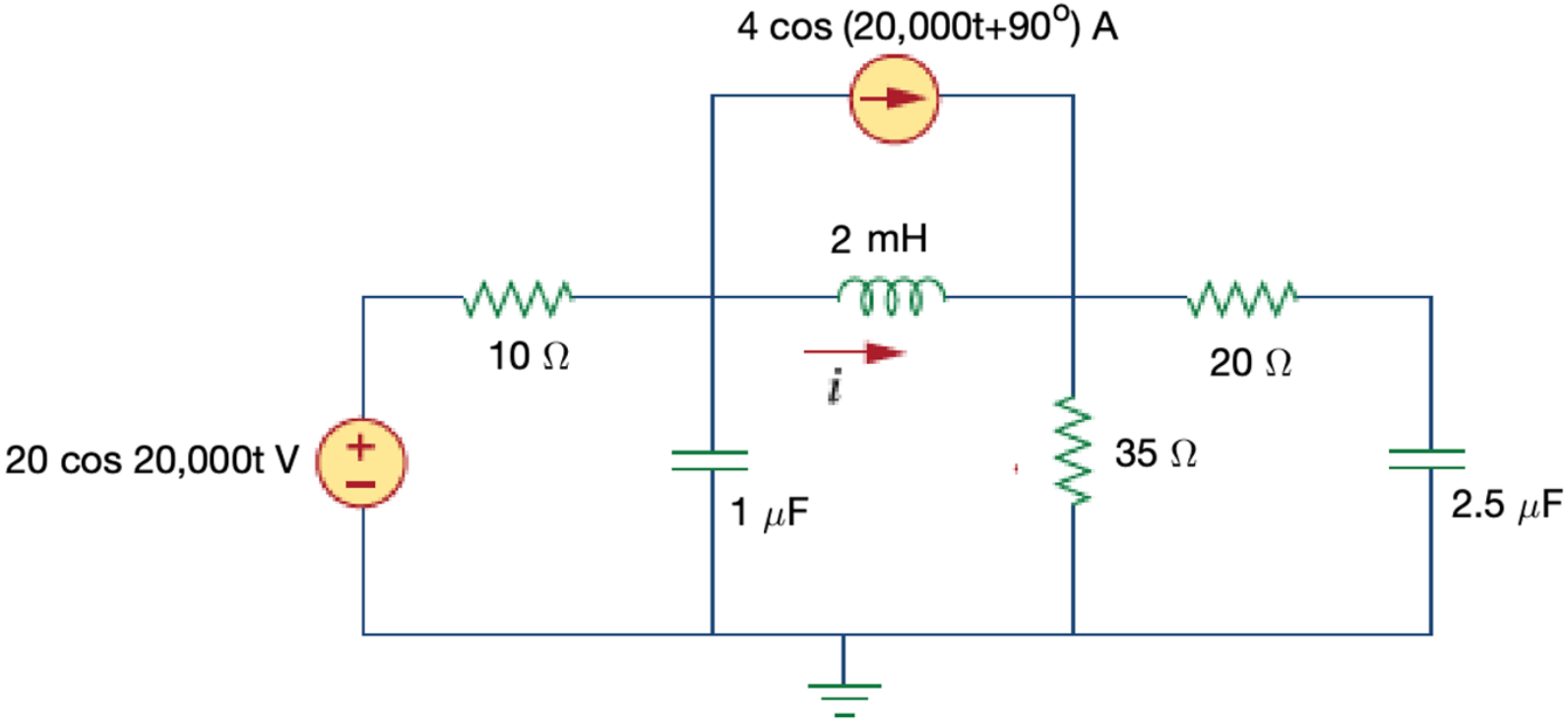
Phasors 6

more examples

Where Are We?

