Phasors – 5

examples

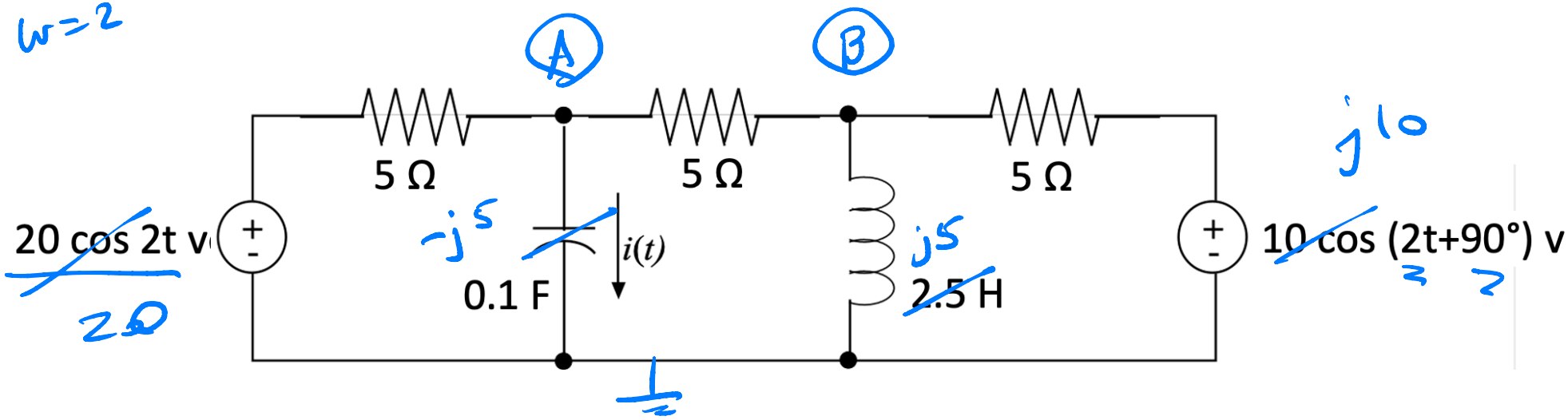
What Now?

- Have used seen that voltage division, series and parallel impedance, and simple analysis all work with phasors
- Let's practice analysis methods
  - Node analysis
  - Dependent sources
  - Super nodes
  - …

$$I = \frac{A}{-j5}$$

Example: Find the current *i*(t).

$\omega = 2$



1- convert

2- node analysis

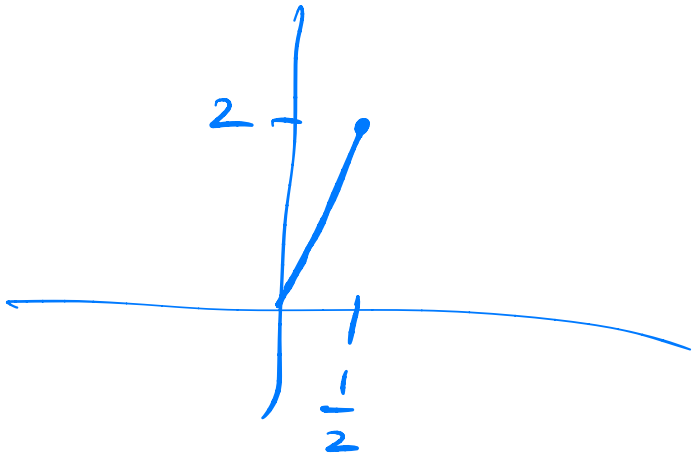
$$\frac{A-20}{5} + \frac{A-B}{5} + \frac{A}{-j5} = 0$$

