Physics 2305 6 May, 2000
Equation Sheet for Exam 4

Quadratic formula: $x(y=0) = (-b/2a) \pm (b^2-4ac)^{1/2}/(2a)$
Dot product: $\mathbf{a}\bullet\mathbf{b} = ab\cos\theta = a_x b_x + a_y b_y + a_z b_z$
Cross product: $\mathbf{a} \times \mathbf{b} = ab\sin\theta$

$v = at + v_o$ $\quad$ $\omega = \alpha t + \omega_o$ $\quad$ $v = \omega r$
$x = (½)\, at^2 + v_o t + x_o$ $\quad$ $\theta = (½)\,\alpha t^2 + \omega_o t + \theta_o$ $\quad$ $s = \theta r$
$v^2 = v_o^2 + 2a(x-x_o)$ $\quad$ $\omega^2 = \omega_o^2 + 2\alpha(\theta-\theta_o)$ $\quad$ $a_t = \alpha r$
$a_r = v^2/r = \omega^2 r$

$R = (v_o^2/g)\sin 2\theta_o$

$\mathbf{F_g} = -m\mathbf{g}$ $\quad$ $W = \int \mathbf{F}(r)\bullet d\mathbf{r}$ $\quad$ $U = mgy$
$\mathbf{F_s} = -k\mathbf{d}$ $\quad$ $W = -\Delta U$ $\quad$ $U = (½)\, kx^2$
$f = \mu N$ $\quad$ $P = dW/dt$

$K = (½)\, mv^2$ $\quad$ $K = (½)\, I\omega^2$ $\quad$ $I = \Sigma\, m_i r_i^2$ $\quad$ $I = I_{cm} + Mh^2$
$\Sigma F = ma$ $\quad$ $\Sigma \tau = I\alpha$ $\quad$ $\tau = \mathbf{r} \times \mathbf{F}$ $\quad$ $\mathbf{l} = \mathbf{r} \times \mathbf{p}$
$\Sigma \mathbf{F} = d\mathbf{p}/dt$ $\quad$ $\Sigma \tau = d\mathbf{l}/dt$
$W = \int \mathbf{F}\bullet d\mathbf{x}$ $\quad$ $W = \int \tau\, d\theta$
$P = \mathbf{F}\bullet\mathbf{v}$ $\quad$ $P = \tau\bullet\omega$
$\mathbf{p} = m\mathbf{v}$ $\quad$ $L = I\omega$

$\mathbf{r}_{cm} = \Sigma\, m_i \mathbf{r}_i \;/\; \Sigma\, m_i$ $\quad$ $\mathbf{v}_{cm} = \Sigma\, m_i \mathbf{v}_i \;/\; \Sigma\, m_i$

$v_{1f} = v_{1i}\,(m_1 - m_2)/(m_1 + m_2) + v_{2i}\, 2m_2/(m_1 + m_2)$
$v_{2f} = v_{1i}\, 2m_1/(m_1 + m_2) + v_{2i}\,(m_2 - m_1)/(m_1 + m_2)$

$T = 2\pi/\omega = 1/f$ $\quad$ $T = 2\pi\,(m/k)^{1/2}$ $\quad$ $T = 2\pi\,(I/\kappa)^{1/2}$
$T = 2\pi\,(L/g)^{1/2}$ $\quad$ $T = 2\pi\,(I/mgh)^{1/2}$

$F_g = G\, m_1 m_2/r^2$ $\quad$ $p = F/A$
$U = -G\, m_1 m_2/r$ $\quad$ $p_2 = p_1 + \rho\, g\, \Delta y$
$v_e = (2GM/R)^{1/2}$ $\quad$ $F_b = \rho_d\, V_d\, g$
$T^2 = (4\pi^2/GM)\, a^3$ $\quad$ $R = \Delta V/\Delta t = Av = \text{constant}$
$p + (½)\rho v^2 + \rho g y = \text{constant}$

$T_F = (9/5)\, T_C + 32°$ $\quad$ $\Delta L = L\,\alpha\,\Delta T$ $\quad$ $H = Q/t = (A/\Sigma R)\,\Delta T$
$Q = m\,c\,\Delta T = n\,c\,\Delta T$ $\quad$ $\Delta V = V\,\beta\,\Delta T$ $\quad$ $R = L/k$
$Q = L\; m$ $\quad$ $\beta = 3\,\alpha$ $\quad$ $P = A\varepsilon\sigma T^4$

$\Delta E_{int} = Q - W$ $\quad$ $\Delta E_{int} = nC_v\Delta T$ $\quad$ $W = \int p\; dV$
$pV = nRT = NkT$ $\quad$ $C_v = (f/2)\, R$ $\quad$ $C_p = C_v + R$

Yes! There's more!

$v_{rms} = (3RT/M)^{1/2} = (3kT/m)^{1/2}$ $\langle K \rangle = (3/2)\, kT$

$pV^{\gamma} = \text{const.}$ $TV^{\gamma-1} = \text{const.}$ $\gamma = C_p/C_v$

$\Delta S = \int dQ/T$ $S = k \ln \Omega$

$\varepsilon = 1 - T_c/T_h$ $K = T_c\,/\,(T_h - T_c)$

Constants:

$g = 9.80$ m/s^2
$G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}
$c = 2.998 \times 10^{8}$ m/s
$\sigma = 5.67 \times 10^{-8}$ W K^{-4}
$R = 8.31$ J mol^{-1} K^{-1}
$k = 1.38 \times 10^{-23}$ J/K
$N_A = 6.02 \times 10^{23}$ particles/mole

1 year = 3.156×10^{7} s = 365.25 d
1 AU = 1.496×10^{11} m
1 $M_{\odot}$ = 1.99×10^{30} kg
1 u = 1.66×10^{-27} kg
1 atm = 101 kPa
32°F = 0°C = 273 K

Densities:

fresh water	1000 kg/m^3
sea water	1025 kg/m^3
air (1 atm, T=293 K)	1.21 kg/m^3
helium	0.179 kg/m^3

Properties of water (1 atm):

melting point	0°C or 273 K
boiling point	100°C or 373 K
specific heat of ice	2.22 kJ kg^{-1} K^{-1}
specfic heat of water	4.186 kJ kg^{-1} K^{-1}
heat of fusion (L_F)	333 kJ/kg
heat of vaporization (L_V)	2256 kJ/kg