

# Aims and Objectives Quantum Physics I Session 11

## SUMMARY SO FAR

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### **Aims (What I intend to do)**

- 1) To summarise the module so far, highlighting how what we have covered fits together.
- 2) To indicate ways in which you may consolidate your knowledge thus far.

### **Objectives (What you should be able to do after completing the lecture and worksheet)**

- 1) To be able to summarise the module so far.
- 2) To be able to recall the basic equations and terms, to know what they are, and when to use them.
- 3) To be able to use your knowledge to solve appropriate quantum problems.

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## Quantum Physics 1 PHY2002 Worksheet 11

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- Task 1.** Go over your lecture notes of the summary so far and check which areas you are weakest on.
- Task 2.** Go back over your lecture notes for the weakest areas and try and improve on them.
- Task 3.** Draw up a list of the important equations we have used so far. Make sure you know when to use them, and what all the bits in them are/mean.
- Task 4.** Have a go at the following problem.

The wave functions describing bound states of a particle of mass  $m$  confined to a square potential well with infinitely high sides positioned at  $x = 0$  and  $x = L$ , are given by:

$$\phi_n = A \sin\left(\frac{n\pi x}{L}\right) \quad n = 1, 2, 3, 4, \dots, \text{ for } 0 \leq x \leq L$$

- 1) What is the form of the wave function in the regions  $x < 0$  and  $x > L$ ?
- 2) State the condition satisfied by  $A$ , under which  $\phi_n$  are said to be normalized.
- 3) A suitable normalization constant is in fact  $A = \sqrt{2/L}$ . For the state with  $n = 2$ , calculate the probability that a measurement of the particle's position yields the following results:
  - i) the particle is located between  $x = 0$  and  $x = L$ ;
  - ii) the particle is located between  $x = 0$  and  $x = L/2$ ;
  - iii) the particle is located between  $x = 0$  and  $x = L/10$ .
- 4) In classical mechanics, if the observer is not told the initial position and momentum of a particle placed in the potential well described above, then the outcome of a subsequent position measurement made on the system will also be governed by a probability distribution.
  - i) In terms of its physical meaning, how is this probability distribution distinct from that of the quantum mechanical distribution.
  - ii) Sketch the classical distribution, and the quantum mechanical one for  $n = 2$ , on the same axes.
  - iii) For each of the cases described in (3) state the classical probability, and compare it with the quantum mechanical result.