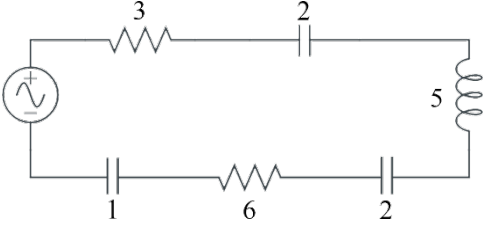
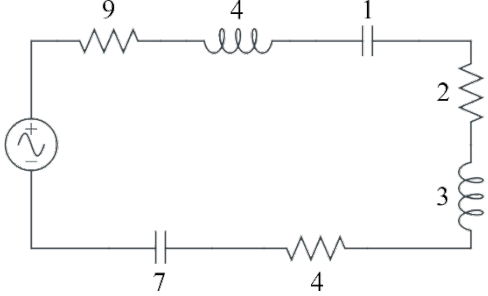


USER MANUAL—CALCULATIONS (SAMPLE RESPONSES)

Calculating Total Impedance

Use the circuit diagrams below to calculate the total impedance for each circuit. Write your final answer in standard form: $a + bi$.

Question 1	Question 2
 <p><i>Total Impedance</i></p> $= 3 - 2i + 5i - 2i + 6 - i$ $= 9$	 <p><i>Total Impedance</i></p> $= 9 + 4i - i + 2 + 3i + 4 - 7i$ $= 15 - i$
<p><i>Total Impedance = <u>9 ohms</u></i></p>	<p><i>Total Impedance = <u>(15 - i) ohms</u></i></p>

Calculating Voltage

Voltage = (Current)(Impedance) is the formula that relates voltage, current, and total impedance. Use this formula in each of the following scenarios to calculate the voltage. Write your final answer in standard form: $a + bi$.

Question 3	Question 4
<p>What is the voltage in a circuit with current $7 + 5i$ and impedance $8 - 6i$?</p> <p><i>Voltage = $(7 + 5i)(8 - 6i)$</i></p> $= 56 - 42i + 40i - 30i^2$ $= 56 - 2i - 30(-1)$ $= 56 - 2i + 30$ $= 86 - 2i$	<p>What is the voltage in a circuit with current $5 + 8i$ and impedance $5 - 8i$?</p> <p><i>Voltage = $(5 + 8i)(5 - 8i)$</i></p> $= 25 - 40i + 40i - 64i^2$ $= 25 - 64(-1)$ $= 25 + 64$ $= 89$
<p><i>Voltage = <u>(86 - 2i) volts</u></i></p>	<p><i>Voltage = <u>89 volts</u></i></p>

Calculating Current

Use the formula $Voltage = (Current)(Impedance)$ in each of the following scenarios to calculate the current. Write your final answer in standard form: $a + bi$.

Question 5

What is the current in a circuit with voltage $2i$ and impedance $1 + i$?

$$\begin{aligned} Current &= \frac{Voltage}{Impedance} = \frac{2i}{1+i} \Rightarrow \frac{(2i) \cdot (1-i)}{(1+i) \cdot (1-i)} = \frac{2i - 2i^2}{1 - i + i - i^2} = \frac{2i - 2(-1)}{1 - (-1)} = \frac{2i + 2}{1 + 1} \\ &= \frac{2 + 2i}{2} = \frac{2}{2} + \frac{2i}{2} = 1 + i \end{aligned}$$

$$Current = \underline{(1+i) \text{ amps}}$$

Definition

- The **complex conjugate** of $a + bi$ is $a - bi$.
 - For example, $9 + 4i$ is the complex conjugate of $9 - 4i$.

Use the complex conjugate and the voltage formula (from above) to calculate the current. Write your final answer in standard form: $a + bi$.

Question 6

What is the current in a circuit with voltage $2 + 5i$ and impedance $5 + 2i$?

$$\begin{aligned} Current &= \frac{2 + 5i}{5 + 2i} \Rightarrow \frac{(2 + 5i) \cdot (5 - 2i)}{(5 + 2i) \cdot (5 - 2i)} = \frac{10 - 4i + 25i - 10i^2}{25 - 10i + 10i - 4i^2} = \frac{10 + 21i - 10(-1)}{25 - 4(-1)} = \frac{10 + 21i + 10}{25 + 4} \\ &= \frac{20 + 21i}{29} = \frac{20}{29} + \frac{21i}{29} = \frac{20}{29} + \frac{21}{29}i \end{aligned}$$

$$Current = \underline{\left(\frac{20}{29} + \frac{21}{29}i \right) \text{ amps}}$$