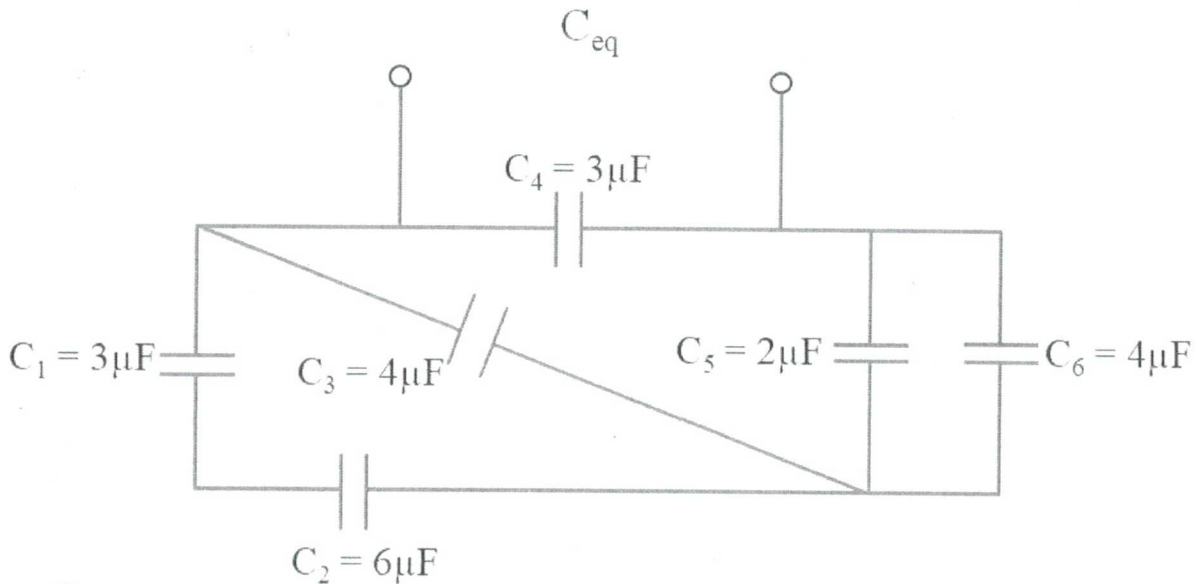


PROBLEM 1: (10 points)Find C_{eq} :

$$C_1 \text{ and } C_2 \text{ series} \rightarrow C_{e1} = \frac{C_1 \times C_2}{C_1 + C_2} = 2 \mu F$$

$$C_{e1} \text{ and } C_3 \text{ Parallel} \rightarrow C_{e2} = C_{e1} + C_3 = 6 \mu F$$

$$C_5 \text{ and } C_6 \text{ Parallel} \rightarrow C_{e3} = C_5 + C_6 = 6 \mu F$$