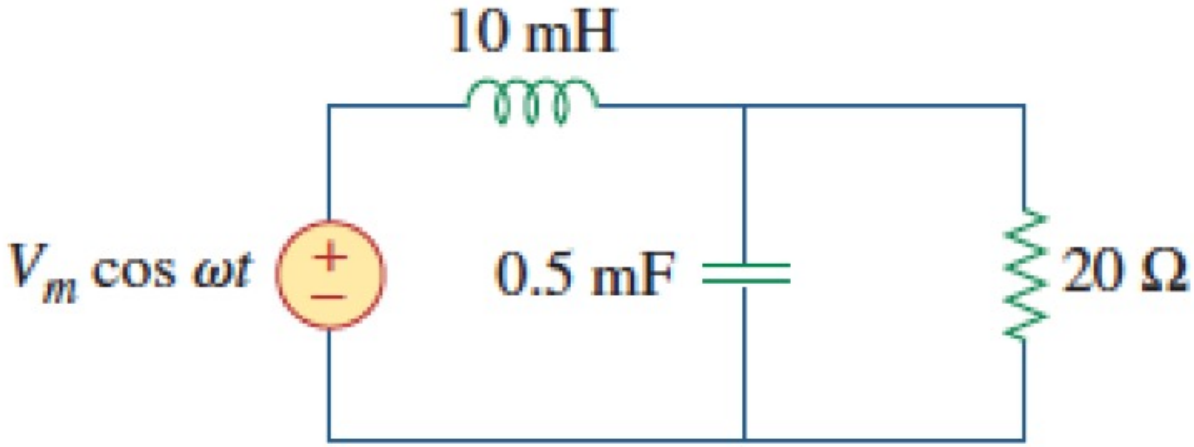
- What we know how to solve: find $i(t)$:



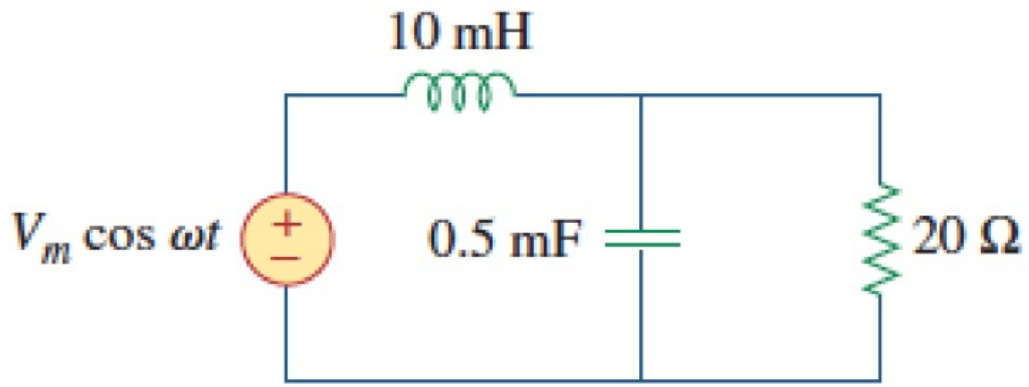
$1.91\cos(20{,}000t - 123°)\ A$

Other Question Types

Sample: for what frequency is the source current the largest?

