Physics 120 / 120 H
General College Physics I
Fall 2011

Final Exam
Formula Sheet

Linear Motion (Constant a):

$s_{ave} = d / \Delta t$
$v_{ave} = \Delta x / \Delta t = (v_i + v_f) / 2$
$a_{ave} = \Delta v / \Delta t$
$v_f^2 - v_i^2 = 2\, a\, \Delta x$
$\Delta x = v_{ave}\, t = \frac{1}{2} (v_i + v_f)\, t$
$\Delta x = v_i\, t + \frac{1}{2}\, a\, t^2$

Rotational Motion (Constant α):

$\omega_{ave} = \Delta\theta / \Delta t = (\omega_f + \omega_i) / 2$
$\alpha_{ave} = \Delta\omega / \Delta t$
$\omega_f^2 - \omega_i^2 = 2\, \alpha\, \Delta\theta$
$\Delta\theta = \omega_{ave}\, t = \frac{1}{2} (\omega_f + \omega_i)\, t$
$\Delta\theta = \omega_i\, t + \frac{1}{2}\, \alpha\, t^2$

Uniform Circular Motion:

$a_c = v^2 / R$
$F_c = (m\, v^2) / R$

Momentum and Impulse:

$\mathbf{p} = m\mathbf{v}$
$\Delta\mathbf{p} = \mathbf{F}_{ave}\, t$

Force and Torque:

$\mathbf{F}_{net} = m\mathbf{a}$
$f_k = \mu_k\, N$
$f_s \leq \mu_s\, N$
$\mathbf{F}_{spring} = -\, k\, (\Delta x)$
$\tau = F_{tan}\, r = Fr \sin\theta = I\, \alpha$

Work, Energy and Power:

$K = \frac{1}{2}\, mv^2$
$U_g = mgh$
$U_{spring} = \frac{1}{2}\, k\, (\Delta x)^2$
$W_{net} = \Delta K = \mathbf{F}_{parallel}\, \mathbf{d} = Fd \cos\theta$
$W_{non\text{-}conservative} = \Delta(K + U) = -\, \Delta U_{internal}$
$\Delta(K + U + U_{internal}) = 0$
$P = W / t$

Quadratic Formula:

$$x = \frac{-\, b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

Center of Mass:

$\mathbf{r}_{CoM} = (\sum m_i\, \mathbf{r}_i) / (\sum m_i)$
$\mathbf{v}_{CoM} = (\sum m_i\, \mathbf{v}_i) / (\sum m_i)$

Angular Momentum:

$L = I\, \omega$
$I_{particle} = m\, r^2_{\perp}$
$\tau = \Delta L / \Delta t$

Projectile Motion:

$R_{level} = [v_0^2 \sin(2\, \theta)] / g$
$x = x_0 + v_{0,x}\, t$
$y = y_0 + v_{0,y}\, t - \frac{1}{2}\, g\, t^2$

Linear & Rotational Variables:

$s = R\Delta\theta$

$v = R\omega$

$a_{tan} = R\alpha$

Waves:

$v = \lambda f$

$f = 1 / T$

$v_{wave\ on\ string} = \sqrt{(F / \mu)}$

Sound:

$v_{sound\ in\ air} = 343$ m/s

$I = E / (At) = P / A$

$\beta = (10\ dB) \log (I / I_0)$

$I_0 = 10^{-12}$ W/m^2

$$f' = \frac{\left(1 \pm \frac{v_o}{v_w}\right)}{\left(1 \mp \frac{v_s}{v_w}\right)} f$$

Simple Harmonic Motion:

$T = 2\pi \sqrt{(m/k)}$ (mass on a spring)

$T = 2\pi \sqrt{(L/g)}$ (simple pendulum)

$f = 1 / T$

Fluids:

$P = F / A$

$\rho = m / V$

$P = P_{atm} + \rho g d$

$P_{atm} = 1.013 \times 10^5$ Pa

$F_B = \rho_{fluid}\ V_{displaced}\ g$

$A_1 v_1 = A_2 v_2$

$P + \frac{1}{2}\rho v^2 + \rho g h = (constant)$

Thermodynamics:

$\Delta L = \alpha\ L_0\ \Delta T$

$\Delta V = \beta\ V_0\ \Delta T$

$Q = C\ \Delta T = mc\Delta T$

$Q = m\ L$

$\Delta U = Q - W$

Ideal Gas Law:

$PV = NkT = nRT$

$k = 1.38 \times 10^{-23}$ J/K

$R = 8.31$ J / (mol·K)

Temperature Conversions:

$T_F = (9/5)\ T_C + 32$

$T_C = (5/9)\ [T_F - 32]$

$T_K = T_C + 273.15$