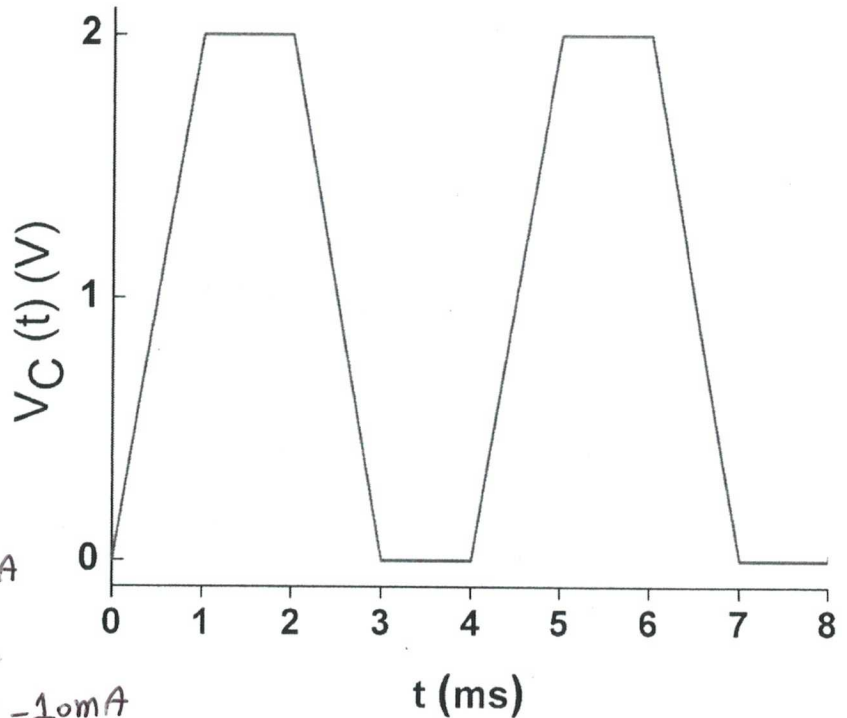
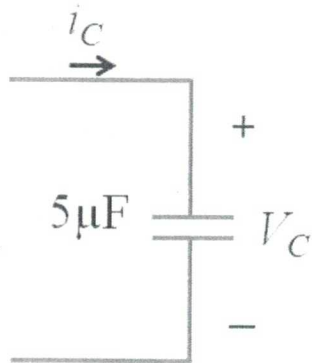
$$C_{e2} \text{ and } C_{e3} \text{ series} \rightarrow C_{e4} = \frac{C_{e2} \times C_{e3}}{C_{e2} + C_{e3}} = 3 \mu F$$

$$C_{e4} \text{ and } C_4 \text{ Parallel} \rightarrow C_{eq} = C_{e4} + C_4 = 6 \mu F$$

C_{eq}	$6 \mu F$
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PROBLEM 2: (20 points)

The voltage of the capacitor is given as a function of time in the following figure between 0ms to 8ms. Plot the current of the capacitor, $i_C(t)$, between 0ms to 8ms. Mark the axes of your plot with numbers and units.



$$q = CV_C \rightarrow i_C(t) = C \frac{dV_C}{dt}$$

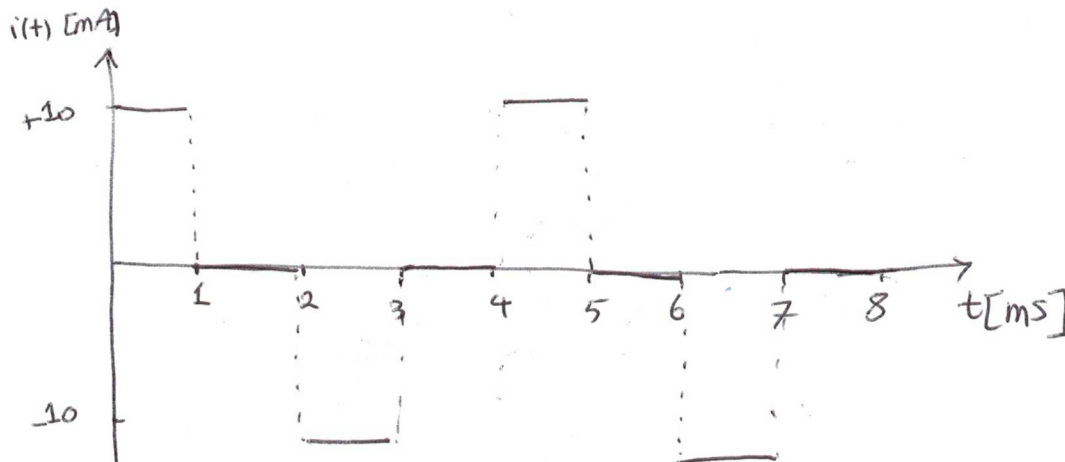
$$0 < t < 10^{-3} \rightarrow i_C(t) = 5 \times 10^{-6} \times \frac{2}{10^{-3}} = 10 \text{ mA}$$

$$10^{-3} < t < 2 \times 10^{-3} \rightarrow i_C(t) = 0$$

$$2 \times 10^{-3} < t < 3 \times 10^{-3} \rightarrow i_C(t) = 5 \times 10^{-6} \times \frac{-2}{10^{-3}} = -10 \text{ mA}$$

