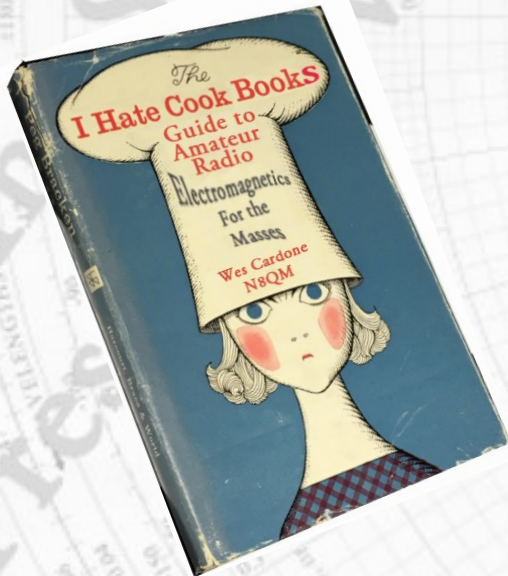


# Smith Charts and More

*[Sponsored by the Chelsea Amateur Radio Club \(WD8IEL\).](#)*

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**December 6, 2022**

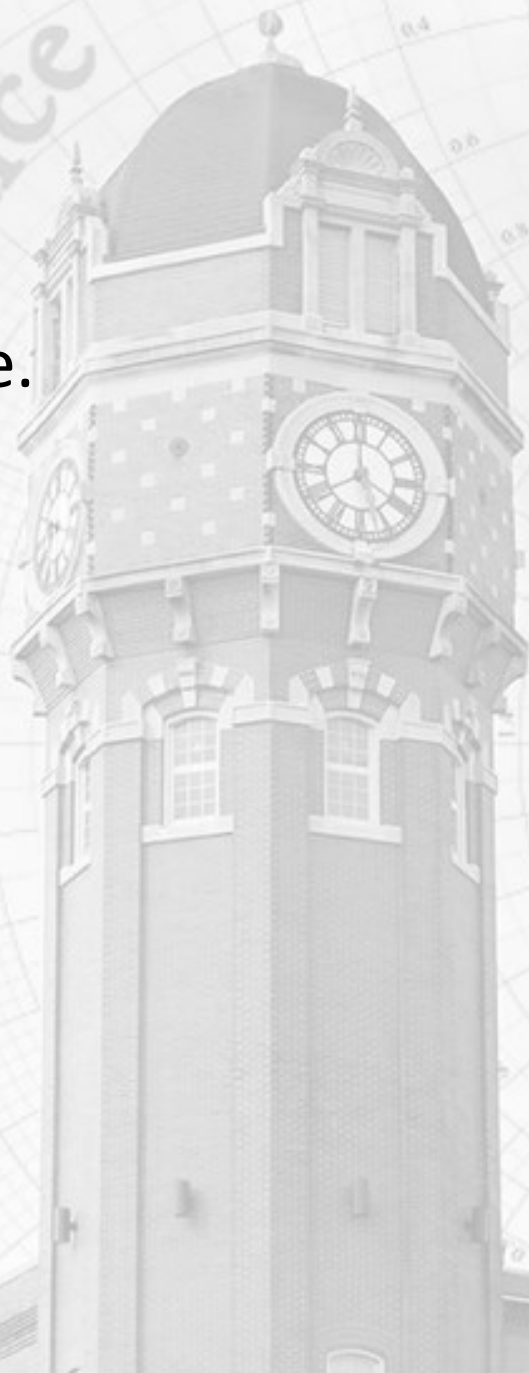


# Strategic Overall Class Objectives

- Prepare for the FCC upgrade license exams efficiently.
- Have fun learning what you thought was a stumbling block.
- Use SimSmith—A Practical Example
- Center lessons on explicit FCC pool questions.

