Big Picture

Phasors

- Nodal ← you are here
- Mesh
- Superposition
- Source transforms
- Norton / Thevenin
- Opamps

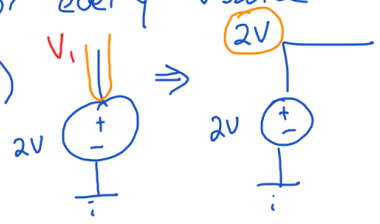
Convert to phasor domain

Convert to time domain

Nodal Analysis KCL: Σi's exiting node = 0

1. Choose ground
2. Label all unknown nodes $V_1, V_2, V_3 \ldots$
3. For every V source reduce 1 unknown

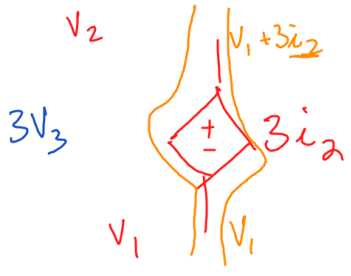
a)



b)

4. KCL @ every node (supernode). Do not do at ground!
5. Dependent sources? "Add an extra equation" (often Ω's Law)

Matrix & Solve



$i_2 = \frac{V_3 - V_4}{6}$

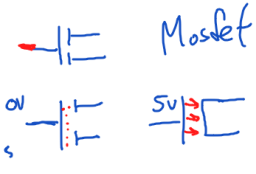
N variables N eqns ✓

N nodes → N eqns

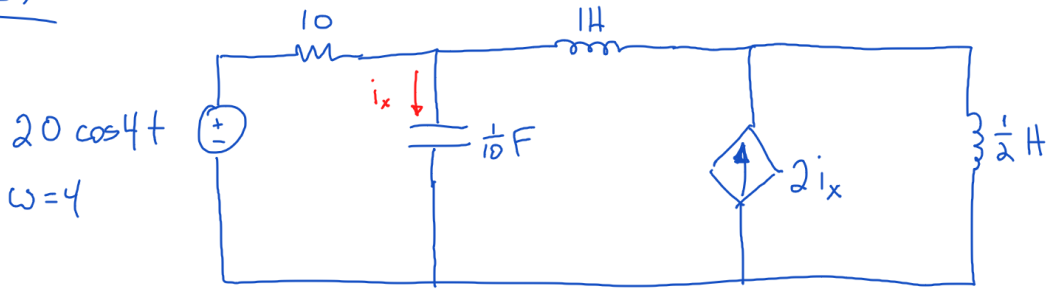
+1 dep source Nodes

+ N+1 variables N eqns

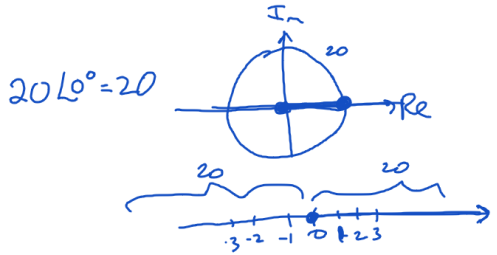
N+1 eqns



Ex



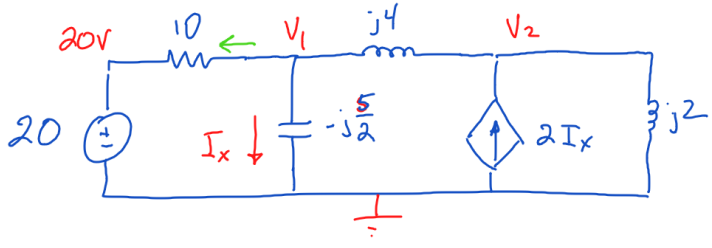
Find i_x



$$Z_c = \frac{1}{j\omega C} = \frac{1}{j4\left(\frac{1}{10}\right)} = -j\left(\frac{10}{4}\right) = -j\frac{5}{2}$$

$$\frac{1}{j} = -j$$

$$Z_L = j\omega L = j4$$



$\frac{8}{20} - \frac{5}{20}$

$$V_1: \quad \frac{V_1 - 20}{10} + \frac{V_1}{-j\frac{5}{2}} + \frac{V_1 - V_2}{j4} = 0 \quad \Rightarrow \quad V_1\left(\frac{1}{10} + j\frac{2}{5} - j\frac{1}{4}\right) + V_2\left(j\frac{1}{4}\right) = 2$$

$$V_2: \quad \frac{V_2 - V_1}{j4} - 2I_x + \frac{V_2}{j2} = 0 \quad \Rightarrow \quad V_1\left(\frac{j}{4}\right) + V_2\left(-\frac{j}{4} + \frac{-j}{2}\right) - 2I_x = 0$$

$$V_1 = I_x\left(-j\frac{5}{2}\right) \quad \Rightarrow \quad V_1 + j\frac{5}{2}I_x = 0$$

$$\begin{bmatrix} 0.1 + j\frac{3}{20} & j0.25 & 0 \\ j0.25 & -j\frac{3}{4} & -2 \\ 1 & 0 & j2.5 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ I_x \end{bmatrix} = \begin{bmatrix} 2 \\ 0 \\ 0 \end{bmatrix}$$

$$I_x = -2.4 + j7.2$$

$$= 7.59\angle 108°$$

$$i_x(t) = 7.59\cos(4t + 108°)\ A$$

Command Window

New to MATLAB? See resources for Getting Started.

```
>> A=[0.1+j*3/20 j*0.25 0;j*0.25 -j*3/4 -2; 1 0 j*2.5]
A =
   0.1000 + 0.1500i   0.0000 + 0.2500i   0.0000 + 0.0000i
   0.0000 + 0.2500i   0.0000 - 0.7500i  -2.0000 + 0.0000i
   1.0000 + 0.0000i   0.0000 + 0.0000i   0.0000 + 2.5000i
>> b=[2;0;0];
>> inv(A)*b
ans =
  18.0000 + 6.0000i
 -13.2000 - 4.4000i
  -2.4000 + 7.2000i
>> ix=ans(3)
ix =
  -2.4000 + 7.2000i
>>
>> abs(ix)
ans =
    7.5895
>> angle(ix)*180/pi
ans =
  108.4349
>>
```