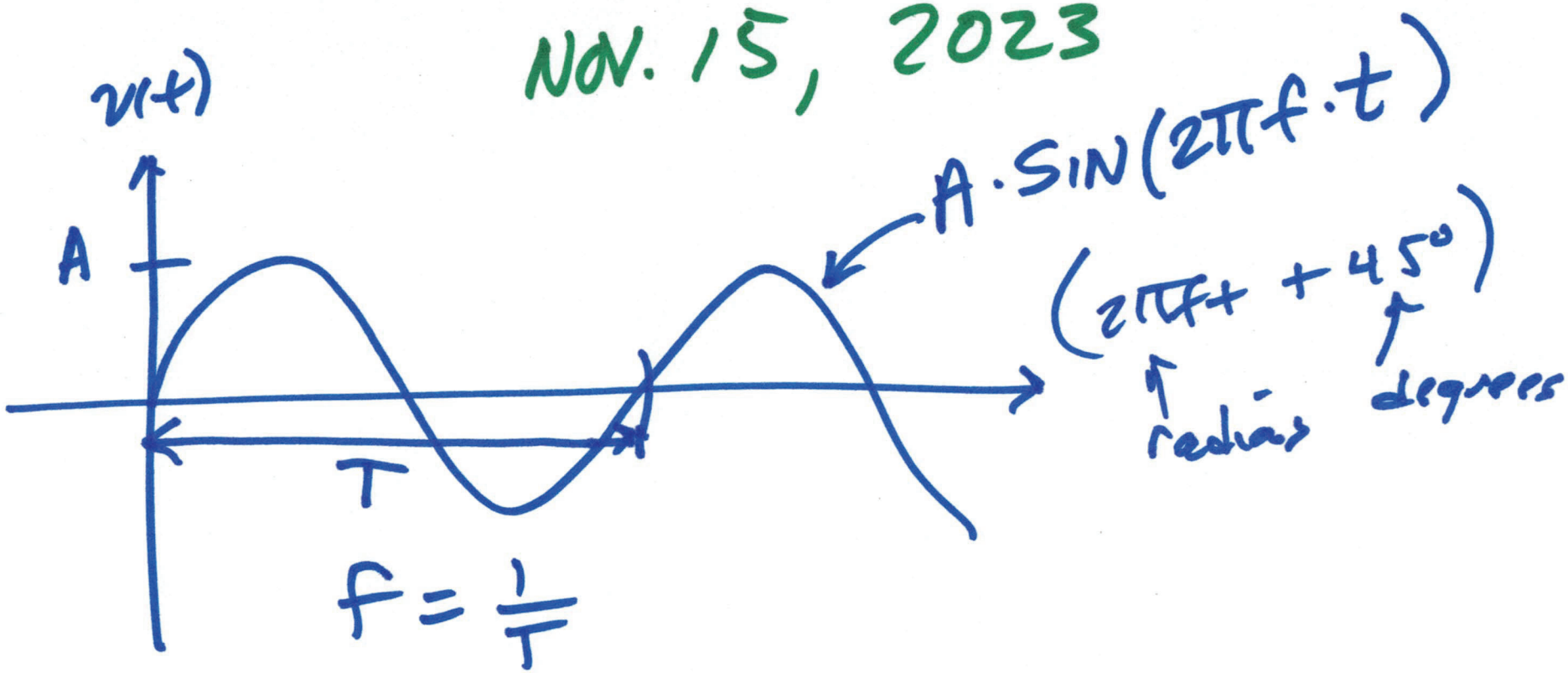
EE 220 Circuits I

Lecture 21

Nov. 15, 2023

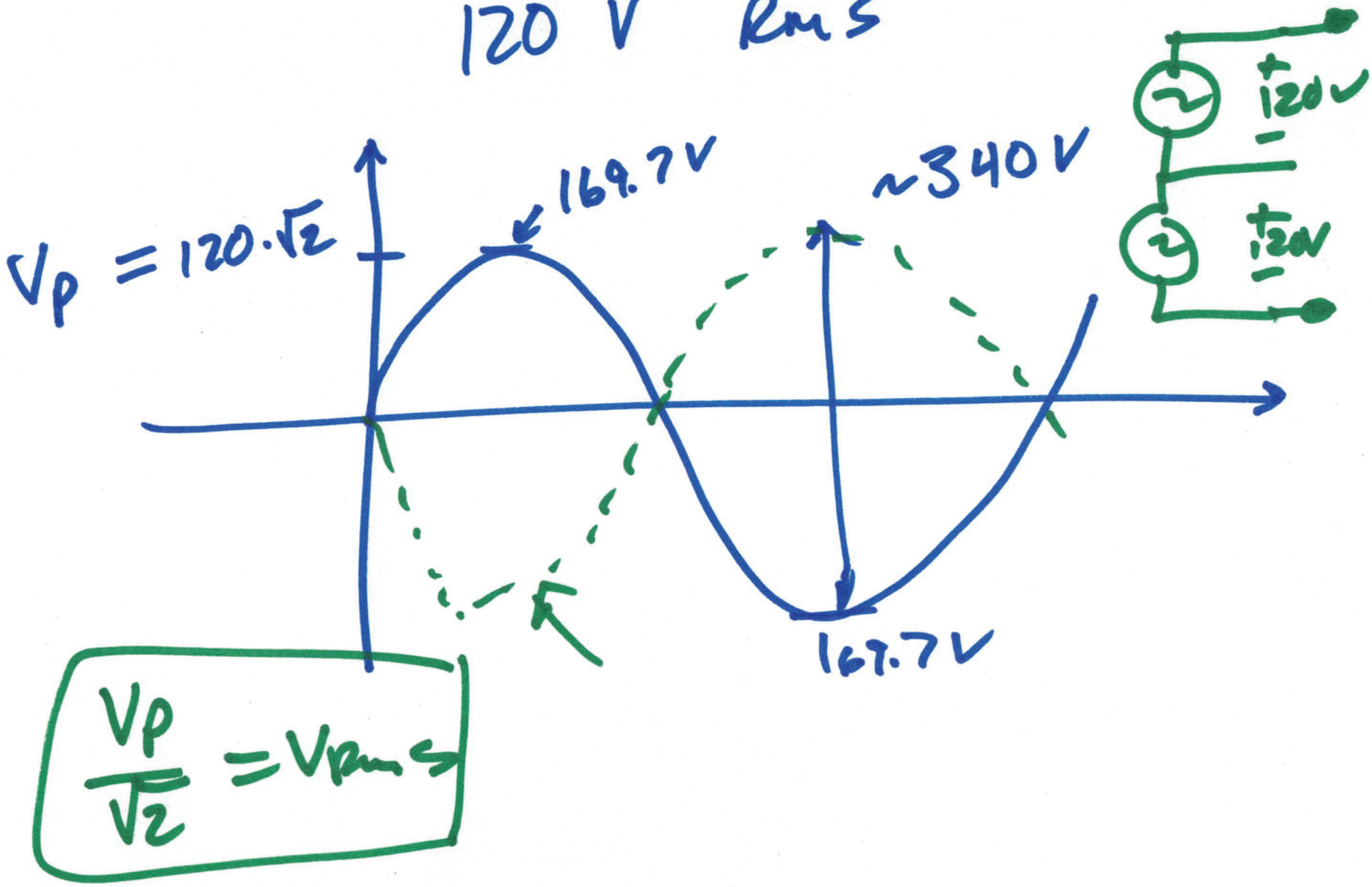


