QP

$PV = nRT = NKT$

$E = E_k + \underbrace{V(x)}_{\text{potential (energy)}}$

$E = \gamma mc^2$, $E = \sqrt{p^2c^2 + m^2c^4}$
$p = \gamma mv$

$k = \frac{2\pi}{\lambda}$, $\omega = 2\pi f$

$V_p = \frac{\omega}{k}$, $V_g = \frac{d\omega}{dk}$

Photoelectric Effect: $E = hf - \phi = \frac{1}{2}mV_{max}^2 = e\underbrace{V_0}_{\text{stopping potential}}$

Planck: $E = hf$
De Broglie: $p = \frac{h}{\lambda}$

$\langle x \rangle = \int_{-\infty}^{\infty} x f(x)\,dx$, $\langle x^2 \rangle = \int_{-\infty}^{\infty} x^2 f(x)\,dx$

$(\Delta x)^2 = \langle x^2 \rangle - \langle x \rangle^2$

$|\Psi(x)|^2 dx$
$|A(k)|^2 dk$

Bandwidth Theorem: $\Delta x \Delta k \geq \frac{1}{2}$
$\Delta t \Delta \omega \geq \frac{1}{2}$

Uncertainty Principles:

$$\Delta x \Delta p \geq \hbar/2$$
$$\Delta E \Delta t \geq \hbar/2$$

TISE: $$\frac{-\hbar^2}{2m}\frac{d^2\phi_n}{dx^2} + V(x)\phi_n = E_n\phi_n$$

TDSE: $$\frac{-\hbar^2}{2m}\frac{\partial^2\psi}{\partial x^2} + V(x)\psi = i\hbar\frac{\partial\psi}{\partial t}$$

QM SHM: $$E_n = \left(n+\tfrac{1}{2}\right)\hbar\omega_{cl}$$

$$\omega_{cl} = \sqrt{\frac{s}{m}}$$

Compton Scattering: