Score _____

Instructions:
1. Do all of your work on this sheet.
2. **Show all of your steps** in problems for full credit.
3. **Be clear and neat** in your work. Any illegible work, or scribbling in the margins, will not be graded.
4. Place your **answers in a box**.
5. If you need more space, you may use the back of the page and write **On back** in the problem space.

1. **Multiple Guess (3 pts)** Find the answer which best fits the question and write it in the space provided.

a. In an RC circuit the voltage _____ the current.
   a) lags;   b) leads.   c) is in phase with;

   $\underline{a}$

b. The impedance has units of
   a) farads; b) ohms; c) hertz d) henries e) none of these

   $\underline{b}$

c. According to Faraday's Law, the induced emf is a result of
   a) capacitance; b) voltage; c) change in flux;
   d) none of these.

   $\underline{c}$

2. **Definition/Principle (4 pts)**

a. Indicate which phasor diagrams below are for a resistor, a capacitor, and an inductor.

L   C   R
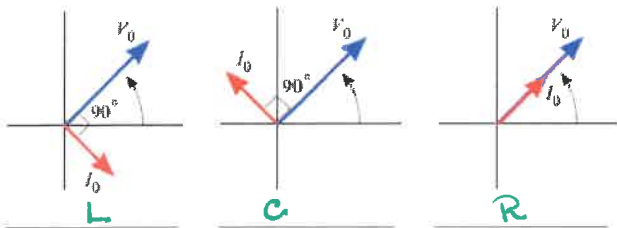
b. Give the exact expression for the inductive reactance in terms of the inductance and frequency.

$$X_L = 2\pi f L$$

Bonus. A $25\,cm \times 15\,cm$ coil rotates in a 1.60 T field at 75 Hz. If the generated emf has peak value of 56.59 V, then how many loops are in the coil?
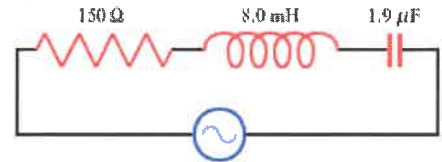
$$\varepsilon_0 = NBA\omega$$

$$N = \frac{56.59}{1.6(.25)(.15)2\pi\, 75} = 2$$

3. **Problems (13 pts)**

a. On the same bar of iron are wound two coils, one with 40 loops and the other with 18. If a 20.0V alternating voltage is connected to the 40 loop coil, what will be the voltage in the 18 loop coil?

$$V_S = \frac{N_s}{N_p}V_p = \frac{18}{40}(20) = 9\,V$$

$\underline{2}$

b. What is the resonant frequency of the given circuit?

$150\,\Omega$ $8.0\,mH$ $1.9\,\mu F$

$$X_L = X_c$$

$$f_0 = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{1.9\times10^{-6}(8\times10^{-3})}}$$

$$= \frac{1}{2\pi\sqrt{1.5\times10^{-8}}} = 1290\,Hz$$

$\underline{3}$

c. What peak voltage is needed to create an rms current of 29.0 A in a circuit containing only a 5.65 μF capacitor, when the frequency of the source is 2.60 kHz?

$$V_{rms} = I_{rms}X_c = \frac{29}{2\pi(2.6\times10^3)(5.65\times10^{-6})}$$

$$= .314\times10^3 = 314\,V$$

$$V_0 = 314\sqrt{2} = 444\,V$$

$\underline{3}$

d. A series LRC circuit includes a resistance of 160 Ω, an inductive reactance of 357 Ω, and a capacitive reactance of 257 Ω. If the voltage source has an rms voltage of 50.0 V, operating at 1.50 kHz. Determine the following:

i. Impedance

$$Z = \sqrt{160^2 + 100^2} = 189\,\Omega$$

ii. Rms Current

$$I_{rms} = \frac{V_{rms}}{Z} = 0.26A$$

iii. Phase $\tan\phi = \frac{100}{160} \Rightarrow \phi = 32°$

iv. Does the current lead, or lag, the voltage? $\underline{lag}$

$\underline{5}$