$$f = \frac{1}{T}$$

$f = 60\ \text{Hz}$, $T = 16.67\ \text{ms}$

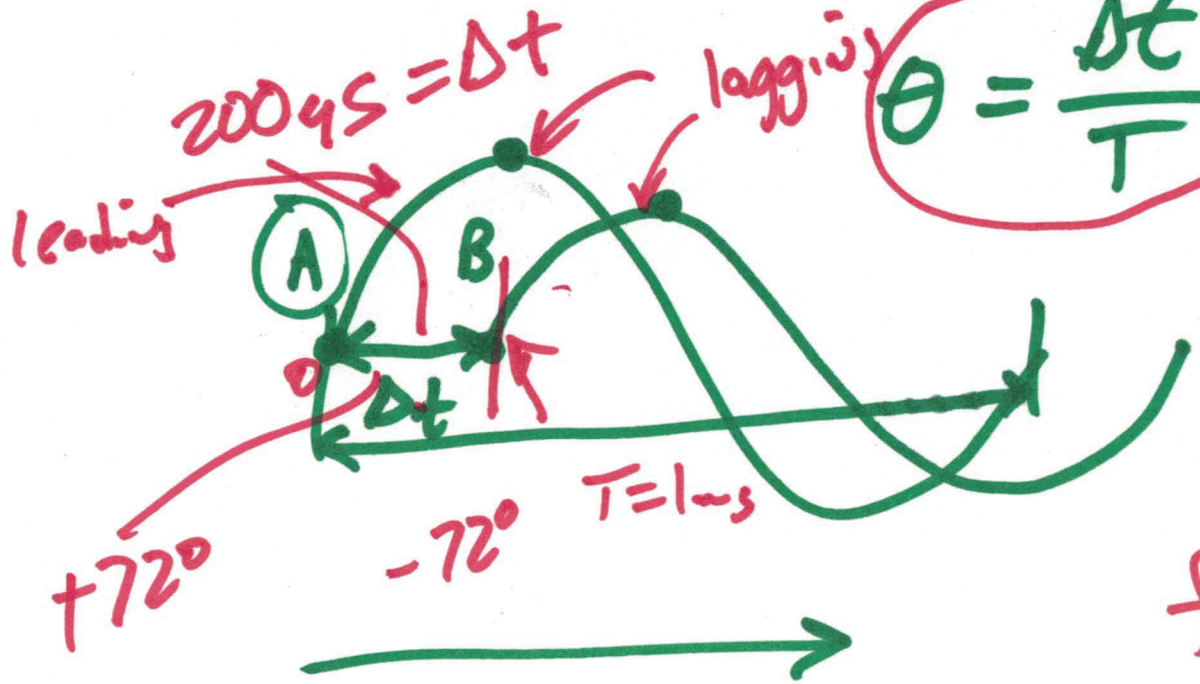
Root Mean Square (RMS)