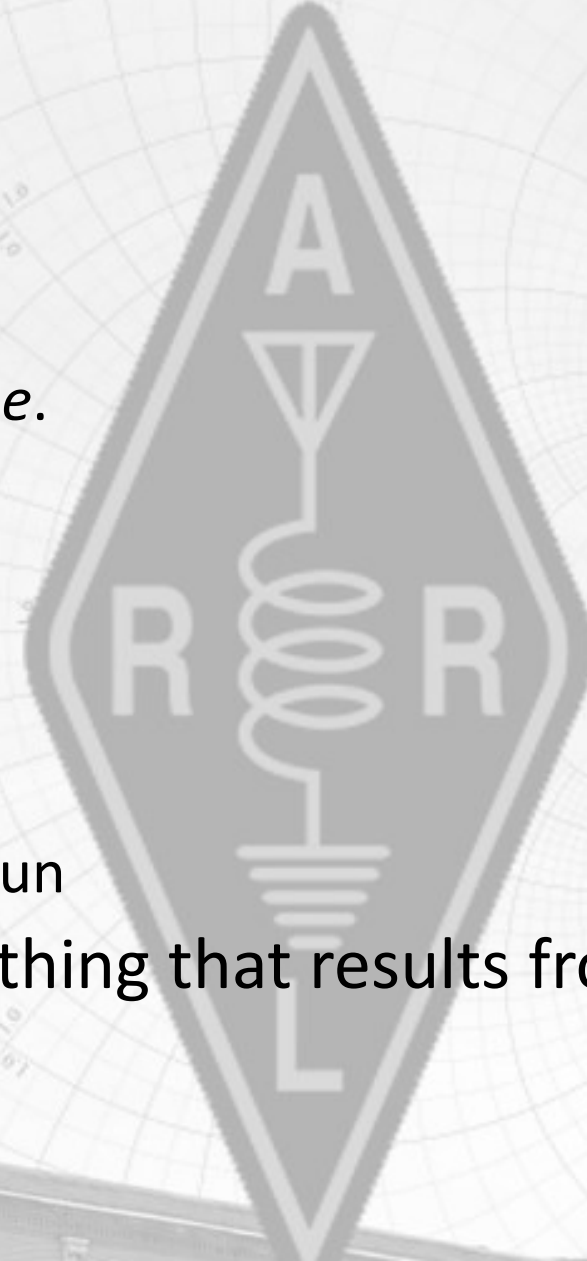
# Tonight...

- We will look at reactance.



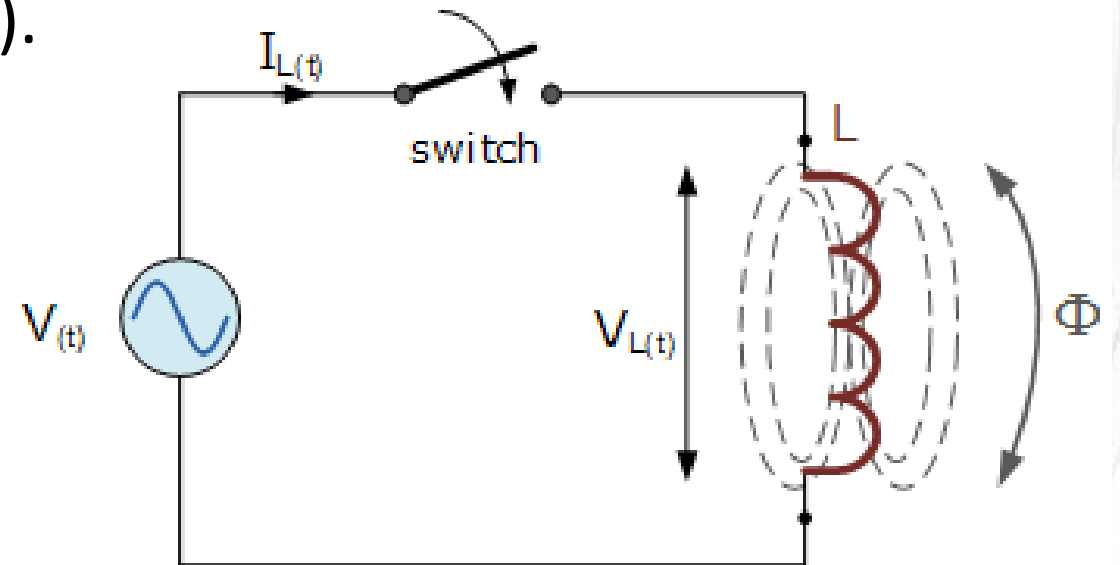
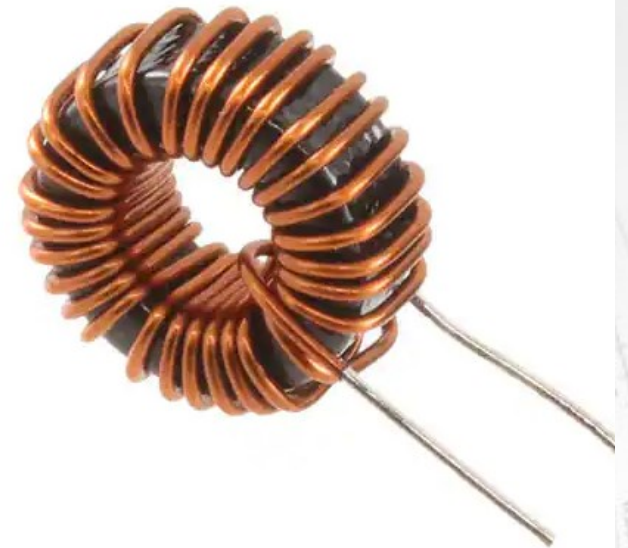
# English Grammar

