

Homework 2

Short Answer Questions

1. Why is a magnetic field used to deflect electron beam but not an electric field in a T.V. picture tube?
2. Compare the specific charge of an electron with that of a proton.
3. A charged particle is fired into a cubical region of space where there is uniform magnetic field. Outside this region, there is no magnetic field. Is it possible that the particle will remain inside the cubical region? Explain.
4. A charged particle is not deflected in a region. Do you think no field is present there?
5. A charged particle moves through a region of space with constant velocity. If the external magnetic field is zero, can we conclude that the external field in the region is also zero? Explain.

Numerical Problems

1. An electron moves in a circular path of radius 20 cm in a uniform magnetic field of $2 \times 10^{-3}T$. Find the speed of the electron and its period of revolution. (Given: Mass of electron = $9.1 \times 10^{-31}kg$.
Ans: $5.6 \times 10^7 Hz$
2. An electron beam passes through a magnetic field of $2 \times 10^{-3}T$ and an electric field of $3.4 \times 10^4 V/m$ both acting simultaneously. If the path of the electron remains undeflected, calculate the speed of the electrons. If the electric field is removed, what will be the radius of the circular path? (Given: Mass of electron = $9.1 \times 10^{-31}kg$.
Ans: $1.7 \times 10^7 m/s, 0.0483 m$
3. A beam of electrons, moving with velocity of $10^7 m/s$, enters midway between two horizontal parallel plates in the direction parallel to the plates which are 5 cm long and 2 cm apart and have a p.d. of V volts between them. Calculate V if the beam is deflected so that it just grazes the edge of the plate. (Assume $e/m = 1.76 \times 10^{11} C/kg$).
Ans: 91 V
4. An oil drop of mass $3.25 \times 10^{-15}kg$ falls vertically with uniform velocity, through the air between vertical plates which are 2 cm apart. When a p.d. of 1000 V is applied to the plates, the drop moves to the positively charged plate, being inclined at 45° to the vertical. Calculate the charge on the oil drop.
Ans: $6.37 \times 10^{-19} C$

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5. Find the electric field required to keep a water drop of radius 10^{-5} cm just suspended in vacuum when charged with one electron. ($e = 1.6 \times 10^{-19} \text{ C}$, density of water $= 1000 \text{ kg m}^{-3}$).

Ans: 256.56 V m^{-1}

Note:

Please upload the solutions to this assignment at our Google classroom. If you are struggling with any particular question(s), do let me know. Detailed solution to these problems will be uploaded before the next class of ours.