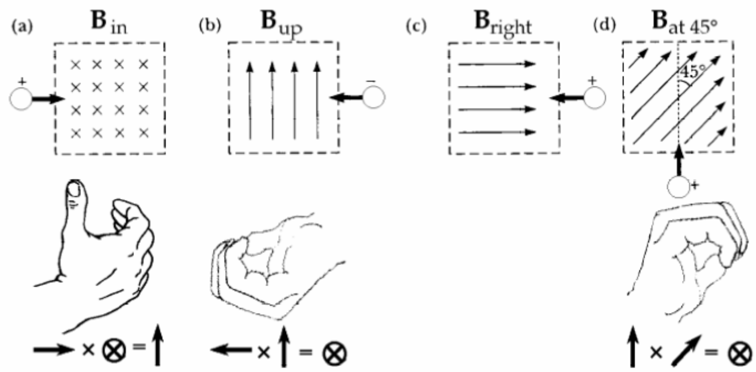
PHYS 232
Homework #6 Solutions

29.1 (a) up

(b) out of the page, since the charge is negative.

(c) no deflection

(d) into the page



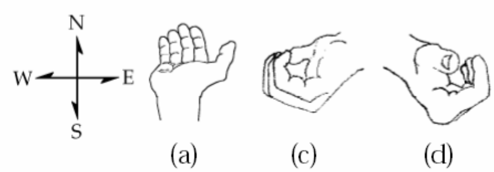
29.2 At the equator, the Earth's magnetic field is horizontally north. Because an electron has negative charge, $\mathbf{F} = q\mathbf{v}\times\mathbf{B}$ is opposite in direction to $\mathbf{v}\times\mathbf{B}$. Figures are drawn looking down.

(a) Down × North = East, so the force is directed **West**

(b) North × North = sin 0° = 0: **Zero deflection**

(c) West × North = Down, so the force is directed **Up**

(d) Southeast × 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 $v\,\mathbf{i}$.

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

$$\mathbf{F}_B = q\mathbf{v}\times\mathbf{B} = Q\left(v\mathbf{i} - \sqrt{2gh}\,\mathbf{j}\right)\times B\mathbf{k} = QvB(-\mathbf{j}) - Q\sqrt{2gh}\,B\mathbf{i}$$

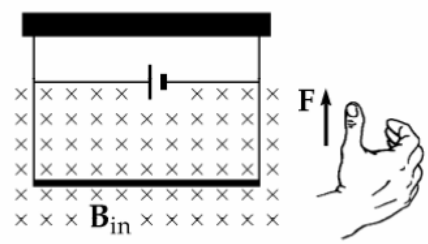
$$\mathbf{F}_B = QvB\text{ vertical} + Q\sqrt{2gh}\,B\text{ horizontal}$$

$$\mathbf{F}_B = 5.00\times10^{-6}\text{ C}(20.0\text{ m/s})(0.0100\text{ T})\,\mathbf{j} + 5.00\times10^{-6}\text{ C}\sqrt{2(9.80\text{ m/s}^2)(20.0\text{ m})}\,(0.0100\text{ T})\;\mathbf{i}$$

$$\mathbf{F}_B = \boxed{(1.00\times10^{-6}\text{ N})\text{ vertical} + (0.990\times10^{-6}\text{ N})\text{ horizontal}}$$

29.16

$$\frac{|\mathbf{F}_B|}{L} = \frac{mg}{L} = \frac{I|\mathbf{L}\times\mathbf{B}|}{L}$$



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

The direction of I in the bar is $\boxed{\text{to the right}}$.