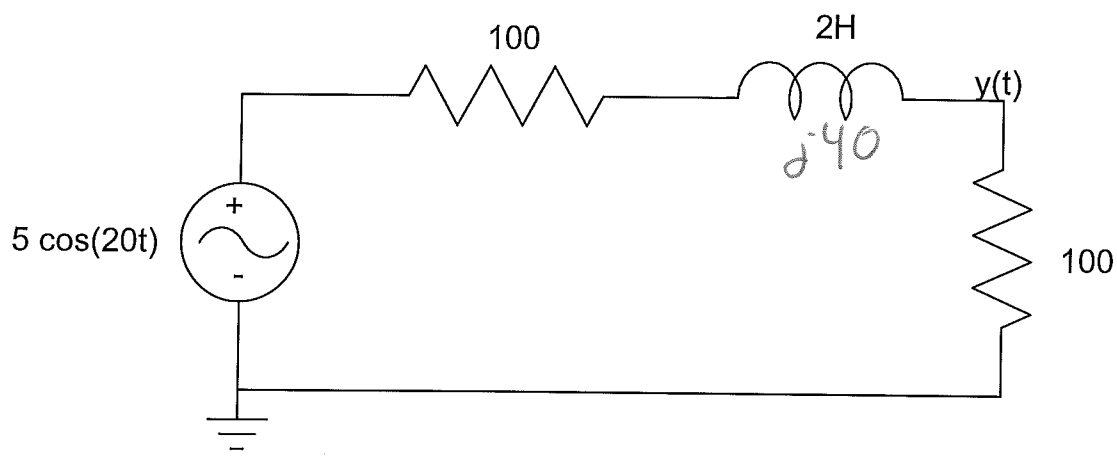
ECE 320: Quiz #2 Name _____ 9:00 / 11:00

Complex Numbers and Phasors - January 26, 2017

1) For the following circuit, determine the phasor impedance for each element and the voltage, y(t)

Phasor Representation for ...		
Vin = 5 cos(20t)	2H Inductor	Y
$5 + j0$	$j40$	$2.45\angle -11^\circ$ $2.40 - j\,0.488$
y(t) = $2.45\cos(20t - 11^\circ)$ $2.40\cos(20t) + 0.488\sin(20t)$		

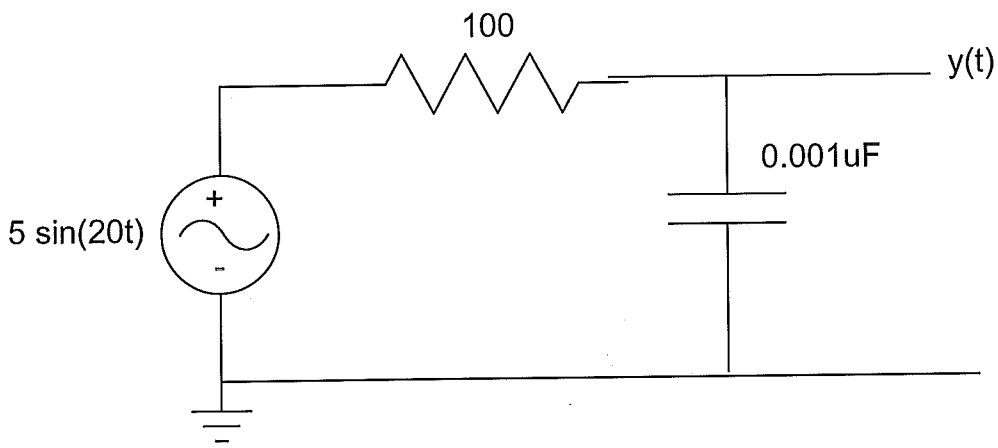


$$Y = \left(\frac{100}{100 + 100 + j40}\right) 5$$

$$= 2.45\angle -11^\circ$$

2) For the following circuit, determine the phasor impedance for each element and the voltage, y(t)

Phasor Representation for ...		
Vin = 5 sin(20t)	0.001F Capacitor	Y
$-j5$	$-j50$	$-2-j$ $2.236\angle -153^\circ$
y(t) = $-2\cos(20t) + \sin(20t)$ $2.236\cos(20t - 153^\circ)$		

