

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 understanding of crystal structure has allowed for semi-conductors and the silicon age of miniaturised systems and technology. e.g. Compact Discs (CD). It has allowed for the use of crystal structures for technology.

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

X-ray diffraction works on the principle of the wave characteristics of X-rays. The X-rays have short wavelengths that can be focused on to the crystals, which diffract and create a diffraction patterns that allows the user to determine the structure of the crystals. The principle can not work with light, since the wave lengths is longer.

Question 25 (6 marks)

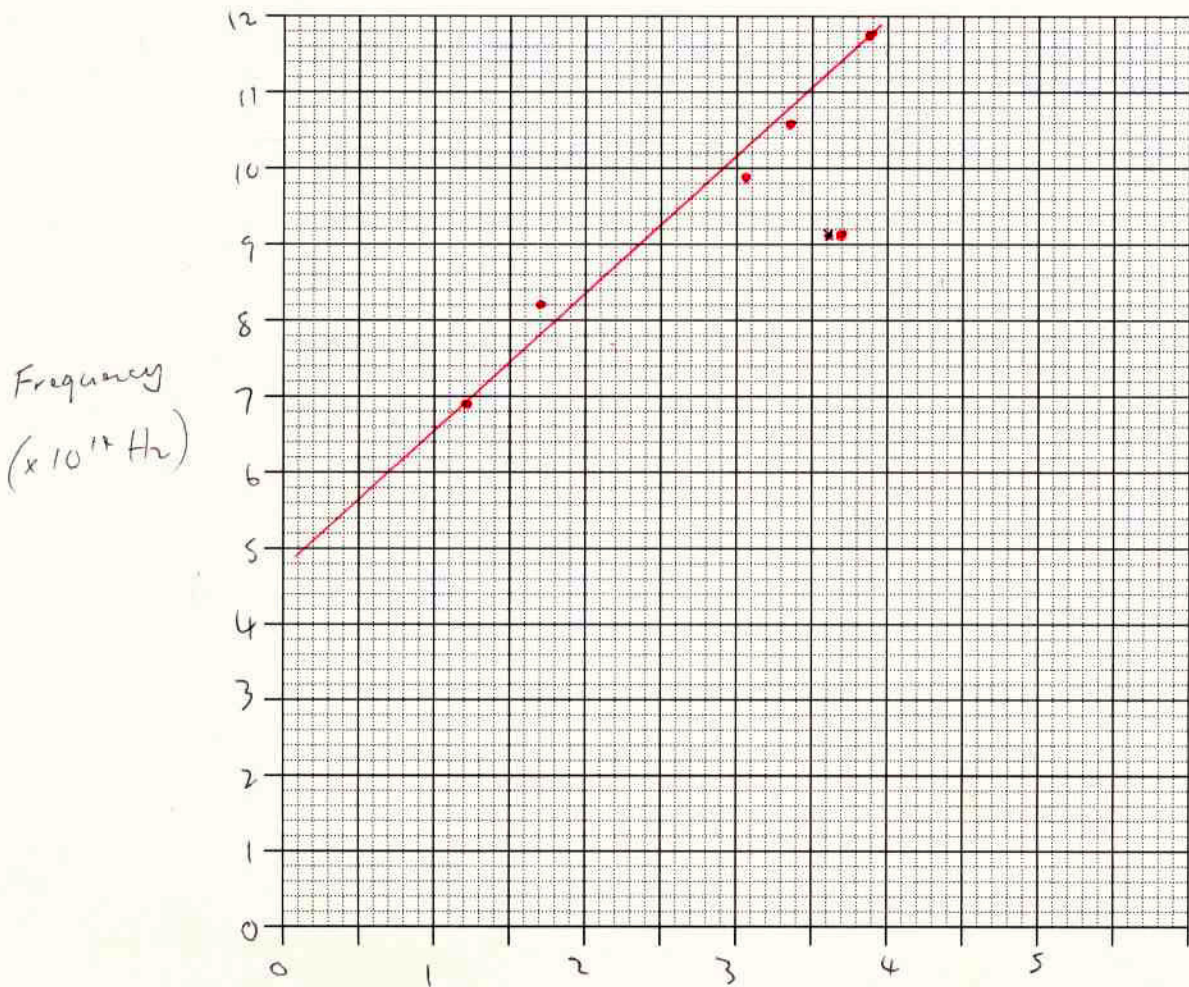
A student carried out an experiment on the photoelectric effect. The frequency of the incident radiation and the energy of the photoelectrons were both determined from measurements taken during the experiment.

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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line of best fit

Question 25 continues on page 23

Energy $\times 10^{-19}$ J

Marks

Question 25 (continued)

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

2

Repeat the process a number of times and average out the results. Disregard any ~~extreme measurements~~ ~~results~~ that are not consistent with other measurements ~~being~~ taken.

Question 26 (8 marks)

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

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There are two types of semiconductor, the p-type and the n-type. The p-type semiconductor is produced by doping group III element with group IV element, producing holes in the crystal. The n-type semiconductor is produced by doping group IV element with group V element, therefore excess of electrons is produced inside the crystal.

When a current is flown through the p-type semiconductor, ^{movement of} positive holes become the ^{majority} charge carrier, as electrons fill in the holes in an opposite direction.

When a current is flown through the n-type semiconductor, movement of excess electrons become the majority charge carrier.

In both cases, conductivity of electricity is greatly increased.