120 V Rms



$$\frac{V_p}{\sqrt{2}} = V_{Rms}$$

Phase shift



$$\theta = \frac{\Delta t}{T} \cdot 360$$

$$= \Delta t \cdot f \cdot 360$$

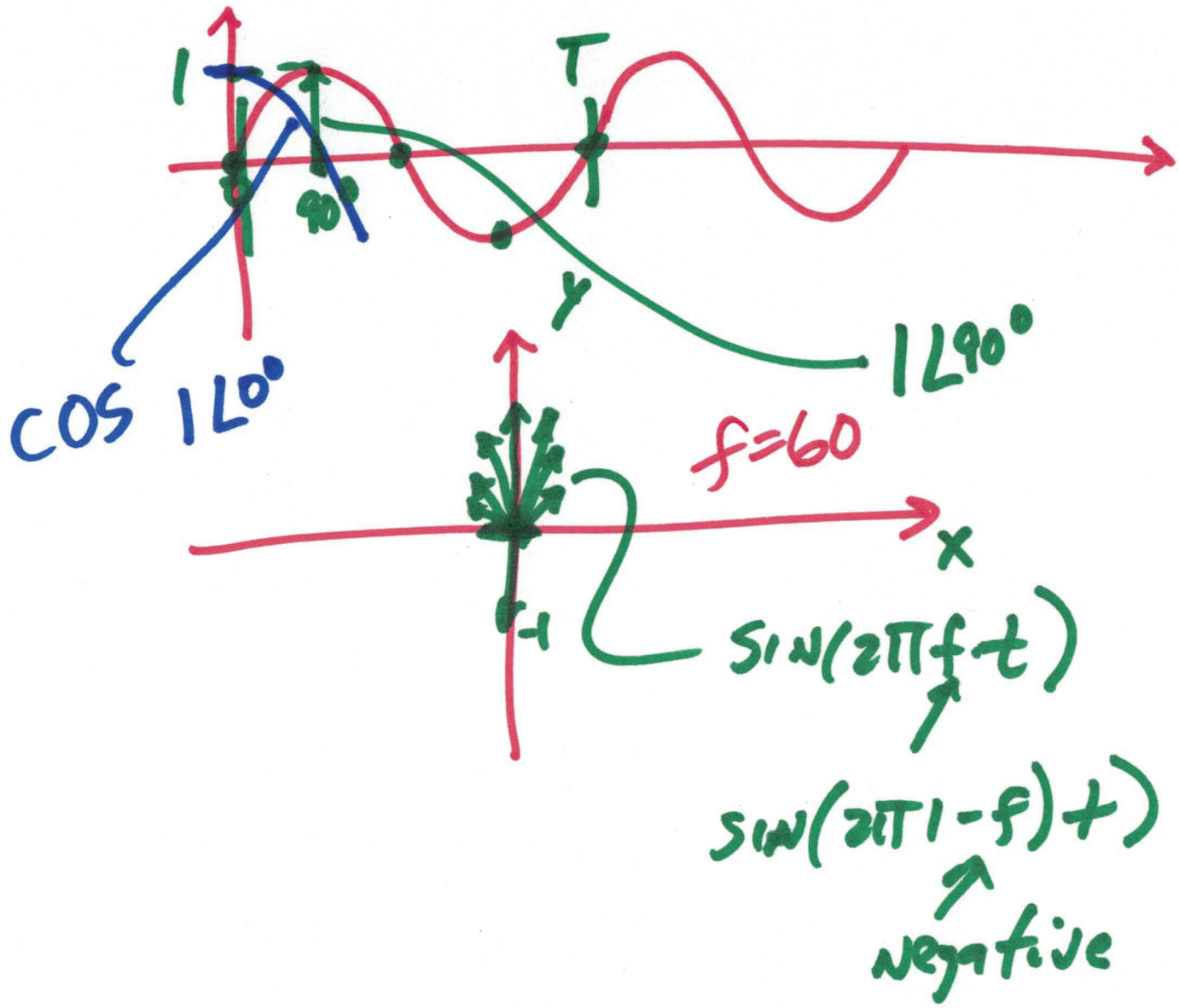
$$f = \frac{1}{T}$$

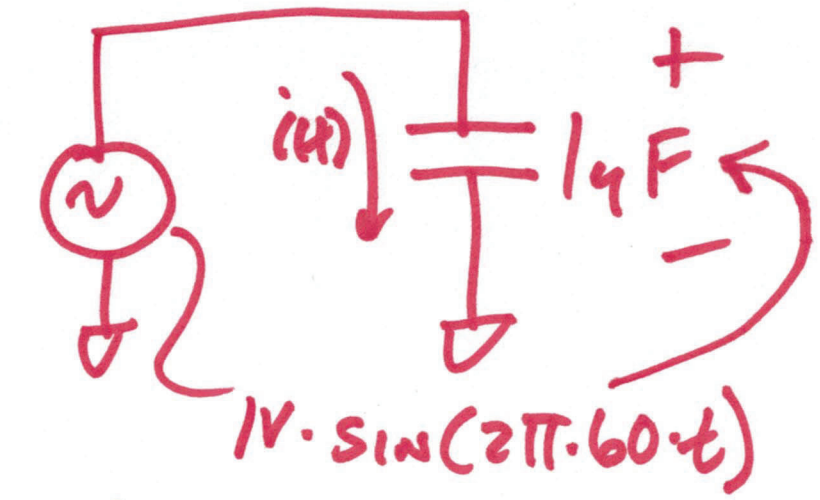
$$f = \frac{1}{1ms} = 1\,KHz$$

$$= 1{,}000\,Hz$$

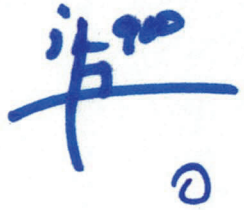
$$\theta = \frac{200\mu s}{1{,}000\mu s} \cdot 360 = \frac{360}{5} = \underline{\underline{72°}}$$

