A_y\hat{y} + A_z\hat{z}$ $A = |\vec{A}| = \left(A_x^2 + A_y^2 + A_z^2\right)^{1/2}$ $\hat{a} = \dfrac{\vec{a}}{|\vec{a}|}$

$C_x = A_x + B_x$ $C_y = A_y + B_y$ $C_z = A_z + B_z$

$\vec{A} \cdot \vec{B} = A_x B_x + A_y B_y + A_z B_z = AB\cos\theta$

Kinematics: $\vec{r} = x\hat{x} + y\hat{y}$ $\vec{v} = \dfrac{d\vec{r}}{dt} = v_x\hat{x} + v_y\hat{y}$ $\vec{a} = \dfrac{d\vec{v}}{dt} = a_x\hat{x} + a_y\hat{y}$

$\Delta\vec{r} = \vec{r}_f - \vec{r}_i$ $<\vec{v}> = \dfrac{\Delta\vec{r}}{\Delta t}$ $<\vec{a}> = \dfrac{\Delta\vec{v}}{\Delta t}$

Constant acceleration: $x = x_o + v_{ox}t + \frac{1}{2}a_x t^2$

Earth's gravity: $g = 9.8\ \text{m/sec}^2$

$v_x = v_{ox} + a_x t$

$v_x^2 = v_{ox}^2 + 2a_x(x - x_o)$

$<v_x> = \dfrac{v_f + v_i}{2}$ $x - x_o = <v_x> \Delta t$

Uniform circular motion: $a_r = \dfrac{v^2}{r}$

Quadratic formula $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Newton's 2nd Law $F_x = ma_x$ $F_y = ma_y$ $F_z = ma_z$

Friction $F_f = \mu N$

Restoring Force (Hooke's Law) $|F_s| = k(l - l_o)$

$|F_x = kx|$

Work & Energy	$W = F \cdot d \cdot \cos(\theta)$	$W_{total} = \Delta K;$ $W_{conservative} = -\Delta U$ $\Delta U_g = mg\Delta y$ or $U = mgh$	$K = \frac{1}{2}mv^2$ $\Delta U_{spring} = \frac{1}{2}k(l - l_o)^2$ $\Delta U_{spring} = \frac{1}{2}kx^2$
Mechanical Energy	$E = K + U$	$\Delta E = W_{nonconservative} = \Delta I$	
Impulse & Momentum	$\vec{J} = \vec{F} \cdot \Delta t = \Delta \vec{p}$	$\vec{p} = m \cdot \vec{v}$	**No external force** : $\vec{p}_{final} = \vec{p}_{initial}$
Rocket	vector version $\vec{F}_{ext} = m\frac{d\vec{v}}{dt} + \vec{V}\frac{dm}{dt}$ $\frac{dm}{dt} > 0$	one dimensional as in the text $v_e > 0\,;\ \frac{dm}{dt} < 0$	$F_{ext,x} = m\frac{dv_x}{dt} + v_{e,x}\frac{dm}{dt}$
Universal Gravitation	$F_g = \frac{G \cdot M \cdot m}{r^2}$ $G = 6.67 \times 10^{-11}\,\frac{N \cdot m^2}{kg^2}$	$U_g = -\frac{G \cdot M \cdot m}{r}$	$v_e = \sqrt{\frac{2GM}{R}}$