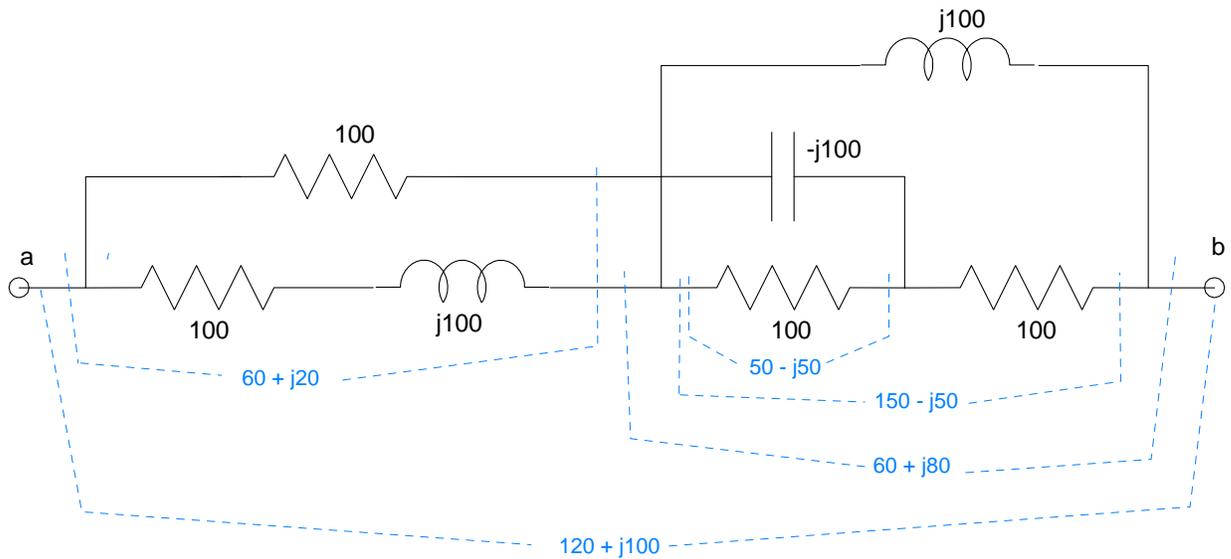


EE 206 Test #3 - Name _____

April 24, 2019

1) Determine the impedance Z_{ab}

$$Z_{ab} = 120 + j100$$



$$(100 + j100) \parallel (100) = 60 + j20$$

$$100 \parallel -j100 = 50 - j50$$

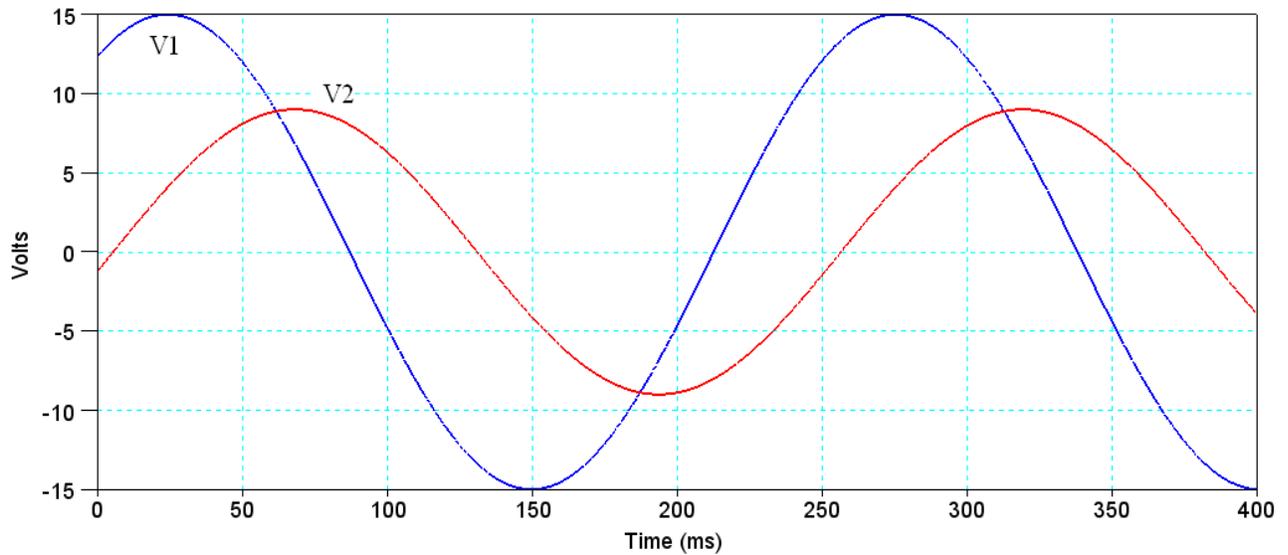
$$(50 - j50) + 100 = 150 - j50$$

$$(150 - j50) \parallel (j100) = 60 + j80$$

$$(60 + j20) + (60 + j80) = 120 + j100$$

2) Determine the frequency and phasor representation for V1 and V2