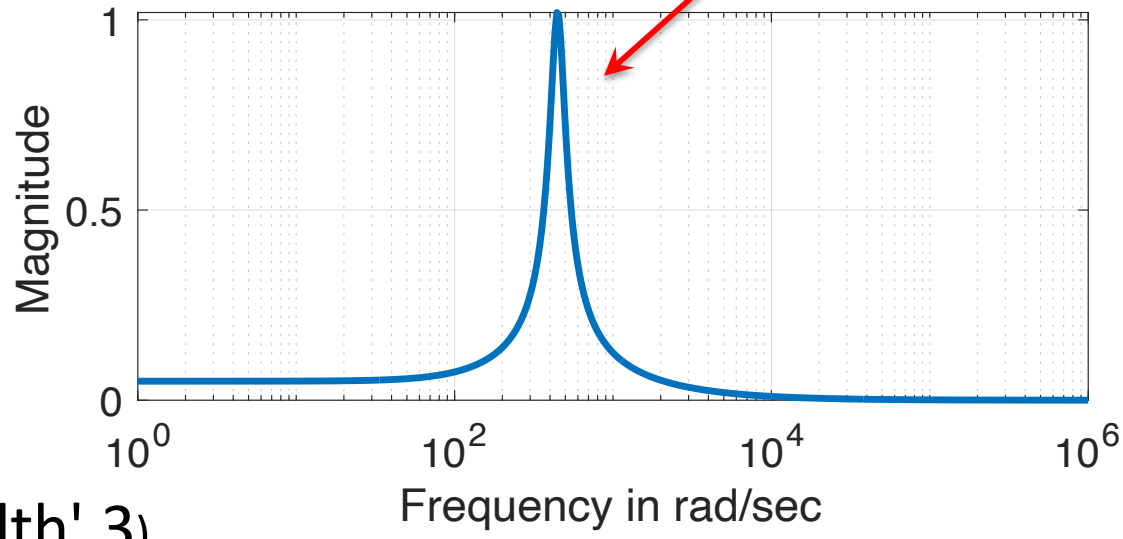


– Method?
  - Numerical calculation
  - Analysis

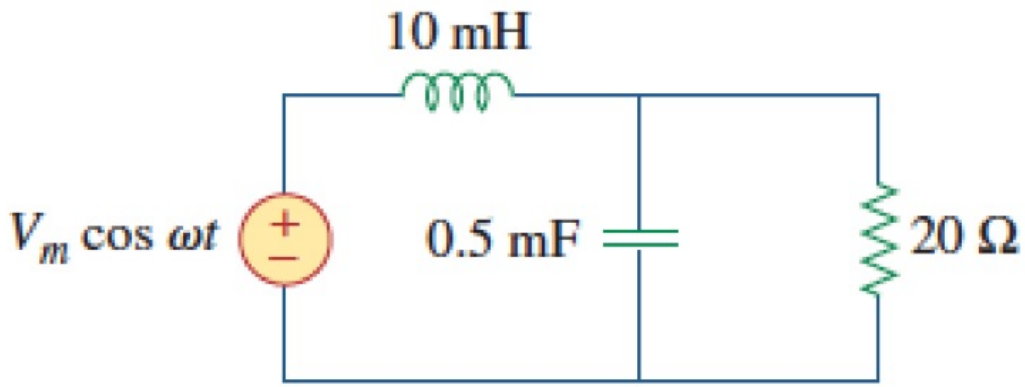


Idea 1 – compute it

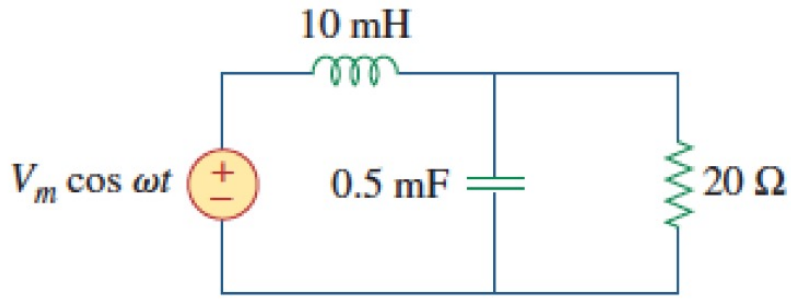
“resonant peak”




```
om = logspace(0,6,500);
ZC = 1./(1j*om*0.5e-3);
ZP = 20*ZC./(20+ZC);
I0 = 1./(1j*om*10e-3+ZP);
semilogx(om,(abs(I0)),'linewidth',3)
```

