Quantum Physics PHY4215 - Exercise Sheet 4

1. What is the minimum X-ray wavelength produced in bremsstrahlung by electrons that have been accelerated through 2.95×10^4 V. **[5]**

2. A double slit experiment is performed with sodium light $\lambda = 589.0$nm. The slits are separated by 0.95mm, and the screen is 2.45cm from the slits. Find the separation between the adjacent maxima on the screen.

[5]

3. A photon of wavelength 8.52pm scatters from a free electron at rest. After the interaction, the electron is observed to be moving in the direction of the original photon. Find the momentum of the photon.

[6]

4. **Linearity and Superposition :** Consider the equation

$$\frac{\partial^2 Y}{\partial x^2} = \frac{1}{c^2}\frac{\partial^2 Y}{\partial t^2}$$

Show that if $Y^{(1)}(x,t)$ and $Y^{(2)}(x,t)$ are two solutions of the equation, then the sum (or superposition) of the solutions $Y^{(1)}(x,t) + Y^{(2)}(x,t)$ is also a solution.

Now try the same exercise with the equation

$$\left(\frac{\partial Y}{\partial x}\right)^2 = \frac{1}{c^2}\frac{\partial^2 Y}{\partial t^2}$$

Does it work ? **[5+5]**

Moral of the story : Superposition of solutions works for linear equations but not for non-linear equations.