6 **(a)** The wave properties of electrons can be demonstrated using electron diffraction. The arrangement used includes a parallel beam of electrons accelerated by a potential difference in a glass envelope as shown in Fig. 6.1. A graphite film is placed perpendicularly to the path of the electron beam.

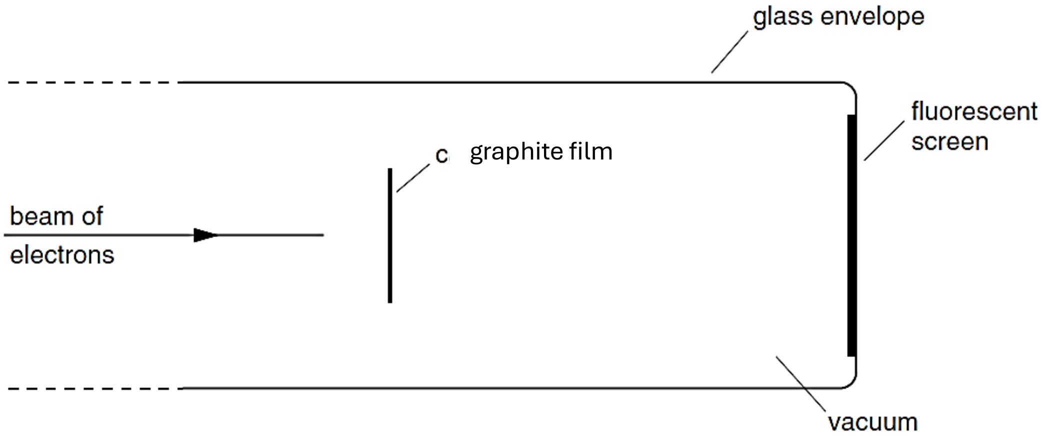

Fig. 6.1

The electrons incident on a fluorescent screen created a pattern consisting of bright and dark rings, as shown in Fig. 6.2.

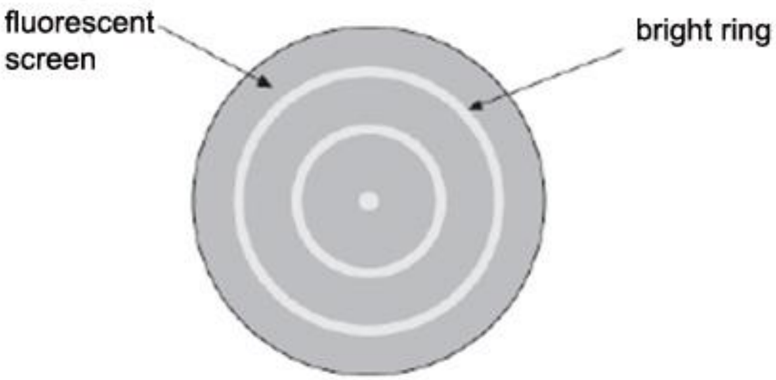

Fig. 6.2

(i) Identify two key features in Fig. 6.2 and explain how they provide evidence for the wave nature of electrons.

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(ii) Electrons of mass *m* are accelerated in a vacuum through a potential difference *V.*

1. Show that the associated wavelength λ of the electrons can be expressed as

$$\lambda = \frac{h}{\sqrt{2meV}}.$$

[2]

2. Hence, calculate the wavelength λ of the electrons, if V = 250 V.

λ =....................................... m [2]

(iii) Describe and explain how the observed pattern in Fig. 6.2 changes as the potential difference V is increased.

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....[2]

(b) The wave properties of matter do not seem to affect us noticeably in everyday life.

When a 80 kg man walks in a straight line at 2.0 m s^{-1} and passes through a doorway of width 1.2 m, he is not obviously deflected from his path.

Show, using Heisenberg's Uncertainty Principle and some appropriate workings, that the deflection of the man is negligible. You may take the width of the doorway as the uncertainty in position of the man.

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[Total: 10]

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millennia institute

2024 Preliminary Examination

Pre-University 3

H2 PHYSICS **9749/03**

Paper 3 Longer Structured Question

Section B Booklet **16 September**

Candidates answer on the Question Paper. **2 hours**

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Do not turn over this page until you are told to do so.

Write your full name, class and Adm number in the spaces at the top of this page.

Write in dark blue or black pen on both sides of the paper.
You may use an HB pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.

The use of an approved scientific calculator is expected, where appropriate.

Section A
Answer **all** questions.

For Examiner's Use
Section B (Circle 1 question)

7		**/ 20**
8		**/ 20**
Presentation		

Section B

Answer **one** question only. **Circle** the question number on the cover page

You are advised to spend one and half hours on Section A and half an hour on Section B.

The number of marks is given in brackets [ ] at the end of each question or part question.

Section B

Answer **ONE** question from this Section in the spaces provided.