PHY101 HW 6 Solutions

Chapter 11 Exercises

(7) If you apply a magnetic to the door and it sticks, then your friend is wrong because aluminum is not magnetic. If the magnetic doesn't stick, then your friend is correct, though aluminum is just one of many materials that is not magnetic.

(18) Electric fields can increase the speed of a charged particle, while a magnetic field can only change the direction that the charged particle is travelling. For the former, $\vec{F}_E = q\vec{E}$ and for the latter $F_B = qvB\sin\theta$ where the angle is between $\vec{v}$ and $\vec{B}$. The direction of F_B is determined by the right hand rule such that F_B is $\perp$ to v. Forces $\perp$ to v cannot change the magnitude of v.

(42) Just as force is decreased/increased in a lever to be able to lift something, voltage is decreased/increased in a transformer. Both energy and therefore power remain conserved in terms of the input and output for both levers and transformers.

Chapter 11 Problems

(1) Use $\frac{V_1}{N_1} = \frac{V_2}{N_2}$ where V_1 is the primary (120 V, $N_1 = 500$) and V_2 is the secondary (12 V). So isolating for N_2 yields

$$N_2 = V_2\left(\frac{N_1}{V_1}\right) = 12\,V\left(\frac{500}{120\,V}\right) = \underline{50}$$

(8) (a) $P = VI \Rightarrow I = \frac{P}{V} = \frac{10^5\,W}{12000\,V} = \underline{8.3\,A}$

(b) $V = IR = (8.3\,A)(10\,\Omega) = 83\,V$ for each wire

(c) For each wire $P = IV = (8.3A)(83\,V) = 689\,W$. So the total loss is $2(689\,W) = 1378\,W$, since there are two wires.

(d) If the V from (a) (12000 V) were less, then I would be larger and then since $P = IV$, the power loss in the wires would be larger!

Other problems

(6) Start w/ $Q = VC$ since the defibrillator is a capacitor. The amount charge delivered to the body is $Q = CV = (15\times10^{-6}\,F)(9000\,V)$

$$= \underline{0.14\,C}.$$

We can calculate the power delivered as well using $P = \frac{E}{\Delta t} = \frac{\frac{1}{2}CV^2}{t}$

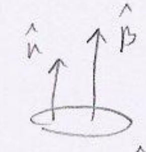
$$= \frac{\frac{1}{2}(15\times10^{-6}\,F)(9\times10^{3}\,V)^2}{.002\,s}$$

$$= \underline{0.3\,MW}.$$

(7) Use Faraday's Law $\left(V_{ind} = -\frac{\Delta\Phi_B}{dt}\right)$ and Ohm's Law $(V = IR)$

$$\Delta\Phi_B = NA\cos(\theta)(B_f - B_i) = 50\,(\pi(.05\,m)^2)\cdot\cos(0)\,(1.8\,T - 0)$$

since it's the magnitude that is changing



$\hat{n} \parallel \hat{B}$

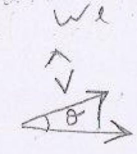
$$= .706\ Tm^2$$

$$V_{ind} = -\frac{\Delta\Phi_B}{\Delta t} = -\frac{.706\ Tm^2}{3.6\,s} = -.196\,V \Longrightarrow \text{Use } I = \frac{V}{R} = \frac{.196\,V}{2.8\,\Omega} = \underline{.07\,A}$$

since there is an ambiguity of a minus sign we only look at the magnitude.

<u>Extra Credit</u>

To find the radius of the coil, use $F_B = ma_\perp = \dfrac{m(v\sin\theta)^2}{r}$



we want the component of the velocity $\perp$ to $\vec{B}$

$$|q_e| v B \sin\theta = \frac{m(v\sin\theta)^2}{r}$$

$$\Rightarrow \quad r = \frac{m v \sin\theta}{q_e B} = \frac{(1.67\times10^{-27}\,\mathrm{kg})(4\times10^{7}\,\mathrm{m/s})\sin(25)}{(1.6\times10^{-19}\,\mathrm{C})(1\times10^{-6}\,\mathrm{T})}$$

$$= \underline{1.77\times10^{5}\ \mathrm{m}}$$

To find the pitch, d, the time for one circle is $\dfrac{2\pi r}{v\sin\theta}$ and then

$$d = v_{\parallel}\left(\frac{2\pi r}{v\sin\theta}\right) = v\cos\theta\,\frac{2\pi r}{v\sin\theta} = \cot(\theta)\,2\pi r = \underline{2.4\times10^{6}\ \mathrm{m}}.$$