Name: ______________________________

> Answer the questions in the spaces provided on the question sheets. If you run out of room for an answer, continue on the back of the page.

1. (Problem 28.47)

   The defining physics is embodied in the equation

   $$\mathcal{E} = -L\frac{dI}{dt}$$

   where L is the induction. Plugging in the numbers from the problem,

   $$\mathcal{E} = -8.00H\,(200A/s) = -1600V$$

   The definition of L comes from the relation, unique to each class of coils, of,

   $$L = \frac{\Phi}{I}$$

   So that flipping it around gives,

   $$\Phi = LI = 8.00H\,(3.00A) = 24Wb$$

2. (Problem 28.61)

   This is the problem which shows us why no circuit goes instantly from 0 current to some non-infinitesimal value of current immediately, which is what the idealized equations told us.

   The guiding equation here is,

   $$I = I_f\left(1 - e^{-t/\tau}\right)$$

   where $tau = L/R = 0.6/3 = 0.2s$ and $I_f = \mathcal{E}/R = 12/3 = 4A$.

   At $t = 0.500$s, $I = 4A(1 - e^{-0.5/0.2}) = 3.67A$.

   The power supplied by the battery is then,

   $$P = I\mathcal{E}_0 = 3.67(12.0) = 44.1W$$

   The resistor:

   $$P_R = I^2R = 40.4W$$

   For the inductor:

   $$P_L = LI\frac{dI}{dt}$$

   So how do we get dI/dt?

   $$\frac{d}{dt}\left(I_f\left(1 - e^{-t/\tau}\right)\right) = \frac{4}{0.2}e^{-t/0.2}$$

   at $t = 0.500$ seconds, this gives $1.64A/s$, and $P_L = 0.6(3.67)(1.64) = 3.6W$

   Note that $P = P_R + P_L$, energy conservation is NEVER violated. Never.

3. (Problem 29.59)

   We are given the equation for charge on this circuit as:

   $$Q = 15\mu C \cos\left(\omega t + \frac{\pi}{4}\right)$$

   To find the current, take the time derivative:

   $$I = \frac{dQ}{dt} = 0.019C \sin(1250t + \frac{\pi}{4})$$

   For the LC circuit, we know that $\omega = \frac{1}{\sqrt{LC}}$, We can extract the ω from the sine function, $\omega = 1250$ rad/s. Solving for C gives $C = 2.3 \times 10^{-4}$F.

4. (28.67):

   Do not focus on this problem or further problems for the final exam.