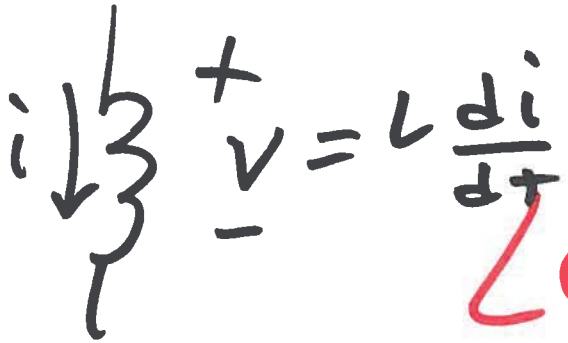
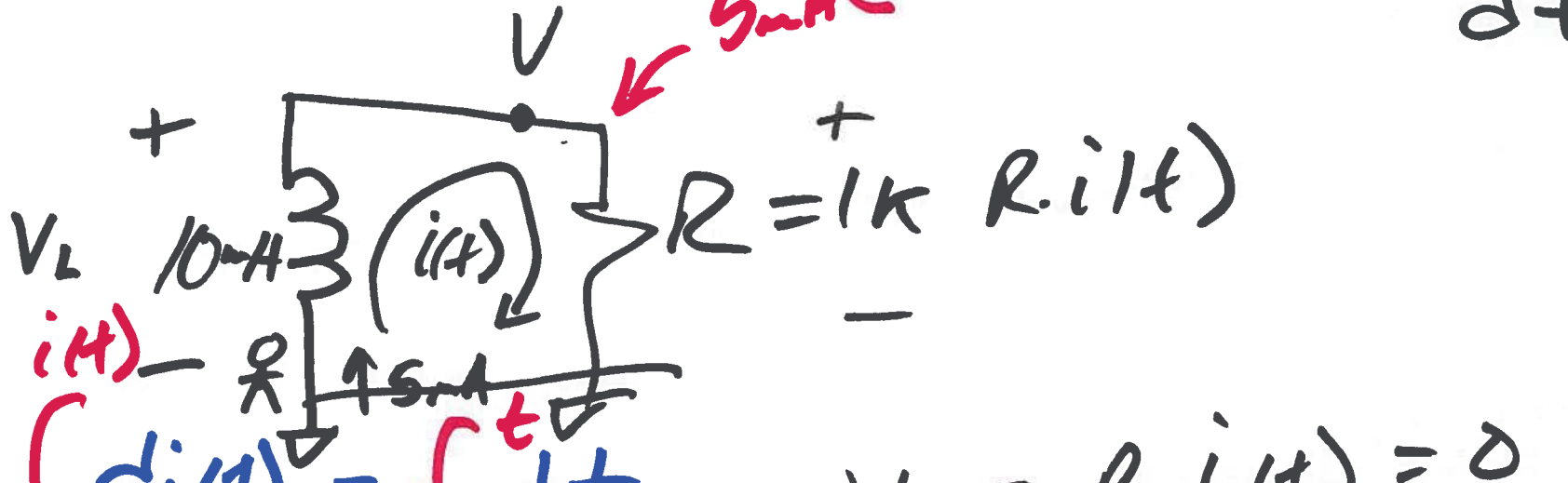
EE 220
Circuits 1
Lecture 21



$$v = L\frac{di}{dt}$$



$$V_L = L\cdot\frac{d(-i(t))}{dt}$$

$$-\frac{L}{R}\int_{-i(0)}^{i(t)}\frac{di(t)}{i(t)} = \int_0^t dt$$

$$V_L - R\cdot i(t) = 0$$

$$-L\frac{di(t)}{dt} = R\,i(t)$$

$$-\frac{L}{R} \cdot = -\frac{L}{R}\int_{i(0^-)}^{i(t)} \frac{di}{i} = \int_0^t dt = t$$