1ms


1
T
90
COS 1∠0°
1∠90°
y
f=60
x
-1
SIN(2πf·t)
SIN(2π1-f)+)
negative



$$i = C\frac{dv}{dt}$$



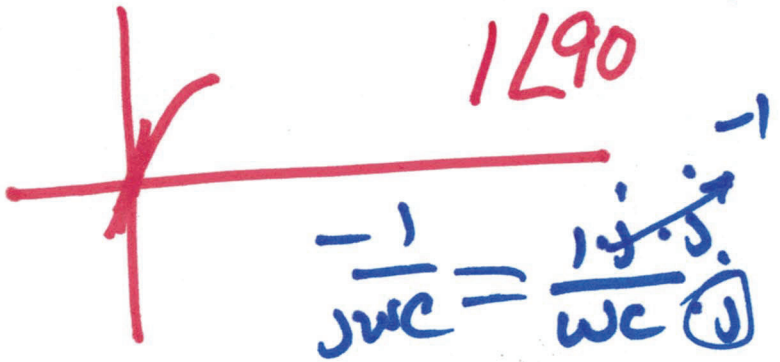
$1\angle 90°$

$$i(t) = C \cdot 2\pi 60 \cos(2\pi 60 t)$$

$$\frac{i(t)}{wc} = 10^{-6} \cdot 2\pi \cdot 60 \cdot \cos(\uparrow)$$

$wc = 2\pi f$

$$i(t) = 377\mu A \cos(\uparrow)$$



$$\frac{-1}{jwc} = \frac{1}{wc}\,j \cdot j$$

$1\angle 90°$

