Discussion 3A

The following notes and sections are useful for this discussion: Note j, Sections 4.5, 5.1, 5.2.

1. Analyzing a Second-Order Circuit (Hambley Example 4.5)

A DC source is connected to a series RLC circuit by a switch that closes at $t = 0$ as shown in Figure 1. The initial conditions are $i(0) = 0$ and $v_C(0) = 0$.

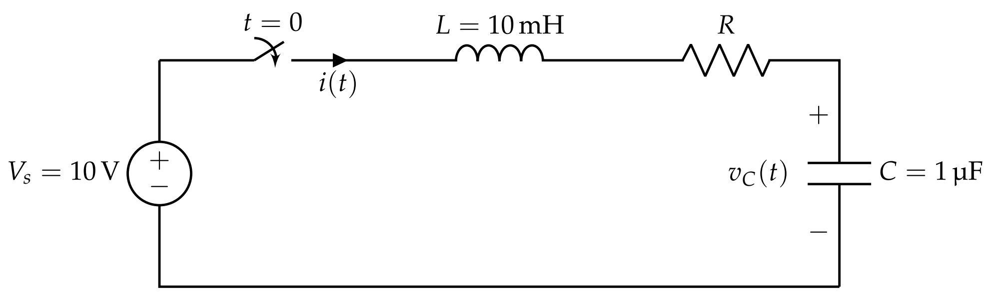
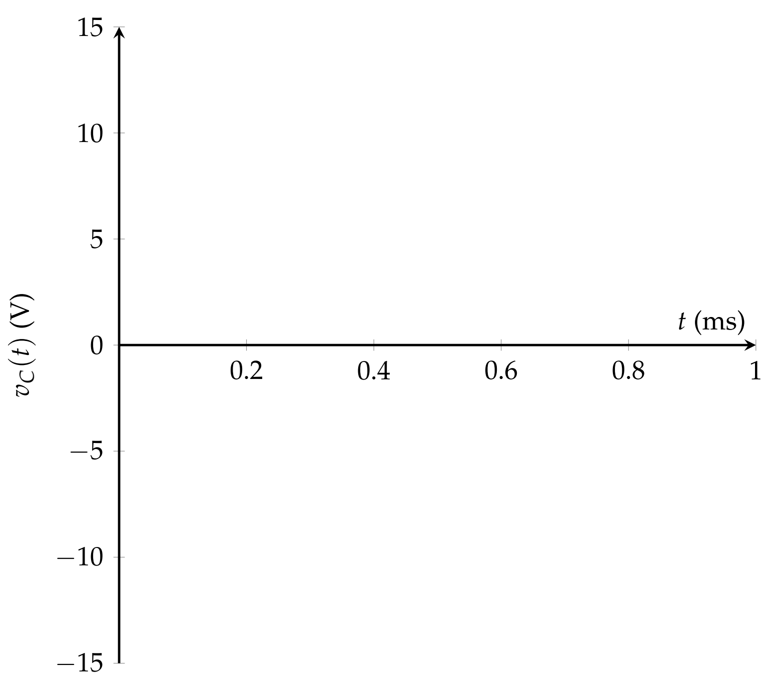


Figure 1: RLC Circuit

(a) **Write the differential equation for $v_c(t)$**

(b) **Solve for $v_C(t)$ if $R = 300\,\Omega$.**

(c) **Plot the equation you calculated for $v_C(t)$.** It may be helpful to draw out each term in your general solution and then add them together.