$$(\ln i(t) - \ln i(0^-)) = t$$

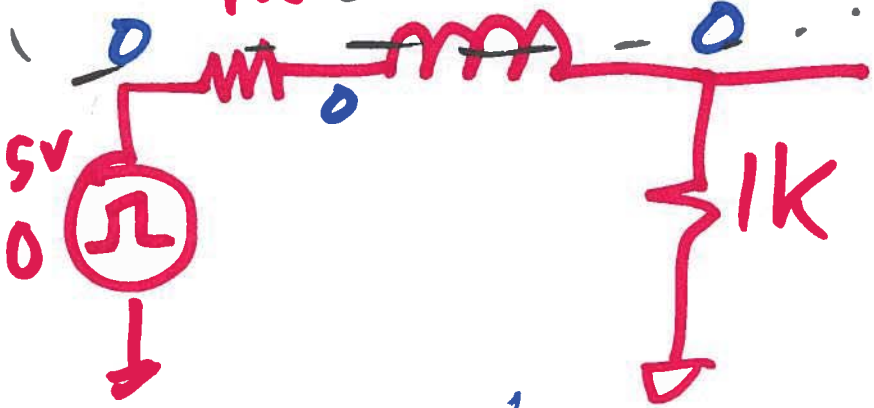
$$\ln i - \ln i(0^-) = -t/L/R$$

$$\ln \frac{i}{i(0^-)} = -t/L/R$$

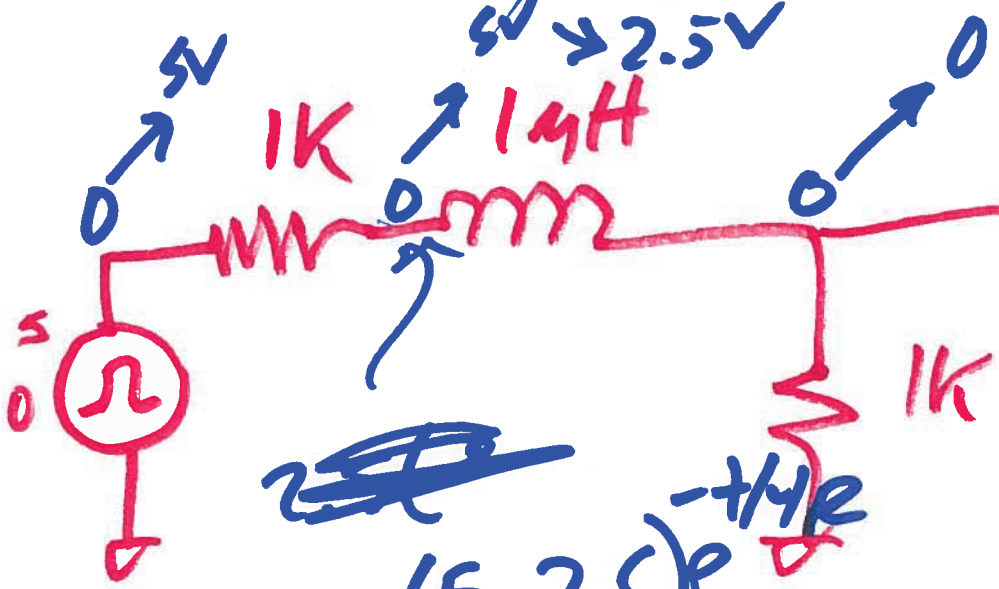
$$i(t) = i(0^-)\, e^{-t/L/R}$$

$$2(t) = 5e^{-t/L/R}$$

(5V 1K 2.5 1mH 2.5V) DC



V(t) = ?



