PHYS 232
Homework #6 Solutions

29.1 (a) up
(b) out of the page, since the charge is negative.
(c) no deflection
(d) into the page

29.2 At the equator, the Earth’s magnetic field is horizontally north. Because an electron has negative charge, \( F = qv \times B \) is opposite in direction to \( v \times B \). Figures are drawn looking down.

(a) Down \( \times \) North = East, so the force is directed West
(b) North \( \times \) North = sin 0° = 0: Zero deflection
(c) West \( \times \) North = Down, so the force is directed Up
(d) Southeast \( \times \) North = Up, so the force is Down
29.8

We suppose the magnetic force is small compared to gravity. Then its horizontal velocity component stays nearly constant. We call it v_i.

From \( v_y^2 = v_{yi}^2 + 2a_y(y - y_i) \), the vertical component at impact is \(-\sqrt{2gh} \). Then,

\[
F_B = qv \times B = Q(v_i - \sqrt{2gh} j) \times Bk = QvB(-j) - Q\sqrt{2gh} Bk
\]

\[
F_B = QvB \text{ vertical } + Q\sqrt{2gh} B \text{ horizontal}
\]

\[
F_B = 5.00 \times 10^{-6} \text{ C}(20.0 \text{ m/s})(0.0100 \text{ T}) \text{ j} + 5.00 \times 10^{-6} \text{ C} \sqrt{2(9.80 \text{ m/s}^2)(20.0 \text{ m})} \text{ (0.0100 T)} \text{ i}
\]

\[
F_B = (1.00 \times 10^{-6} \text{ N}) \text{ vertical } + (0.990 \times 10^{-6} \text{ N}) \text{ horizontal}
\]

29.16

\[
\frac{|F_B|}{L} = \frac{mg}{L} = \frac{I[L \times B]}{L}
\]

\[
I = \frac{mg}{BL} = \frac{(0.0400 \text{ kg/m})(9.80 \text{ m/s}^2)}{3.60 \text{ T}} = 0.109 \text{ A}
\]

The direction of \( I \) in the bar is to the right.