PH107

WP FT and HUP

Utkarsh

Autumn Semester 2020-21

Q1

- (b) $x = \pm\frac{\ln 2}{\alpha}$
- (e) $k = \pm\alpha$

Q4

- $y = 2\frac{A}{x}\sin\left(\frac{kx}{2}\right)\cos\left(k_o x - \omega t\right)$
- $y1 = 2\frac{A}{x}\sin\left(\frac{kx}{2}\right)$ is the envelope and $\cos\left(k_o x - \omega t\right)$ is the oscillatory part.
- $y1$ has central maximum at $x = 0$.
- For first minimum, $\frac{\mathrm{d}y1}{\mathrm{d}x} = 0$ gives $\frac{\Delta kx}{2} = \tan\frac{\Delta kx}{2}$
- $\Delta x \Delta k = 8.986 >= 0.5$

Q7

- When slit width is large compared to wavelength, then spot size = slit width.(Why?)
- Spot radius $= 2\frac{\lambda D}{w}$.
- Minimum spot radius when $w = 2\frac{\lambda D}{w}$

Q8

- (b) $E = \frac{p^2}{2m} + \frac{1}{2}kx^2$
- $\langle E \rangle = \frac{\langle p^2 \rangle}{2m} + \frac{1}{2}k\langle x^2 \rangle$
- $\langle E \rangle = \frac{(\Delta p)^2}{2m} + \frac{1}{2}k(\Delta x)^2$
- $\Delta x = \frac{\hbar}{2\Delta p}$
- $\langle E \rangle = \frac{(\Delta p)^2}{2m} + \frac{1}{2}\frac{k\hbar^2}{(\Delta p)^2}$
- $\langle E \rangle$ is min when $\frac{\mathrm{d}\langle E \rangle}{\mathrm{d}\Delta p} = 0$
- (c) $\langle E \rangle = \frac{\langle p^2 \rangle}{2m} - \frac{Ze^2}{r}$
- $\Delta x = r$

Q10

- (b)$\Delta t = 10^{-8}s$
- Use $\Delta E \Delta t = \frac{\hbar}{2}$
- Spectral width $2\Delta E = 6.6 \times 10^{-8} eV$
- (c) Search resonant absorption.

Tut 8 Wave function and Operators

Q5

- $\hat{G}\phi(x) = ih\frac{\mathrm{d}\phi(x)}{\mathrm{d}x} + Ax\phi(x) = \lambda\phi(x)$ (Let!)
- solve the above differential equation to get the required eigenfunction.

Q6

- $x = 2ato2a + dx \implies \phi(x) = \phi(2a) = Aexp(-(2a)^2/a^2) = \frac{100}{N}$
- $x = atoa + dx \implies \phi(x) = \phi(a) = Aexp(-(a)^2/a^2) = \frac{100e^3}{N}$ (Why?)

Q7

- Ans.: $\frac{(0.25)^2}{(0.25)^2+(0.75)^2}$