1) a) $V_{Th} = I_C \left[R + \frac{1}{jwC} \right]$

$Z = R - \frac{1}{wC}$

$|Z| = \sqrt{R^2 + \frac{1}{Cw^2}}$

$|Z| = \sqrt{(3.9k)^2 + \left(\frac{1}{2000\pi \times 10^{-8}} \right)^2}$

$|Z| = 16.39 k\Omega$

$\theta = \arctan \left(\frac{1}{2000\pi \times 10^{-8}} \right) = 78.63$

$I_C = \frac{A}{Z} = \frac{5}{16.4} = 0.304 \angle 78.63^\circ$

b) $Z = \sqrt{(5.9)^2 + \left(\frac{1}{wC} \right)^2}$

$I_C = \frac{5}{Z}$

$\theta = \arctan \left(\frac{1}{wC} \right)$

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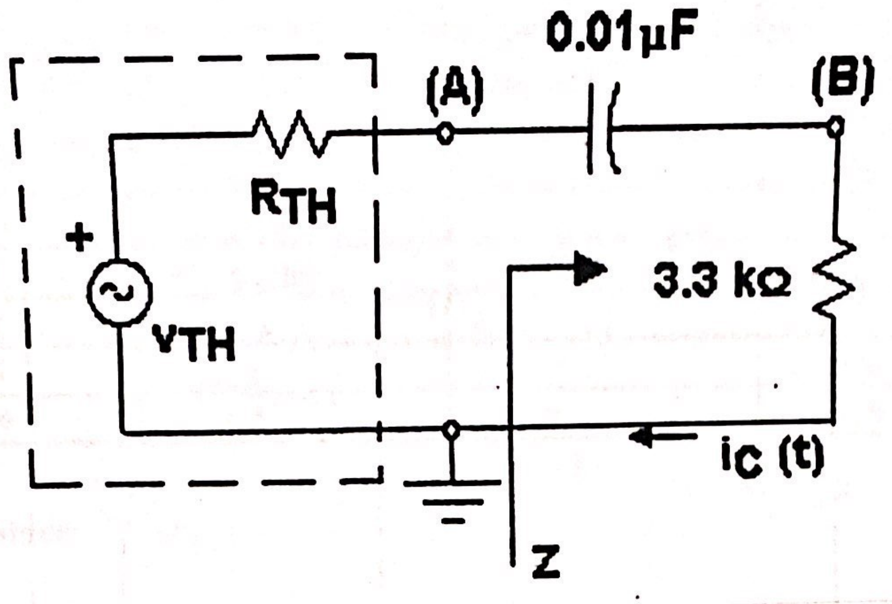

Fig (6.1)

Table (6.1)

Frequency (kHz)	$\lvert Z \rvert$ (kΩ)	θ°_Z	$\lvert I_C \rvert$ (mA)
0.5	32.885	83	0.155
1	16.4	78	0.3
2	8.86	63.75	0.59
5	5.032	39.5	0.95
10	4.21	22	1.186
20	3.98	11.5	1.25
50	3.92	4.66	1.277

2- Suppose that the capacitor in Fig (6.1) is replaced with a **"practical"** inductor whose equivalent circuit consists of a series combination of an inductive element of **0.5H** and a resistive element of **700Ω.**

a) Find the **SSS expression** for the inductor current $i_L(t)$.

b) Suppose that the frequency of $v_{TH}(t)$ is varied as listed in table (6.2), find the magnitude and phase angle of the impedance **Z**, where $Z = |Z|\angle\theta^\circ_Z$, and the peak value of the inductor current $|I_L|$, for each frequency setting.

Table (6.2)

Frequency (kHz)	$\lvert Z \rvert$ (kΩ)	θ°_Z	$\lvert I_L \rvert$ (mA)
0.1	4.012	4.48	1.23
0.2	4.05	8.92	1.25
0.5	4.297	21.4	1.16
1	5.085	38.13	0.98
2	7.45	57.5	0.67
5	16.20	75.7	0.308
10	31.65	82.7	0.159

6.4 Procedure:

Part I: The Sinusoidal-Steady-State Behaviour of An RC Circuit

1- Connect channel **"1"** of the oscilloscope across the output terminals of the function generator. Set the controls of the function generator to provide an **"open-circuit"** sinusoidal voltage of **5V (peak)** @ a frequency **(f)** of **500Hz.**

Connect the circuit shown in Fig (6.1). Set the oscilloscope for **ac-coupling, Y-Positions @ screen centre, Trigger Source @ Channel 1,** and **Trigger Slope @ Rising.** Connect channel **"1"** of the oscilloscope to display the voltage waveform @ node (A), and channel **"2"** to display the voltage waveform @ node (B). [*The "2" display now represents the (scaled-up) current waveform (3300) $i_C(t)$.*]

2- Measure the peak-value of $\mathbf{v_A(t)}$ and $\mathbf{v_B(t)}$, and record in table (6.3) under $\lvert V_A \rvert$ & $\lvert V_B \rvert$, respectively. Evaluate the peak value of the current $\lvert I_C \rvert$.

Phase-Angle Measurement

To measure the phase angle θ° [which is defined here as the phase angle of $\mathbf{v_B(t)}$ relative to $\mathbf{v_A(t)}$] as accurately as possible, proceed by setting the oscilloscope controls as follows:

First: Set **Horizontal Sensitivity** to display about **one period** of the **"1"** display. Adjust **Trigger Level** to trigger the **"1"** display @ the positive-going **zero crossing** instant, and move this point (with **"X-Position"** adjustment) to the left end of the screen.