# *The Really Important Formulas*

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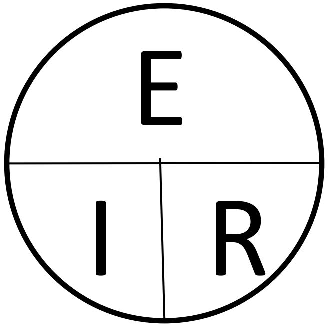
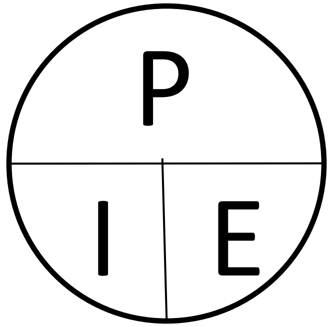
## *Ohm's Law*




P = Power (Watts)
E = Potential Difference (Volts)
I = Current (Amps)
R = Resistance (Ohms)

## *Frequency & Wavelength*

300 / Frequency (MHz) = Wavelength (M)
300 / Wavelength (M) = Frequency (MHz)

## *Transformer Turns Ratio*

Turns ratio = $\frac{N_P}{N_S}$

$N_P$ = Primary turns
$N_S$ = Secondary turns

Voltage will vary by the turns ratio.
Current will vary by the inverse.

## *Series & Parallel*

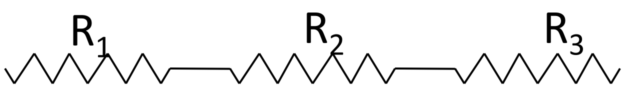
Series Resistance = R1 + R2 + R3 …

Parallel Resistance = $\frac{R_1 \times R_2}{R_1 + R_2}$

Inductance is calculated like Resistance
Capacitance is calculated in reverse

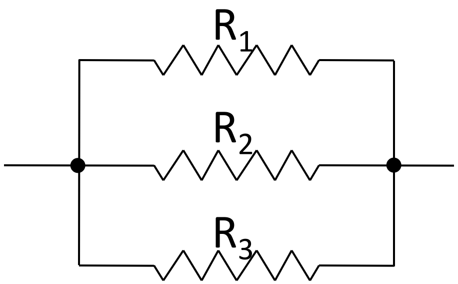
# Other Important Formulas

## Series & Parallel (Resistance)




- $R_T = R_1 + R_2 + R_3$
- $I = E / R_T$ -> Current is the same, wherever you measure it.
- $E$ at $R_x = I_T * R_x$ -> Voltage drop is different at each resistor.

  -> Total voltage drop is the sum of $E_1 + E_2 + E_3$




$$R_T = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$$

- $I_x = E / R_x$ -> Current is different at each resistor.
- $E_x = E_T$ -> Voltage drop is the same, wherever you measure it.

## Frequency and period

$F = 1 / T$ and $T = 1 / F$ *where 'T' = 1 cycle*

## Series & Parallel Resistance (non-math)

If x equal value resistors are in parallel, the total R is the value of one resistor over the number of resistors, or R / X.

The total resistance in a parallel circuit is always less than that of the smallest resistor.

The total resistance of two equal value resistors is half the value of either resistor.

# Unit Conversions

| Name | Symbol | Multiplier | Exponent |
|---|---|---|---|
| Giga | G | X 1 000 000 000 | $10^9$ |
| Mega | M | X 1 000 000 | $10^6$ |
| Kilo | K | X 1 000 | $10^3$ |
| | | UNIT | |
| milli | m | / 1 000 | $10^{-3}$ |
| micro | µ | / 1 000 000 | $10^{-6}$ |
| nano | n | / 1 000 000 000 | $10^{-9}$ |
| pico | p | /1 000 000 000 000 | $10^{-12}$ |

# *Reactance*

## *Capacitive and Inductive Reactance*

- **Capacitance** (*C*) refers to the physical properties of a capacitor.
- **Inductance** (*L*) refers to the physical properties of an inductor.
- **Reactance** (*X*), measured in ohms, is the opposition to AC current by a capacitor or inductor (or both).
- **Impedance** (*Z*), AC resistance, is reactance plus pure resistance. (See optional formulas for the math.)
- **Capacitive reactance** ($X_C$)is the opposition to AC current flow by a capacitor.
  - It is inversely proportional to frequency.
- **Inductive reactance** ($X_L$)is the opposition to AC current flow by an inductor.
  - It is directly proportional to frequency.

***Capacitive Reactance***

$$X_C = \frac{1}{2 \pi f C}$$

***Inductive Reactance***

$$X_L = 2 \pi f L$$

# *Decibels*

| Power | Decibel |
|---|---|
| 2 | 3 |
| 4 | 6 |
| 6 | 8 |
| 8 | 9 |
| 10 | 10 |
| 100 | 20 |
| 1000 | 30 |

<- Remember this chart, and you know all the decibel conversions you need to know for the exam. Also read the article at http://www.ve3fyn.ca/nvis/Decibel.htm

* A change of 1 dB is generally the minimum a person can detect if it is expected. A change of 3 dB, (doubling or halving the power) is generally the minimum a person can detect if it is not expected.