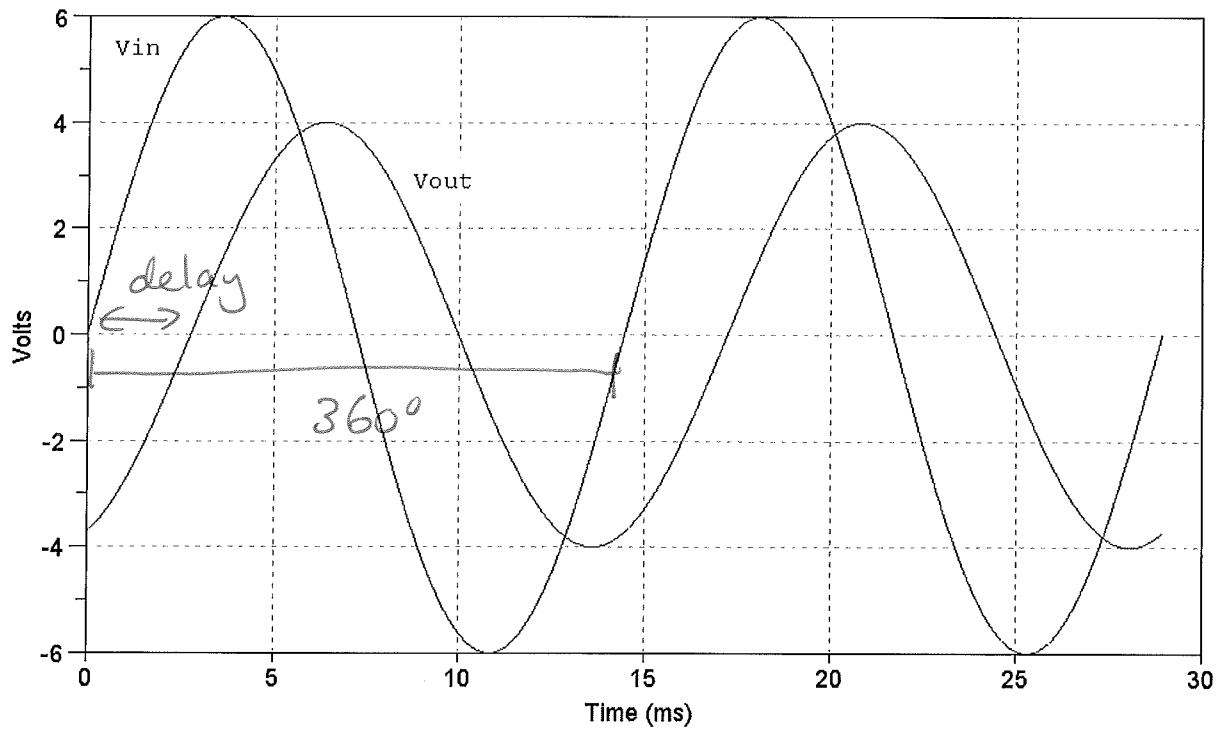


$$Y = \left(\frac{-j50}{-j50 + 100}\right)(-j5)$$

$$Y = 2.236\angle -153^\circ$$

3) The input and output voltage as seen on an oscilloscope are shown below. Determine the following:

Gain from Vin to Vout	Phase Shift from Vin to Vout	Frequency (Hz)
$\frac{4}{6}$	-61°	71 Hz



period = 14ms

$f = \frac{1}{\text{period}} = 71\,Hz$

$\text{phase} = -\left(\frac{12mm}{70mm}\right)360^\circ = -61^\circ$

4) A circuit has the following transfer function:

$$Y = \left(\frac{10s+3}{s^2+15s+100}\right)X$$

Find y(t) assuming

$$x(t) = 100 + 50\cos(10t)$$

y(t) = $3 + 33.3\cos(10t - 1.7^\circ)$

$X(t) = 100$

$s = 0$

$\left(\frac{10s+3}{\ldots}\right) = \frac{3}{100}$

$y = \left(\frac{3}{100}\right)100$

$y = 3$

$x = 50\cos(10t)$

$s = j10$

$\left(\frac{10s+3}{s^2+15s+100}\right)_{s=j\omega} = .667\angle -1.7^\circ$

$y = (.667\angle -1.7^\circ)(50\cos(10t))$

$y = 33.3\cos(10t - 1.7^\circ)$

5) A circuit has the following transfer function

$$Y = \left(\frac{10s+3}{s^2+15s+100}\right)X$$

What is the differential equation relating X and Y?

$$y'' + 15y' + 100y = 10x' + 3x$$

Bonus! It takes 109 million pounds of coal producing 327 million pounds of CO2 to power 300 million cell phones for a year.

- How many pounds of Uranium does it take?
- How much CO2 does this Uranium produce?

2-3 million : 1 ratio

36 to 54 pounds of uranium