| Frequency (Hz) | V1 | | V2 | |
|----------------|----------------|-----------------|----------------|-------------------|
| | Amplitude (Vp) | Phase (degrees) | Amplitude (Vp) | Phase (degrees) |
| 4.0 Hz | 15.0 V | -36 deg | 9.0 V | -100.8 deg |



Period:

$$T = 255ms - 5ms = 250ms$$

$$f = \frac{1}{T} = \frac{1}{250ms} = 4Hz$$

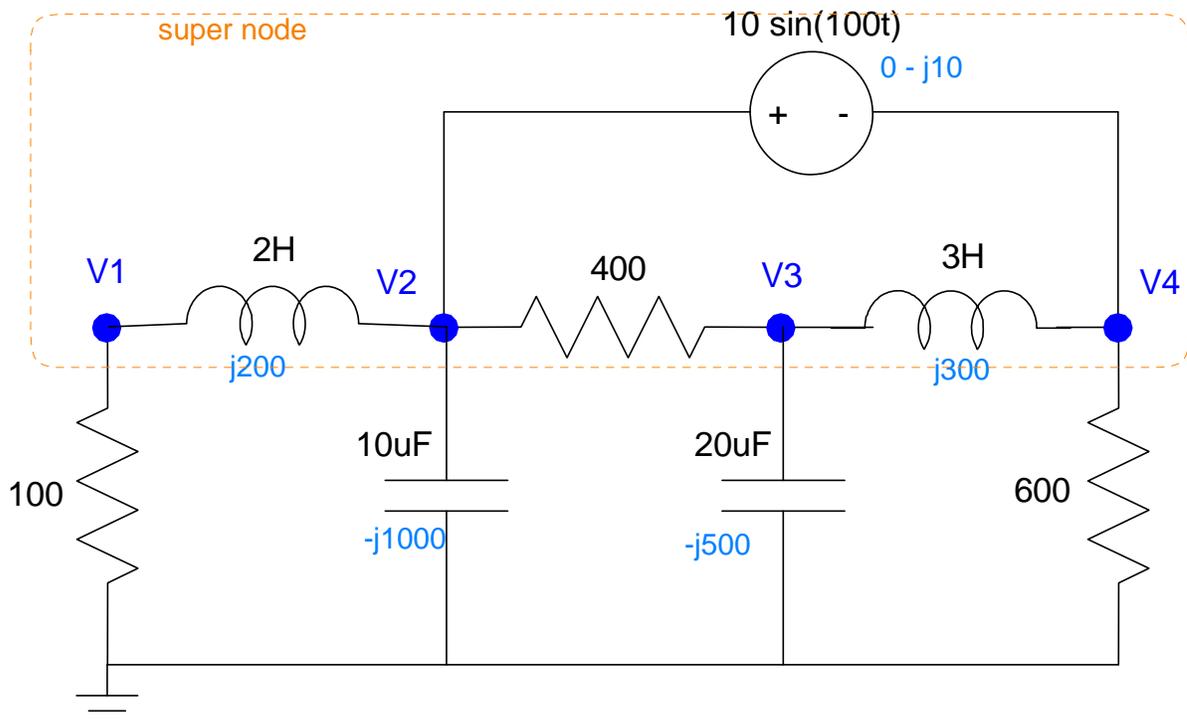
$$\phi_1 = -\left(\frac{25ms \text{ delay to peak}}{250ms \text{ period}}\right) \cdot 360^\circ$$