$$\frac{B-A}{5} + \frac{B}{j5} + \frac{B-j10}{5} = 0$$

3- solve $A = 10 - j2.5$ $\quad I = \dfrac{10-j2.5}{-j5}$

$$I = \frac{10 - j2.5}{-j5} = j\left(\frac{10}{5} - j\frac{2.5}{5}\right)$$

$$= 2j + \frac{1}{2} = \frac{1}{2} + j2$$

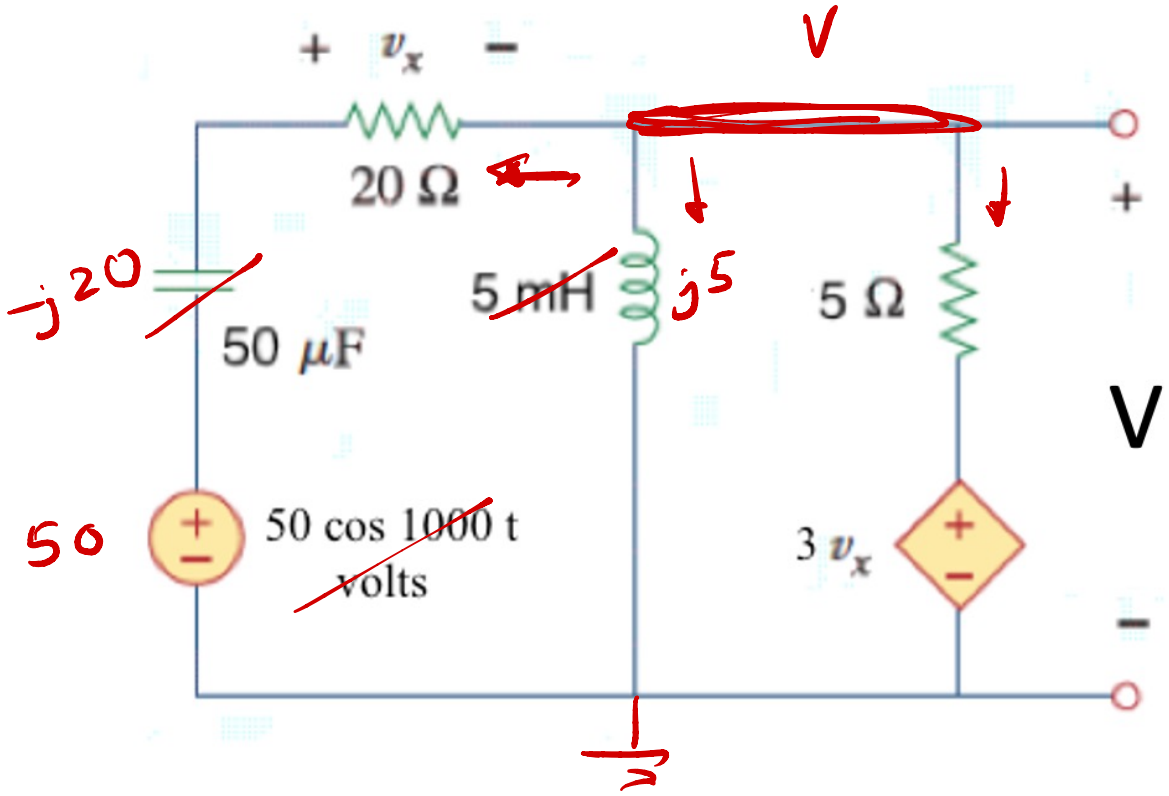


$$= 2.2 \angle 76^\circ$$

$$2.06 \cos(2t + 76^\circ)\ A$$

$1.12\cos(2t + 153^\circ)\ A$

Example: Find V



1- convert

$j\omega L = j\,1000 \cdot \frac{5}{10^3}$

$\frac{1}{j\omega C} = -j\,\frac{10^6}{1000\,50}$

$= -j\,\frac{1000}{50}$

2- node

$\frac{V-50}{20-j20} + \frac{V}{j5} + \frac{V-3v_x}{5} = 0$

$v_x = \frac{50-V}{20-j20} \cdot 20$

$$\frac{V-50}{20-j20} + \frac{V}{j5} + \frac{V-3v_x}{5} = 0$$

$$v_x = \frac{50-V}{20-j20} \cdot 20\,\frac{(1+j)}{1+j}$$

$$= \frac{50-V+50j-jV}{2}$$

$$\frac{V-50}{20-j20} + \frac{V}{j5} + \frac{V}{5} - \frac{3}{5}\,\frac{50-50j-V(1+j)}{2} = 0$$

