

ELEC 4705 - Quiz 1

Thurs. Sept. 28th 2017

Name:

Student Number:

1. The Classical and Quantum Pictures

- a) Name the Set of differential equations that describe light classically (1)

Light was described classically by Maxwell's Equations

- b) Name the differential equation that describes quantum mechanical objects (1)

Quantum mechanical objects are described by Schrodinger's wave equation.

- c) What is the basic statement of the physical interpretation of Heisenberg's uncertainty principal? (2)

That you cannot know both position and velocity (or energy and time) to infinite precision, greater precision on one is reduced precision on the other.

- d) What is an example of a behaviour of electrons that was explained by treating them as quantum mechanical objects? (3)

Quantization of energy levels around atoms, and absorption or emission spectra, OR double slit experiment with electrons, OR other.

2. Quantum Details

- a) What is a wave packet and what does it accomplish? (3)

Wave packets are the result of summation (superposition) of infinite numbers of waves to localize and serves to localize quantum mechanical objects

- b) What do group and phase velocity mean? (2)

group velocity is the velocity of the wave envelope itself while phase velocity is the velocity of any one component wave

3. Wells, and Tunnelling

- a) What is Tunnelling and why is it unique to the quantum mechanical picture of physics? (2)

Tunnelling is a unique property of quantum mechanics that arises from the probabilistic nature of the wavefunction. because barriers only affect the probability of presence, it is possible for a particle to end up on the other side of a barrier without having to gain sufficient energy to go over top of it.

- b) Is tunnelling useful or presenting any limitations for any modern day technologies? If yes, what technologies? If no, why? (4)

Yes, tunnelling is important in modern electronics. It has brought Moores law to an end because the next generation of transistors would be too small to properly regulate the flow of current. But tunnelling also made mosfets possible in the first place. additionally there are things like resonant tunnelling diodes that are based entirely on tunnelling.

- c) Sketch an electron in its lowest energy state in a well with finite height barriers (2)