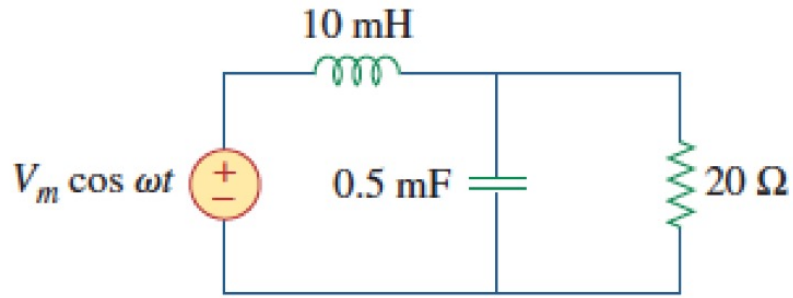


Idea 2 – analyze it




```
>> syms w real
>> zc = 1/(1j*w*5e-4)

zc =

-2000i/w

>> zp = 20*zc/(20+zc)

zp =

40000i/(w*(2000i/w - 20))

>> z = 1j*w*1e-2 + zp

z =

(w*1i)/100 + 40000i/(w*(2000i/w - 20))
```

Or use a tool

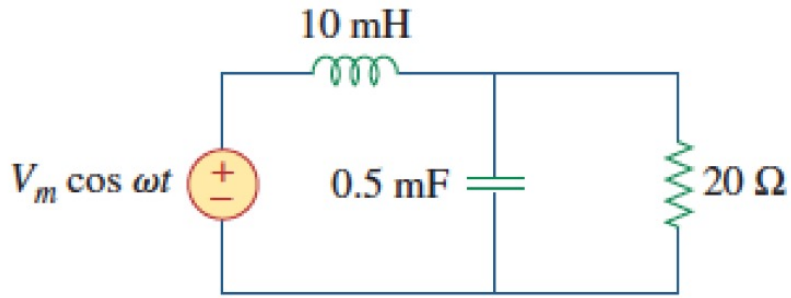



```
>> H = 1/z;
>> aH = sqrt( real(H)^2 + imag(H)^2 );
>> pretty(aH)
```

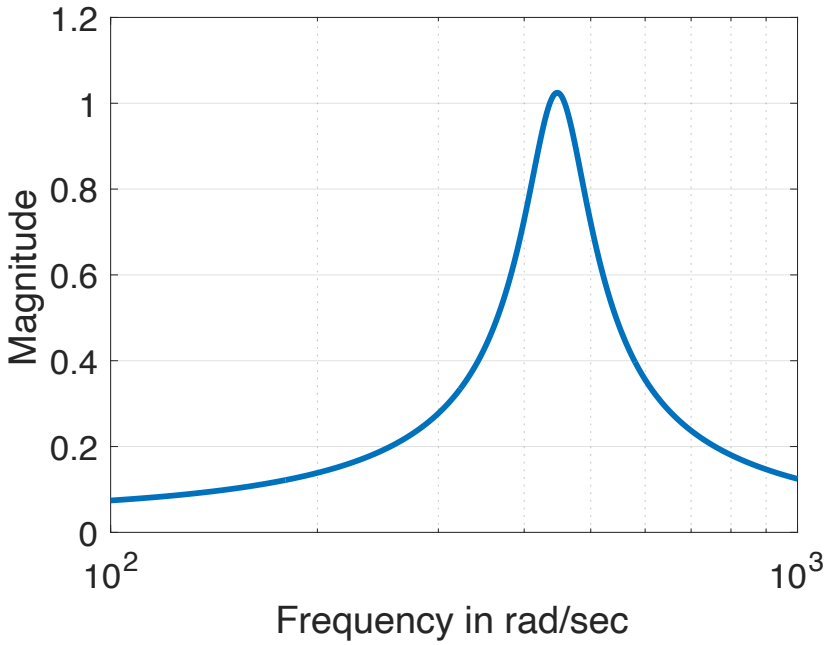
$$\mathrm{sqrt}\left(\left(\frac{\omega}{100} - \frac{800000}{\omega + \frac{4000000}{\omega + 400}}\right)^2 + \frac{640000000000000}{\left(\omega + \frac{4000000}{\omega + 400}\right)^2}\right)$$

