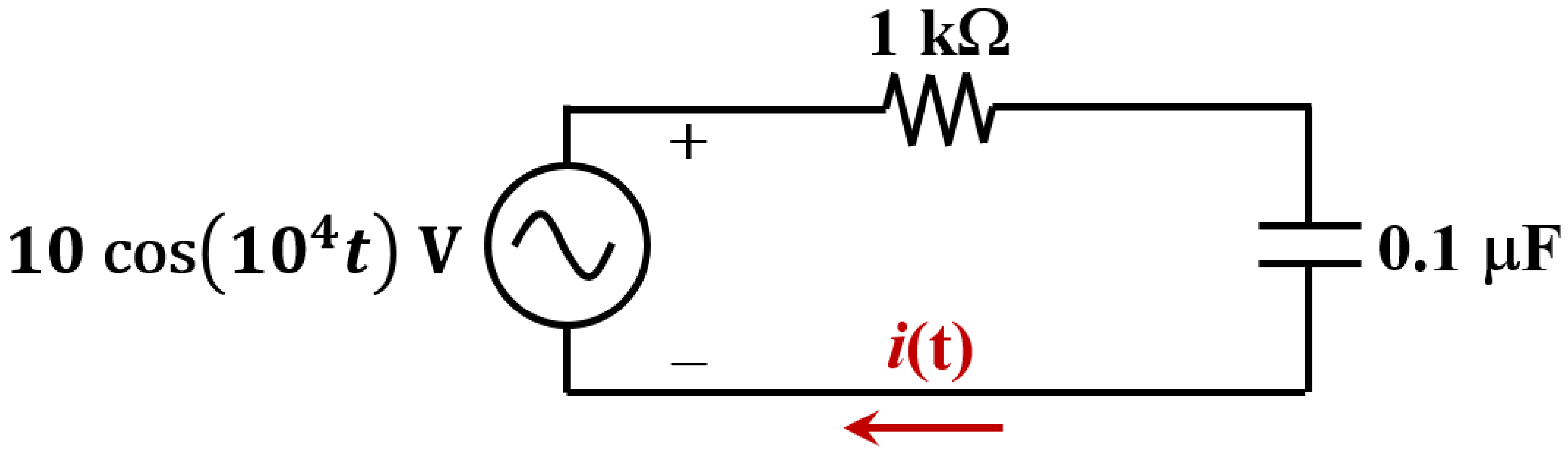
CG1111: Engineering Principles and Practice I

Additional practice questions for
AC Circuit Analysis

NUS
National University of Singapore

Question 1

- Find the current *i*(t) using phasors & impedances

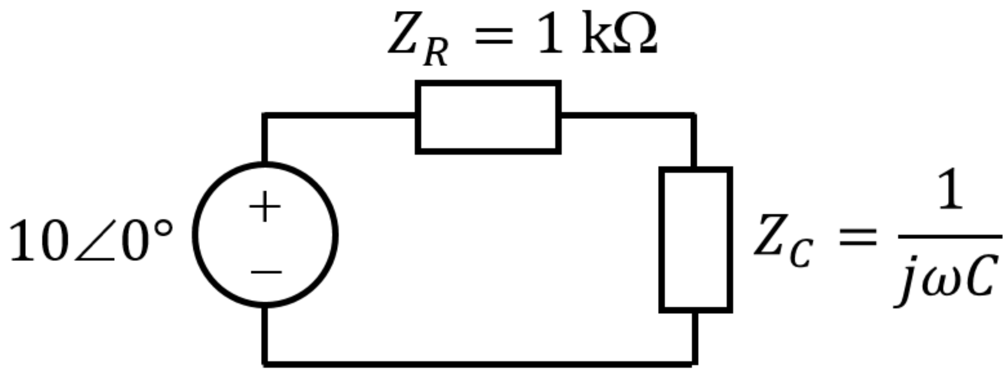


Concepts tested:

- Phasors & impedances
- AC circuit analysis techniques

Solution to Q1

Convert all elements into phasor & impedances:



$\omega = 10^4$ rad/s

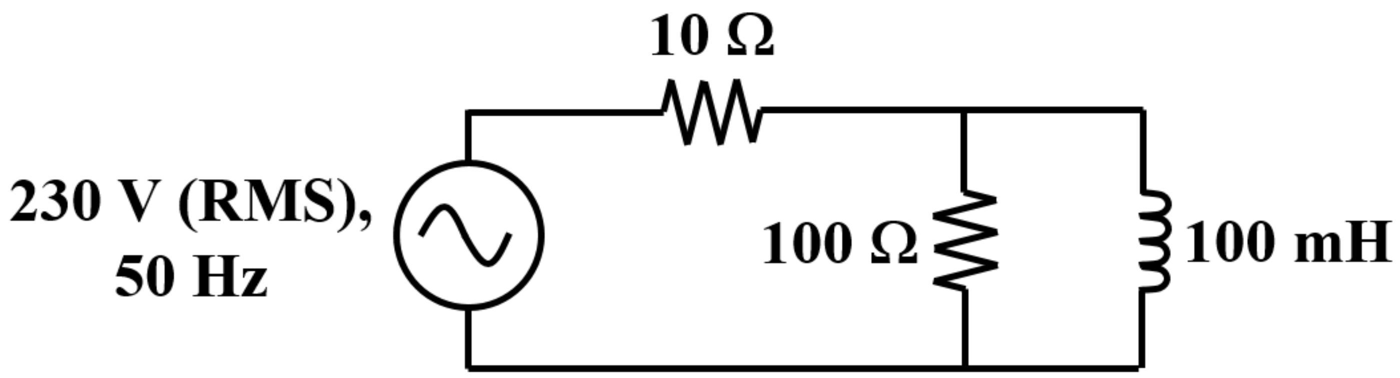
$$Z_C = \frac{1}{j \times 10^4 \times 0.1 \times 10^{-6}} = -j1000\ \Omega$$

$$I_L = \frac{10\ \angle 0°}{1000 - j1000} = \frac{10\ \angle 0°}{1000\sqrt{2}\ \angle{-45°}} = 7.07 \times 10^{-3} \angle 45°$$

$$i(t) = 7.07 \times 10^{-3} \cos(10^4 t + 45°)\ \mathrm{A}$$

Question 2

- Find the RMS value of the current drawn from the AC source

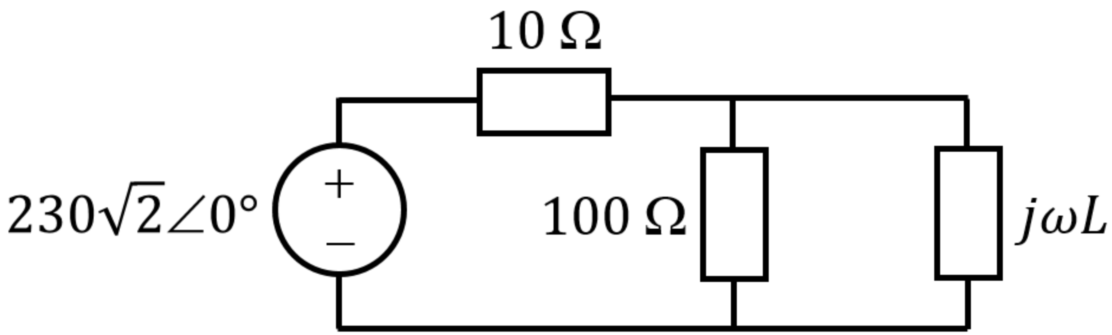


Concepts tested:

- Phasors & impedances
- AC circuit analysis techniques

Solution to Q2

Convert all elements into phasor & impedances:



$\omega = 2\pi \times 50 = 314\ \text{rad/s}$
$j\omega L = j314 \times 0.1 = j31.4\ \Omega$

