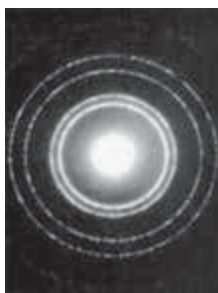


- 5 The image shows a diffraction pattern formed when a beam of electrons passes through thin metal foil.



Which of the following would cause the diameter of the rings to increase?

- A Decreasing the number of electrons in the beam.
- B Decreasing the speed of electrons in the beam.
- C Increasing the number of electrons in the beam.
- D Increasing the speed of electrons in the beam.

(Total for Question 5 = 1 mark)

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12 In 1925 Franck and Hertz were awarded the Nobel Prize in Physics “for their discovery of the laws governing the impact of an electron upon an atom”.
In one of their experiments, a beam of high-speed electrons is fired through mercury vapour.

An electron in the beam collides with a mercury atom, which becomes excited. The atom returns to its initial state by emitting electromagnetic radiation of a single frequency.

(a) Explain why excited atoms only emit certain frequencies of radiation.

(5)

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- (b) An electron travelling with a speed of $2.5 \times 10^6 \text{ ms}^{-1}$ collides with a stationary mercury atom and continues at a speed of $2.1 \times 10^6 \text{ ms}^{-1}$.

The table gives a range of wavelengths for ultraviolet, visible and infrared radiation.

Type of radiation	Typical range of wavelengths / m
ultraviolet	2.0×10^{-7} to 4.0×10^{-7}
visible	4.0×10^{-7} to 7.8×10^{-7}
infrared	7.8×10^{-7} to 1.0×10^{-3}

Deduce the type of radiation that is emitted by the stationary mercury atom.

(4)

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Type of radiation

(Total for Question 12 = 9 marks)

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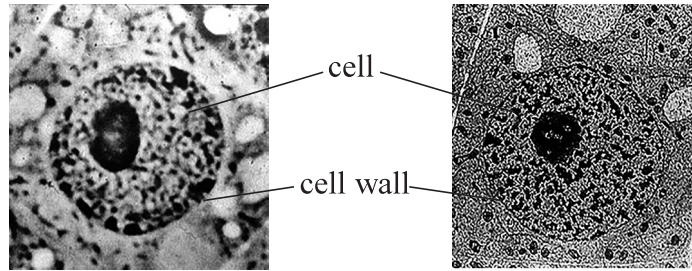
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14 An optical microscope uses a beam of visible light. An electron microscope uses a beam of electrons.

A biologist looked at an animal cell using both microscopes. The two images are shown; both have the same magnification.



using optical microscope

using electron microscope

www.udel.edu

(a) An electron in the beam of the electron microscope has a velocity of 2% of the speed of light.

Calculate the de Broglie wavelength of the electron.

(3)

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de Broglie wavelength =

(b) The image of the animal cell produced by the electron microscope is less blurred than the image produced by the optical microscope.

Explain why.

(2)

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- (c) The biologist measured the diameter of the cell from one of the images. He recorded four measurements. The image had a magnification of $\times 800$.

Diameter of image /cm			
2.4	2.5	1.1	2.2

Determine a value for the diameter of the actual cell.

(2)

Diameter of cell =

(Total for Question 14 = 7 marks)

TOTAL FOR SECTION A = 60 MARKS

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