$$I(jw) = C \cdot \frac{2\pi 60}{w} \cdot 1\angle 0°$$

$1\angle 0°$

$V = I \cdot Z$

impedance (Resistance + Reactance)

$w = 2\pi f$

omega

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$$Z = \frac{1}{jwc}$$

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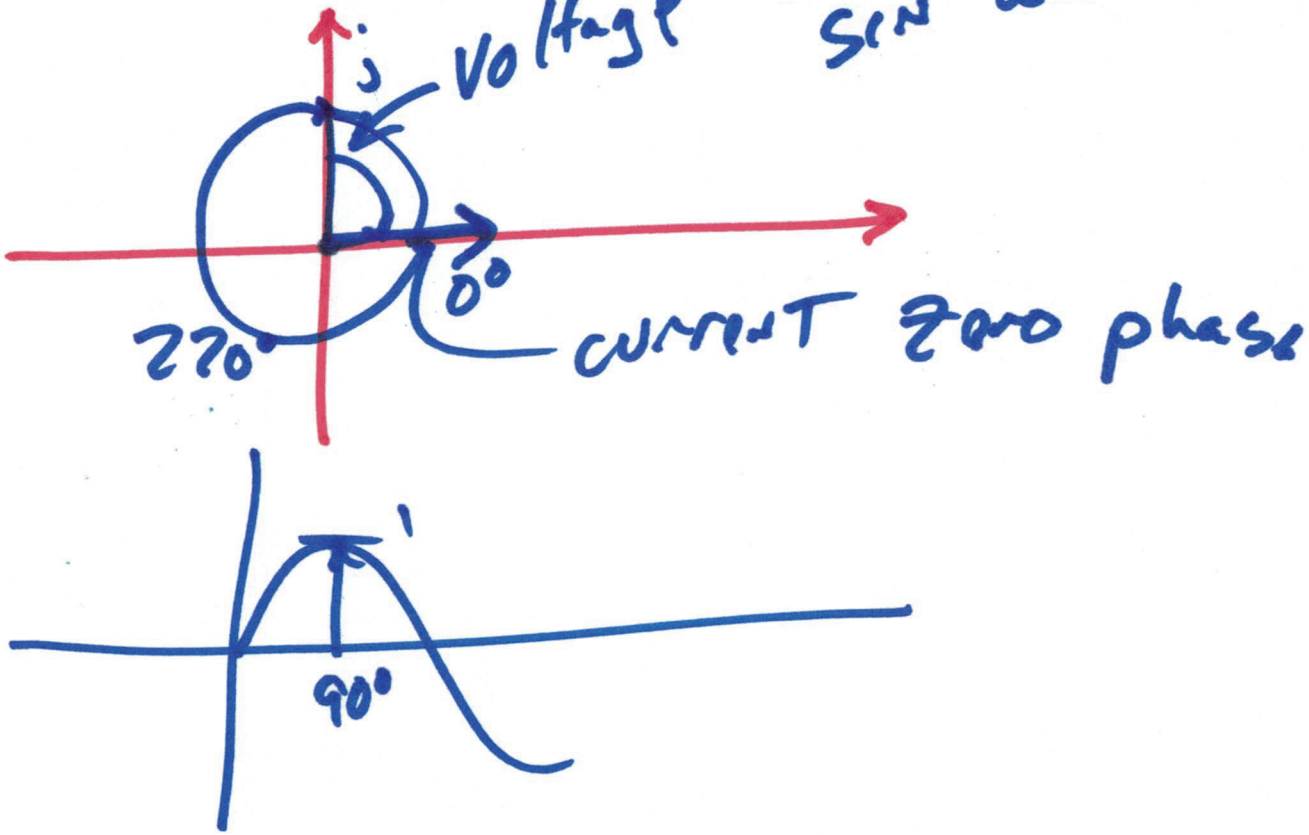
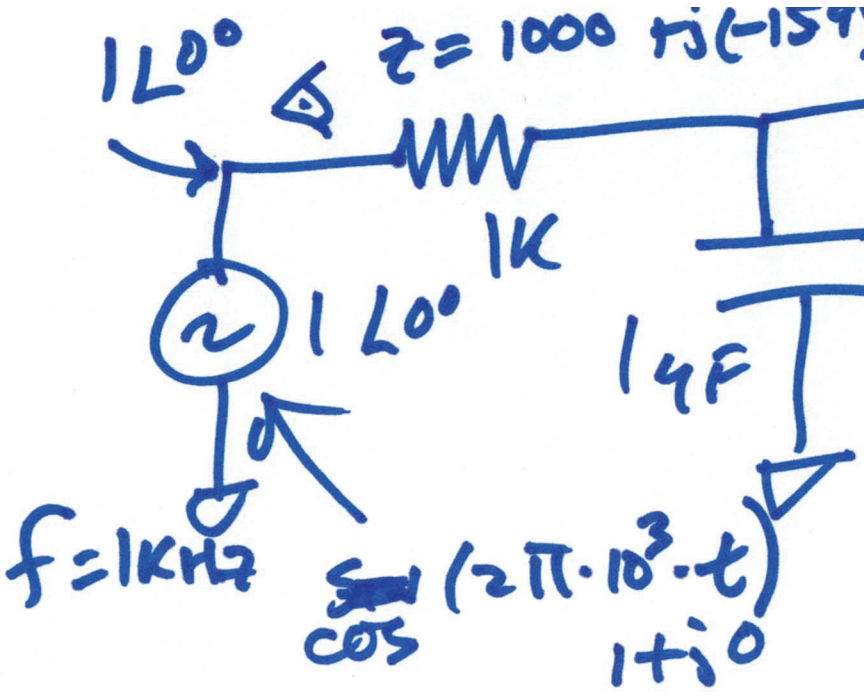
$$Z_C = \frac{1}{j\omega C} = \frac{1}{j2\pi fC}$$