$$\phi_1 = -36^\circ$$

$$\phi_2 = -\left(\frac{70ms \text{ delay to peak}}{250ms \text{ period}}\right) \cdot 360^\circ$$

$$\phi_2 = -100.8^\circ$$

3) Write N equations to allow you to solve for the N unknown voltages



$$L \rightarrow j\omega L$$

$$C \rightarrow \frac{1}{j\omega C}$$

$$a \cos(\omega t) + b \sin(\omega t) \rightarrow a - jb$$

Equations:

$$V_2 - V_4 = -j10$$

$$\left(\frac{V_1}{100}\right) + \left(\frac{V_1 - V_2}{j200}\right) = 0$$

$$\left(\frac{V_3 - V_2}{400}\right) + \left(\frac{V_3}{-j500}\right) + \left(\frac{V_3 - V_4}{j300}\right) = 0$$

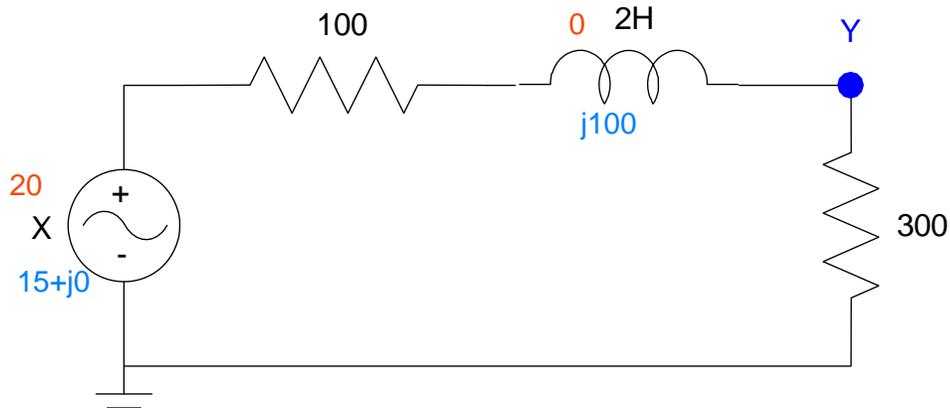
$$\left(\frac{V_1}{100}\right) + \left(\frac{V_2}{-j1000}\right) + \left(\frac{V_3}{-j500}\right) + \left(\frac{V_4}{600}\right) = 0$$

4) Assume

$$x(t) = 20 + 15 \cos(50t)$$

Determine the voltage, $y(t)$

$$y(t) = 15 + 10.59 \cos(50t) + 2.65 \sin(50t)$$



DC (orange)

$$L \rightarrow j\omega L = 0$$

$$Y = \left(\frac{300}{300+100} \right) 20$$

$$Y = 15$$

$$y(t) = 15$$

AC (blue)

