

2001 HIGHER SCHOOL CERTIFICATE EXAMINATION

Physics

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Centre Number

Section I – Part B (continued)

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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

the development of semiconductors due to the crystal lattice that could be doped.

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

they used the small wavelengths of x-rays to reflect off the surface of crystal structures to form emission spectrums. They used these ~~part~~ emission spectrum to work out what the crystal structure looked like and the size and shape.

Question 25 (6 marks)

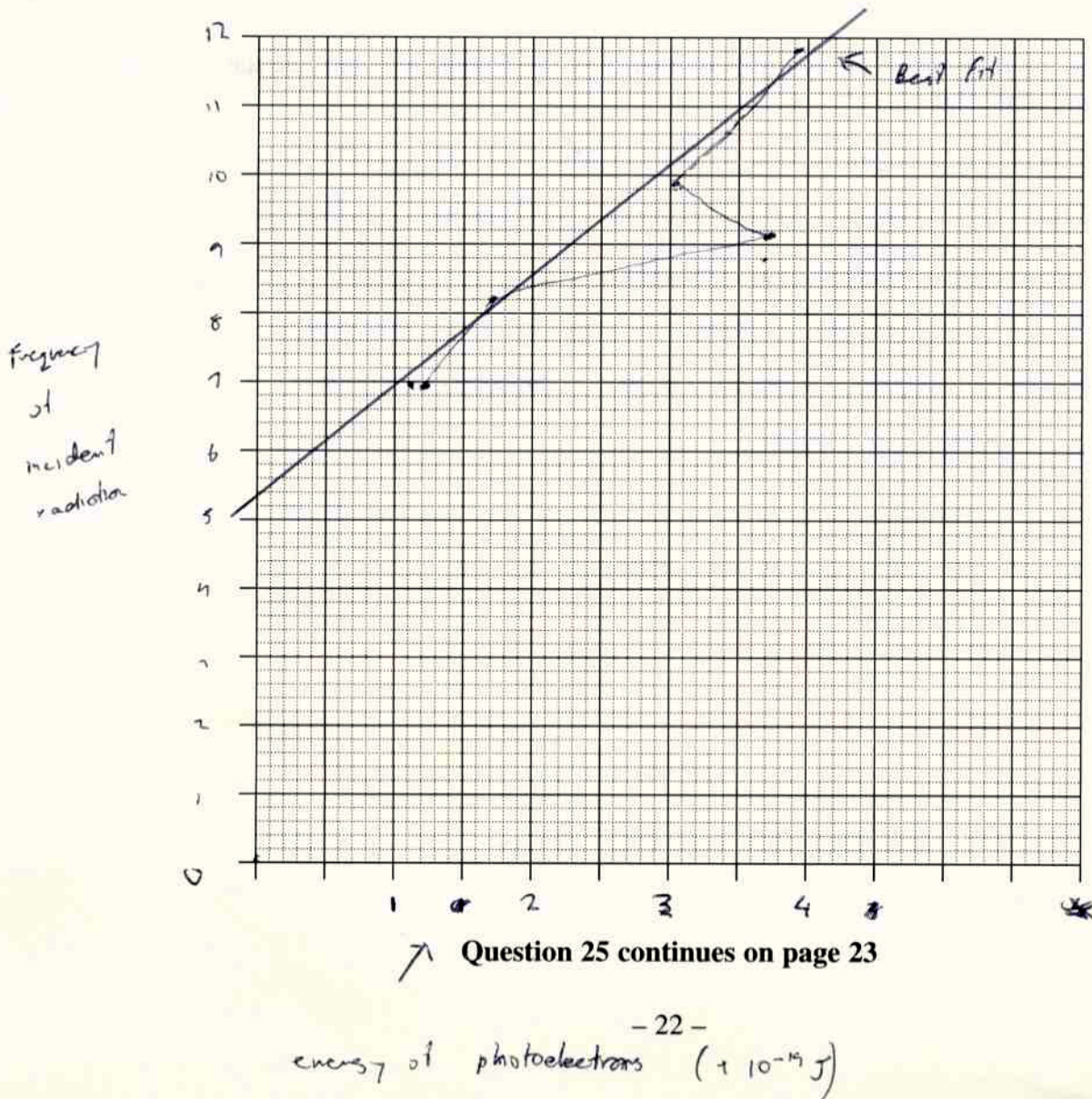
A student carried out an experiment on the photoelectric effect. The frequency of the incident radiation and the energy of the photoelectrons were both determined from measurements taken during the experiment.

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.

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Question 25 (continued)

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

2

- by ~~test~~ taking repeated measurements
- ensuring all conditions are the same for every test run
- repeating any outstanding / incorrect results
- it is hard to comment when I do not ~~understand~~ ^{know} the exact nature of the experiment

Question 26 (8 marks)

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

8

- In a P-type semiconductor it is doped with group III elements and this results in +vely charge [holes] being left in the structure of the semiconductor. These positive holes are then what allows the semiconductor to conduct electricity that it wasn't able to before as these positive holes now allow electrons movement when connected to a electric field.
- In a N-type semiconductor it is doped with group V elements which results in surplus amounts of electrons in the structure of the semiconductor. These extra electrons allow the ~~sem~~ semiconductor conduct electricity as it wasn't able to before as they are easily excited and move to the conduction band where they have plenty of ~~room~~ room to move when a electric field is applied.