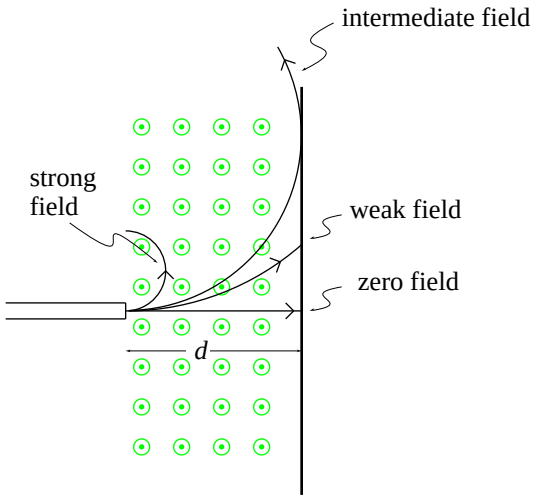
Protective shield against charged bullets



The $\vec{B}$ field should be perpendicular to the beam. To make the electrons turn *up* as shown, the field must point *out* of the page. (Remember that the charge is negative, so $\vec{F}$ is in the opposite direction of $\vec{v} \times \vec{B}$.)

The paths are circular with radii

$$r = \frac{mv}{eB}.$$

To avoid hitting the plate, we must have

$$\begin{aligned} r &< d \\ \frac{mv}{eB} &< d \qquad [\![\text{But } \tfrac{1}{2}mv^2 = K, \text{ so } v = \sqrt{2K/m}.]\!] \\ \frac{\sqrt{2mK}}{eB} &< d \\ B &> \frac{\sqrt{2mK}}{ed}. \end{aligned}$$

This is reasonable: the field strength at which the beam just glances the plate increases with K and decreases with d.

Grading: Starting out — some sort of sketch: 2 points
field orientation: 2 points
equation for radius: 2 points
use of equation to find $B > \sqrt{2mK}/ed$: 4 points