where

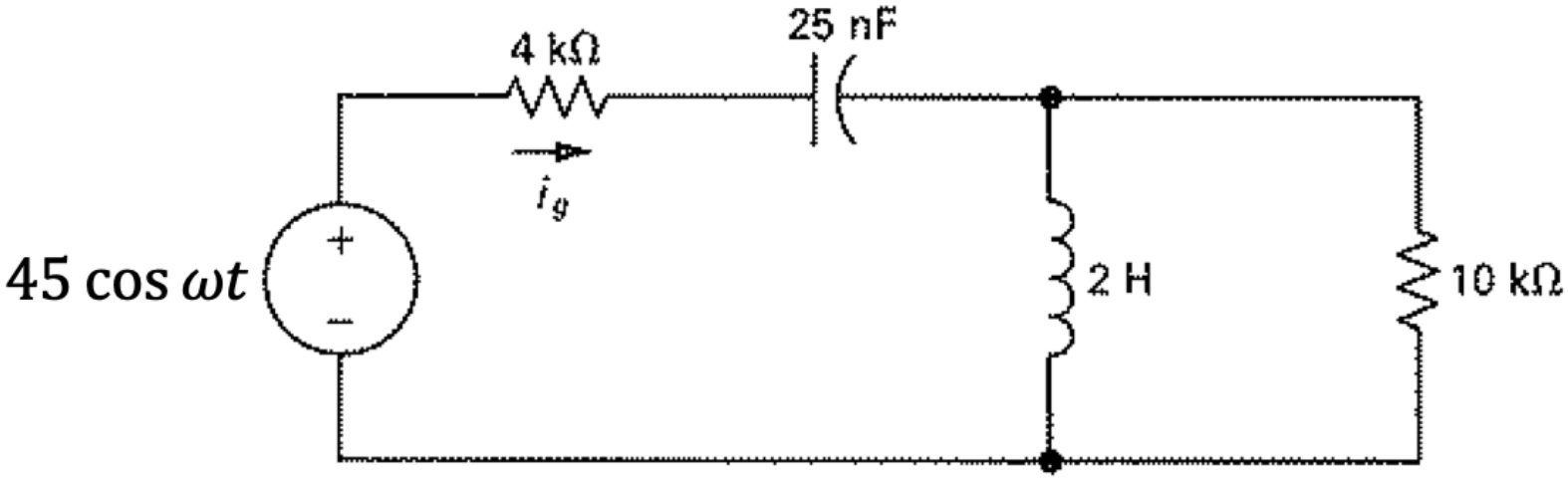
$$\#1 == \left(\frac{640000000000000}{\left(\omega + \frac{4000000}{\omega + 400}\right)^2} + \left(\frac{\omega}{100} - \frac{800000}{\omega + \frac{4000000}{\omega + 400}}\right)^2\right)^2$$




```
>> daH = diff(aH,w);
>> solve(daH,w)

ans =

  (20000*110^(1/2) - 10000)^(1/2)
 -(20000*110^(1/2) - 10000)^(1/2)

>> eval(ans(1))

ans =

  446.9472
```



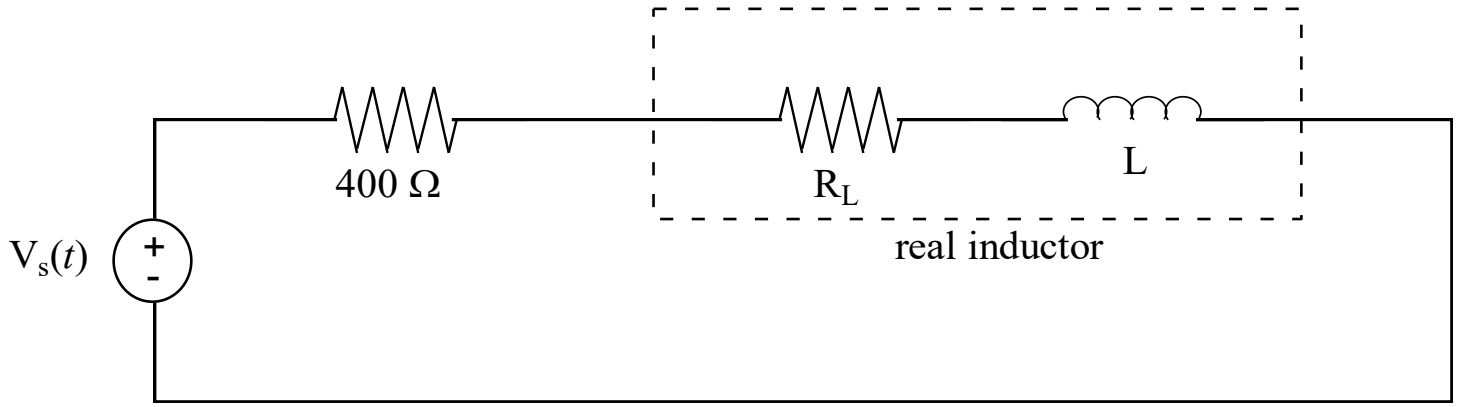
Example: At what frequency ω is i_g in phase with the voltage source?