$$L \rightarrow j\omega L = j100$$

$$15 \cos(50t) + 0 \sin(50t) \rightarrow 15 - j0$$

$$Y = \left(\frac{300}{(300)+(100+j100)} \right) (15 - j0)$$

$$Y = 10.59 - j2.65$$

$$y(t) = 10.59 \cos(50t) + 2.65 \sin(50t)$$

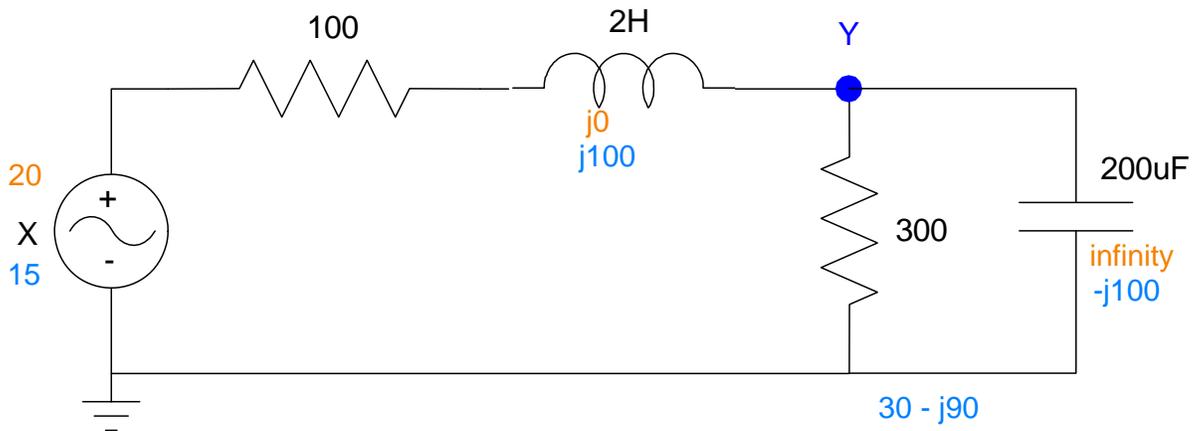
The total answer is the DC term plus the AC term

5) Assume

$$x(t) = 20 + 15 \cos(50t)$$

Determine the voltage, $y(t)$

$$y(t) = 15 + 2.65 \cos(50t) + 10.59 \sin(50t)$$



DC (orange)

AC (blue)

$$Y = \left(\frac{300}{300+100} \right) 20$$

$$L \rightarrow j\omega L = j100$$

$$Y = 15$$

$$C \rightarrow \frac{1}{j\omega C} = -j100$$

$$y(t) = 15$$

$$V \rightarrow 15 - j0$$

$$(300) \parallel (-j100) = 30 - j90$$

$$Y = \left(\frac{(30-j90)}{(30-j90)+(100+j100)} \right) (15 - j0)$$

$$Y = 2.65 - j10.59$$

$$y(t) = 2.65 \cos(50t) + 10.59 \sin(50t)$$

The total answer is the DC plus the AC term

Bonus! Suggest one thing that the U.S. government could do to reduce income inequality

(currently done in the U.S.A)

Make K-12 education free

- *Victorian England: only the wealthy could afford to send their kids to school*

Make college affordable (public universities)

- *Land Grants like NDSU*

Have a progressive tax system (people who make more pay a higher percentage)

- *0% tax rate if you make less than \$12,000 / year (standard deduction)*
- *37% for income above \$510,000*

Have a minimum wage

- *1900's wages were 25 cents per day with 14 hour work days*

Establish trade unions

- *Check on management.*
- *Profits must be shared or else you get a strike*

Have an inheritance tax

- *Make it harder to accumulate massive wealth over generations*

(currently done elsewhere)

Half of the board of trustees must be hourly workers (Germany, Iceland)

- *Profits must be shared more equitably*
- *More prone to invest in a factory to keep jobs local than moving production over seas*

Make college free (Germany, Norway, Spain, elsewhere)

- *Everyone has a chance to go to college - regardless of how rich your parents are*

(Other ideas being kicked around...)

Implent a salary cap (through the tax code: 90% income tax on income above \$10 million - Eisenhower)

- *No point in keeping all of a company's profits to yourself (90% tax rate).*
- *Profits have to go somewhere else, like investing in the company, paying employees more, investing in the community*

Raise the inheritance tax on inheritances above \$10 million (Pommeroy)

- *The greatest sin a person can do is to die rich. Andrew Carnigie.*
- *Do something with your wealth before you die: build a university, cure a disease, start a company...*
- *A voluntary tax: if you don't want to pay it, don't die rich.*

Tax all income the same (capital gains are treated like other income)

- *Most investment income goes to the wealthy (people with money to invest).*
- *Currently the capital gains tax rate (20%) is about half of the income tax rate (37%)*

Raise the minimum wage