Test 3 2B solutions (1 (rest sheet below.)

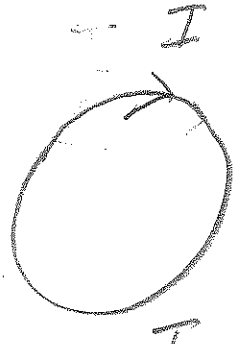
1.

a. $A = \pi r^2 = (3.14)(0.03)^2$
$= 2.83 \times 10^{-3}\ m^2$

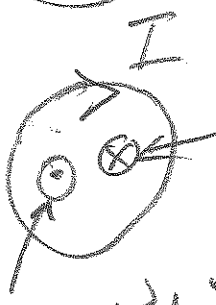
b. $|\mathcal{E}| = N \cdot A \frac{\Delta B}{\Delta t}$
$= (1)(2.827 \times 10^{-3}) \cdot 10$
$= 2.83 \times 10^{-2}\ (V)$
$= 28.3\ mV$

c. $I = \frac{|\mathcal{E}|}{R}$
$= \frac{28.27 \times 10^{-3}\ (V)}{40\ \Omega}$
$= 0.706 \times 10^{-3}$
$= 0.706\ mA$

d.



e.



2.

a. $L = \frac{|\mathcal{E}|}{\left|\frac{\Delta I}{\Delta t}\right|}$

$L = \frac{0.0160\ (V)}{0.1280\ A/s}$
$= 0.125\ H = 125\ mH$

b. Left end higher. Voltage induced opposes increase in I.

3. $\frac{N_2}{N_1} = \frac{V_2}{V_1}$

$\frac{834}{275} = \frac{V_2}{25}$

$V_2 = \left(\frac{834}{275}\right) \cdot 25$

$= 76\ (V)$

b. step up

c. Extra credit discussion Later:

answer: 13.6 Ω

4. a. $\frac{1}{2} C V_1^2 = U_2$

$= \frac{1}{2} 10 \times 10^{-6} (10)^2$

$= \frac{1}{2} (1000) \times 10^{-6}$

$= 500 \times 10^{-6}\ J$

$= 0.500 \times 10^{-3}\ J$

$= 0.500\ mJ$

b. $\frac{1}{2} L (0.5)^2 = 0.500 \times 10^{-3}$

$L = \frac{1 \times 10^{-3}}{0.25}$

$L = 4 \times 10^{-3}\ H$

$L = 4\ mH$

$Q = 0$ when $I = I_m$

c. $w = \frac{1}{\sqrt{LC}}$

$= \sqrt{\frac{1}{4 \times 10^{-3} \cdot 10^{-5}}} = \sqrt{0.25 \times 10^8}$

$= 0.5 \times 10^4 = 5 \times 10^3$

$= 5000\ rad/s$

test 3

(3)

(5.) a, b, c

$$Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

ω (RAD/S)	$\omega L - \frac{1}{\omega C}$	MATH WORK:
1001	$403.45\,\Omega$	$1001 \cdot (0.902) - \frac{1}{(1001)2\times10^{-6}} = 403.45\,\Omega$
751	$11.62\,\Omega$	$751 \cdot (0.902) - \frac{1}{(751)(2\times10^{-6})} = 11.62\,\Omega$
502	$-543\,\Omega$	$502 \cdot (0.902) - \frac{1}{(502)(2\times10^{-6})} = -543\,\Omega$

$Z = \sqrt{R^2 + (\omega L - \frac{1}{\omega C})^2}$

	Z
1001	$\sqrt{201^2 + 403.9^2} = 451.0.7\,\Omega$
751	$\sqrt{201^2 + 11.62^2} = 201.34\,\Omega$
502	$\sqrt{201^2 + (-543)^2} = 579.5\,\Omega$

(d.) $$\frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{(0.902)(2.01\times10^{-6})}} = 743.3\ \frac{RAD}{S}$$

(e.) $I_m = \frac{100}{201} = 0.500\,A$

(f.) $I_m = \frac{100}{201.3} = 0.50\,A$

(g.) Both near or at RESONANCE.

