Visit https://rb.gy/mugq69 for a video explanation of these formulas.

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2024 Physics 1 Derived Equations (25) Formula Sheet

Equations	Notes
Rotational Motion	
$I = xmr^2$	Rotational Inertia where x is the coefficient. For a point mass/wheel/thin ring ($x = 1$), sphere ($x = \frac{2}{5}$), disk/cylinder ($x = \frac{1}{2}$), rod from center ($x = \frac{1}{3}$), and rod from end ($x = \frac{1}{12}$)
Kinematics	
$t = \sqrt{\frac{2\Delta y}{g}}$	Time taken for a projectile to hit the ground assuming 0 vertical velocity
$t = \frac{2v_o sin(\theta)}{g}$	Time in air assuming 0 vertical displacement
$R = v_{0x}t = \frac{2{v_0}^2 cos(\theta)sin(\theta)}{g}$	Range of a projectile assuming 0 vertical displacement.
$H = \frac{(v_0 \sin(\theta))^2}{2g}$	Maximum height of a projectile
Dynamics	
$a = gsin(\theta)$	Acceleration on a frictionless incline
$N = mg$	Normal force on a flat non-accelerating object

Equations	Notes
$N = ma \pm mg$	Normal force (aka apparent weight) acting on a object
$N = mgcos(\theta)$	Normal force on an incline
$f = \mu mgcos(\theta)$	Friction force on an incline
$a = \dfrac{m_1 g - m_2 g}{m_1 + m_2}$	Acceleration of a massless pulley. Net force divided by total mass. $m_1 > m_2$
$a = \dfrac{m_1 g - m_2 g}{m_1 + m_2 + x m_p}$	Acceleration of a pulley with mass where $m_1 > m_2$ and x is the coefficient of moment of inertia
Dynamics (Circular Motion)	
$v = \sqrt{gr}$	Minimum velocity for object to move in a vertical circle
$v = \sqrt{\mu gr}$	Maximum velocity of an object moving in a horizontal circle due to friction
$N = ma_c \pm mg$	Apparent weight of object moving in a vertical circle: at top (use $-$), at bottom (use $+$)
$v = \sqrt{\dfrac{Gm_p}{d}}$	Orbital velocity of any object around a planet (p), where d is distance from masses' centers
$T = 2\pi\sqrt{\dfrac{d^3}{Gm_p}}$	Orbital period of any object around a planet (p), where d is distance from masses' centers

Equations	Notes
Momentum	
$L = mrv$	Angular momentum using linear speed
$I = 2mv$	Impulse of an object that rebounds at an identical speed.
Energy	
$P = Fv$	Power given net force and velocity.
$v_f = \sqrt{2gh}$	Velocity after sliding or being dropped from rest
$v_f = \sqrt{\frac{2gh}{1+x}}$	Final linear velocity of object rolling down a ramp, where x is the coefficient of rotational inertia.
$v_{esc} = \sqrt{\frac{2GM_p}{r_p}}$	Escape velocity of an object, from a planet (p)
Simple Harmonic Motion	
$PE = KE = mg(L - Lcos(\theta))$	Total mechanical energy of a pendulum given just the length and angle of the string.
$v_{max} = \sqrt{2g(L - Lcos(\theta))}$	Maximum velocity of a pendulum given just the length and angle of the string.