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Modern Physics
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Assignment 1

1. Consider a classical sinusoidal traveling wave given by the equation below; where λ is the wavelength and ν is the frequency so that $\nu\lambda = v$ (the speed of its propagation).

$$\Psi(x,t) = \sin 2\pi\left[\frac{x}{\lambda} - \nu t\right]$$

   Please show that

$$\Psi(x,t) = \Psi(x + vt_0, t + t_0),$$

   and briefly explain what this means.

2. If $\Psi_1(x,t)$ and $\Psi_2(x,t)$ are both solutions of the Schrödinger equation, please show that any linear combination $\alpha\Psi_1(x,t) + \beta\Psi_2(x,t)$ is also a solution; where α and β are scalars.

3. Define $e^{i\theta}$ by $e^{i\theta} = \cos\theta + i\sin\theta$ and please prove the following relationships.

   (a) $e^{i\theta}e^{i\phi} = e^{i(\theta+\phi)}$

   (b) $\left(e^{i\theta}\right)^n = e^{in\theta}$