$dB = 10Log(P_2/P_1)$ *where 'P' is power* $dB = 20Log(E_2/E_1)$ *where 'E' is voltage*
On your calculator: $(P_2 \div P_1)$ {Log} * 10 = or $(E_2 \div E_1)$ {Log} * 20 =
dB to Power Ratio on your calculator: (dB ÷ 10) {2ndF} {$10^x$} =

**To convert a two-digit decibel to its power ratio:**
The first digit tells you the magnitude. The second digit tells you the value.
So, with 36 dB, the '3' tells you it's in the thousands.
The '6' is a power radio of 4. So 36 dB = 4000 times the power.

# *Good Stuff That's Not on the Basic Exam*

## *Impedance turns ratio*

$$\frac{N_P}{N_S} = \sqrt{\frac{Z_P}{Z_S}}$$

Where:
$N_P$ = Number of primary turns,
$N_S$ = Number of secondary turns,
$Z_P$ = Primary impedance,
$Z_S$ = Secondary impedance.

## *Impedance*

$$Z = \sqrt{R^2 + X^2}$$

Z = Impedance (ohms)
R = Resistance (ohms)
X = Reactance (ohms)

## *Resonant Frequency*

- Current lags behind voltage in an inductor.
- Current leads voltage in a capacitor.
- At the resonant frequency in an RLC circuit, the inductor and capacitor are in-phase.
- In an RLC series circuit, at resonance, current is maximum.
- In a parallel LC circuit, at resonance current is minimum.

***Resonance***

$$f_r = \frac{1}{2\pi\sqrt{(L\,C)}}$$

# *More Good Stuff That's Not on the Basic Exam*

## *Q of Tuned Circuits*

- "Q" refers to the sharpness of the response curve of a tuned circuit.
- It is the ratio between $X_L$ and R.
- Note that Q is frequency sensitive, as $X_L$ varies with frequency.

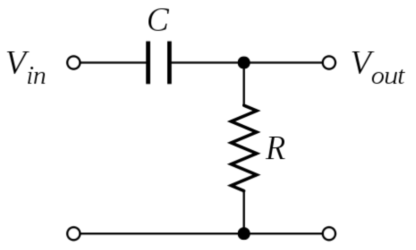
$$Q = \frac{X_L}{R}$$

- A high Q (50 – 250) indicates a coil with little resistance at RF, and a sharp response curve.
- Capacitors have a very high Q, which is effectively irrelevant.
- In a parallel tuned circuit, Q is impedance over reactance (Z / X)

$$Q = \frac{Z}{X}$$

# *Cut-off Frequencies* *(also not on exam)*

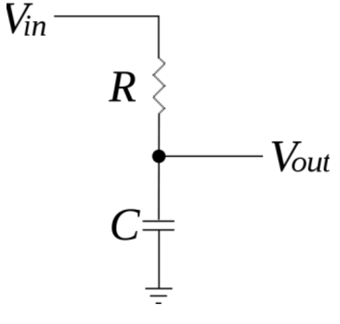
## *High-Pass Filters*




$$f_c = \frac{1}{2\pi\tau} = \frac{1}{2\pi RC},$$

- High-pass filters pass high frequencies and reject signals at frequencies below the cut-off point.
- At the cut-off point, output power is ½ input power.
- R represents the impedance of the circuit in question.
- Higher value capacitors lower the cut-off frequency (frequencies below the cut-off are attenuated).

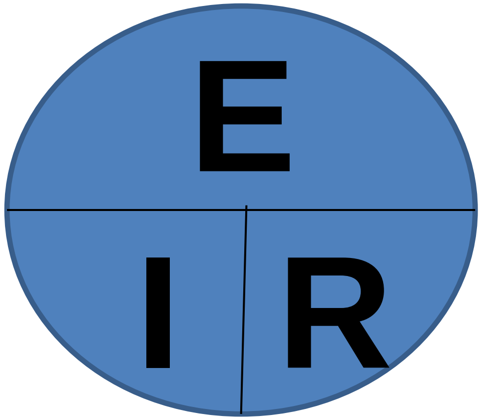
## *Low-Pass Filters*

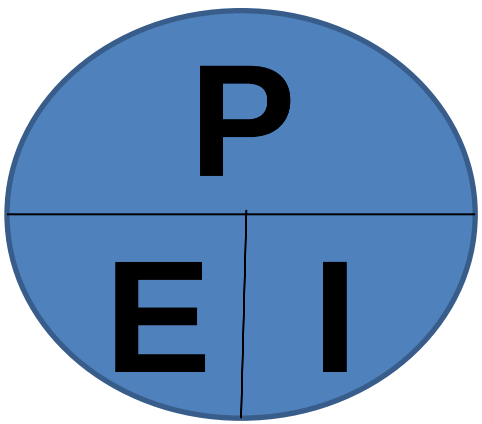



$$f_c = \frac{1}{2\pi\tau} = \frac{1}{2\pi RC},$$

- Low-pass filters pass low frequencies and shunt higher frequencies to ground.
- At the cut-off point, output power is ½ input power.
- R represents the impedance of the circuit in question.
- Lower value capacitors lower the cut-off frequency (frequencies above the cut-off are attenuated).

## *In Case you Forgot…*




E = voltage (energy)
    measured in volts
I = current
    measured in amperes
R = resistance
    measured in ohms
P = power
    measured in watts

| | |
|---|---|
| E = I * R | P = E * I |
| I = E / R | E = P / I |
| R = E / I | I = P / E |

Other formulae may be derived from this. For example:
P = E * I
E = R * I  Therefore, P = R * I * I, or $P = R * I^2$