- What is a gerund?
  - a verb that's acting as a noun
  - i.e. ***Killing*** *the president was an atrocious crime.*
  - Generally found in the participle form (...ing).
  - To kill is a verb but used here as a noun.
  - The verb is “was,” a form of “to be.”
- What then is a noun acting as a verb?
  - Reactance
  - The verb is “to react” but made here into a noun
- Reactance in the electrical domain is something that results from a verb action.



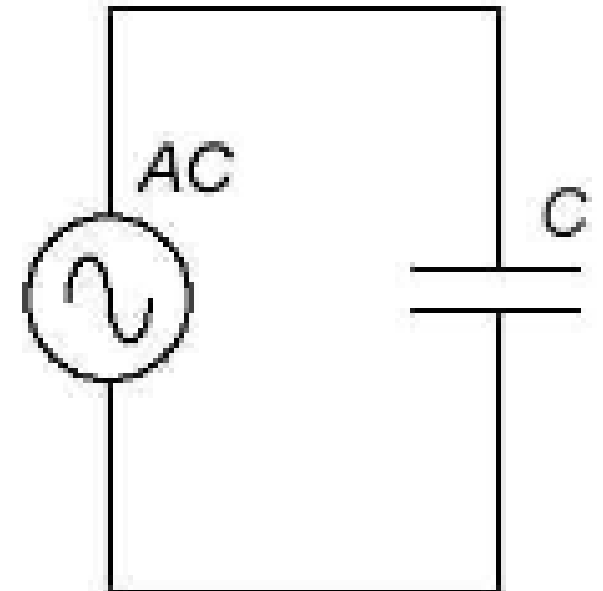
# Inductors

- Inductance is electrical wire wrapped around something.
- This produces inductance
- But... if all you had was a straight wire, that too has inductance. (generally 20nH per inch).



# Capacitors

- Capacitance is plates near each other.
- This “distance” enables a storage of energy.
- Think of it as a bucket of water.
  - One capacitor will store only so much energy
  - Another larger capacitor will store all that much more energy.



# Mix the Two...what happens?

- Inductive reactance is plus ( $+X_L$ )
- Capacitive reactance is minus ( $-X_C$ )
- What happens when you add the two Together?
  - $Z = X_L + X_C = X_L + (-X_C) = X_L - X_C = Z$
- What about antennas?
  - Recall a straight wire has inductance (20nH/inch)
  - Wire also has capacitance dependent on its distance from the ground plane.
- What happens when an antenna's reactance is neutralized?
  - The capacitive reactance has neutralized the inductive reactance
  - Result: a net zero reactance
  - Leaving only the real part of a vector impedance— $50 + j0$  Ohms.