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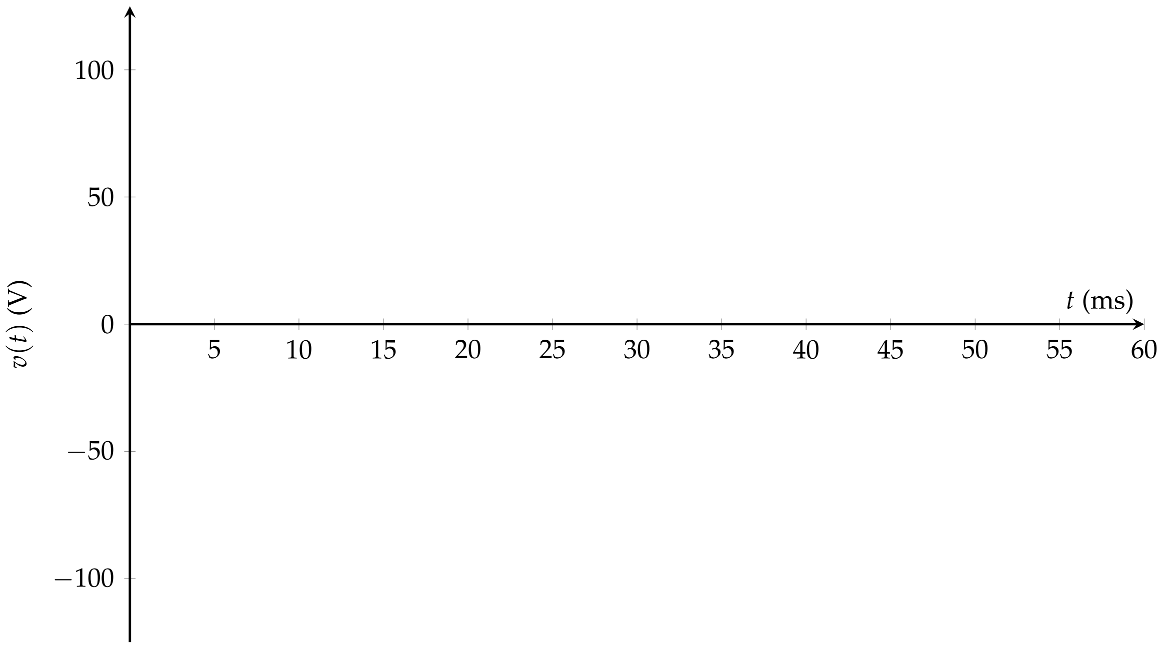
2. Power Delivered by a Sinusoidal Source (Hambley Example 5.1)

Suppose that a voltage given by $v(t) = 100\cos(100\pi t)$V is applied to a 50-Ω resistance.

(a) **Sketch $v(t)$ to scale versus time.**



(b) **Find the rms value of the voltage and the average power delivered to the resistance.**

(c) **Find the power as a function of time and sketch to scale.**

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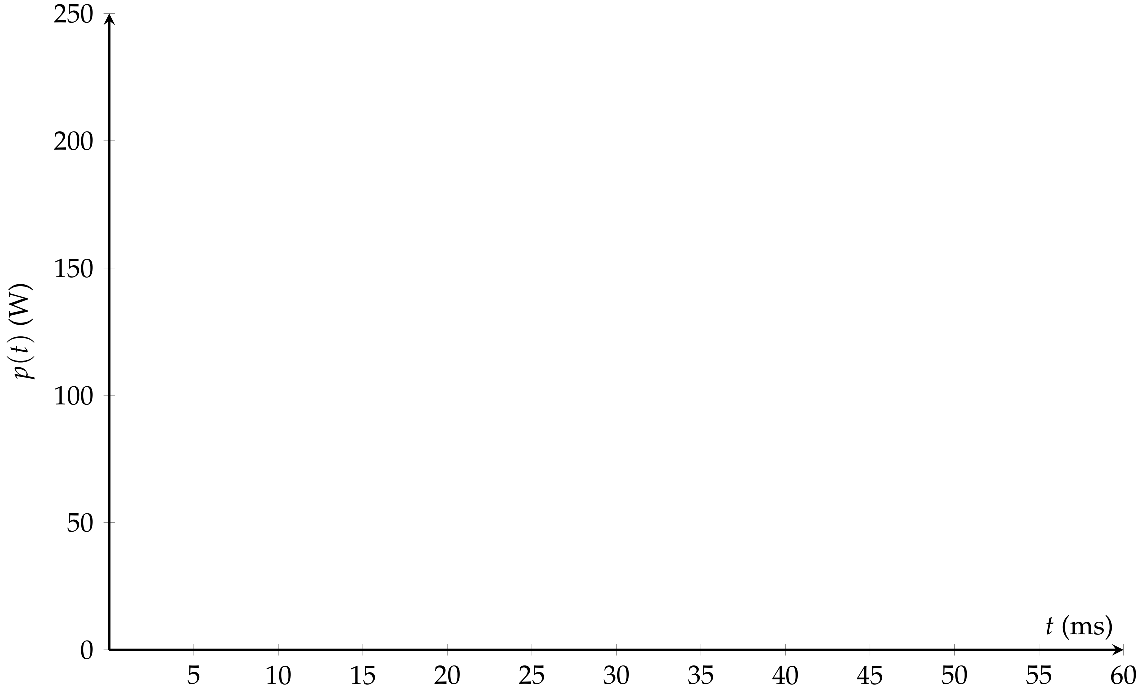