$42.6\cos(1000t + 31.6°)\ V$

$$\frac{V-50}{20-j20} + \frac{V}{j5} + \frac{V}{5} - \frac{3}{5}\cdot\frac{50-50j-V(1+j)}{2} = 0$$

$$V\left(\frac{1}{20-j20} + \frac{1}{j5} + \frac{1}{5} + \frac{(1+j)3}{10}\right) = \frac{50}{20-j20} + \frac{3}{5}\cdot\frac{50-50j}{2}$$

$$V = \frac{\frac{50}{20-j20} + \frac{3}{5}\cdot\frac{50-50j}{2}}{\frac{1}{20-j20} + \frac{1}{j5} + \frac{1}{5} + \frac{(1+j)3}{10}}$$

$$\frac{20(1-j)}{20(1-j)}$$

$$12.6\cos(1000t + 31.6°)\ V$$

3.24

300

$$V = \frac{50 + 2(1-j)\,3 \cdot 5\angle -90^\circ}{1 - j\,4(1-j) + 4(1-j) + 2(1-j)\,3(1+j)}$$

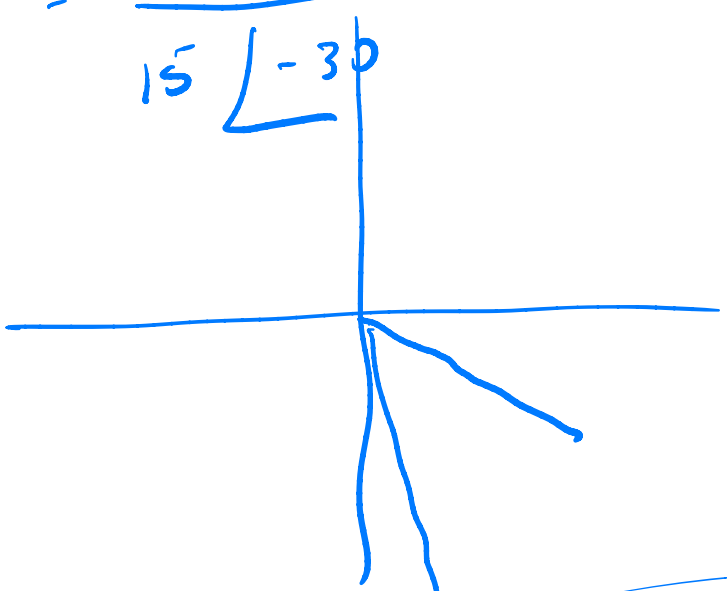
$$= \frac{50 - 600j}{13 - 8j} = \frac{610\angle -80^\circ}{15\angle -30^\circ}$$

?