10^4 rad/sec

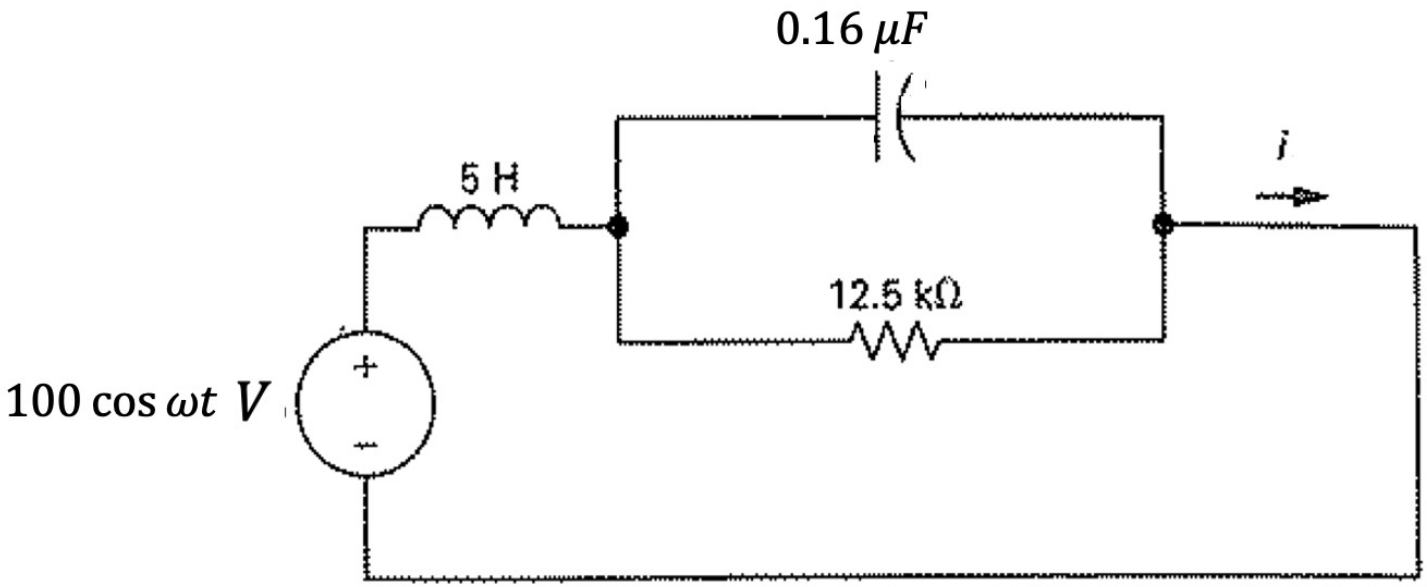
10^4 rad/sec

Example: We model a real inductor as shown with a series parasitic resistance R_L. To measure its parameters, R_L and L, we build the circuit shown (with a 60 Hz source) and use an AC voltmeter to measure the amplitudes of the component voltages. Given $|V_S| = 120\ V, |V_R| = 100\ V, |V_L| = 30$, find R_L and L.



$70\ \Omega, 259\ mH$

Practice problem: At what frequency does the current i have the largest magnitude? What is that magnitude?



$1120 \frac{rad}{sec}$; $43.8\ mA$