Physics 10164 - Exam 3C

Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work even if you get the right answer. Clearly indicate your answer with a circle or a box and remember to include correct units and significant figures.

1. (30 pts) A transformer connects a wall outlet to a laptop computer. The current from the wall going into the transformer is 0.25 Amps, and the rms voltage is 120 Volts. The output voltage to the laptop is 6.0 Volts.

a) If the number of turns in the primary coil of the transformer is 240 turns, what is the number of turns in the secondary?
b) If the cord connecting the transformer to the laptop has a resistance of 0.11 Ohms, how much power is dissipated by resistance in the cord?

a) Input voltage = 120 ← primary

Output voltage = 6 ← secondary

$$\Delta V_p = \frac{N_p}{N_s}\Delta V_s \Rightarrow 120 = \frac{240}{N_s}(6)$$

$$N_s = \frac{240}{120}(6) = 12 \text{ turns}$$

b) $I_p \Delta V_p = I_s \Delta V_s$

$(0.25)(120) = I_s(6)$

$30 = I_s(6)$

$I_s = 5A$

$P_{lost} = I_s^2 R$

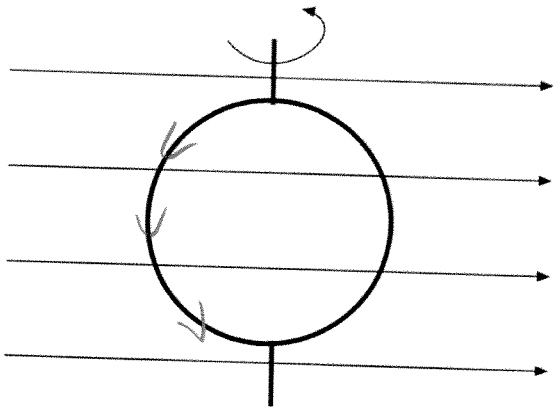
$= (5)^2(0.11) = 2.8W$

2. (40 pts) A 35 turn circular loop has a radius of 6.5 cm and is initially oriented so that an external 1.6 T magnetic field is parallel to the plane of the loop as shown. The loop rotates 90 degrees in 0.30 sec.

a) Find the magnitude of the average induced EMF in the loop during the 0.30 sec time interval.

b) Find the direction of the induced current in the loop (be sure to show your work, explain each step in your logic).

c) The induced EMF in the loop is not constant over the 0.30 sec time interval (what you calculated in part a was an average). At which time is it larger, t = 0 or t = 0.30 s? Justify your answer.



$$|\mathcal{E}| = N\frac{\Delta\Phi_B}{\Delta t} \qquad 0 \to 1$$

$$= \frac{NBA\Delta\cos\theta}{\Delta t}$$

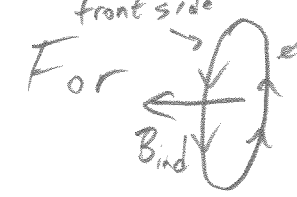
$$= \frac{(35)(1.6)\pi(.065)^2(1)}{0.30}$$

$$= 2.5 \text{ Volts}$$

b) Φ_B = →, increasing

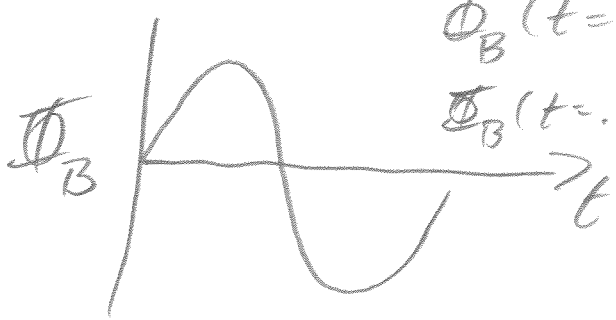
so B_{ind} = ←

For



I_{ind} = ccw

c)



$\Phi_B(t=0) = 0$ ← biggest slope

$\Phi_B(t=.30) = \max$

$\Delta\Phi_B/\Delta t$

So

$\mathcal{E}$ is largest at $t = 0$

3. (30 pts) An object is 12 cm in front of an unknown mirror. The image is upright and 1.5 times larger than the object.

a) What type of mirror is this (convex or concave)? Justify your answer.
b) For what object distance is the image 1.5 times smaller than the object and inverted?

$p = 12\text{ cm}$

$M = +1.5 = -\frac{q}{p}$, so $q = -1.5p$

$q = -18\text{ cm}$

a)

$\frac{1}{12} - \frac{1}{18} = \frac{1}{f}$

$\frac{1}{36} = \frac{1}{f}$ $f = +36$ (concave since $f+$)

b) $M = -\frac{1}{1.5} = -\frac{q}{p}$ $p = 1.5q$

$q = \frac{p}{1.5}$

$\frac{1}{p} + \frac{1.5}{p} = \frac{1}{36}$

$\frac{2.5}{p} = \frac{1}{36}$ $p = 90\text{ cm}$