$v_s = 2.5$

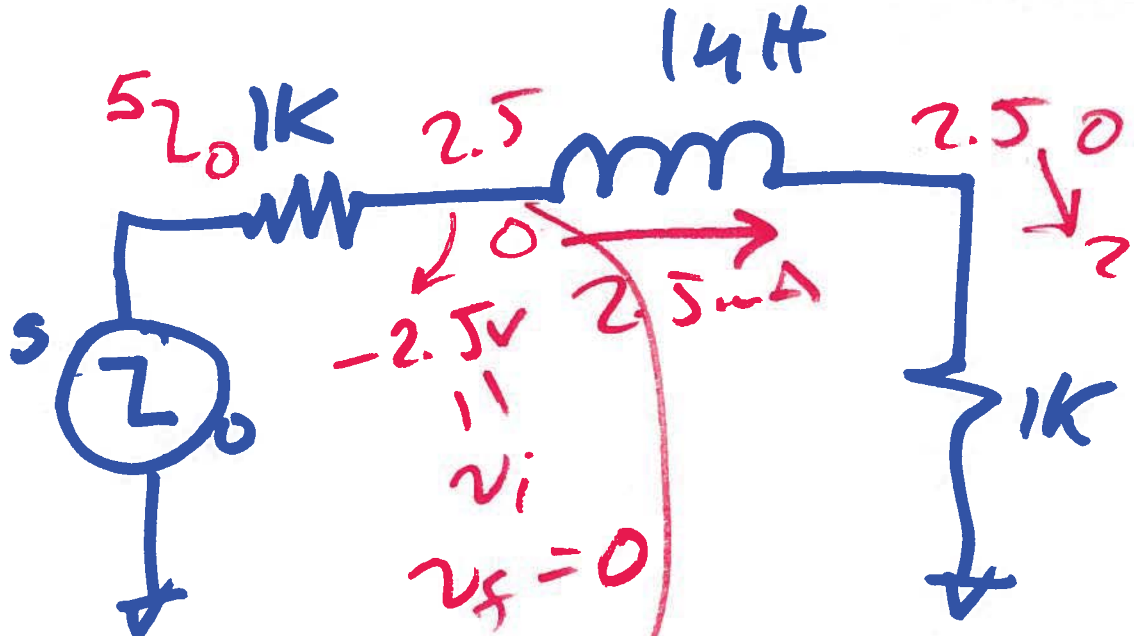
$v_i = 0$

V(t) =

$2.5 + (0 - 2.5)e^{-t/\tau}$

$= 2.5(1 - e^{-t/\tau})$

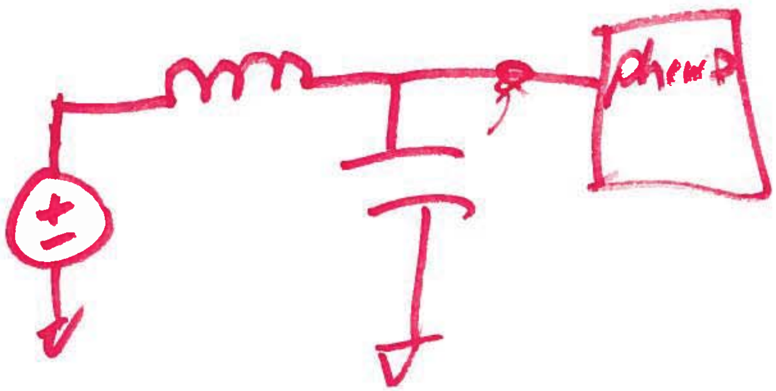
$2.5 + (5 - 2.5)e^{-t/\tau}$



$$2.5e^{-t/\tau}$$

$$2.5 = v_i$$

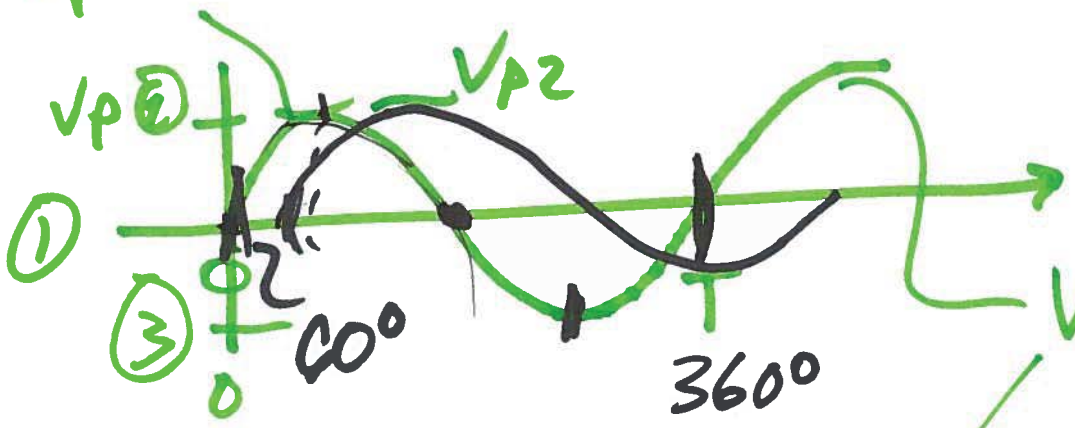
$$v_f = 0$$