$(1-j)(1-j)$

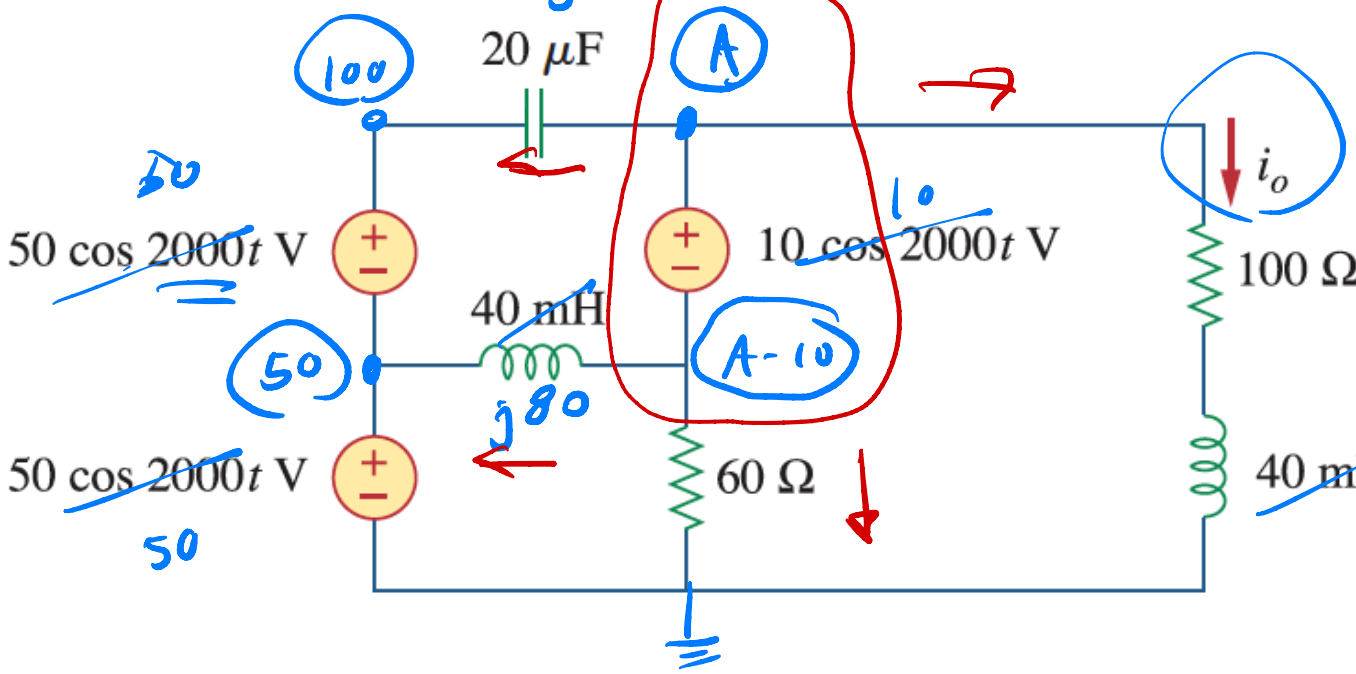
$= 1 - j - j - 1$

$= -2j$



$4.16\cos(1000t + 31.6°)\ V$

Example: Find i_o



$I_o = \frac{A}{100 + j80}$

$\frac{1}{j\omega C} = \frac{-j10^6}{2000} = -j\frac{10^3}{8}$

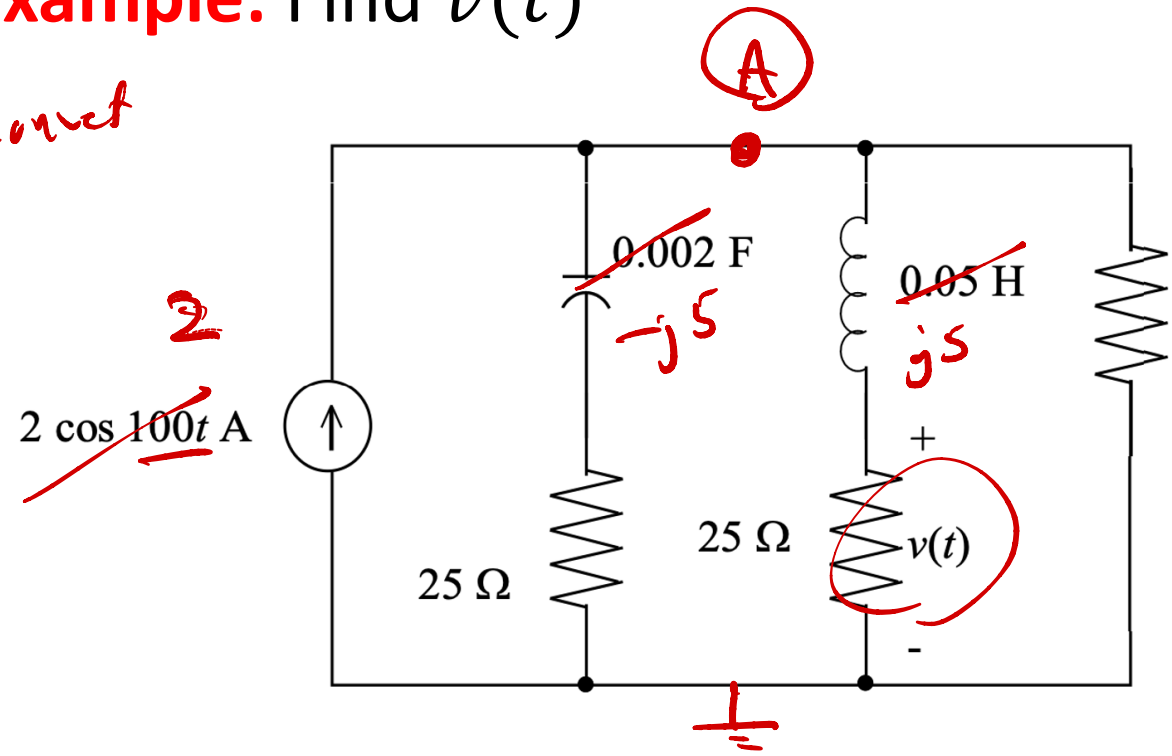
2- supernode eq:

$$0 = \frac{A-100}{-j25} + \frac{A-10-50}{j80} + \frac{A-10}{60} + \frac{A}{100+j80}$$

3- solve

$822\cos(2000t + 3.69°)\ mA$

Example: Find $v(t)$



$-j\frac{1}{100 \cdot .002}$

1- convert

2

$-j5$

$j5$

$V = A \cdot \frac{25}{25+j5}$

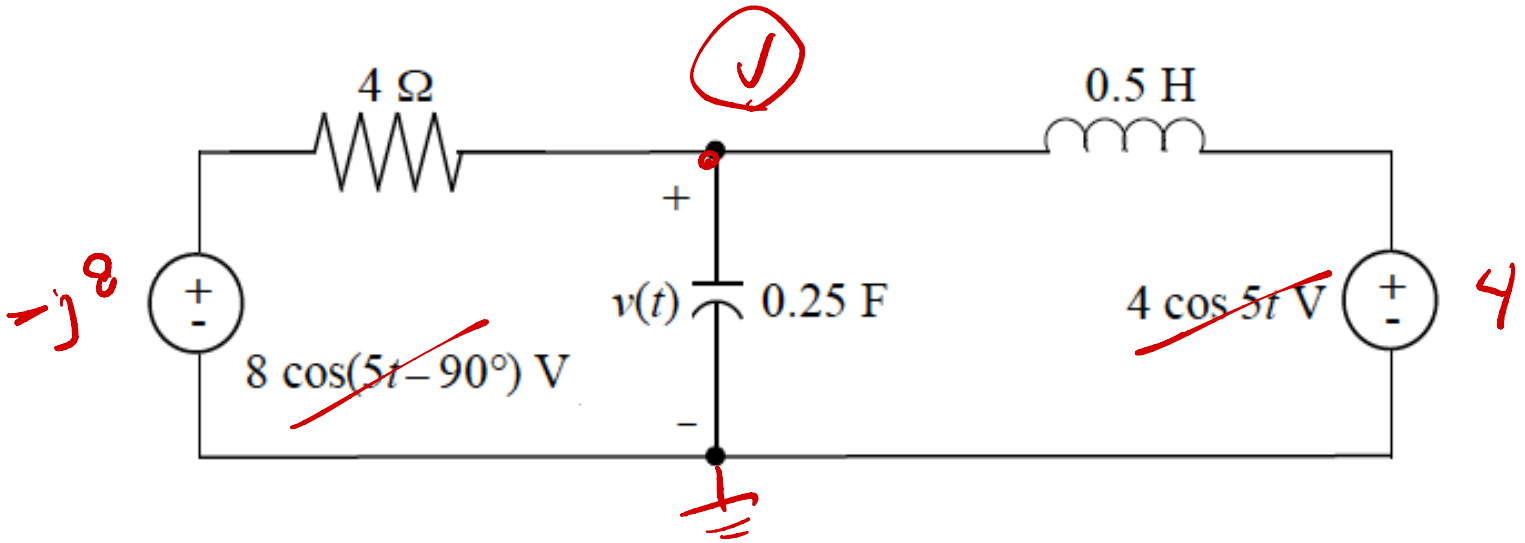
2- node

