2001 HIGHER SCHOOL CERTIFICATE EXAMINATION

Physics

Centre Number

Section I – Part B (continued)

Student Number

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**

Understanding of crystal structure has had an impact on computer science. By altering the structure of a crystal, scientists can use the lattice as a series of on-off switches, like binary code, meaning huge amounts of information may one day be stored in a small crystal

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

As visible light waves had too large a wavelength to penetrate the gaps in the crystal lattice, hence making microscopes ineffective, the Braggs used X-rays to determine the structure of crystals.

~~[illegible] the [illegible]~~

~~the X-rays were directed at the crystal~~

Marks

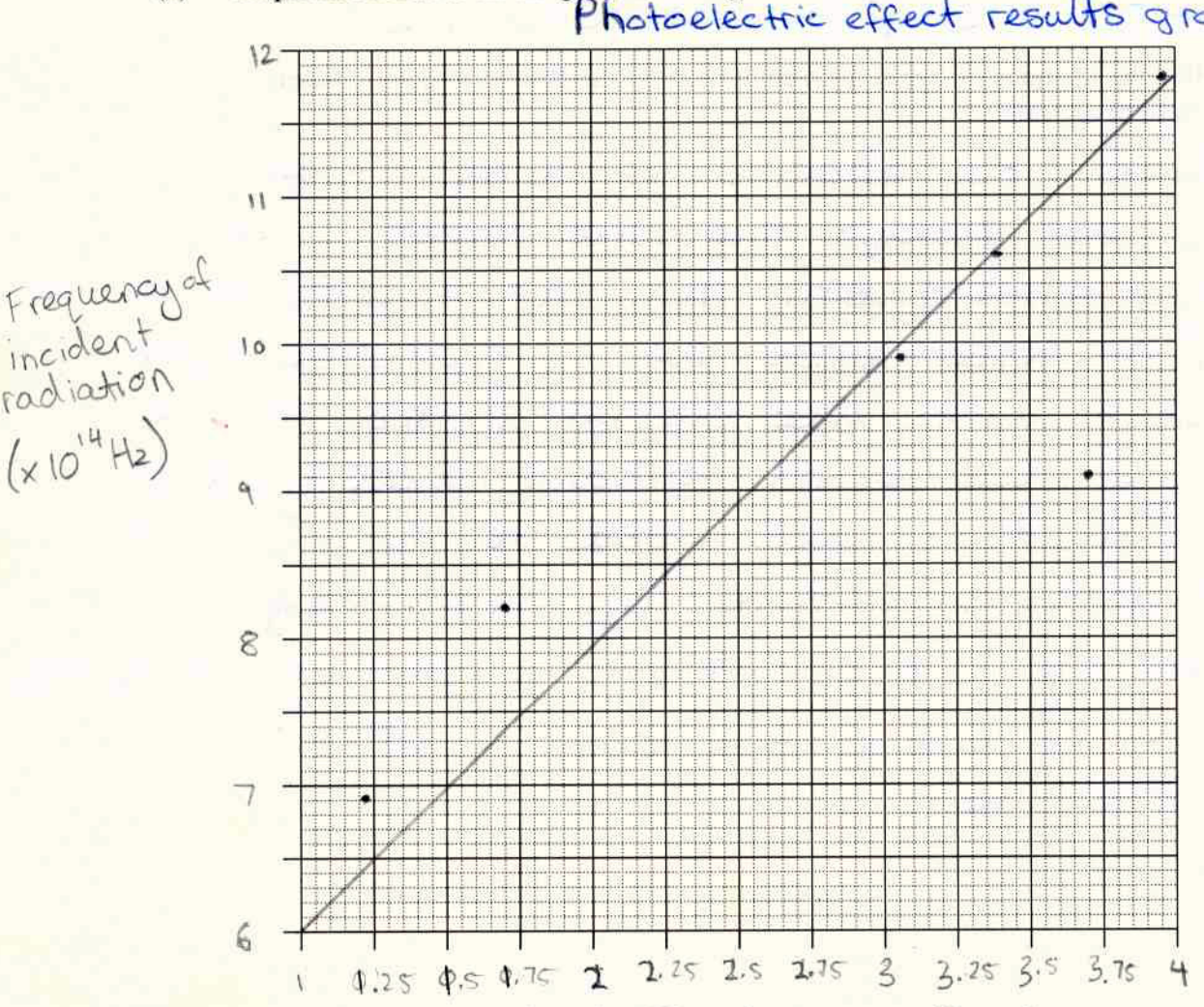
Question 25 (6 marks)

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 repeating the experiment again to see if the results were accurate, 3 time even. Vary the type of metal used to see if frequency of light is correct. Make sure the metal is at the same temperature each time. make sure that the background light does not vary.

Question 26 (8 marks)

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

There are two kinds of semiconductors, p-type and n-type. A p-type semiconductor has "holes" which appear to move as electrons fill the hole, giving apparent movement of positive charge, hence the name "p-type". In terms of this semiconductor, a hole is just a place where an electron "should" be but isn't and when an electron moves to fill the hole, another hole is produced. With an "n-type" semiconductor, there are actually a surplus of electrons. As there are too many, some electrons "push" other electrons out because they have more momentum, and then these electrons move on and "push" the electrons along and so the current moves.