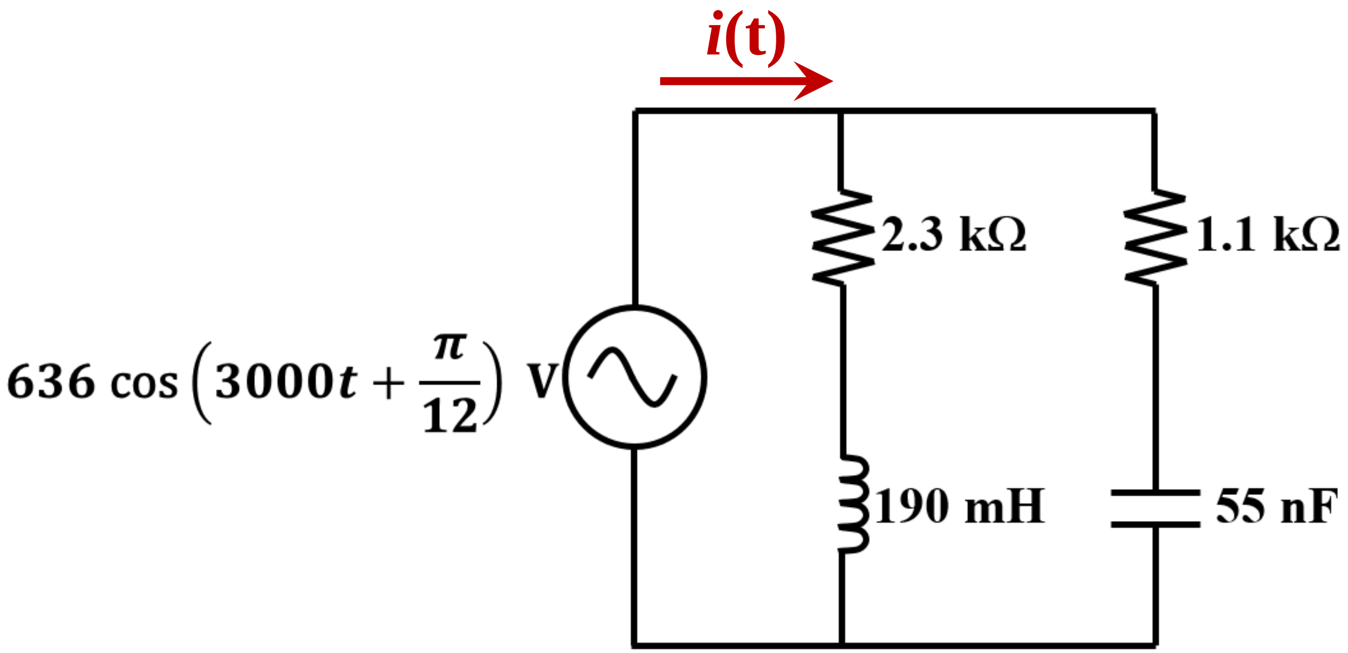
$$Z_{\text{Total}} = 10 + 100||j31.4 = 10 + \frac{100 \times j31.4}{100 + j31.4} = 18.98 + j28.59\ \Omega$$

$$I = \frac{230\sqrt{2}}{18.98 + j28.59} = \frac{230\sqrt{2}}{34.3\ \angle 56.4°} = 6.7\sqrt{2}\ \angle{-56.4°}$$

$I_{\text{rms}} = 6.7\ \text{A}$

Question 3

- Find the current $i(t)$ using phasors & impedances

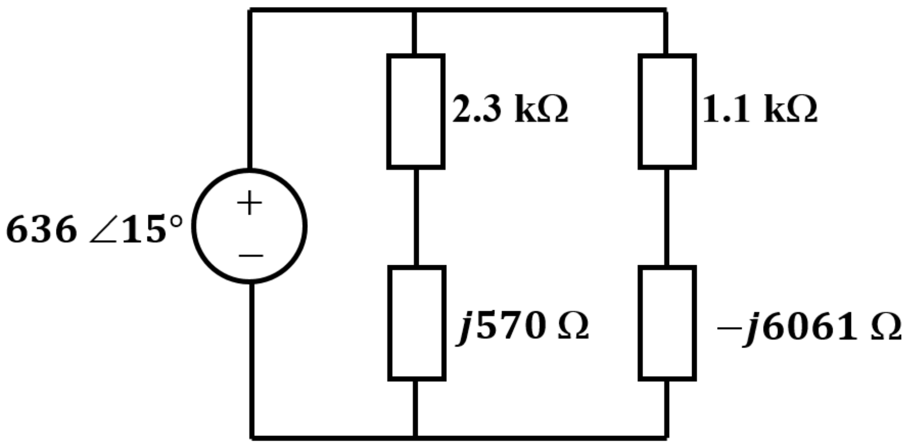


Concepts tested:

- Phasors & impedances
- AC circuit analysis techniques

Solution to Q3

Convert all elements into phasor & impedances:



$$\omega = 3000 \text{ rad/s}$$

$$Z_C = \frac{-j}{\omega C} = \frac{-j}{3000 \times 55 \times 10^{-9}} = -j6061\ \Omega$$

$$Z_L = j\omega L = j3000 \times 190 \times 10^{-3} = j570\ \Omega$$

Solution to Q3

We can simply combine the impedances using series/parallel reduction:

$$Z = (2300 + j570)||(1100 - j6061)$$

$$= \frac{(2300 + j570) \times (1100 - j6061)}{(2300 + j570) + (1100 - j6061)} = 2260\,\angle{-7.56°}$$

$$I = \frac{636\,\angle 15°}{2260\,\angle{-7.56°}} = 0.2814\,\angle 22.56°$$

Therefore, $i(t) = 0.2814\cos(3000t + 22.56°)$