NATIONAL UNIVERSITY OF SINGAPORE

EE2111A – ELECTRICAL ENGINEERING PRINCIPLES & PRACTICE II

by

MID-SEMESTER QUIZ

(Semester 2: AY2022/2023)

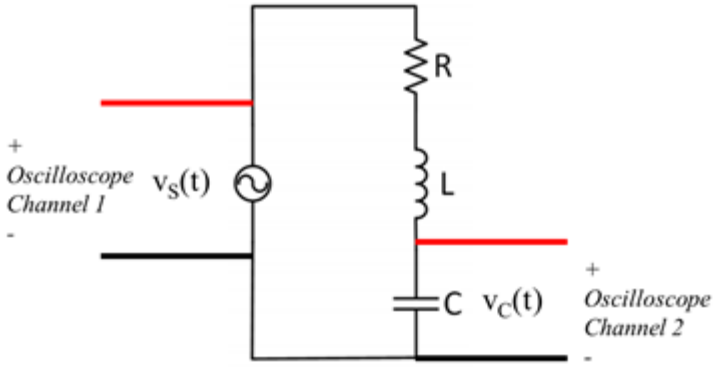
04 March 2023

Time Allowed: 1.5 Hour

INSTRUCTIONS TO STUDENTS:

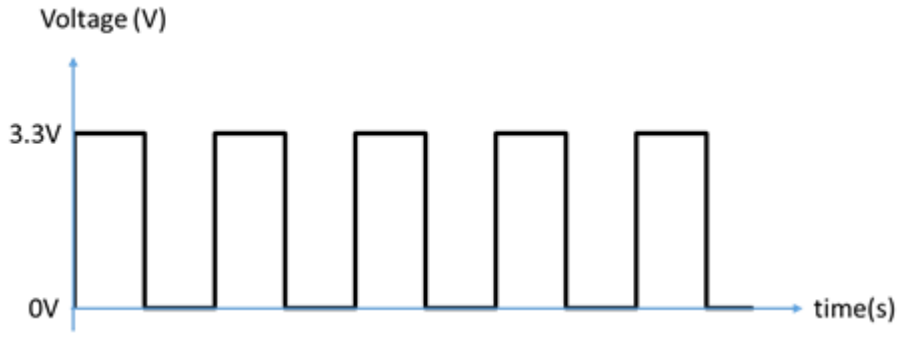
1. This quiz contains 20 questions and comprises 14 printed pages including the cover page.
2. Students are required to answer **ALL** questions.
3. **Please shade your matriculation number correctly on the scantron sheet.**
4. **Write your matriculation number and your contact number on the scantron sheet.**
5. Use a 2B pencil to shade completely all entries and the correct answers on the scantron sheet.
6. More than one answer (over-writing) per question will carry zero marks.
7. Do not submit the question paper, submit only the scantron sheet.
8. This is an **OPEN BOOK ASSESSMENT.**
9. All hardcopy materials related to the topic are permitted.
10. No laptop or mobile devices are allowed.

1. Bob was observing the voltage across the capacitor in a series RLC circuit as shown below on the oscilloscope in the EPP lab. Which of the following statements are TRUE?



A. The trigger can only be set to Channel 1 to observe both signals stably.
B. The trigger can only be set to Channel 2 to observe both signals stably.
C. The trigger can be set to EITHER Channel 1 OR Channel 2 to observe both signals stably.
D. The signals cannot be observed stably no matter which channel the trigger level is set to.

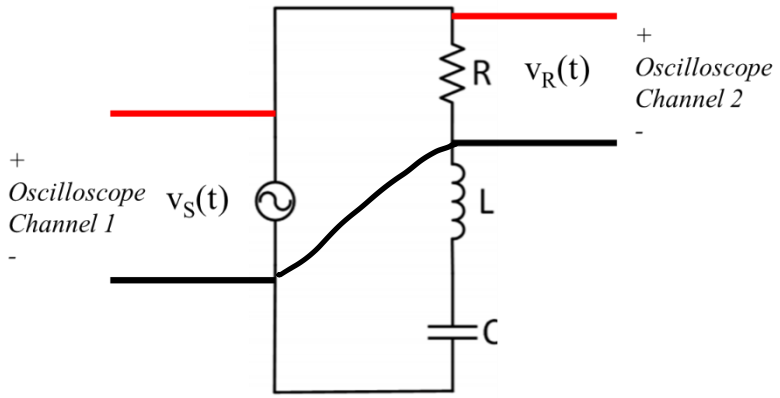
2. Bob generated a square wave as shown below from a signal generator. To observe the signal as shown below on the oscilloscope in the EPP lab, which of the following statements should be followed?



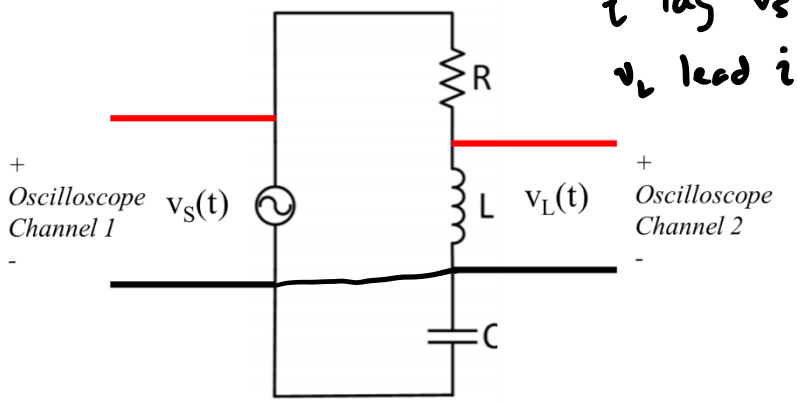
A. AC coupling should be used to observe this signal.
B. DC coupling should be used to observe this signal.
C. GND (ground) coupling should be used to observe this signal.
D. Either AC Coupling or DC Coupling can be used to observe this signal correctly.

