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Let's examine all three relations;

Resistor

Capacitor

Inductor

These are all of the form;

Where Z is the **impedance**

Therefore for electrical impedances;

Resistor **(real-only)**

Capacitor **(imaginary only)**

Inductor **(imaginary only)**

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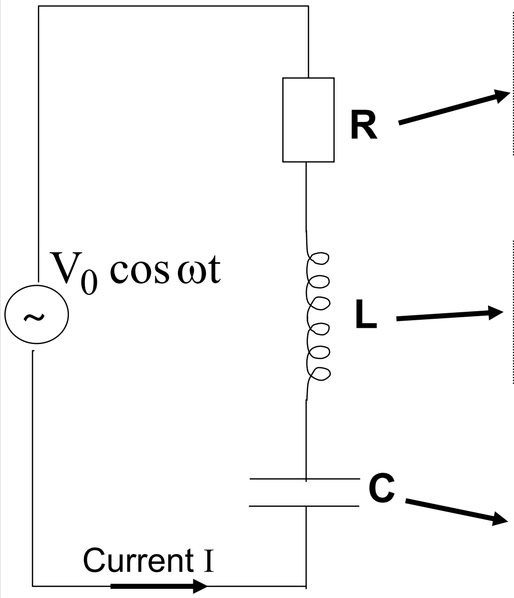
We refer to the real and imaginary parts of complex impedance (Z) in a certain way.

To express this more clearly;

Series LCR Circuit

This is a good example of a complex impedance.



V in phase with I

V is 90° ahead of I

V is 90° behind I

Think about the voltages in a series circuit;

the applied driving voltage is divided between the components

Now, Kirchoff's Laws applied to this AC circuit, tell us the same current I flows through all components.

So, by substitution;

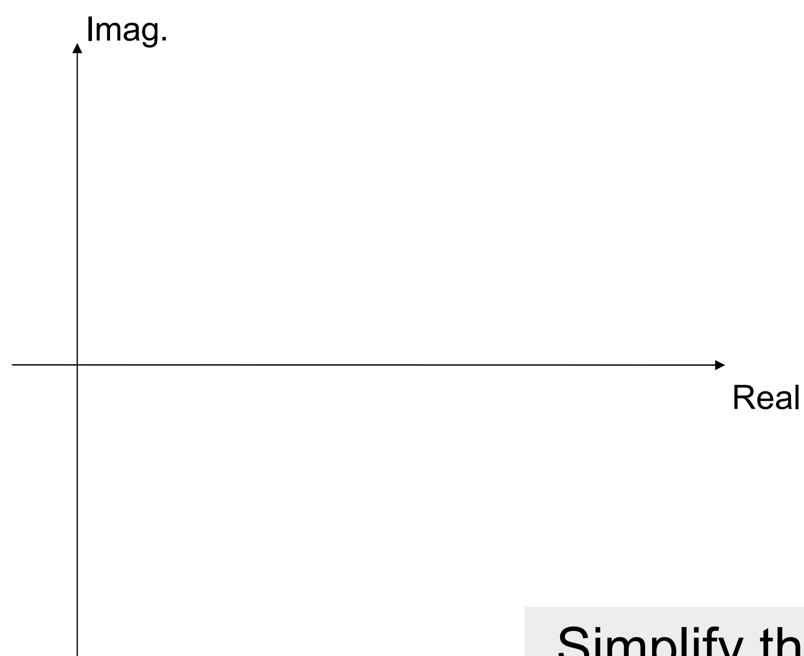
Simplifying;

The expression for the impedance;

This tells us the **electrical impedance** in a series LCR circuit.

Compare it to the expression for the **mechanical impedance**.

