

ELEC 4705 - Quiz 1

Fri. Sept. 28th 2018

Name:

Student Number:

1. (4 points) What was a big failing of classical physics? List one thing and describe it.

Any of:

The photo electric effect (ejection of electrons from surface irradiated by light) and its dependence on wavelength of light and independence of intensity below the minimum wavelength could not be adequately explained without introduction of photon (quantization of light) Black body radiation, light intensity curves could not be adequately explained using classical physics (would runaway to infinity - a non-physical behaviour) Heat capacity of solids at low temperatures didn't match up with theory

2. What was the big change for light and particles that quantum physics brought about and what was the classical picture?

(a) (4 points) Light:

Quantization: wave particle duality and the introduction of the photon which meant that waves existed as quantized energy packets and not as just a wave anymore

(b) (2 points) Particles:

Particles were treated not just as hard spheres but instead had a wavelength as well

3. (4 points) What are wave packets, how are they described, and what can they be used to describe?

Wave packets are a summation (superposition) of infinitely many waves to localize the electron in space

4. Figure 1 shows an electron and a finite barrier

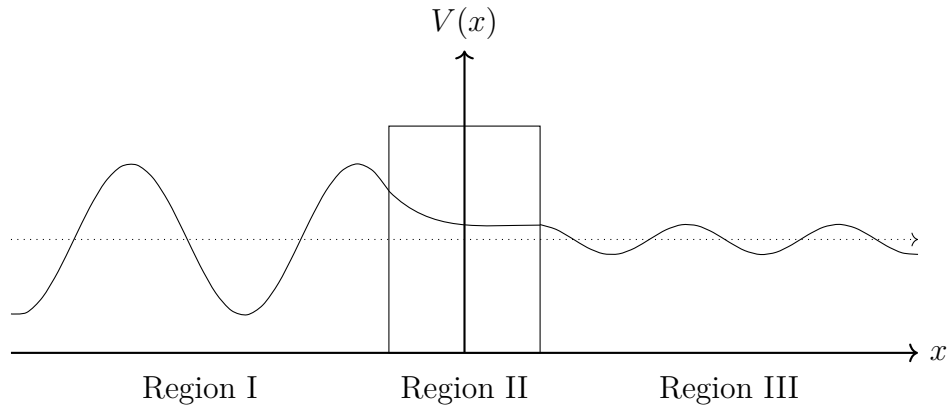


Figure 1: Electron and a Finite Barrier

- (a) (2 points) What behaviour made possible by quantum mechanics is happening in region II?

Tunnelling is behaviour that makes this possible

- (b) (4 points) Why is there a difference in the amplitude in regions I and III?

The difference in amplitude is the difference in probability of appearing in that region

(c) (5 points) If the barrier were wider, what would you expect to change in region III?

If the barrier were wider you would expect the amplitude of probability to be much lower.

(d) (5 points) How would the drawing be expanded if it were to represent a periodic semiconductor lattice?

If the drawing were expanded to be a periodic lattice you would expect the barrier to be repeated periodically