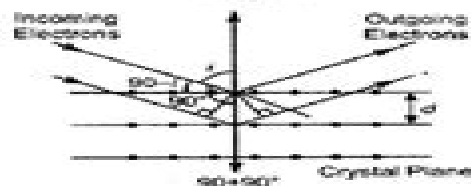


Solved Paper 2008

Physics

Directions : Questions No. 1, 2 and 3 are based on the following paragraph.

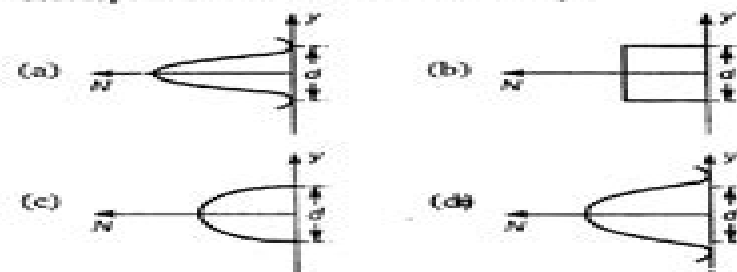
Wave property of electrons implies that they will show diffraction effects. Davisson and Germer demonstrated this by diffracting electrons from crystals. The law governing the diffraction from a crystal is obtained by requiring that electron waves reflected from the planes of atoms in a crystal interfere constructively (see figure).



- Electrons accelerated by potential V are diffracted from a crystal. If $d = 1 \text{ \AA}$ and $i = 30^\circ$, V should be about ($h = 6.6 \times 10^{-34} \text{ J-s}$, $m_e = 9.1 \times 10^{-31} \text{ kg}$, $e = 1.6 \times 10^{-19} \text{ C}$)
 (a) 2000 V (b) 50 V
 (c) 500 V (d) 1000 V
- If a strong diffraction peak is observed when electrons are incident at an angle i from the normal to the crystal planes with distance d between them (see figure), de-Broglie wavelength λ_{dB} of electrons can be calculated by the relationship (n is an integer)
 (a) $d \sin i = n\lambda_{dB}$ (b) $2d \cos i = n\lambda_{dB}$
 (c) $2d \sin i = n\lambda_{dB}$ (d) $d \cos i = n\lambda_{dB}$
- In an experiment, electrons are made to pass through a narrow slit of width d comparable to their de-Broglie wavelength. They are detected on a screen at a distance D from the slit (see figure).



Which of the following graphs can be expected to represent the number of electrons N detected as a function of the detector position y ($y = 0$ corresponds to the middle of the slit)?



- A planet in a distant solar system is 10 times more massive than the earth and its radius is 10 times smaller. Given that the escape velocity from the earth is 11 km s^{-1} , the escape velocity from the surface of the planet would be
 (a) 1.1 km s^{-1} (b) 11 km s^{-1}
 (c) 110 km s^{-1} (d) 0.11 km s^{-1}

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