2001 HIGHER SCHOOL CERTIFICATE EXAMINATION

Physics

Centre Number

Student Number

Section I – Part B (continued)

Marks

Question 24 (6 marks)

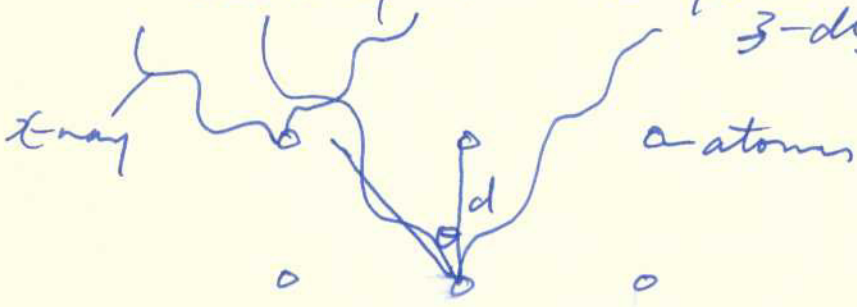
Sir William Bragg and his son Sir Lawrence Bragg shared the Nobel prize for physics in 1915 for their work on X-ray diffraction and crystal structure analysis.

(a) Describe ONE way in which an understanding of crystal structure has impacted on science. **2**

The crystal structure was found to be a lattice form and scientists have discovered the different formations for conductors, semi conductors and insulators which has help to assist in many scientific advancements.

(b) Outline the methods of X-ray diffraction used by the Braggs to determine the structure of crystals. **4**

X-rays were exposed on to the surface of crystals. Scientists used the x-ray's wave nature of diffraction to determine the distance between the atoms in the lattice, the formation of the lattice. by detecting the deflected ex-ray. This process was repeated for all sides of the crystal to gain a 3-dimensional view of its lattice structure.



Marks

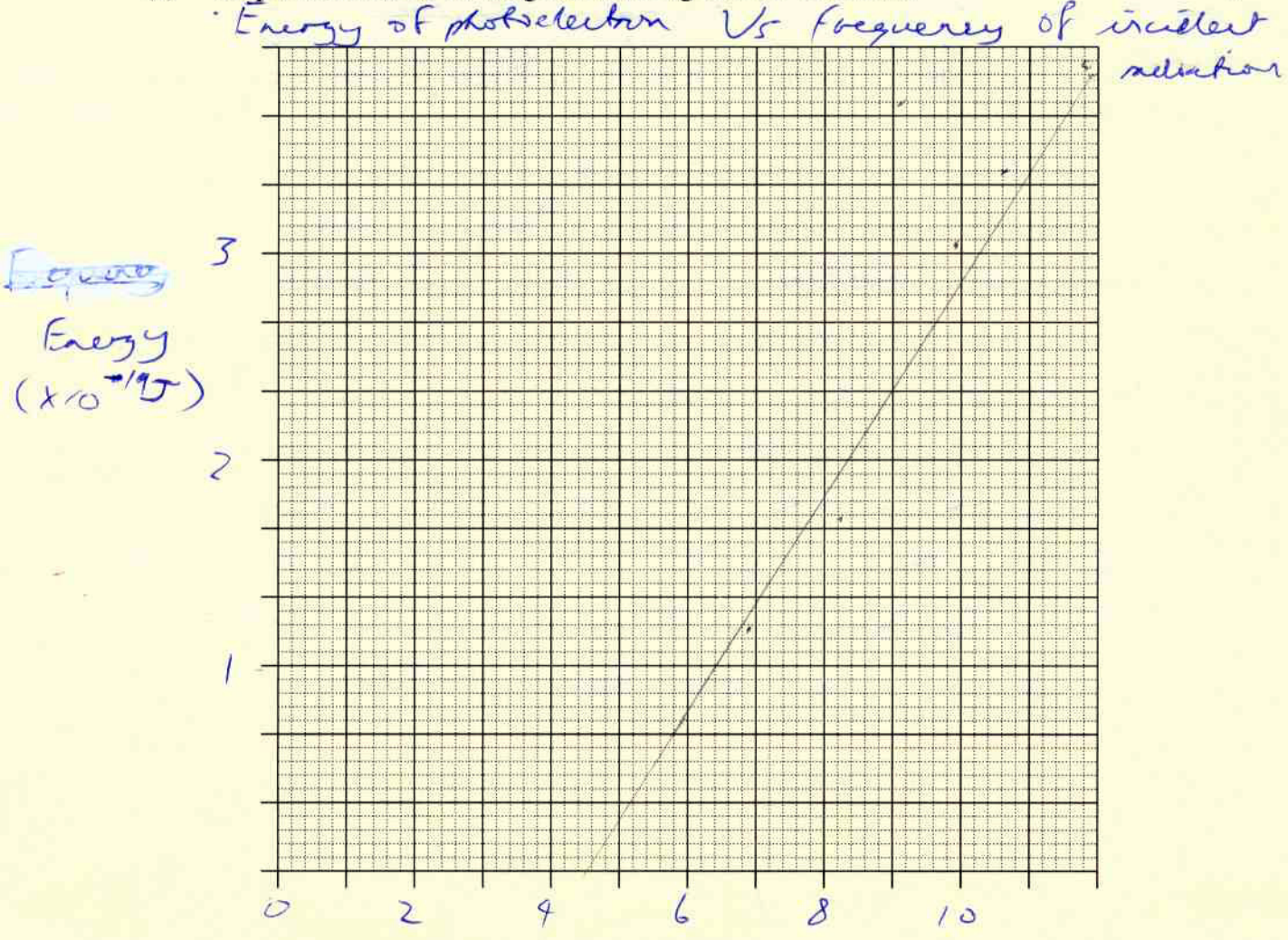
Question 25 (6 marks)

A student carried out an experiment on the photoelectric effect. The frequency of the incident radiation and the energy of the photoelectrons were both determined from measurements taken during the experiment.

The results obtained are shown in the table:

Frequency of incident radiation ($\times 10^{14}$ Hz)	*Energy of photoelectrons* ($\times 10^{-19}$ J)
6.9	1.22
8.2	1.70
9.1	3.70
9.9	3.05
10.6	3.38
11.8	3.91

(a) Graph these results on the grid, including the line of best fit. **4**



Question 25 continues on page 23

Marks

Question 25 (continued)

(b) How could the reliability of the experiment be improved? **2**

By performing more trials of different frequency.

~~Make sure the distance between the source of radiation and the meter is be~~

Question 26 (8 marks)

In the context of semiconductors, explain the concept of *electrons* and *holes*. **8**

In a semiconductor the valence and conduction band has a small gap. Therefore heat is needed for the electrons to jump to the conduction band. In cool temperatures the electrons are tightly bounded to the atom and no free electrons exist. As the temperature increases, it is able to break the bond of the atom and the electrons exists freely, the hole that is left behind and the electron is an electron hole pair. The conductivity of a semiconductor could be increase or decrease through doping. If it is dope with elements of group III there is more holes, if it is dope with elements from group V there is more electrons. As the electrons exist freely, they can be attracted by the holes. When attracted, the electron has move from one hole to another and it seems the electrons are moving one way and the holes in the other.