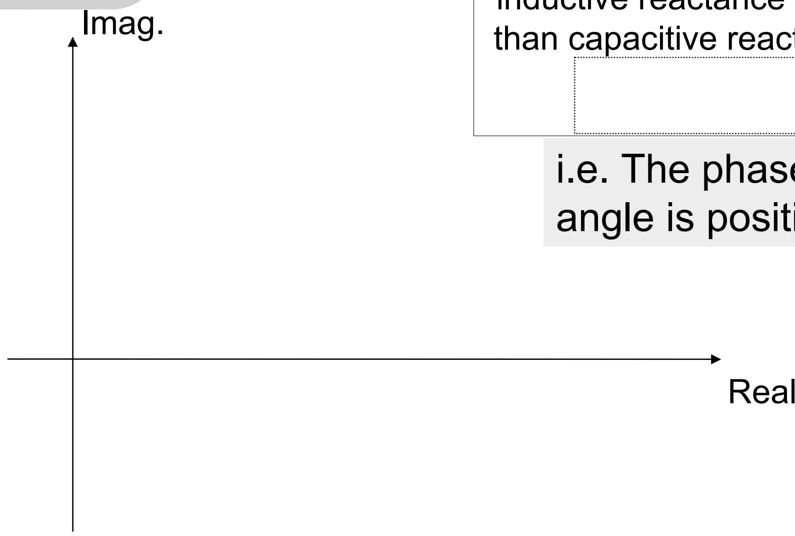
Since all three voltages *compete* within the series circuit, then we can represent them on the same phasor diagram.



Simplify this!

This diagram drawn with inductive reactance larger than capacitive reactance.

i.e. The phase angle is positive



I_0Z is the phasor representing the applied voltage

ϕ is the phase difference between …………

.... and the ……………...

But if the driving voltage has a frequency such that;

$$X_L<X_C$$

i.e. The phase angle will be negative

A quick bit of info…..

The impedance of an inductor

It is …………………………………….

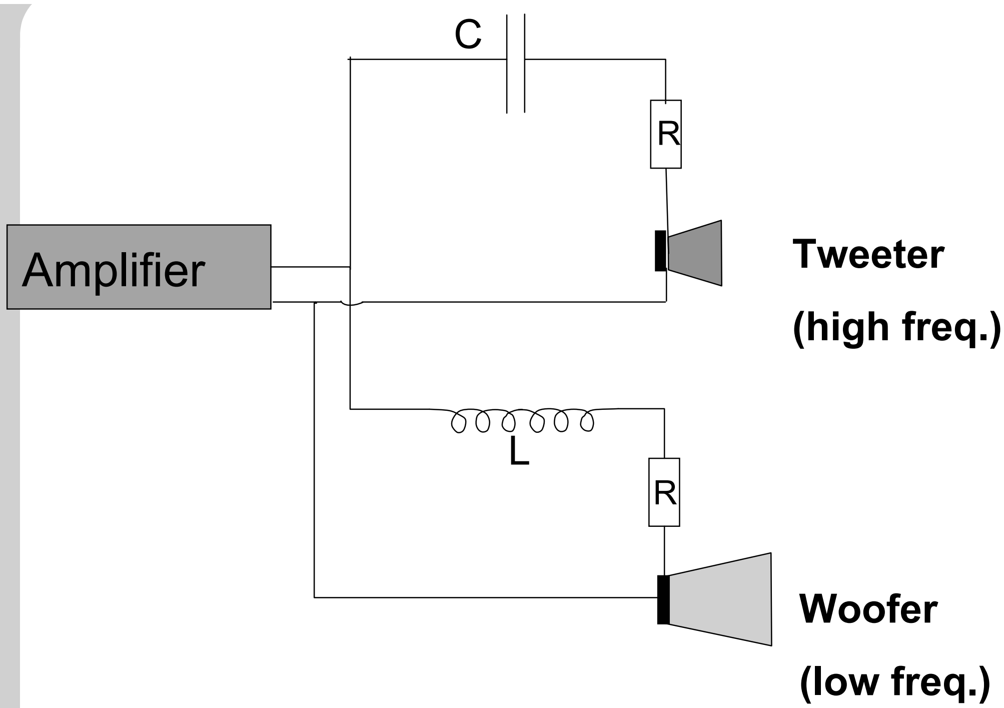
So if the circuit is driven with by a high frequency source, the ………………….. will high;

→ causing …………………...

Inductors ………. the flow of ………………….. current.

The opposite is true for a capacitor

Crossover network-loudspeaker (parallel circuit)



Final expression.

So now we can write three things;

By substitution;

The current has a magnitude V_0/Z and a phase difference ϕ w.r.t voltage

When is the current highest?