$$\left(\frac{A}{25-j5} + \frac{A}{25+j5} + \frac{A}{25} = 2 \right) 25$$

$$\frac{A}{(-2j)} + \frac{A}{(1+2j)} + A = 50$$

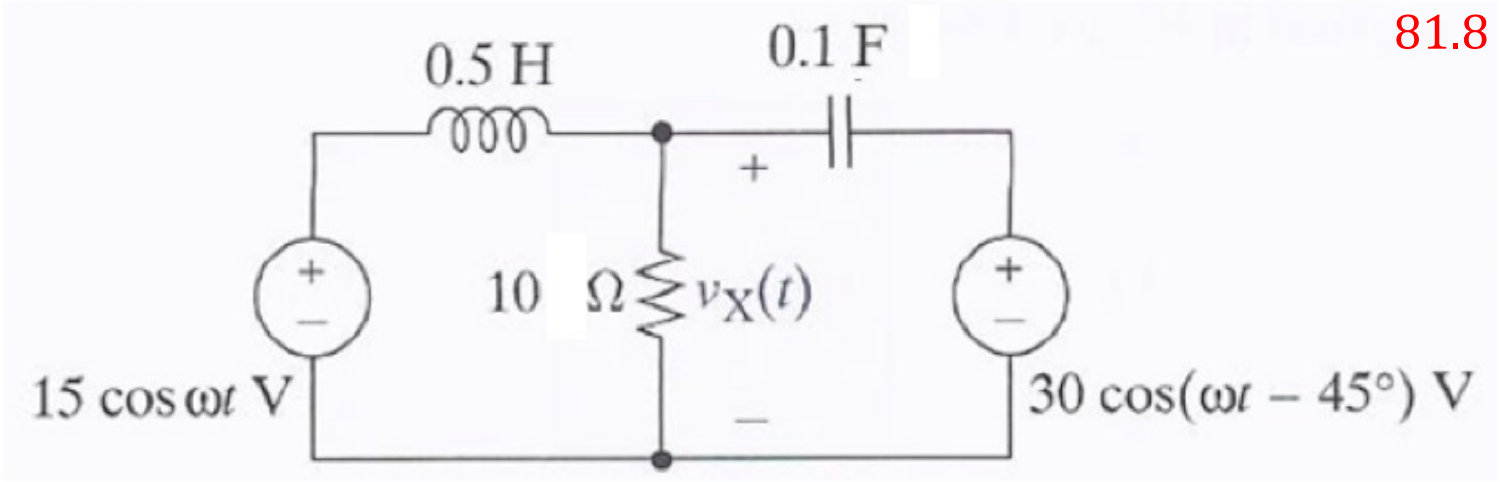
$16.8\cos(\,100t - 11.3°)\ V$

Example: find $v(t)$ – try node analysis



$4.06\cos(5t - 164°)\ V$

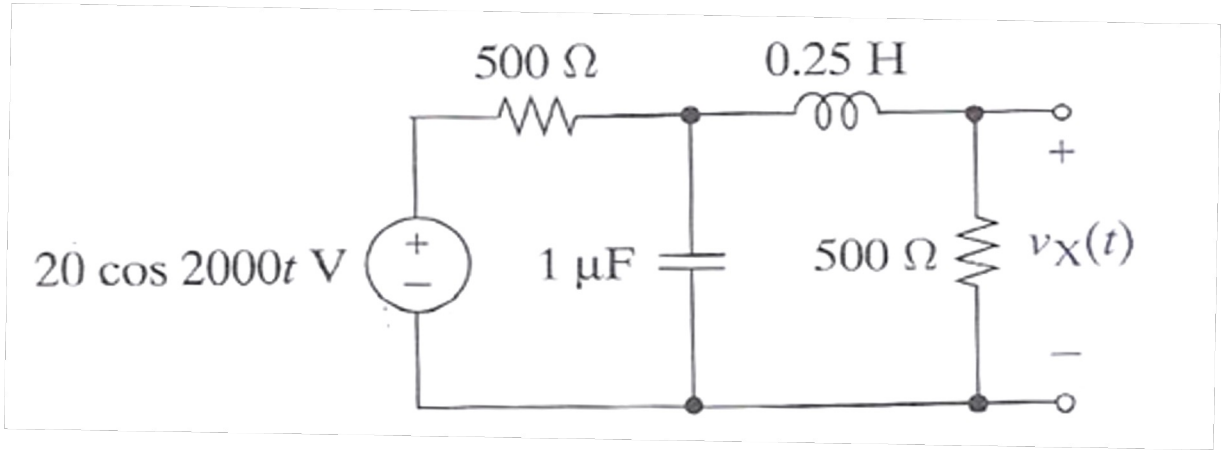
Practice problem: find $v(t)$ with $\omega = 5$ rad/sec