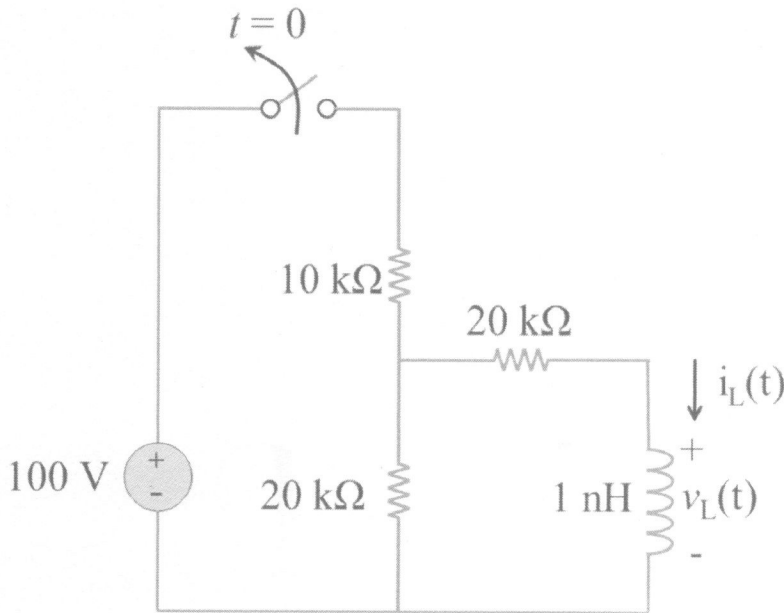
$$3 \times 10^{-3} < t < 4 \times 10^{-3} \rightarrow i_C(t) = 0$$

This repeats again from $t = 4 \times 10^{-3}$ to $t = 8 \times 10^{-3}$.

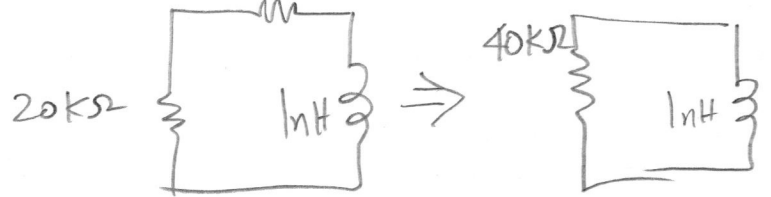


PROBLEM 3: (30 points)

Find $i_L(t)$ and $v_L(t)$.



For $t > 0$,



$$\tau = \frac{L}{R} = \frac{1\text{nH}}{40\text{k}\Omega} = 2.5 \times 10^{-14} \text{ s}$$

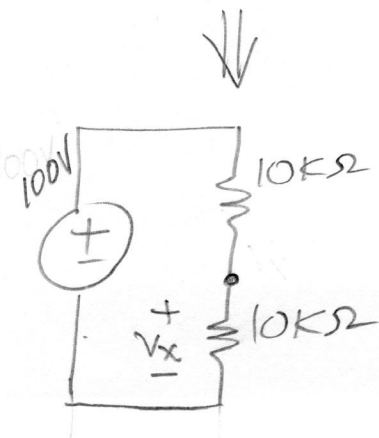
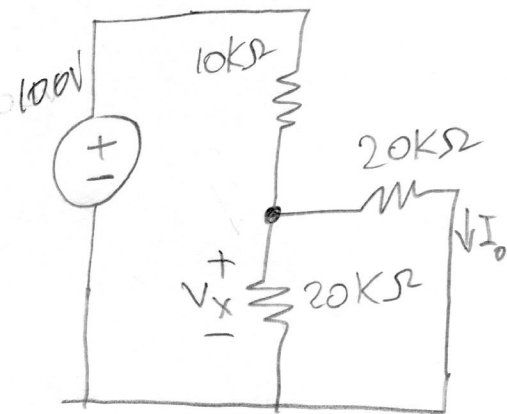
$$i_L(t) = I_0 e^{-t/\tau} = (2.5 \times 10^{-3}) e^{-t/(2.5 \times 10^{-14})} \text{ A}$$