(4

test 3 ⟶ 2 ⟶ R

(6.)

$$t = \frac{D}{c}$$

$$t = \frac{3.84 \times 10^{8}\ m}{3 \times 10^{8}\ m/s}$$

$$t = 1.28(s)$$

Name_____

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1. (40 POINTS) A single loop (N = 1) of wire of radius r = 0.0300 m lies with its face parallel to the page. It is in an external uniform perpendicular magnetic field pointing OUT as shown in the diagram below by the dot surrounded by a circle ⊙. Suppose the external magnetic field magnitude is INCREASING with rate $\Delta B/\Delta t = 10.00$ T/s.

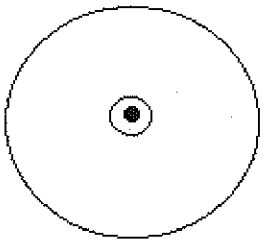
(a) (5 points) What is the area A of the wire loop?

(b) (10 points) What is the magnitude $|\varepsilon|$ of the voltage induced in the wire loop ?

(c) (10 points) The loop has resistance R = 40.0 Ω. What is the current I in the loop?

(d) (10 points) In the figure below, indicate the direction of the current I, clockwise or counter-clockwise, in the loop. Draw a labeled curved arrow on the loop representing the current direction.

(e) (5 points) In the figure below, indicate the direction of the induced magnetic field , *in or out.* Indicate this direction by drawing a labeled IN ⊗ or OUT ⊙ symbol within the circle.



Name_____

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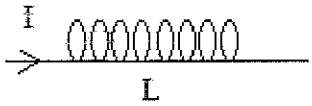
2. (40 points) The current I flowing rightward through inductor L is *increasing* at a steady rate of 0.1280 A/s. The magnitude $|\ \varepsilon_L\ |$ of the voltage difference between the right end and the left end of the inductor is 0. 0160 (V).



(a) (30 points) What is the inductance L?

(b) (10 points) Which end of the inductor above is at *higher* voltage, the left end or the right end? Explain.

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3. (20 points) A transformer consists of 275 *primary* windings and 834 *secondary* windings . If the potential difference across the *primary* coil is 25.0 (V),

(a) (17 points) what is the voltage across the *secondary* coil?

(b) (3 points) Is this a *step up* or *step down* transformer? Explain.

(c) (5 points) EXTRA CREDIT . What is the effective load resistance of the secondary coil if it is connected across a 125 Ω resistor ?

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Name_____
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4. (30 POINTS) THE LC CIRCUIT. A 10.00 μF capacitor C is initially charged to a voltage V of 10.00 (V). It is then connected in series with an inductor L. Charge and current *oscillations* ensue.

(a) (10 points) What is the *total* energy U of the circuit?
(b) (10 points) If the *maximum* current in the inductor is $I_m = 0.500$ (A), then what is the inductance L? What is the charge Q on the positive plate of the capacitor when the current reaches its maximum value I_m ?
(c) (10 points) What is the angular frequency ω of the charge oscillations?

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5. (40 points). Compute the impedance Z of a series R-L-C circuit at angular frequencies ω =
(a) (6 points) 1001 rad/s
(b) (6 points) 751 rad/s
(c) (6 points) 502 rad/s.

Assume R = 201 Ω, L = 0.902 H and C = 2.01 μF.

(d) (6 points) What is the resonant angular frequency ω_{RES} of the circuit?

Assume the voltage source amplitude is V_m = 100.00 (V).

(e) (6 points) What is the current amplitude I_m when the circuit is at the resonant angular frequency?
(f) (5 points) What is the current amplitude I_m when the circuit is at 751 rad/s?
(g) (5 points) Should the answers to (e) and (f) be nearly equal? Explain.

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6. EXTRA CREDIT. (10 POINTS) How much time t (in seconds) does it take light to travel from the Moon to the Earth, a distance D = 384,000 km? Assume the speed of light is $c = 3.00 \times 10^{8}$ m/s.