

University Electrical Engineering

Name: _____ Score: _____

1. Write the phasor $10\angle 30^\circ$ 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 $C = 1$ μ F. 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 $+90^\circ$
☐ Shrinks along $+90^\circ$
☐ Stays flat at 0°
☐ Shrinks along -90°
9. The RL load ($I = 2$ A through $R = 30\ \Omega$, $X = 40\ \Omega$) has Q equal to –
☐ 120 var
☐ 80 var
☐ 160 var ($= |I|^2 X$)

☐ 200 var

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

☐ Unstable

☐ Underdamped

☐ Critically damped: fastest return without ringing

☐ Overdamped

1. **8.66 V**

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

2. **1150 W**

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

3. **10000 rad/s**

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

4. **159.2 kHz**

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

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 $L \cdot i(0)$**

The initial condition enters as a source: $L i(0)$ volts in series, or $\frac{i(0)}{s}$ 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°**

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

9. **160 var ($= |I|^2 X$)**

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