eta® international common formulas
for use on all basic electronics exams as well as the general communications technician-level 1 (gct1) exam

conversion factors

<table>
<thead>
<tr>
<th>formula</th>
<th>value</th>
</tr>
</thead>
<tbody>
<tr>
<td>π (Pi)</td>
<td>3.14</td>
</tr>
<tr>
<td>2π</td>
<td>6.28</td>
</tr>
<tr>
<td>log₁₀π</td>
<td>0.497</td>
</tr>
<tr>
<td>1 meter</td>
<td>3.28 feet</td>
</tr>
<tr>
<td>1 inch</td>
<td>2.54 centimeters</td>
</tr>
<tr>
<td>1 radian</td>
<td>57.3°</td>
</tr>
</tbody>
</table>

resonant frequency formulas

where f is in kHz, L is in microhenries, C is in microfarads

\[ f_{res} = 159.2 \frac{1}{\sqrt{LC}} \]

where f is in Hz, L is in henries, C is in farads

\[ f_{res} = \frac{1}{2\pi \sqrt{LC}} \]

frequency & wavelength formulas

\[ f = \text{frequency}, \ \lambda = \text{wavelength} \]

0.5λ = 180° = half wave and 0.25λ = 90° = quarter wave

\[ f_{1/4\lambda} = (3 \times 10^5) / \lambda_{\text{metres}} \quad \text{or} \quad f_{1/4\lambda} = 984 / \lambda_{\text{metres}} \]

\[ \lambda_{\text{metres}} = (3 \times 10^5) / f_{1/4\lambda} \quad \text{or} \quad \lambda_{\text{metres}} = 984 / f_{1/4\lambda} \]

\[ c = f \times \lambda \quad \text{where} \ c = \text{the speed of light} \]

sine wave conversion

- effective value (RMS) = 0.707 x peak value = 1.11 x average value
- peak value = 1.414 x effective value (RMS)
- average value over positive half period = 0.637 x peak value = 0.9 x effective value (RMS)
- identify: waveform, peak (amplitude), RMS, 1 cycle over time period (frequency), peak to peak, and practical average

peak value (V_p or V_max) Relative to zero

RMS value (V_RMS) = V_p x 0.707

average value (V_a) = V_p x 0.637

peak to peak value (2V_p)

periodic time T (Frequency = 1/T)

voltage gain in decibels

Gain dB = 20log(V_{out} / V_{in})

ratio of two power levels in decibels

Gain dB = 10log(P_{out} / P_{in})

resistors in series

R = R_1 + R_2 + R_n...

resistors in parallel

\[ 1 / R = (1 / R_1) + (1 / R_2) + (1 / R_n) \]

inductors connected in series

L = L_1 + L_2 + L_n...

inductors connected in parallel

\[ 1 / L = (1 / L_1) + (1 / L_2) + (1 / L_n) \]

ohm's law

\[ I = \text{current} \quad P = \text{power} \quad R = \text{resistance} \quad E = \text{voltage} \]

reactance of inductors

\[ XL = 2\pi fL \]

where

\[ XL \] reactance, \[ f \] frequency, and \[ L \] inductance

energy storage in a capacitor

\[ Q = CV \quad \text{where} \ Q = \text{charge (in Coulombs)}, \ C = \text{capacity (in Farads)}, \ V = \text{potential difference (in Volts)} \]

\[ W = \frac{1}{2} CV^2 \]

where \ W = \text{energy (in Joules)}, \ C = \text{capacity (in Farads)}, and \ V = \text{potential difference (in Volts)}

 capacitors connected in parallel

\[ C = C_1 + C_2 + C_3 + \ldots \]

\[ \frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \ldots \]

reactance of capacitors

\[ X_C = \frac{1}{2\pi fC} \]

impedance for a series circuit

where \ Z = \text{impedance}

\[ Z = \sqrt{R^2 + X_L^2} \]

impedance for R and X in parallel

\[ \frac{1}{Z} = \frac{1}{R} + \frac{1}{X} \]

battery internal resistance

\[ V_{out} = EMF - (R_{int} x I_{out}) \]

resonant frequency formulas

\[ f_{res} = \frac{1}{2\pi \sqrt{LC}} \]

where

\[ f_{res} \] resonant frequency, \[ L \] inductance, \[ C \] capacitance

resistors in series

\[ R = R_1 + R_2 + R_n \]

reactance of capacitors

\[ X_C = \frac{1}{2\pi fC} \]

impedance for R and X in parallel

\[ \frac{1}{Z} = \frac{1}{R} + \frac{1}{X} \]

battery internal resistance

\[ V_{out} = EMF - (R_{int} x I_{out}) \]