Algebra II
Semester Exam
Applied Problem #1

Name Ashley Rosa

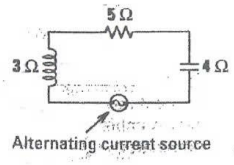
Chapter 4: Use Complex Numbers in Real Life - Electricity

Please write neatly, use complete sentences where needed, and show all work.

Overview

Circuit components such as resistors, inductors, and capacitors all oppose the flow of current. This opposition is called *resistance* for resistors and *reactance* for inductors and capacitors. A circuit's total opposition to current flow is *impedance*. All of these quantities are measured in ohms (Ω).

Component and symbol	Resistor	Inductor	Capacitor
Resistance or reactance	R	L	C
Impedance	R	Li	$-Ci$



The table shows the relationship between a component's resistance or reactance and its contribution to impedance.

Series Circuits

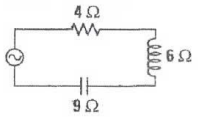
A *series circuit* is also shown with the resistance or reactance of each component labeled.

The impedance for a series circuit is the sum of the impedances for the individual components. Find the impedance of the circuit show above.

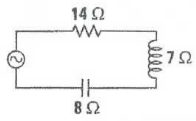
Impedance of circuit $= 5 + 3i + (-4i)$
$= 5 - i$

The impedance of the circuit is $5 - i\ \Omega$

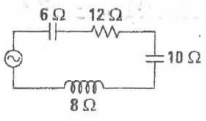
Find the impedance of the circuits below.



$= 4 + 6i + (-9i)$
$= 4 - 3i\ \Omega$



$= 14 + 7i + (-8i)$
$= 14 - i\ \Omega$



$= 12 + 8i + (-6i) + (-10i)$
$= 12 + 8i + (-16i)$
$= 12 + 8i\ \Omega$

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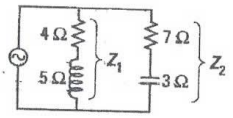
Parallel Circuits

In a *parallel circuit*, there is more than one pathway through which the current can flow. To find impedance Z of a parallel circuit with two pathways, first calculate the impedances Z_1 and Z_2 of the pathways separately by treating each pathway as a series circuit. Then apply this formula:

$$Z = \frac{Z_1 Z_2}{Z_1 + Z_2}$$

What is the impedance of each parallel circuit shown below?



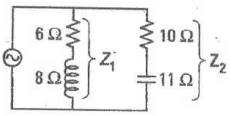
$z_1 = 4+5i$
$z_2 = 7+(-3i)$

$i^2 = -1$

$$Z = \frac{(4+5i)(7+(-3i))}{(4+5i)+(7+(-3i))} = \frac{28-12i+35i-15i^2}{(4+7)+(5-3)i} = \frac{28+23i-15(-1)}{11+2i} = \frac{28+23i+15}{11+2i} = \frac{43+23i}{11+2i}$$

$$= \frac{(43+23i)}{(11+2i)} \cdot \frac{(11-2i)}{(11-2i)} = \frac{473-86i+25-46i^2}{121-22i+22i-4i^2} = \frac{473+167i-46(-1)}{125} = \frac{519+167i}{125} \quad z = \frac{519}{125} + \frac{167}{125}i$$

$$Z = \frac{519}{125} + \frac{167}{125}i\ \Omega$$



$z_1 = 6+8i$
$z_2 = 10+(-11i)$

$$Z = \frac{(6+8i)(10+(-11i))}{(6+8i)+(10+(-11i))} = \frac{60-66i+80i-88i^2}{(6+10)+(8+11)i} = \frac{60+14i-88(-1)}{16-3i} = \frac{60+14i+88}{16-3i} = \frac{148+14i}{16-3i}$$

$$= \frac{148+14i}{16+3i} \cdot \frac{16+3i}{16+3i} = \frac{2368+444i+224i+42i^2}{256+48i-48i+9i^2} = \frac{2326+668i}{265}$$

$$Z = \frac{2326}{265} + \frac{668}{265}i\ \Omega$$