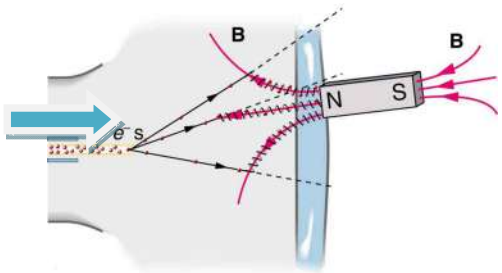
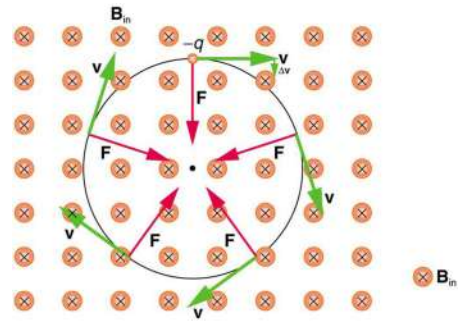
# PROBLEM SET OF MAGNETIC FIELDS

**P1:** A magnet brought near an old-fashioned TV screen such as in the figure below (TV sets with cathode ray tubes instead of LCD screens) severely distorts its picture by altering the path of the electrons that make its phosphors glow. *(Don't try this at home, as it will permanently magnetize and ruin the TV.)*

To illustrate this, calculate the radius of curvature of the path of an electron having a velocity of $6 \times 10^7 m/s$ perpendicular to a magnetic field of strength $B = 0.5T$ (obtainable with permanent magnets).



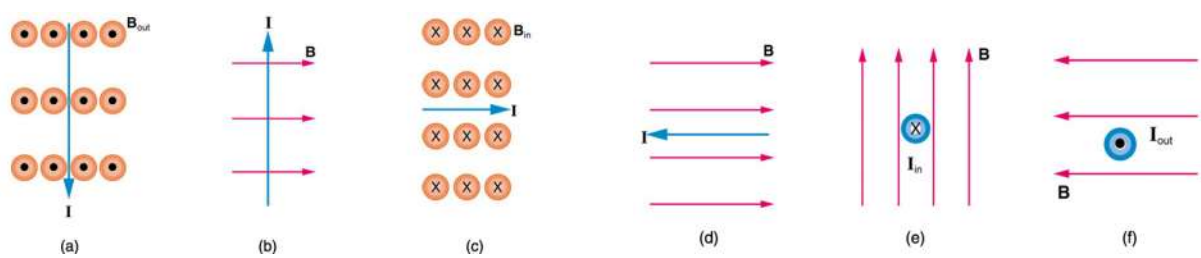

**Answer:** $r = 0.683mm$

**P2:** A velocity selector in a mass spectrometer uses a $0.1T$ magnetic field. (a) What electric field strength is needed to select a speed of $4 \times 10^6 m/s$? (b) What is the voltage between the plates if they are separated by $1cm$?

(Hint: In a mass spectrometer magnitudes of the electric and magnetic forces are equal. Voltage means $|\Delta V| = V = Ed$ )

**Answers:** $a)\ E = 4 \times 10^5 V/m \quad b)|\ \Delta V| = 4 \times 10^3 V$

**P3:** What is the direction of the magnetic force on the current in each of the six cases in the following figure.




**P4:** A DC power line for a light-rail system carries $1000A$ at an angle of $30^0$ to the Earth's field. What is the magnitude of the magnetic force exerting on a $100m$ section of this line? **Answer:** $F = 2.5N$

**P5:** What is the angle between a wire carrying an $8A$ current and the $1.2T$ magnetic field it is in if $50cm$ of the wire experiences a magnetic force of $2.88N$ in magnitude? **Answer:** $\theta = 37^0$

**P6:** Find the current in a long straight wire that would produce a magnetic field twice the strength of the Earth's at a distance of $5cm$ from the wire. (The Earth's field is about $5 \times 10^{-5}T$) **Answer:** $I = 25A$