$$0 + (-2.5 - 0)e^{-t/\tau}$$

$$\tau = \frac{L}{R}$$

$V_p \angle 0^\circ$ AC Voltages @AM



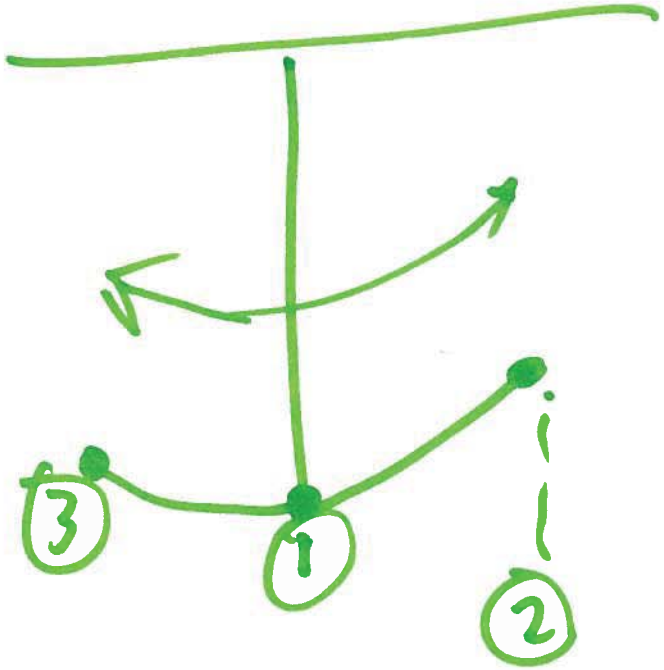
$$f = \frac{1}{T}$$

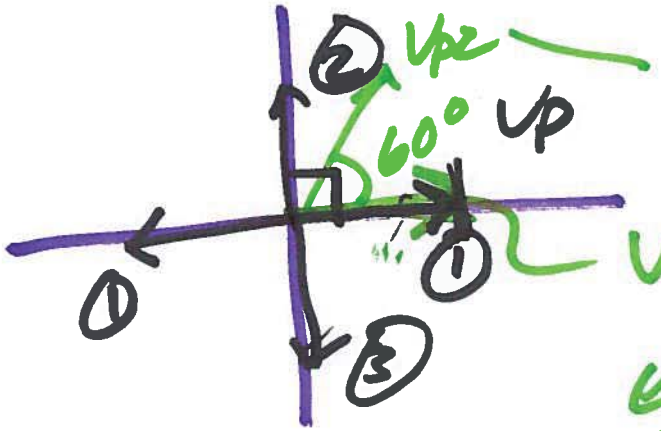
$$V_p \sin(2\pi \cdot t)$$

$$V_p \sin(360t + 90^\circ)$$

$$V_p \sin(2\pi \cdot t + 90^\circ)$$

Rads Deg.