# Next Week...

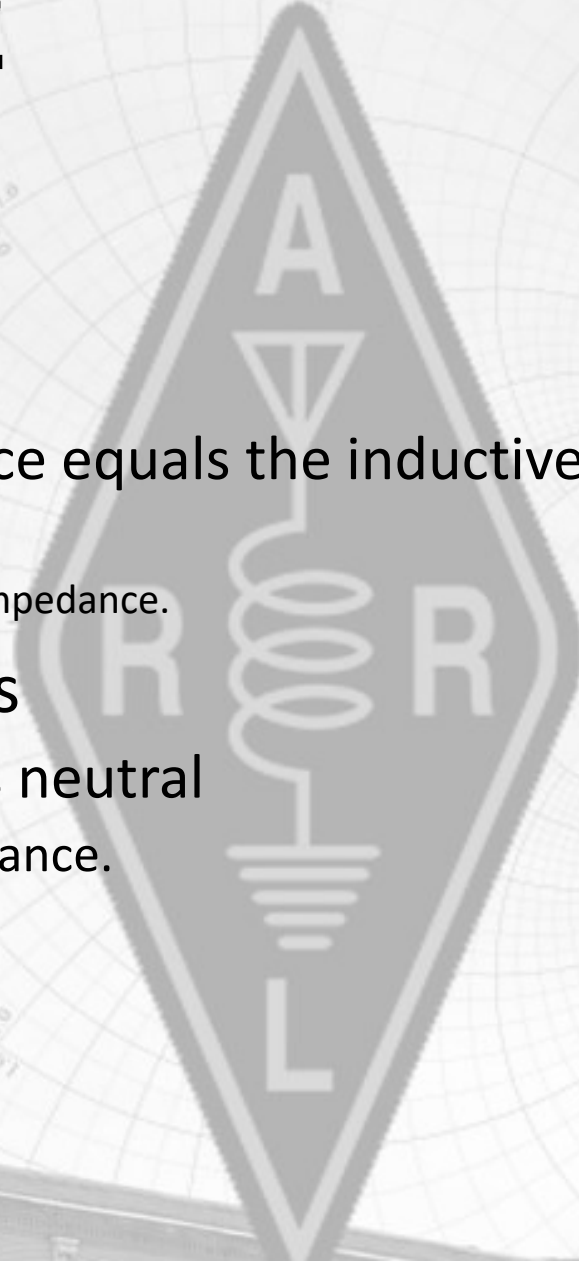
- Next week we play hooky
- Christmas break until January 10<sup>th</sup>





