Trig:
\[
\begin{align*}
\sin \theta &= a/c \\
\cos \theta &= b/c \\
\tan \theta &= a/b \\
c^2 &= a^2 + b^2
\end{align*}
\]

Quadratic Formula:
\[
Ax^2 + Bx + C = 0
\]
has solutions:
\[
x = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}
\]

Misc Formulas:
- Circumference of a circle = \(2\pi R\)
- Area of a circle = \(\pi R^2\)
- Surface Area of a Sphere = \(4\pi R^2\)
- Volume of sphere = \((4/3)\pi R^3\)
- Volume of cylinder = \(\pi R^2L\)

Differentiation:
\[
\begin{align*}
dx^n/dx &= nx^{n-1} \quad (n \neq 0) \\
d\cos(x)/dx &= -\sin(x) \quad (x \text{ in radians}) \\
d\sin(x)/dx &= \cos(x) \quad (x \text{ in radians}) \\
d(f(x) + g(x))/dx &= df(x)/dx + dg(x)/dx
\end{align*}
\]

Integration:
\[
\int x^n dx = \frac{x^{n+1}}{n+1} + C
\]

1-D Motion:
- displacement = \(\Delta x\)
- \(v_{\text{average}}\): \(\Delta x/\Delta t = (x_2 - x_1)/(t_2 - t_1)\)
- \(a_{\text{average}}\): \(\Delta v/\Delta t = (v_2 - v_1)/(t_2 - t_1)\)

Given \(x(t)\)
- \(v(t) = dx/dt\) (instantaneous)
- \(a(t) = dv/dt = d^2x/dt^2\) (instantaneous)

1-D Motion with Const. Acc.:
\[
x(t) = x_0 + v_{0x}t + (1/2) at^2 \\
v(t) = v_0 + at \\
v^2 = v_0^2 + 2a(x - x_0)
\]

Projectile Motion:
\[
x(t) = x_0 + v_{0x}t \\
v_x(t) = v_{0x} \\
a_x(t) = 0 \\
y(t) = y_0 + v_{0y}t + (1/2) a_yt^2 \\
v_y(t) = v_{0y} + a_yt \\
a_y(t) = a_y
\]

For motion over level ground
- Range = \(v_{0x}^2 \sin(2\theta_0)/g\)
- Acceleration due to gravity: \(g = 9.8 \text{ m/s}^2\) downward

Newton's Second Law:
\[
\mathbf{F}_{\text{net}} = \sum \mathbf{F}_{\text{ext}} = m\mathbf{a}
\]

Circular Motion:
\[
a_c = v^2/R \\
T = 1/f \\
v = 2\pi R/T
\]

Frictional Forces:
\[
f_s \leq \mu_s F_N \\
f_k = \mu_k F_N \\
\mu_s > \mu_k
\]

Work and Kinetic Energy
\[
\begin{align*}
W &= F\Delta x \\
W &= \int F \, dx \\
K &= \frac{1}{2}mv^2 \\
W_{\text{net}} &= \Delta K \\
\Delta K &= K_f - K_i
\end{align*}
\]

Potential Energy
\[
\Delta U = U(x) - U_0(x_0) = -\int Fdx
\]

For gravity on earth's surface:
\[
F_g = mg \\
U(y) = U_0 + mgx
\]

For gravity in general:
\[
F_g = -GmM/r^2 \\
U(r) = -GmM/r
\]

For springs:
\[
F = -kx \\
U(x) = (1/2)kx^2
\]

With conservative forces only:
\[
E_{\text{tot}} = K + U \quad \text{(a constant)} \\
\Delta E_{\text{tot}} = \Delta K + \Delta U = 0
\]

With non-conservative forces:
\[
\Delta E_{\text{tot}} = \Delta K + \Delta U = W_{NC}
\]

Gravity
- Kepler's third law:
\[
T^2/R^3 = 4\pi^2/GM_{\text{sun}} \\
G = 6.67 \times 10^{-11} \text{ N.m}^2/\text{kg}^2
\]

Power
\[
P_{\text{avg}} = W/t \\
P = dW/dt \\
P = \mathbf{F} \cdot \mathbf{v}
\]