Z_C ↑ Reactance

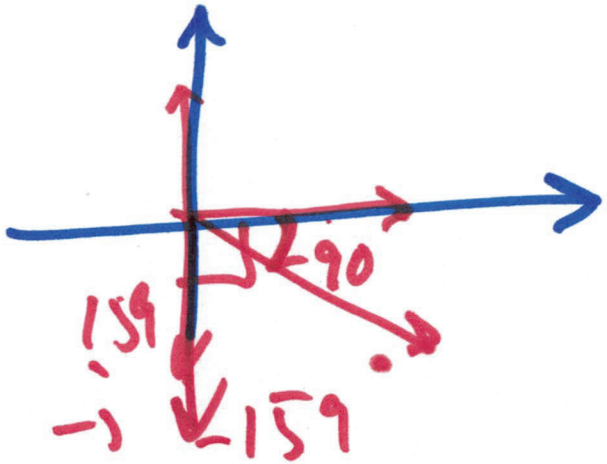




$$\frac{1}{j\omega C} = \frac{1}{j \cdot 2\pi \cdot 10^3 \cdot 10^{-6}}$$

$$\frac{1}{2\pi f} = -j159$$

$$V_{OUT} = 1\angle 0^\circ \cdot \frac{0 + j(-159)}{1000 + j(-159)}$$



$$V_{OUT} = 1\angle 0^\circ \cdot 159\angle -90^\circ$$

$$V_{OUT} = \frac{1\angle 0^\circ \cdot 159\angle -90}{\sqrt{(1000)^2 + (-159)^2}\ \tan^{-1}\frac{-159}{1000}}$$

$$V_{oT} = \frac{120 \cdot .159 \angle -90}{1012 \angle -9^\circ}$$

$$V_{oT} = .157 \angle -90 - (-9)$$

$$0.157 \angle -81^\circ$$

$$-81 = \frac{\Delta t}{1ms} \cdot 360$$

$\Delta t = 225\,\mu s$

lagging