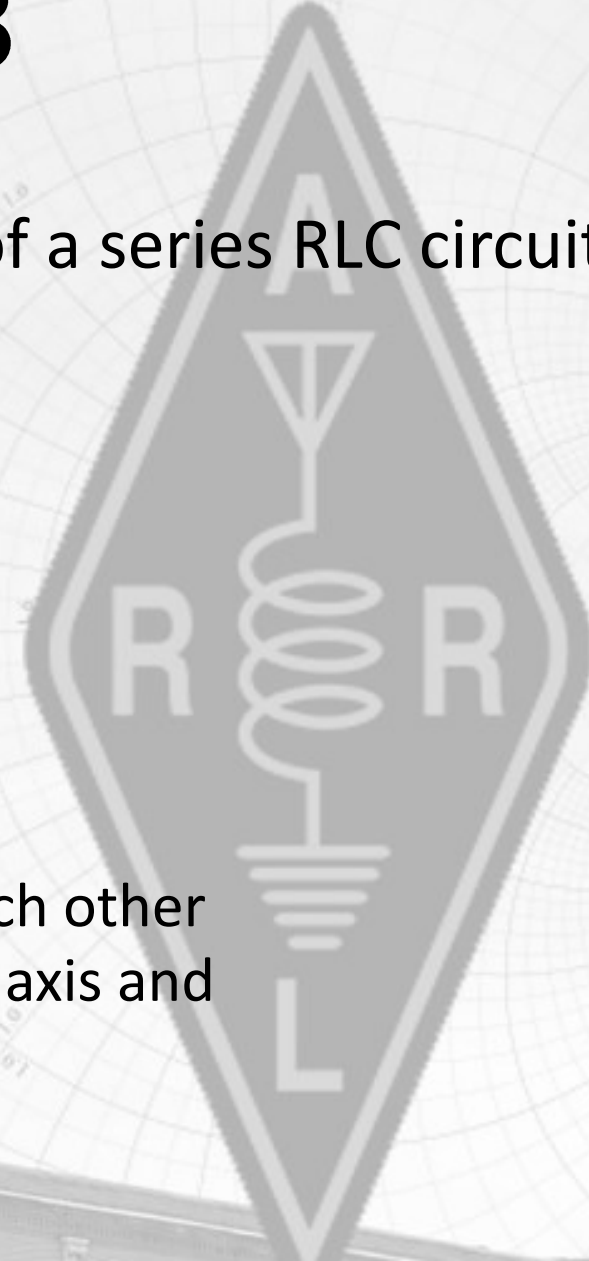
# FCC Pool Question E5A02

- What is resonance in an LC or RLC circuit
  - The highest frequency that will pass current
  - The lowest frequency that will pass current
  - The frequency at which the capacitive reactance equals the inductive reactance.
  - The frequency at which the reactive impedance equals the resistive impedance.
- This is a critical element of antenna analysis
  - The antenna is resonant when the reactance is neutral
    - The capacitive reactance equals the inductive reactance.



# FCC Pool Question E5A03

- What is the magnitude of the impedance of a series RLC circuit at resonance?
  - High, as compared to the circuit resistance
  - Approximately equal to capacitive reactance
  - Approximately equal to the inductive reactance
  - ~~Approximately equal to the circuit resistance~~
- Why?
- At resonance reactance
  - Is neutral
  - Capacitive and Inductive reactances cancel each other
  - Therefore, there is no travel along the vertical axis and
  - There is only resistive impedance



# FCC Pool Question E5A04

- What is the magnitude of the impedance of a parallel RLC circuit at resonance?
  - ~~Approximately equal to the circuit resistance~~
  - Approximately equal to the inductive reactance
  - Low compared to the circuit resistance
  - High compared to the circuit resistance
- No matter whether series or parallel, at resonance, reactance is neutral, capacitive and inductive canceling each other.
- Only a resistive component is left.

# FCC Pool Question E5B12

- What is admittance
  - The inverse of impedance
  - The term for the gain of a field effect transistor
  - The turns ratio of a transformer
  - The inverse of Q factor
- Hints to use if you don't remember while taking the test
  - You are going to have to remember that admittance has something to do with or is related to impedances.
  - Therefore
    - A field effector transistor answer is out of the question leaving 1, 3 & 4.
    - A transformer is disqualified leaving only 1 & 4.
    - You will likely recall that admittance is the inverse of something making the last elimination tough. You will have to remember that Q is not an impedance thing.

# FCC Pool Question E5C01

- Which of the following represents capacitive reactance in rectangular notation
  - $-jX$
  - $+jX$
  - Delta
  - Omega
- Rule out 3 & 4, those are gibberish answers leaving only 1 & 2.
- Nos 1 & 2 are both viable answers as far as relevance is concerned.
- Is easy to forget which is which
- Recall that  $+X$  (northern hemisphere) is inductive
- Therefore,  $-X$  is capacitive reactance.

# FCC Pool Question E5C03

- What coordinate system is often used to display the resistive, inductive, and/or capacitive reactance components of impedance?
  - Maidenhead grid
  - Faraday grid
  - Elliptical coordinates
  - Rectangular coordinates
- A Maidenhead grid is for a global grid square locator map eliminating No 1 and Faraday grid is just plain gibberish eliminating No 2.
- Elliptical coordinates are unheard of so eliminate No 3...
- ...leaving No 4.

# FCC Pool Question E5C06

- What does the impedance  $50 - j25$  represent?
  - 50 Ohms resistance in series with 25 Ohms inductive reactance
  - 50 Ohms resistance in series with 25 Ohms capacitive reactance
  - 25 Ohms resistance in series with 50 Ohms inductive reactance
  - 25 Ohms resistance in series with 50 Ohms capacitive reactance
- There are no non-sense answers here to eliminate
- You should immediately recognize the  $R \pm jX$  convention cluing you in to eliminating Nos 3 & 4 leaving only 1 & 2.
- You need to remember that minus (-) reactance is capacitive leaving you with No 2.

# Questions

*The Smith Chart  
Presented with Elegance*

