

PHYS2581 Foundations2A: Q1

The energy eigenfunctions of a particle in an infinite square well from $0 \leq x \leq L$ are $\psi_n(x) = \sqrt{\frac{2}{L}} \sin(n\pi x/L)$. A particle in the well has an initial wave function which is NOT itself an energy eigenfunction,

$$\Psi(x, t = 0) = A \sin^3(\pi x/L)$$

.

These questions also give you practice in just looking up standard integrals using the online wolfram alpha site

<http://www.wolframalpha.com/>

i) Normalise $\Psi(x, 0)$ using wolfram alpha i.e. input

integrate $\sin^6[\pi x/L]$ between 0 and L

into the box at the wolfram alpha site and hit return (you should get the answer $5L/16$ for the definite integral) [1 mark]

ii) Calculate $\langle x \rangle$ using the wolfram alpha site [2 marks]

iii) Calculate $\langle p \rangle$ using the wolfram alpha site [3 marks]

iv) Calculate $\langle p^2 \rangle$ [3 marks]

v) hence calculate kinetic energy $\langle T \rangle = \langle p^2 \rangle / 2m$ [1 mark]