FUNDAMENTAL PHYSICAL LAWS AND RELATIONSHIPS

Things you must know:

(1) Definition of an approximation for average velocity (and the position update formula)

(2) Definition of momentum $\gamma = \dfrac{1}{\sqrt{1-\left(|\vec{v}|/c\right)^2}}$

(3) The Momentum Principle (also, the momentum update formula and derivative form)

Specific Results

Projectile Motion: $x_f = x_i + v_{xi}\Delta t$ $\quad y_f = y_i + v_{yi}\Delta t - \frac{1}{2}g(\Delta t)^2$

$v_{xf} = v_{xi}$ $\quad v_{xf} = v_{xi} - g\Delta t$

$\vec{F}_{grav_{2\leftarrow 1}} = -G\dfrac{m_1 m_2}{|\vec{r}_{2\leftarrow 1}|^2}\hat{r}_{2\leftarrow 1}$ $\quad |\vec{F}_{grav}| \approx mg$ near the Earth's surface

$\vec{F}_{elect\ 2\leftarrow 1} = \frac{1}{4\pi\varepsilon_o}\dfrac{q_1 q_2}{|\vec{r}_{2\leftarrow 1}|^2}\hat{r}_{2\leftarrow 1}$ $\quad |\vec{F}_{Buoy}| = mg_{\,fluid.displaced}$

$|\vec{F}_{spring}| = k_s|s|$, opposite the stretch $\quad Y = \dfrac{F/A}{\Delta L/L} = \dfrac{k_{s,atomic}}{d_{atomic}}$ $\quad v = \sqrt{\dfrac{k_{s.atomic}}{m_{atomic}}}d_{atomic}$

$x(t) = A\cos(\omega t) + x_{eq}$ $\quad \omega = \sqrt{\dfrac{k_s}{m}}$ $\quad T = \dfrac{2\pi}{\omega}$

CONSTANTS

$G = 6.7\times10^{-11}$ N·m²/kg² $\quad g$ = 9.8 N/kg $\quad c = 3\times10^8\, m/s$

$M_{Earth} = 6\times10^{24}\, kg$ $\quad M_{moon} = 7\times10^{22}\, kg$

Radius of the Earth = $6.4\times10^6\, m$ $\quad$ Radius of the Moon = 1.75×10^6 m

Distance from Sun to Earth = 1.5×10^{11} m $\quad$ Distance from Earth to Moon = 4×10^8 m

Typical atomic radius $r \approx 10^{-10}\, m$ $\quad$ Avogadro's number = 6×10^{23} molecules/mole

m electron = $9\times10^{-31} kg$ $\quad m_{\text{proton}} \approx m_{\text{neutron}} \approx m_{\text{hydrogen atom}} = 1.7\times10^{-27} kg$