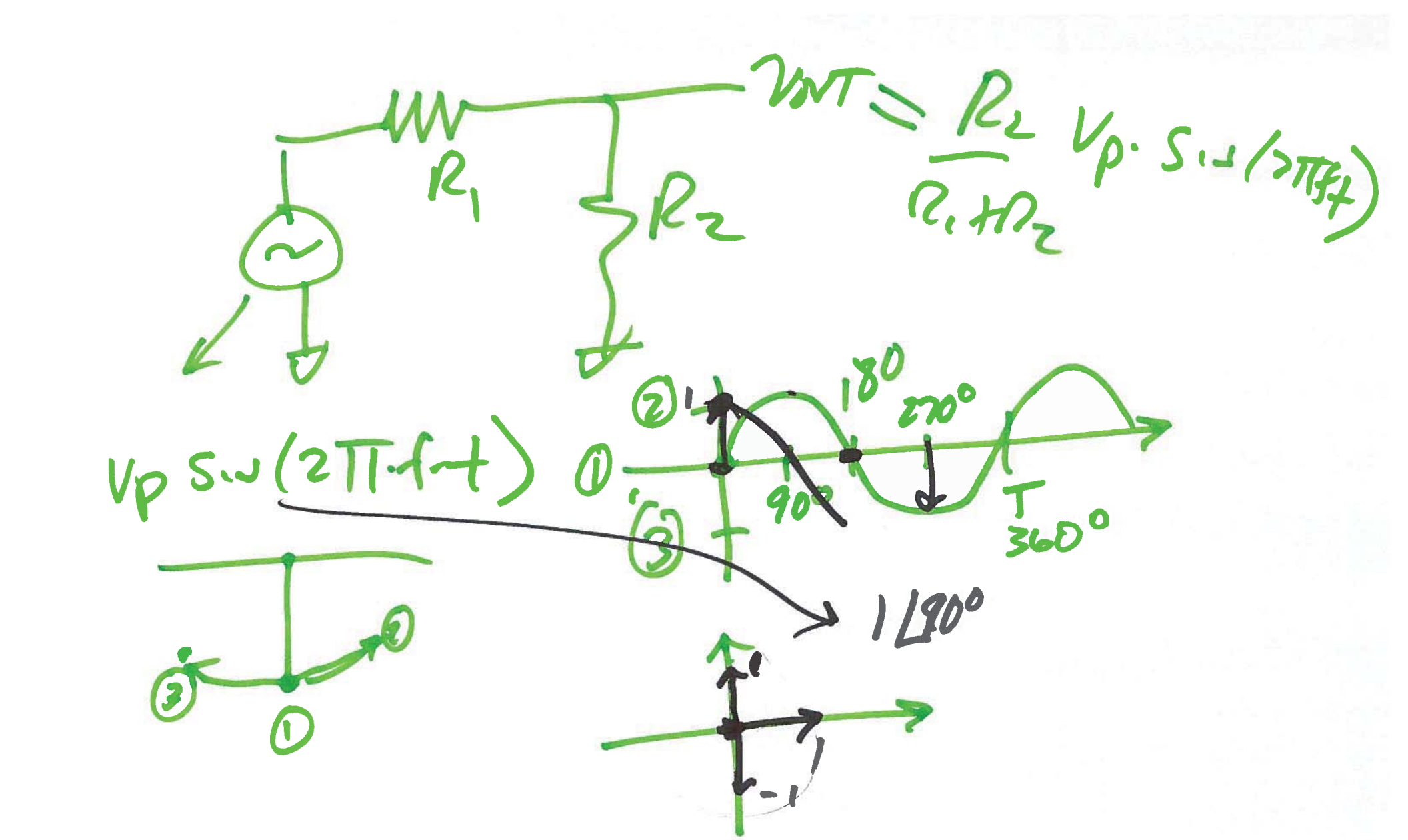




$V_{p2} \angle 60^\circ$

$V_p \angle 0^\circ$ (V_{p2} sin(2πt + 60°))

$V_p \sin(2\pi t)$


$V_{OUT} = \frac{R_2}{R_1+R_2} V_p \cdot \sin(2\pi f t)$
R_1
R_2
$V_p \sin(2\pi \cdot f \cdot t)$
1
2
3
90°
180°
270°
T
360°
$1\angle 90°$

b)

Examples

$v(t) = \cos(2\pi \cdot 60 \cdot t) \Rightarrow 1\angle 0°$

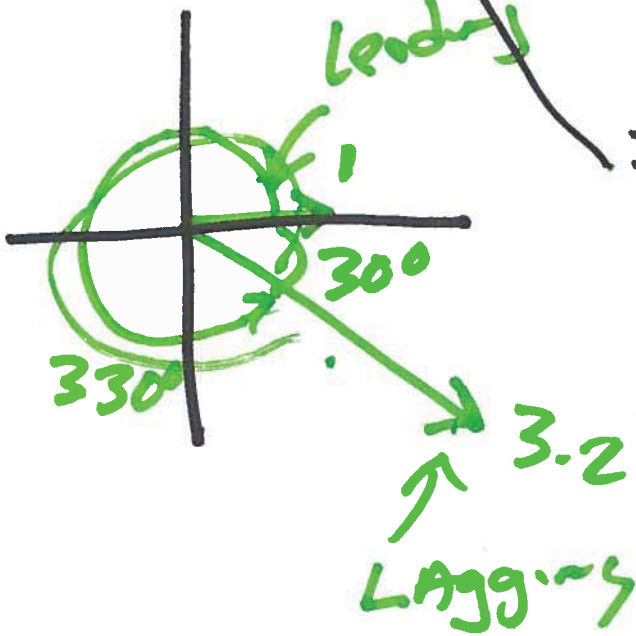
$= 2\cos(2\pi \cdot 60 \cdot t) \Rightarrow 2\angle 0°$

