PHYS 172 Exam 3 Equation list

$\vec{v}_{avg} = \frac{\Delta\vec{r}}{\Delta t} \equiv \frac{\vec{r}_f - \vec{r}_i}{t_f - t_i}$ $\quad r_f = r_i + \frac{v_i + v_f}{2}\left(t_f - t_i\right)$ $\quad \vec{p} = \gamma m\vec{v}$ $\quad \gamma = 1\Big/\sqrt{1-\left(v/c\right)^2}$

$d\vec{p}/dt = \vec{F}_{net}$ $\quad \Delta\vec{p} \equiv \vec{p}_f - \vec{p}_i = \vec{F}_{net}\Delta t$ $\quad \Delta\vec{p}_{system} + \Delta\vec{p}_{surrounding} = \vec{0}$

$\frac{d\vec{p}}{dt} = \frac{d\left|\vec{p}\right|}{dt}\hat{p} + \left|\vec{p}\right|\frac{d\hat{p}}{dt}$ $\quad \left(\frac{d\vec{p}}{dt}\right)_{\perp} = p\frac{v}{R} = F_{\perp}$ $\quad \left(\frac{d\vec{p}}{dt}\right)_{\parallel} = \frac{dp}{dt} = F_{\parallel}$

$\vec{F}_{grav\ \text{on 2 by 1}} = -G\frac{m_2 m_1}{\left|\vec{r}_{2-1}\right|^2}\hat{r}_{2-1}$ $\quad \left|\vec{F}_{\text{grav}}\right| \approx mg$ $\quad \vec{F}_{\text{elec on 2 by 1}} = \frac{1}{4\pi\varepsilon_0}\frac{q_2 q_1}{\left|\vec{r}_{2-1}\right|^2}\hat{r}_{2-1}$ $\quad \vec{f}_{\max} \approx -\mu F_N\hat{v}$

$\left|\vec{F}_{spring}\right| = k_S\left|s\right|$ $\quad k_s = Y\,A/L$ $\quad F_T/A = Y\,\Delta L/L$ $\quad k_{\text{interatomic}} = Yd$

$\vec{F}_{air} \approx -\frac{1}{2}C\rho A v^2\hat{v}$ $\quad v_{\text{terminal}} = \sqrt{2mg/\left(C\rho A\right)}$ $\quad v_{esc} = \sqrt{2GM/R}$

$U_{\text{grav}} = -G\frac{m_2 m_1}{\left|\vec{r}\right|}$ $\quad \Delta U_{\text{grav}} \approx \Delta\left(mgy\right)$ $\quad U_{\text{electric}} = \frac{1}{4\pi\varepsilon_0}\frac{Qq}{\left|\vec{r}\right|}$

$U_{\text{spring}} = \frac{1}{2}k_s s^2 + U_0$

$\Delta E_{sys} = W_{surr} + Q$ $\quad dW = \vec{F}\cdot d\vec{r}$ $\quad W \equiv F_{\parallel}\Delta r$ $\quad P = dW/dt = \vec{F}\cdot\vec{v}$

$E = \gamma mc^2$ $\quad K \equiv E - mc^2 \approx mv^2/2 = p^2/(2m)$ $\quad E^2 - \left(pc\right)^2 = \left(mc^2\right)^2$

$E_{system} = Mc^2$ $\quad E_{rest} = mc^2$ $\quad \Delta E_{\text{thermal}} = mC\Delta T$

$x = A\cos\left(\omega t\right)$ $\quad \omega = \sqrt{k_s/m}$ $\quad T = 2\pi/\omega$ $\quad f = 1/T$

$\vec{r}_{cm} = \frac{1}{M}\sum_i m_i\vec{r}_i$

$K_{total} = K_{trans} + K_{rot} + K_{vib}$ $\quad K_{trans} \equiv \frac{1}{2}Mv_{cm}^2$ $\quad \Delta K_{trans} = W_{point\ part.}$

$\vec{L}_A \equiv \vec{r}_A \times \vec{p}$ $\quad \vec{\tau}_A \equiv \vec{r}_A \times \vec{F}$ $\quad \Delta\vec{L}_A = \vec{\tau}_A\,\Delta t$

$\Delta\vec{L}_{system} + \Delta\vec{L}_{surroundings} = \vec{0}$ $\quad \vec{L}_{total} = \vec{L}_{trans} + \vec{L}_{rot}$

$I = \sum_i m_i r_i^2$ $\quad \vec{L}_{rot} = I\vec{\omega}$ $\quad E_{rot} = \frac{1}{2}I\omega^2$

Constants:

$G = 6.7\times10^{-11}$ N×m^{2}kg^{-2}	$1/(4\pi\varepsilon_0) = 9\times10^{9}$ Nm^{2}C^{-2}	
c = 3×10^8 m/s	g = 9.8 N/kg	N_A = 6×10^{23} mol^{-1}
1 eV = 1.6×10^{-19} J	1u = 1.66×10^{-27} kg	e = 1.6×10^{-19} C
h = 6.6×10^{-34} kg·m^2/s	$\hbar \equiv h/(2\pi)$	

Geometry:

π = 3.14

Circle: *circumference* = $2\pi r$, *area* = πr^2

Sphere: *area* = $4\pi r^2$, *volume* = $(4/3)\pi r^3$