HW #6

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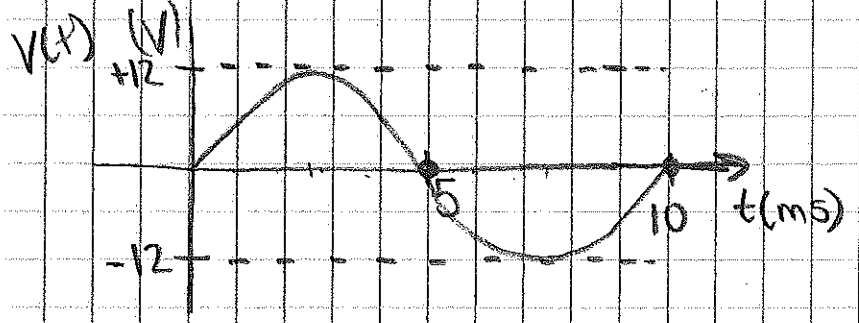
1) The Voltage across a 10 μF capacitor is shown below. Determine and plot the waveform for the capacitor current.



Note: $i = C\frac{dv}{dt}$; Amplitude: 12; Period: 5ms

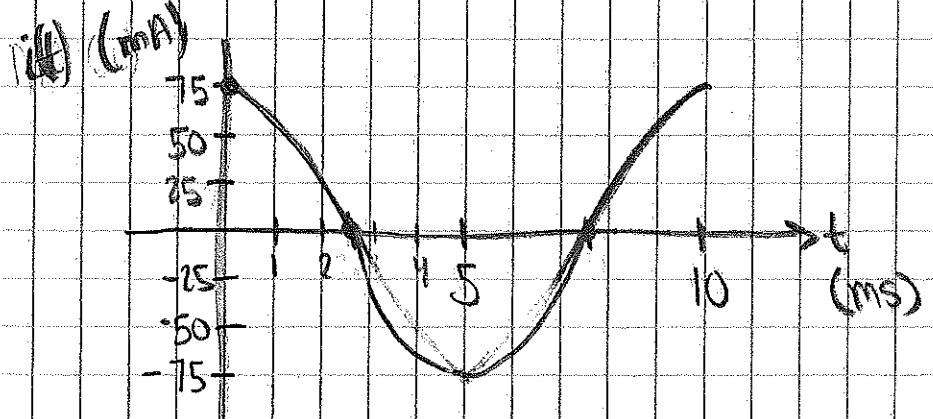
The voltage plot takes on this form:

$v(t) = 12\sin(200\pi t)$ b/c $\pi = 2\pi/.01 = 200\pi$

$i(t) = (10\mu F)\left(12\sin(200\pi t)\frac{d}{dt}\right)$

$i(t) = (10\mu F)(12)(200\pi)(\cos(200\pi t))$

$\boxed{i(t) = 0.0754\cos(200\pi t)}$



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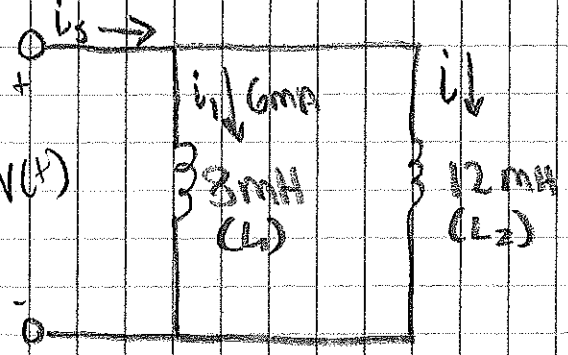
2) Two inductors are connected in parallel as shown in the CKT below. Find i.



Note that the voltage across both inductor is equal.