$= \sin(2\pi \cdot 60 \cdot t) \Rightarrow 1\angle 90°$

$+ 330°$

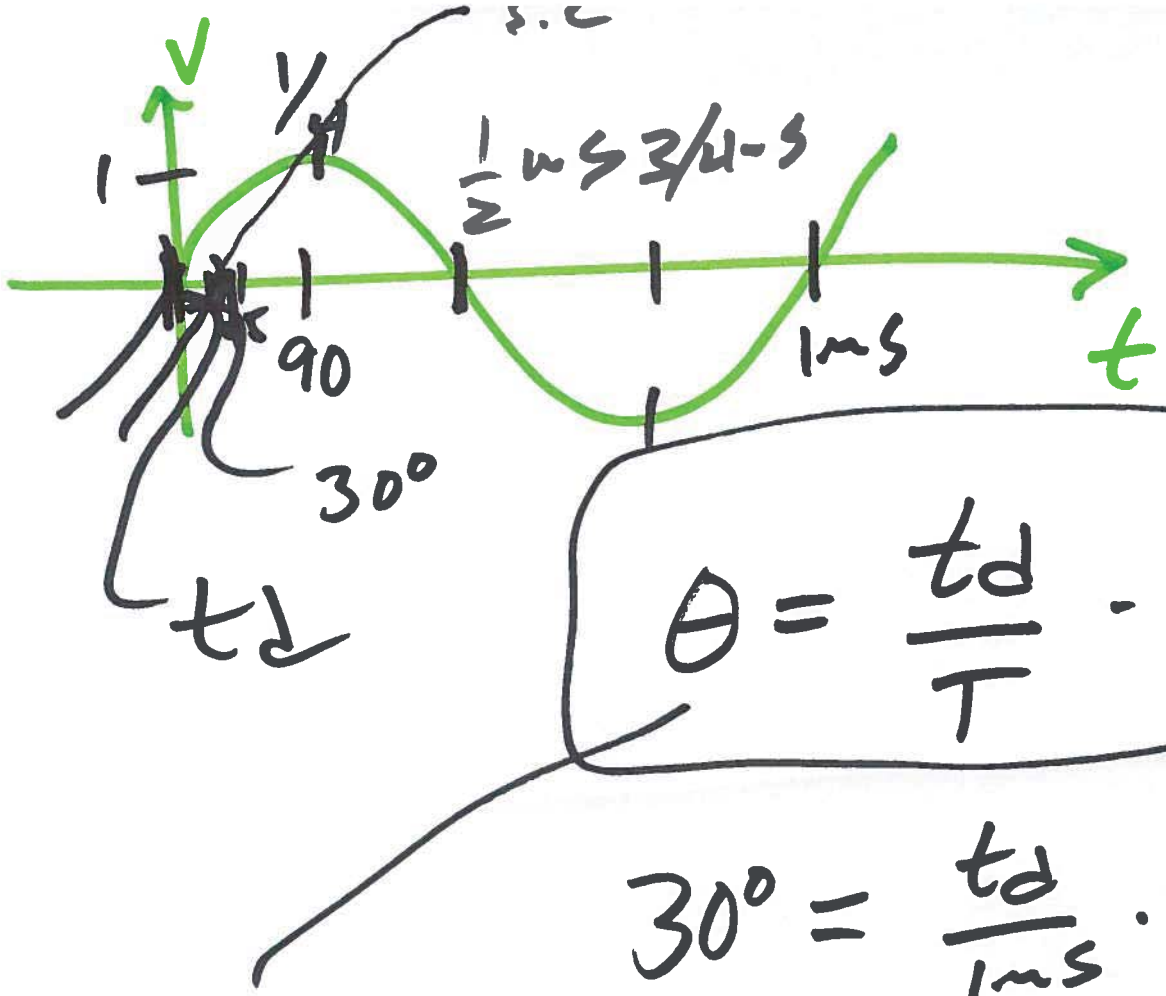
$= 3.2\cos(2\pi 60 t - 30°)$

$\Rightarrow 3.2\angle -30°$



$= 2\sin(2\pi \cdot 60 t - 30°)$

$\Rightarrow 2\angle 60°$



$$\theta = \frac{t_d}{T} \cdot 360$$

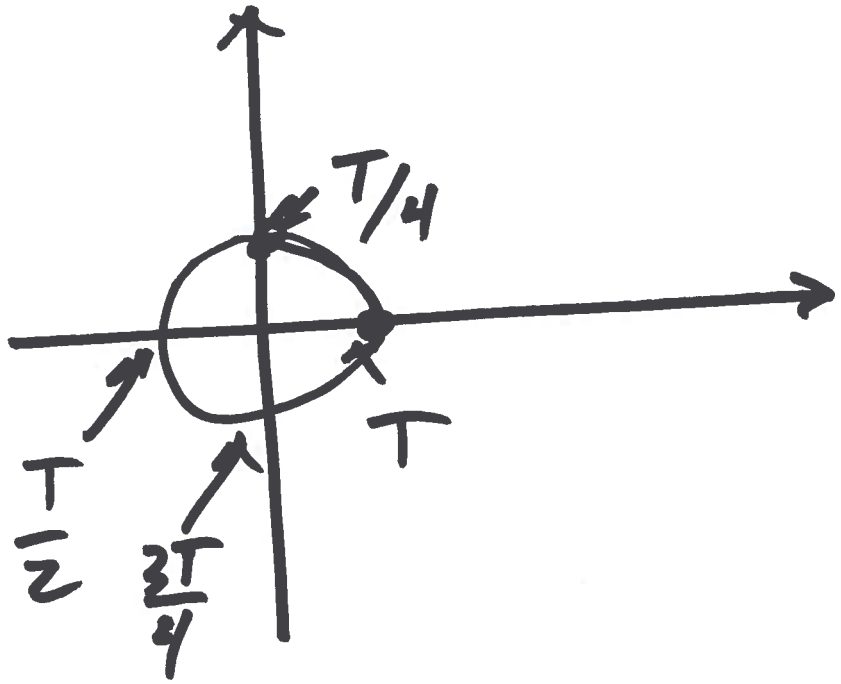
$$30° = \frac{t_d}{1ms} \cdot 360$$

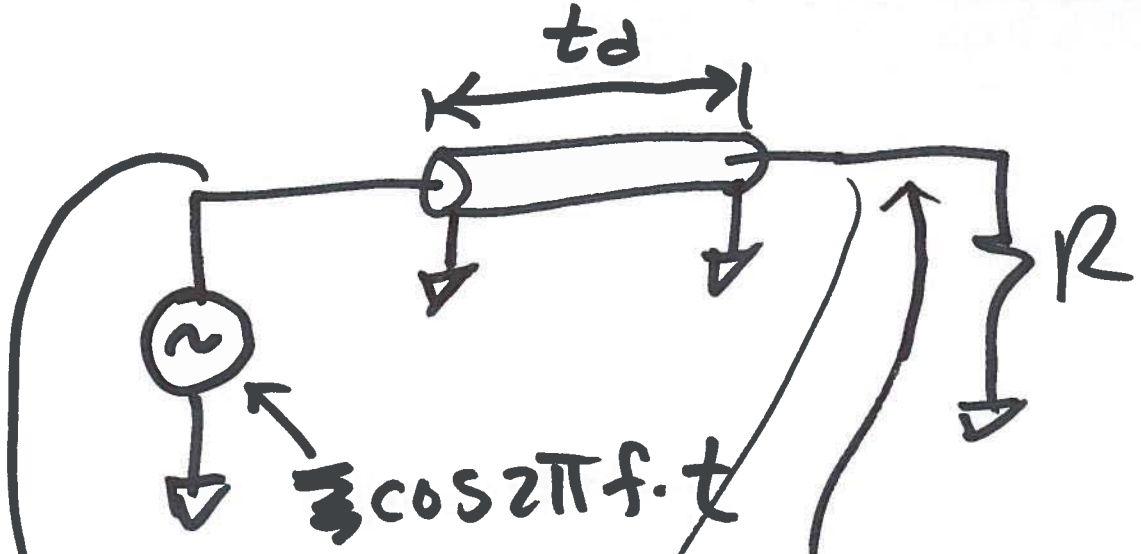
$$t_d = \frac{30}{360} \cdot 1ms$$

$$= \frac{1}{12} ms$$

$$\theta = t_d \cdot f \cdot 360$$

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


T/4
T
T/2
3T/4



$V_p \cos(2\pi f \cdot t - \theta)$

$\theta = \frac{t_d}{T} \cdot 360$

$= t_d \cdot f \cdot 360$

Input $V_p \angle 0°$

$V_p e^{j2\pi f t}$

$V_p \angle -\theta$

$V_p e^{j2\pi f(t - t_d)}$

$e^{j2\pi f \cdot (-t_d)}$

$V_p e^{j2\pi f \cdot t}$