

# Frontiers in Physics: Sample Exam Question

## Quantum Mechanics is true/Unbreakable Codes

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- 1) Light arrives at the observer in packets of energy called photons. How many photons does a 1mW intensity HeNe laser (632nm) emit per second? [2]
- 2) Light may be linearly or circularly polarised. In terms of the electric field, draw two simple diagrams to explain what this means. [1]
- 3) Give an example of an optical component which can separate a light beam into two orthogonal polarisation states. [2]
- 4) In principle how might such a device be used to receive binary information encoded onto a light beam [2]
- 5) If a polariser is aligned at 45 degrees to the vertical what is the percentage probability that a photon will be transmitted if it is; a) horizontally polarised, b) vertically polarised [1]
- 6) What happens to the accuracy of the information if the sender transmits photons with horizontal and vertical polarisation but the receiver measures these photons with a polariser aligned at 45degrees? [1]
- 7) What happens to a photon when it is received by the detector, i.e. is it a) reflected, or b) absorbed? [1]
- 8) In secure quantum communication, both the sender and receiver randomly chose the orientation of their polarising components and use single photons to carry the information. Briefly explain how this means that anyone trying to eavesdrop this message (i.e. an intermediate receiver/transmitter) will corrupt the flow of information between the sender and intended receiver. [4]