$$v_L = L \frac{di_L}{dt} = (1 \times 10^{-9})(2.5 \times 10^{-3}) \cdot e^{-t/(2.5 \times 10^{-14})} = -100 e^{-t/(2.5 \times 10^{-14})} \text{ V}$$

For $t < 0$,

$$V_x = 100 \frac{10}{20} = 50 \text{ V}$$

$$i_L(0) = \frac{50}{20\text{k}} = 2.5 \text{ mA} = I_0$$



$i_L(t)$	$(2.5 \times 10^{-3}) e^{-t/(2.5 \times 10^{-14})}$ A
$v_L(t)$	$-100 e^{-t/(2.5 \times 10^{-14})}$ V

PROBLEM 4: (20 points)

- a) Given $i(t) = 5 \cos(\omega t + \pi/6)$ amps. Find the phasor \mathbf{I} that represents $i(t)$ (express your answer for \mathbf{I} in rectangular/cartesian form $x + jy$)

$$\overline{\mathbf{I}} = 5 \angle \pi/6$$

$$x = r \cos \theta = 5 \cos(\pi/6) = 5 \frac{\sqrt{3}}{2}$$

$$y = r \sin \theta = 5 \sin(\pi/6) = \frac{5}{2}$$

\mathbf{I}	$\frac{5\sqrt{3}}{2} + j \frac{5}{2}$
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- b) Convert the phasor $\mathbf{V} = 1 + j\sqrt{3}$ to time domain expression $v(t)$. (express the angle in **radians** not degrees)

$$r = \sqrt{x^2 + y^2} = \sqrt{1 + 3} = \sqrt{4} = 2$$

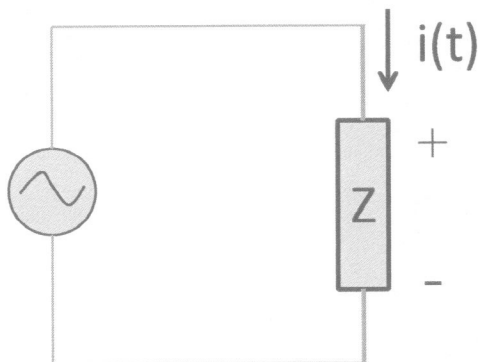
$$\theta = \tan^{-1}\left(\frac{y}{x}\right) = \tan^{-1}(\sqrt{3}) = \pi/3$$

$$v(t) = 2 \cos(\omega t + \pi/3)$$

$v(t)$	$2 \cos(\omega t + \pi/3)$
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PROBLEM 5: (20 points)Find \mathbf{V} , \mathbf{I} , and $i(t)$ if $\mathbf{Z} = 10 e^{j\pi/4} \Omega$.(express your answers for \mathbf{V} and \mathbf{I} in polar form $re^{j\theta}$)(express all angles in **radians** not degrees)

$$v_s(t) = 10 \cos(20t + \pi/3) \text{ volts}$$



$$\bar{V}_s = 10 e^{j\pi/3} \text{ V}$$

$$\bar{I} = \frac{\bar{V}_s}{\mathbf{Z}} = \frac{10 e^{j\pi/3}}{10 e^{j\pi/4}} = e^{j\pi/12} \text{ A}$$

$$i(t) = \cos(20t + \pi/12) \text{ A}$$

\mathbf{V}	$10 e^{j\pi/3} \text{ V}$
\mathbf{I}	$e^{j\pi/12} \text{ A}$
$i(t)$	$\cos(20t + \pi/12) \text{ A}$