$81.8\cos(5t + 112°)$ V

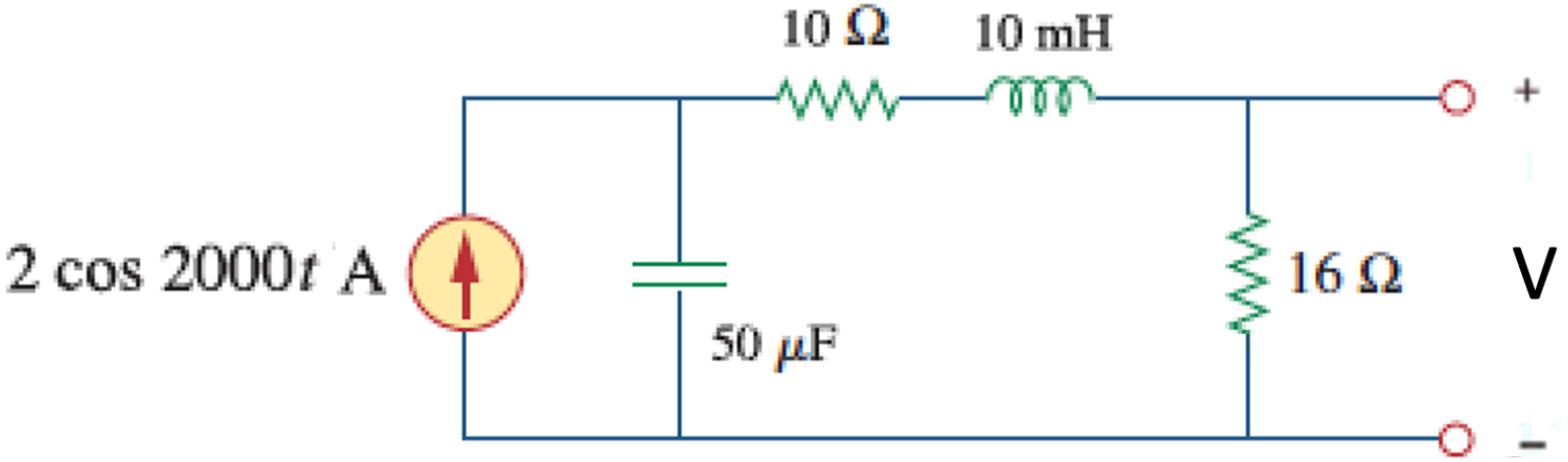
Practice problem: find $v_X(t)$

$6.67\cos(2000t - 90°)\ V$



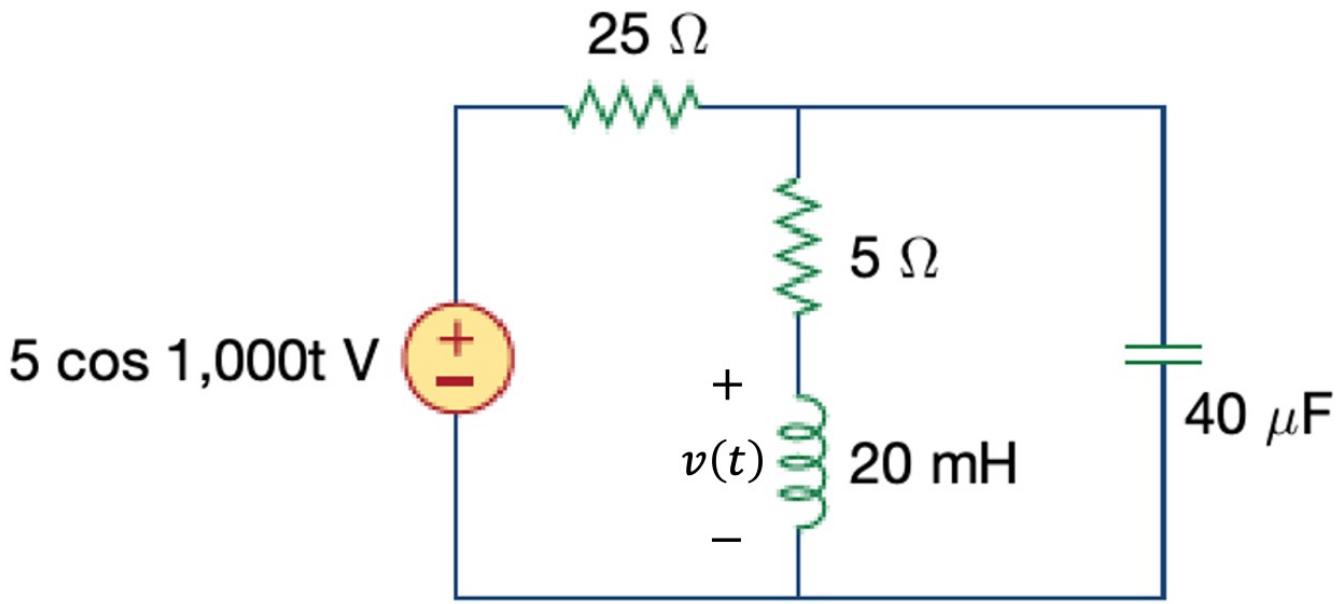
Practice problem: find $v(t)$

$13.8\cos(2000t - 115°)\ V$



