Discuss why neutron beams are used in determining the structure of crystals.

Try HSC 2012: Question 34

Check your answer by reviewing the solution guidelines on the next page.
Solution Guidelines

(The solution is more detailed than required in a H.S.C. answer. The solution is designed to give your greater depth of knowledge in preparation of your H.S.C. Physics examination)

Many solids have a crystal structure where the atoms arrange themselves in a regular pattern known as a crystal lattice.

A neutron beam can be used to locate the position of atoms in a crystal.

It is important in the understanding of the behaviour and properties of materials and for the creation of new materials with special properties that the location of the atoms are known in molecules and crystals.

Beams of very high energy particles such as neutrons can be used as probes to investigate the structure of matter and to identify the location of atoms.

To determine the location of atoms in a crystal, the wavelength of the particle beam must of similar magnitude of the atomic spacing within the crystal. Hence, the higher the energy (higher velocity and momentum $p = mv$) of a particle, the smaller the deBroglie wavelength $\lambda = h/p$. The smaller the deBroglie wavelength, the smaller the detail that can be investigated (the better the resolving power of a beam of such particles).