Physics Equation Sheet

Chapter 2: Motion in One Dimension

Displacement

$\Delta x = x_f - x_i$

Average Velocity

$v_{avg} = \Delta x / \Delta t$

$= (x_f - x_i) / (t_f - t_i)$

Average Acceleration

$a_{avg} = \Delta v / \Delta t$

$= (v_f - v_i) / (t_f - t_i)$

Displacement with Constant Acceleration

$\Delta x = ½(v_f - v_i)\Delta t$

Velocity with Constant Acceleration

$v_f = v_i + a\Delta t$

Displacement with Constant Acceleration

$\Delta x = v_i\Delta t + ½a(\Delta t)^2$

Final Velocity After Any Displacement

$v_f^2 = v_i^2 + 2a\Delta x$

Chapter 3: Two-Dimensional Motion and Vectors

Pythagorean Theorem for Right Triangles

$c^2 = a^2 + b^2$

Definition of the Tangent Function for Right Triangles

Tan θ = Opposite / Adjacent

Definition of the Sine Function for Right Triangles

Sin θ = Opposite / Hypotenuse

Definition of the Cosine Function for Right Triangles

Cos θ = Adjacent / Hypotenuse

Vertical Motion of a Projectile That Falls from Rest

$v_{y,f} = a_y\Delta t$

$v_{y,f}^2 = 2a_y\Delta y$

$\Delta y = ½\, a_y(\Delta t)^2$

Horizontal Motion of a Projectile

$v_x = v_{x,i} = \text{constant}$

$\Delta x = v_x\Delta t$

Projectiles Launched at an Angle

$v_x = v_{x,i} = v_i\cos\theta = \text{constant}$

$\Delta x = (v_i\cos\theta)\Delta t$

$V_{y,f} = v_i\sin\theta + a_y\Delta t$

$V_{y,f}^2 = v_i^2(\sin\theta)^2 + 2a_y\Delta y$

$\Delta y = (v_i\sin\theta)\Delta t + ½a_y(\Delta t)^2$

Chapter 4: Forces and the Laws of Motion

Newton's Second Law

$\sum F = ma$

Coefficient of Friction Forces

$\mu_k = F_k / F_n$

$\mu_s = F_s / F_n$

Chapter 5: Work and Energy

Work

$W = Fd$

Net Work Done by a Constant Net Force

$W_{net} = F_{net}\, d \cos \theta$

Kinetic Energy

$KE = \frac{1}{2} mv^2$

Work-Kinetic Energy Theorem

$W_{net} = \Delta KE$

Gravitational Potential Energy

$PE_g = mgh$

Elastic Potential Energy

$PE_{elastic} = \frac{1}{2} kx^2$

Conservation of Mechanical Energy

$ME_i = ME_f$

Power

$P = W / \Delta t$

$P = Fv$

Chapter 6: Momentum and Collisions

Momentum

$P = mv$

Conservation of Momentum

$m_1v_{1,i} + m_2v_{2,i} = m_1v_{1,f} + m_2v_{2,f}$

Perfect Inelastic Collision

$m_1v_{1,i} + m_2v_{2,i} = (m_1 + m_2)v_f$

Conservation of Kinetic Energy in Elastic Collision

$½\ m_1v_{1,i}^2 + ½m_2v_{2,i}^2 = ½\ m_1v_{1,f}^2 + ½m_2v_{2,f}^2$

Chapter 7: Circular Motion and Gravitation

Centripetal Acceleration

$a_c = v_t^2 / r$

Centripetal Force

$F_c = (mv_t^2) / r$

Newton's Law of Universal Gravitation

$F_g = G\ (m_1m_2 / r^2)$

Period of an Object in Circular Orbit

$T = 2\pi\ (r^3 / Gm)^{½}$

Speed of an Object in Circular Orbit

$v_t = (Gm / r)^{½}$

Torque

$T = Fd \sin \theta$

Torque Net

$T_{net} = \sum T = T_1 + T_2 = F_1d_1 + (-F_2d_2)$

Mechanical Advantage

$MA = F_{out} / F_{in}$

$= d_{in} / d_{out}$

Conservation of Torque

$T_{in} = T_{out}$

$F_{in}\,d_{in} = F_{out}\,d_{out}$

Efficiency

W_{out} / W_{in}