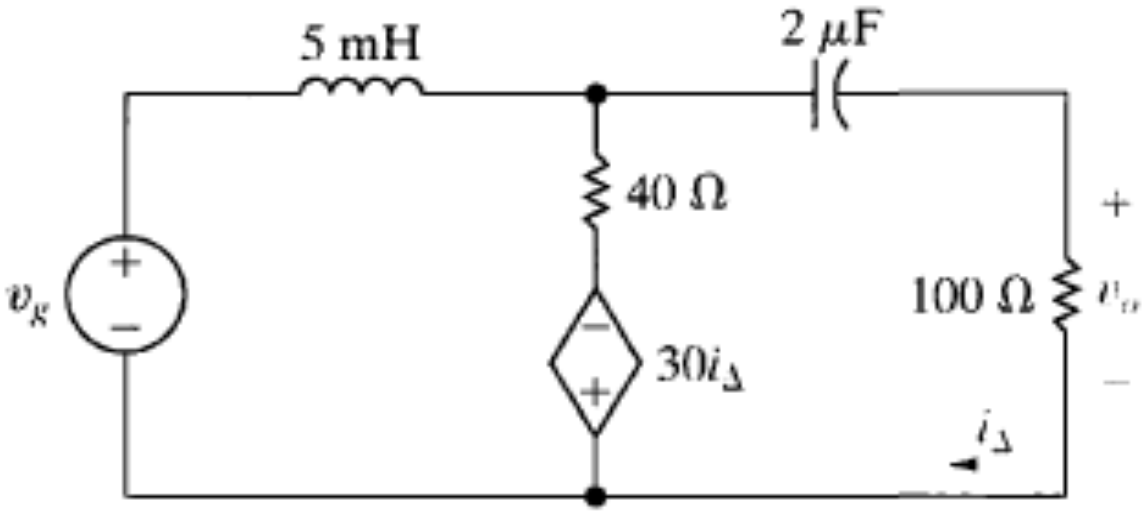
Practice problem: find $v(t)$

$3.71\cos(1000t + 21.8°)\ V$



Example: find $v(t)$ if $v_g(t) = 130 \cos 10{,}000\, t$ V,

f



$73.2 \cos(10{,}000t - 67.5°)\ V$