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3. Complex Number Review

Recall Euler's Formula:

$$e^{j\theta} = \cos(\theta) + j\sin(\theta) \tag{1}$$

$$e^{j\omega t} = \cos(\omega t) + j\sin(\omega t) \tag{2}$$

Complex exponentials will also be seen written in a magnitude + phase notation as seen in the textbook. The following expressions are equivalent:

$$Re^{j\theta} = R\angle\theta \tag{3}$$

(a) **Convert the following complex numbers from polar form to Cartesian form.**

$$\mathbf{X_1} = 2\sqrt{2}e^{j225^\circ} = 2\sqrt{2}\angle 225^\circ \tag{4}$$

$$\mathbf{X_2} = e^{-j90^\circ} = 1\angle -90^\circ \tag{5}$$

(b) **Convert the following complex numbers from Cartesian form to polar form.**

$$\mathbf{X_3} = 3 + j4 \tag{6}$$

$$\mathbf{X_4} = -\sqrt{3} + j \tag{7}$$

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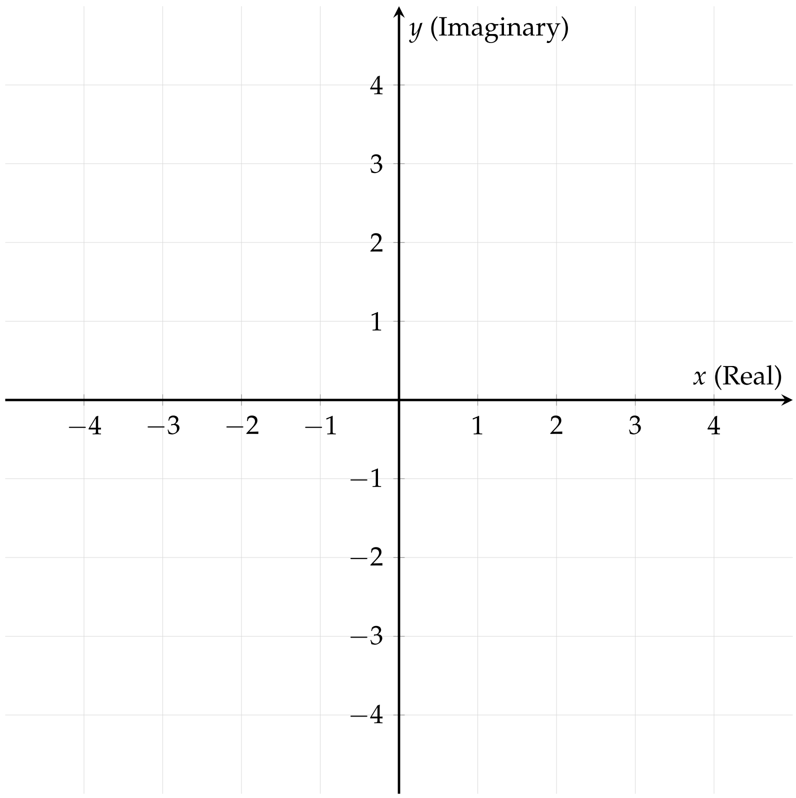
(c) **Plot the vectors from parts (a) and (b) on the complex plane.**



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