include all units and directions

Kinematics:

$\Delta\vec{d} = \vec{v}_{av}\Delta t$

$\Delta\vec{v} = \vec{a}_{av}\Delta t$

$\vec{v}_{av} = \frac{\vec{v}_1 + \vec{v}_2}{2}$

$\vec{v}_2 = \vec{v}_1 + \vec{a}\Delta t$

$\Delta\vec{d} = \left(\frac{\vec{v}_1 + \vec{v}_2}{2}\right)\Delta t$

$\Delta\vec{d} = \vec{v}_1\Delta t + \frac{1}{2}\vec{a}(\Delta t)^2$

$\vec{v}_2^2 = \vec{v}_1^2 + 2a\Delta d$

Circular Forces:

$a_c = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2} = 4\pi^2 rf^2$

$\sum F = \frac{mv^2}{r} = \frac{4\pi^2 mr}{T^2} = 4\pi^2 mrf^2$

$InLoop: v = \sqrt{3gr} ....v_{old} = 1.4v_{new}$

Banked Curve:

$F_a = F_g \tan\theta$

$g\tan\theta = a$

$v = \pm\sqrt{g\tan\theta r}$

$\theta = angle.of.bank$

Friction:

$\mu_s = \frac{F_s}{F_N}$ y

$\mu_k = \frac{F_k}{F_N}$

Projectile Motion

$Ground.Level: \Delta y = \Delta t(v_y - 4.9\Delta t)$

$Other: 0 = -4.9t^2 + v_y t - \Delta y$

Acceleration

$F_{app} - F_f = ma$

Forces:

$\vec{F}_g = mg$

$\vec{F}_{net} = ma$

$F_g = \frac{Gm_1 m_2}{r^2} = \frac{m_S v^2}{r}$

$G = 6.67\times 10^{-11}$

$UniformMotion: F_f = F_{app}$

$F_x = \cos\theta F_{app}$

$F_y = \sin\theta F_{app}$

Curve:

$F_{app} = F_f = mg\mu_k$

$v = \sqrt{\frac{F_{app}\times r}{m}}$

Coefficient of Friction:

$Static:$

$F_{app} = F_f$

$Kinetic:$

$F_{app} - F_{net} = F_f$

Tension:

$T_{1y} = T_1\cos\theta$

$T_{2y} = T_2\cos\theta$

$F_g = T_{1y} + T_{2y}$

Inclined Plane:

$Down:$

$F_{app} = F_g\sin\theta$

$F_{net} = F_{app} - F_f$

$Up:$

$F_f = mg\cos\theta\times\mu$

include all units and directions

Work:

$W = F\Delta d$

$W = F(\cos\theta)\Delta d$

$W_{with,\, friction} = F_{net}\Delta d$

$W_{total} = \Delta E_k$

Energy:

$\Delta E_g = mgh$

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

$W = \Delta E_k = \frac{1}{2}m(v_f^2 - v_i^2)$

$E_{th} = F_k\Delta d$

Conservation of Energy:

$mgh + \frac{1}{2}mv^2 = mgh' + \frac{1}{2}mv^{2}{}'$

Elastic Potential Energy:

$F = -kx(stretched)$

$F = kx(compressed)$

$E_e = \frac{1}{2}kx^2$

Frictionless Simple Harmonic Motion:

$a_c = \frac{4\pi^2 r}{T^2}$

$T = 2\pi\sqrt{\frac{m}{k}}$

$f = \frac{1}{T}$

$A = \frac{-k}{mx}$

Momentum:

$\vec{p} = m\vec{v}$

$\Delta\vec{p} = m(\vec{v}_2 - \vec{v}_1)$

$\Delta\vec{p} = \sum\vec{F}\Delta t$

$\vec{p}_{total} = m_1\vec{v}_1 + m_2\vec{v}_2$

$m_1\Delta\vec{v}_1 = -m_2\Delta\vec{v}_2$

$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$

$\frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 = \frac{1}{2}m_1v_2^2{}' + \frac{1}{2}m_2v_2^2{}'$

$elastic.hitting.stationary: v_1' = \left(\frac{m_1 - m_2}{m_1 + m_2}\right)v_1$

$F\Delta t = m\Delta v$

$e = \frac{v_2' - v_1'}{v_1 - v_2}$

Kepler's Law

$v = \sqrt{\frac{GM}{r}}$

$C = \frac{r^3}{T^2} = \frac{GM}{4\pi^2}$

$E_T = E_K + E_g = -\frac{GM_E m}{r_E}$

$\Delta E_g = \left(-\frac{GMm}{r_2}\right) - \left(-\frac{GMm}{r_1}\right)$

$v = \sqrt{\frac{2GM_E}{r_E}} = \sqrt{\frac{2E_K}{m}}$