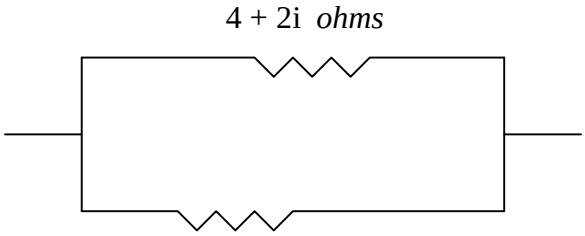
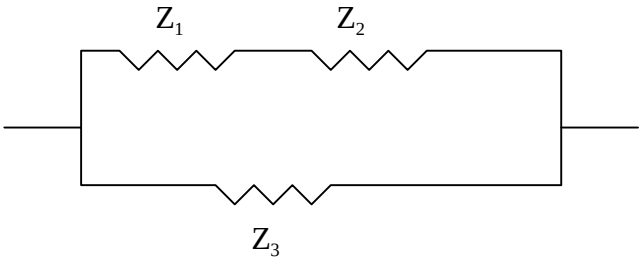
PROBLEM 2: CAR SPEAKERS

If you wish to install speakers in your car stereo, you need to match the speakers to the impedance of the amplifier used. In order to match the speaker you want with the car stereo, you may have to install a resistor in parallel to the speaker. Suppose the speaker has an impedance of **4 + 2*i*** ohms and the resistor has an impedance of **4 - 2i** ohms. Use the formula $Z_T = \frac{Z_1 Z_2}{Z_1 + Z_2}$ to find the total impedance of the parallel circuit.



EXTENSION

Determine a formula to find the total impedance in a parallel circuit where one branch of the circuit has resistors connected in series. If possible, test your conjecture by actually building the circuit. Determine the frequency and calculate $i\omega L$ and $\frac{1}{i\omega C}$.



FURTHER EXTENSIONS

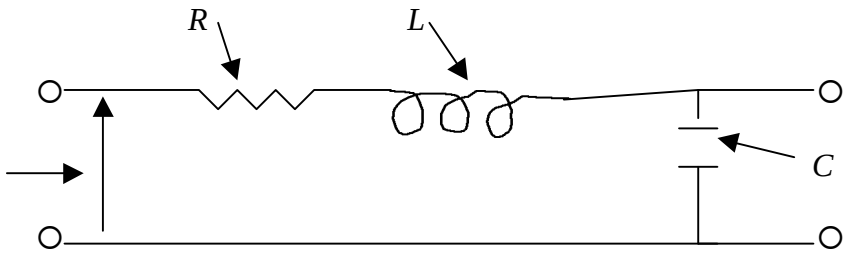
Explore the capabilities of the calculator. Specifically:

1. Determine what the absolute value of a complex number refers to.
2. Determine what the argument of complex number refers to.
3. Find the conjugate of a complex number.
4. Isolate either the real or imaginary part of a complex number.

ONE SOLUTION TO PROBLEM 2: CAR SPEAKERS

Impedance is a measure of the total opposition to current flow in an alternating current circuit composed of ohmic and non-ohmic devices. Ohmic devices follow Ohm's Law. Non-ohmic devices do not follow Ohm's Law because they depend on the frequency of an alternating current.

REPRESENTATION OF A CIRCUIT



R = Pure Resistance
L = The Inductive Component
C = The Capacitance component

The Complex number Z results when pure resistance, inductance, and capacitance are added together.

$$Z = R + X_L + X_C \text{ where } X_L = i\omega L,\ X_C = \frac{1}{i\omega C}, \text{ and } \omega = 2\pi * \text{the frequency}$$

of the alternating current.

Note that the higher the frequency, the larger X_L and the smaller X_C. It follows that the lower the frequency, the lower the effect of inductance and the greater the effect of capacitance.

Any electrical circuit consists of these three components, R, X_L, and X_C. However, when the current is DC, $X_L = 0$, because the frequency is 0, and the circuit at C is open so X_C is nonexistent. The concept of impedance is important in electronic circuit design, computer circuit design, and video/audio circuit design.

Solving this problem is simply a matter of putting our complex numbers into the formula and simplifying. This can be done very easily on either the CFX 9850Ga Plus or the ALGEBRA FX2.0.

- From the MAIN MENU, choose "Run."
- Press [OPTN] followed by [F3] so the complex number functions are available.
- Type in **4 + 2i**, using [F1] for **i**.
- To store it in the "A" memory, press [→], then [ALPHA] (the red key), [X,θ,T], and [EXE].
- Store **4 – 2i** in alpha B by following similar keystrokes, but using the [log] key for alpha B.
- Now simply type in the formula, using A and B instead of Z_1 and Z_2. The screen along with the solution, 2.5 ohms, is shown below.