3.

$$a) F = qv \times B$$

$$F = \left(-1.6\times10^{-19}\right)\begin{pmatrix} \vec{i} & \vec{j} & \vec{k} \\ 2.0\times10^{6} & 3.0\times10^{6} & 0 \\ .030 & -.15 & 0 \end{pmatrix}$$

$$F = (6.2\times10^{-14}\ N)\vec{k}$$

$$b) F = \left(1.6\times10^{-19}\right)\begin{pmatrix} \vec{i} & \vec{j} & \vec{k} \\ 2.0\times10^{6} & 3.0\times10^{6} & 0 \\ .030 & -.15 & 0 \end{pmatrix}$$

$$F = (-6.2\times10^{-14} N)\,\vec{k}$$

9.

If the electron travels in a straight line, then the net force on it must be zero.

$$qvB = qE = q\left(\frac{V}{d}\right)$$

$$B = \frac{V}{vd}$$

substituting for the velocity, $\frac{1}{2}mv^2 = eV$

$$B = \frac{V}{d}\left(\frac{m}{2eV}\right)^{\frac{1}{2}}$$

$$B = \frac{100\,\text{volts}}{.02\,\text{meters}}\left(\frac{9.11\times10^{-31}}{2\left(1.6\times10^{-16}\right)1000}\right)^{\frac{1}{2}} = 2.67\times10^{-4}\,T$$

38.

$$a)\ f = \frac{qB}{2\pi m}$$

$$f = \frac{\left(1.6\times10^{-19}\right)(1.2)}{2\pi\left(1.67\times10^{-27}\right)} = 18.2\times10^{6}\,Hz$$

$$b)\ KE = \frac{q^2B^2R^2}{2m}$$

$$KE = \frac{\left(1.6\times10^{-19}\right)^2(1.2)^2(.5)^2}{2\left(1.67\times10^{-27}\right)} = .276\times10^{-11}\,\text{joules}$$

$$1.6\times10^{-19}\,\text{joules} = 1\,eV$$

$$KE = .17\times10^{8}\,eV = 17MeV$$

40.

$$F = ILB\sin\Theta$$
$$F = 13\text{amps}(1.8\text{m})(1.5\text{T})\sin(35^\circ)$$
$$F = 20.1\,\text{newtons}$$

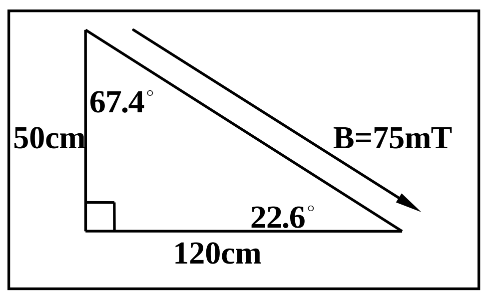
46.

$$F = ma = ILB\sin\Theta$$
$$a = \frac{IdB}{m}$$
$$v = at = \frac{IdB}{m}t$$
$$v = \frac{IdBt}{m}$$

direction: away from the generator.

43.

$$F = ILB\sin\Theta$$
$$F_{120cm} = (1.2\text{m})(4\text{amp})(.075\text{T})\sin(22.6^\circ)$$
$$F_{120cm} = .138\,\text{newtons up}$$
$$F_{50cm} = (.5\text{m})(4\text{amp})(.075\text{T})\sin(67.4^\circ)$$
$$F_{50cm} = .138\,\text{newtons down}$$
$$F_{130cm} = 0$$



b) the forces are equal and oposite so they cancel out.

49.

Let $\vec{n}$ be the vector normal to the area.

Note: $\vec{n}$ and B are 60° apart.

$$\Gamma = NIAB\sin(60^\circ)$$
$$\Gamma = 20(.1\text{amps})(.05\text{m})(.1\text{m})(.5\text{T})(.866)$$
$$\Gamma = .0043\,n\cdot m$$

Direction? $\Gamma = \vec{r}\times\vec{F}$

$\vec{r}$ is in the x – direction

$\vec{F}$ is in the z – direction

Right – hand rule, Γ is in the – y – direction

63.

a) $\Gamma = \vec{\mu} \times \vec{B}$

$\mu = NiA = (1)(.2)\pi(.08)^2 = .004$

$$\Gamma = \begin{pmatrix} \vec{i} & \vec{j} & \vec{k} \\ .60 & -.80 & 0 \\ .25 & 0 & .3 \end{pmatrix}$$

$$\Gamma = .004\left(-.24\vec{i} - .18\vec{j} + .20\vec{k}\right)$$

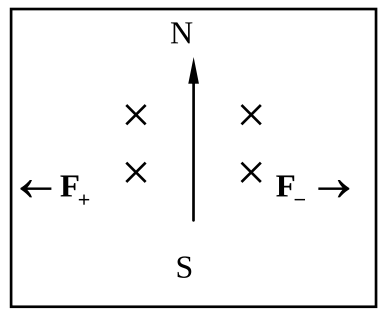
b) Magnetic potential energy

$$U = -\vec{\mu} \circ \vec{B}$$

$$U = -.004\left(.60\vec{i} - .80\vec{j}\right) \circ \left(.25\vec{i} + .30\vec{k}\right)$$

$$U = 6 \times 10^{-4} \text{ joules}$$

73. a) East, see diagram



b) $12\text{keV} = 12 \times 10^3 \left(1.6 \times 10^{-19} \text{ joules}\right)$

$$\frac{1}{2}mv^2 = 12 \times 10^3 \left(1.6 \times 10^{-19}\right)$$

$$v = \sqrt{\frac{2\left(12 \times 10^3\right)\left(1.6 \times 10^{-19}\right)}{9.11 \times 10^{-31}}} = 6.5 \times 10^7 \ \frac{m}{sec}$$

$$F = ma = qvB$$

$$9.11 \times 10^{-31} a = 1.6 \times 10^{-19}\left(6.5 \times 10^7\right)\left(5.5 \times 10^{-5}\right)$$

$$a = 6.3 \times 10^{14} \ \frac{m}{sec^2}$$

c) y = deflection; work like a trajectory problem.

$$x = v_0 t \Rightarrow t = \frac{x}{v_0}$$

$$y = \frac{1}{2}at^2 = \frac{1}{2}a\left(\frac{x}{v_0}\right)^2$$

$$y = \frac{1}{2}\left(6.3 \times 10^{14}\right)\left(\frac{.2}{6.5 \times 10^7}\right)^2 = .00298 \text{ meters}$$

80.

$$a)F(max) = qvB = 1.6\times10^{-19}(7.2\times10^{6})(83\times10^{-3})$$

$$F(max) = 9.56\times10^{-14}\text{newtons}$$

$$F(min) = 0$$

$$b)F = ma = qvB\sin\Theta$$

$$9.11\times10^{-31}(4.9\times10^{14}) = 9.56\times10^{-14}\sin\Theta$$

$$\Theta = .266^{\circ}$$