Classical Mechanics

Translation
The motion of objects as a whole

Kinematics

Laws:
none

Definitions:
Position $\vec{r}$
Displacement $d\vec{r}$
Velocity $\vec{v} \equiv \frac{d\vec{r}}{dt}$
Acceleration
$\vec{a} \equiv \frac{d\vec{v}}{dt}$

Useful Relations:
Kinematic Equations
$x = x_o + v_o t + \frac{1}{2} a t^2$
$v = v_o + at$
$v^2 = v_o^2 + 2a(x - x_o)$
$x - x_o = \frac{1}{2}(v + v_o)t$
Tangential Velocity
$v_t = \frac{2\pi r}{T}$
Centripetal Acceleration
$a_c = \frac{v^2}{r}$

Force

Laws:
Newton's Laws
1. Law of Inertia
2. $\Sigma \vec{F} = m\vec{a}$
3. Action/Reaction

Definitions:
Coefficient of Friction
$\mu \equiv \frac{F_{fr}}{F_n}$

Useful Relations:
Mass/weight Rule
$F_g = mg$

Air Resistance
$F_d = bv$

Hooke's Rule
$F_s = kx$

Terminal Speed
$v_t = \frac{mg}{b}$

Momentum

Laws:
Conservation of Linear Momentum

Definitions:
Linear Momentum
$\vec{p} \equiv m\vec{v}$

Impulse
$\vec{J} \equiv \int_0^t \vec{F} dt$

Center of Mass
$\vec{r}_{cm} \equiv \frac{1}{M} \int \vec{r} dm$

Useful Relations:
Original 2nd Law
$\Sigma \vec{F} = \frac{d\vec{p}}{dt}$

Impulse/Momentum Theorem
$\Delta \vec{p} = \vec{J}$

Energy

Laws:
Conservation of Energy
$\Delta K + \Delta U = W_{nc}$

Definitions:
Work
$W \equiv \int \vec{F} \bullet d\vec{s}$
Power $P \equiv \frac{dW}{dt}$
Kinetic Energy
$K \equiv \frac{1}{2} m v^2$
Potential Energy
$\Delta U \equiv -W_c$

Useful Relations:
Work-Energy Theorem
$W_{net} = \Delta K$
Gravitational Potential Energy
$U_g = mgy$
Spring Potential Energy
$U_s = \frac{1}{2} k x^2$

Rotation
The spinning motion of objects

Kinematics | Torque | Angular Momentum | Energy

Dot Product $\vec{A} \bullet \vec{B} \equiv AB\cos\theta = A_x B_x + A_y B_y + A_z B_z$

Cross Product $\vec{A} \times \vec{B} \equiv AB\sin\theta \hat{n}$
$\vec{A} \times \vec{B} = \left(A_y B_z - A_z B_y\right)\hat{i} + \left(A_z B_x - A_x B_z\right)\hat{j} + \left(A_x B_y - A_y B_x\right)\hat{k}$

Acceleration due to gravity $g = 9.80\ m/s^2$

Moon - mass: 7.36×10^{22} kg radius: 1.74×10^6 m

Earth - mass: 5.98×10^{24} kg radius: 6.38×10^6 m
Earth - moon distance: 3.82×10^8 m

Sun - mass: 1.99×10^{30} kg radius: 6.96×10^8 m
Sun - Earth distance: 1.50×10^{11} m