27-8. $\vec{\mathbf{F}} = q\vec{\mathbf{v}} \times \vec{\mathbf{B}}$. Recall (see p. 25) the formula for the cross product:

$$\vec{\mathbf{v}} \times \vec{\mathbf{B}} = \begin{vmatrix} \hat{\mathbf{i}} & \hat{\mathbf{j}} & \hat{\mathbf{k}} \\ v_x & v_y & v_z \\ B_x & B_y & B_z \end{vmatrix} = (v_yB_z - v_zB_y)\hat{\mathbf{i}} + (v_zB_x - v_xB_z)\hat{\mathbf{j}} + (v_xB_y - v_yB_x)\hat{\mathbf{k}}$$

Note that in this problem where $B_x = B_y = 0$, $v_z$ will not enter into the cross product result and hence is unconstrained. (In general, the portion of $\vec{\mathbf{v}}$ parallel to $\vec{\mathbf{B}}$ produces zero force, as $\vec{\mathbf{a}} \times \vec{\mathbf{b}} = 0$ if $\vec{\mathbf{a}} \| \vec{\mathbf{b}}$, since $\theta = 0°$ or $180° \Rightarrow \sin\theta = 0$.)

(a) Using $\vec{\mathbf{F}} = q\vec{\mathbf{v}} \times \vec{\mathbf{B}}$ and that $B_x = B_y = 0$, we have here:

$$\Big(-3.4\hat{\mathbf{i}} + 7.4\hat{\mathbf{j}}\Big) \times 10^{-7} = (-5.6 \times 10^{-9})\Big(v_yB_z\hat{\mathbf{i}} - v_xB_z\hat{\mathbf{j}}\Big)$$

or

$$\begin{aligned} -3.4 \times 10^{-7} &= (-5.6 \times 10^{-9}) \cdot v_y \cdot (-1.25) \\ 7.4 \times 10^{-7} &= -(-5.6 \times 10^{-9}) \cdot v_x \cdot (-1.25) \end{aligned}$$

or

$$\begin{aligned} \frac{-3.4 \times 10^{-7}}{5.6 \times 10^{-9} \cdot 1.25} &= v_y = -48.6 \text{ m/s} \\ \frac{-7.4 \times 10^{-7}}{5.6 \times 10^{-9} \cdot 1.25} &= v_x = -106 \text{ m/s} \end{aligned}$$

(b) As statred above $v_z$ is unconstrained

(c)

$$\Big(-106\hat{\mathbf{i}} - 48.6\hat{\mathbf{j}}\Big) \cdot \Big(-3.4\hat{\mathbf{i}} + 7.4\hat{\mathbf{j}}\Big) \times 10^{-7} = (360.4 - 359.6) \times 10^{-7} \approx 0$$

In fact with more sigfigs this result is exactly zero, so the angle must be 90°

27-11. $\Phi_M = \vec{\mathbf{B}} \cdot \vec{\mathbf{A}} = B\pi R^2 \cos\theta$

(a) $\Phi_M = .23\pi.065^2 \cos 0° = 3.05 \times 10^{-3}$ Wb

(b) $\Phi_M = .23\pi.065^2 \cos 53.1° = 1.83 \times 10^{-3}$ Wb

(c) $\Phi_M = .23\pi.065^2 \cos 90° = 0$ Wb

27-54. $\vec{\mathbf{F}} = q\vec{\mathbf{v}} \times \vec{\mathbf{B}}$. In this problem, only $B_x$ is non-zero, so we have:

$$\vec{\mathbf{F}} = q\vec{\mathbf{v}} \times \vec{\mathbf{B}} = q \begin{vmatrix} \hat{\mathbf{i}} & \hat{\mathbf{j}} & \hat{\mathbf{k}} \\ v_x & v_y & v_z \\ B_x & 0 & 0 \end{vmatrix} = q\left(v_zB_x\hat{\mathbf{j}} - v_yB_x\hat{\mathbf{k}}\right)$$

So

$$\vec{\mathbf{F}} = (9.45 \times 10^{-8})\Big(5.85 \cdot 0.45\hat{\mathbf{j}} + 3.11 \cdot 0.45\hat{\mathbf{k}}\Big) \times 10^4 = \Big(2.49\hat{\mathbf{j}} + 1.32\hat{\mathbf{k}}\Big) \times 10^{-3} \text{ N}$$