$$i_1 = \frac{L_2}{L_1+L_2} i_s \quad \& \quad i = \frac{L_1}{L_1+L_2} i_s$$

$$6mA = \frac{12mH}{20mH} i_s \qquad i = \frac{8mH}{20mH}(10mA)$$

$$6mA = \frac{3}{5} i_s \qquad i = \frac{2}{5}(10mA)$$

$$\underline{i_s = 10mA} \qquad \boxed{i = 4mA}$$

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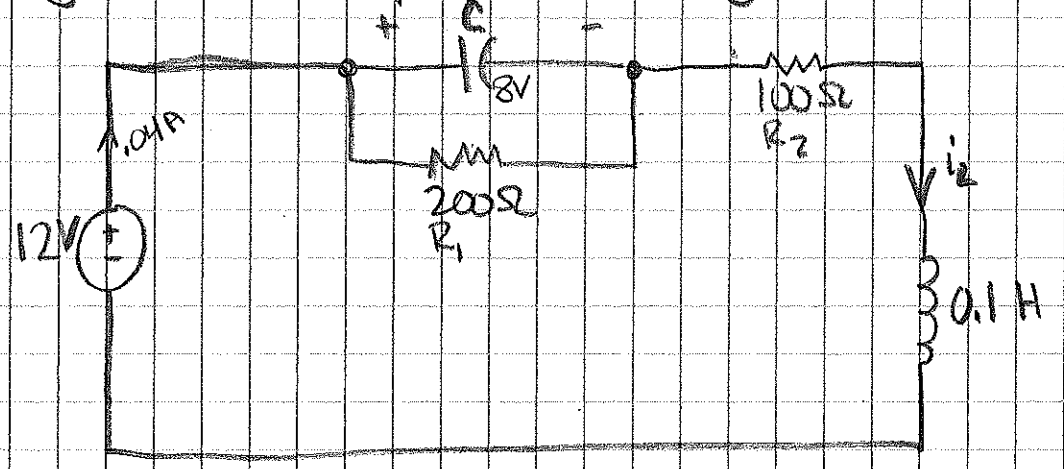
3) Find the value of C if the energy stored in the capacitor in the figure below is equal to stored energy in the inductor.



Note: energy stored (W) = $\frac{1}{2}CV_c^2$ & $W = \frac{1}{2}Li_L^2$

$$\cancel{\tfrac{1}{2}}CV_c^2 = \cancel{\tfrac{1}{2}}Li_L^2$$

$$CV_c^2 = Li_L^2$$

Note: $V_c = V_{R_1}$, and in DC circuit an inductor has 0 V_L and a capacitor acts like an open circuit...

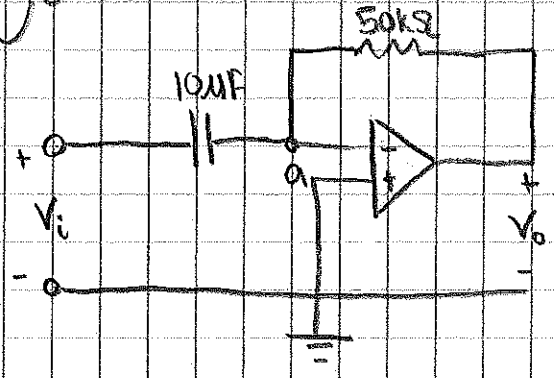
$$C(200i_L)^2 = Li_L^2$$

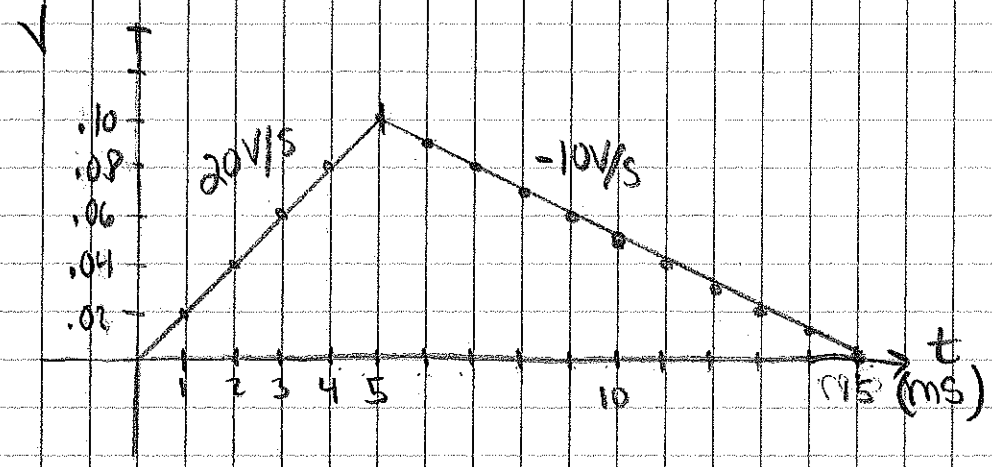
$$C(40000)i_L^2 = Li_L^2$$

$$C = L/40000 = .1/40000$$

$$\boxed{C = 3\ \mu F}$$

4) A voltage waveform has the following characteristics: a positive slope of 20 V/s for 5 ms followed by a negative slope of 10 V/s for 10 ms. If the waveform is applied to a differentiator with $R = 50k\Omega$, $C = 10\mu F$, sketch the output voltage waveform.





Note: $V_o = -RC\frac{dv_i}{dt}$ $\Rightarrow$

... assume: $t < 0$: $V_o = 0V$

$0 \le t \le 5ms$ $V_o = (50k)(10\mu)(20\frac{V}{s})$

$\underline{V_o = -10\,V}$

$5ms \le t \le 15ms$ $V_o = (50k)(10\mu)(-10\frac{V}{s})$

$\underline{V_o = 5V}$