1. Write the phasor $10\angle 30°$ V in rectangular form. What is its real part, in volts?

   _____ V

2. A load draws 10 A RMS from 230 V RMS with the current lagging by 60°. What is its real power, in watts?

   _____ W

3. A series RLC has L = 10 mH and C = 1 µF. What is ω_0, in rad/s?

   _____ rad/s

4. L = 1 mH and C = 1 nF. What is the resonant frequency f_0, in kHz?

   _____ kHz

5. An RC low-pass with its output across C passes DC unchanged.

   ☐ True ☐ False

6. In the s-domain, an inductor with initial current i(0) becomes

   ☐ A resistor R

   ☐ 1/(sC) plus a source

   ☐ Just sL, the past is forgotten

   ☐ Impedance sL plus a series voltage source $L \cdot i(0)$

7. To use a two-port in a design, you need to know the components inside it.

   ☐ True ☐ False

8. As frequency rises, the impedance of a capacitor

   ☐ Grows along +90°

   ☐ Shrinks along +90°

   ☐ Stays flat at 0°

   ☐ Shrinks along −90°

9. The RL load (I = 2 A through R = 30 Ω, X = 40 Ω) has Q equal to –

   ☐ 120 var

   ☐ 80 var

   ☐ 160 var ($= |I|^2X$)

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10. Series RLC with $\alpha = \omega_0$ is

    ☐ Unstable

    ☐ Underdamped

    ☐ Critically damped: fastest return without ringing

    ☐ Overdamped

1. **8.66 V**

   $10\cos 30^\circ = 8.66$ V; the imaginary part is $10\sin 30^\circ = 5$ V, so the phasor is $8.66 + j5$ V.

2. **1150 W**

   $P = VI\cos\theta = 230 \times 10 \times 0.5 = 1150$ W. The power factor 0.5 means half of the 2300 VA does work.

3. **10000 rad/s**

   $\omega_0 = \dfrac{1}{\sqrt{LC}} = \dfrac{1}{\sqrt{10^{-2} \times 10^{-6}}} = \dfrac{1}{10^{-4}} = 10\,000$ rad/s.

4. **159.2 kHz**

   $\omega_0 = \dfrac{1}{\sqrt{10^{-3} \times 10^{-9}}} = 10^6$ rad/s, and $f_0 = \dfrac{\omega_0}{2\pi} = 159.2$ kHz.

5. **True**

   At $\omega = 0$ the capacitor is an open circuit, so no current flows and $H = 1$: the output equals the input.

6. **Impedance sL plus a series voltage source $\mathbf{L \cdot i(0)}$**

   The initial condition enters as a source: $L\,i(0)$ volts in series, or $\dfrac{i(0)}{s}$ in parallel. Drop it and every answer claims the circuit starts at rest.

7. **False**

   The parameter set describes everything the outside world can see at the two ports. Two boxes with the same parameters behave identically in any circuit.

8. **Shrinks along $-90°$**

   $Z_C = \dfrac{1}{j\omega C}$: its size $\dfrac{1}{\omega C}$ falls with frequency at a fixed $-90°$. The inductor is the mirror image ($+90°$, grows).

9. **160 var ($= |\mathbf{I}|^2\mathbf{X}$)**

   $Q = |I|^2 X = 4 \times 40 = 160$ var, a check that never uses the phase angle; $P = 4 \times 30 = 120$ W likewise.

10. **Critically damped: fastest return without ringing**

    The roots $-\alpha \pm \sqrt{\alpha^2 - \omega_0^2}$ merge into one repeated real root, the border between ringing and creeping.

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