PHYS2581 Foundations 2A: QM2.1

A particle is described by the wave function

$$\Psi(x) = A\exp(-ax^2).$$

i) Normalise $\Psi(x)$, i.e. determine the value of A. [1 mark]

(Whenever useful you are encouraged to make use Wolfram Alpha `http://www.wolframalpha.com/` e.g. input

`integrate exp(-a x^2) between -infty and infty`

into the box at the Wolfram alpha site and hit return – You should get the answer $\sqrt{\pi/a}$ for the definite integral. In an exam a hint at the end of the question would give you required integrals or information to allow you to transform them into a simple integral.)

ii) Calculate the expectation value of x, $\langle x\rangle$. [2 marks]

iii) Calculate the expectation value of p, $\langle p\rangle$. [3 marks]

iv) Calculate the expectation value of p^2, $\langle p^2\rangle$. [3 marks]

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