3. Bob was observing the voltage signals across the various components in a series RLC circuit as shown below on the oscilloscopes in the EPP lab. Which of the following statements are true?

Measurement 1:



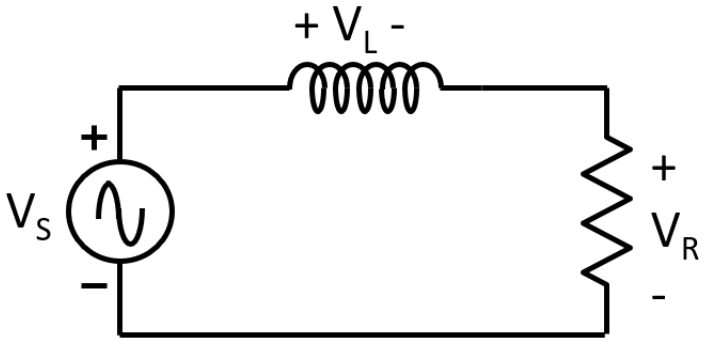
Measurement 2:



i lag V_s $< 90°$
v_L lead i by 90°

A. In both measurements, the signals on Channel 2 are observed to be in phase with the signal on Channel 1.
B. In both measurements, the signals on Channel 2 are observed to be lagging the signal on Channel 1.
C. In measurement 1, the signals on both channels are observed to be in phase. In measurement 2, the signal on Channel 2 is observed to be lagging the signal on Channel 1.
D. In measurement 1, the signals on both channels are observed to in phase. In measurement 2, the signal on Channel 2 is observed to be leading the signal on Channel 1.

4. In a series RL circuit, the RMS values of the voltages across R and L are measured as $V_{R,RMS}$=50V, $V_{L,RMS}$ =75V, respectively. What would be the approximate RMS voltage of the source voltage, $V_{S,RMS}$?



A. $V_{S,RMS}$ = 25V

B. $V_{S,RMS}$ = 90V

C. $V_{S,RMS}$ = 100V

D. $V_{S,RMS}$ = 125V

5. Which of the following statements is/ are **always TRUE** for a series R-L-C circuit driven by a sinusoidal voltage source?

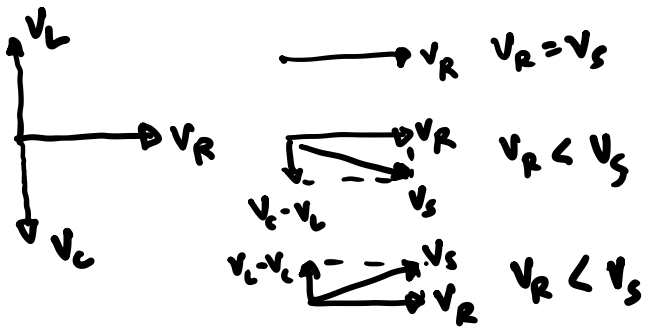
   i. Voltage drop across the resistor is **less** than the source voltage.
   ii. Voltage drop across the inductor is **less** than the source voltage.
   iii. Voltage drop across the capacitor is **less** than the source voltage.

A. All three options

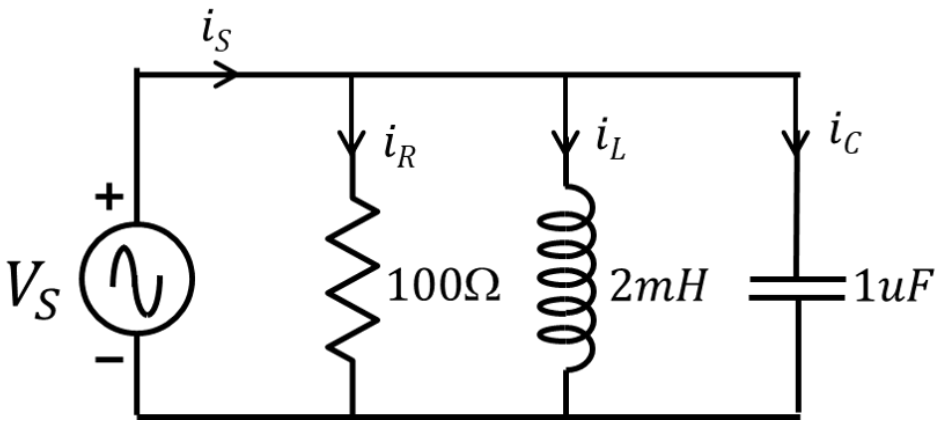
B. Option (i) and option (ii) only

C. Option (i) and option (iii) only

D. None of the options



6. The source Vs in the circuit below provides a sinusoidal signal at a RMS voltage of 100V and frequency of 50Hz.



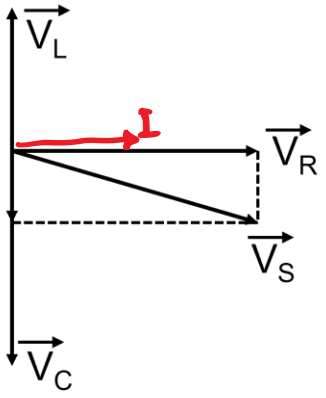
Which of the following statements are true?

(i) i_R is in phase with V_S
(ii) i_R leads V_S by 90°
(iii) i_L leads V_S by 90°
(iv) i_C leads V_S by 90°
(v) i_L lags V_S by 90°
(vi) i_C lags V_S by 90°

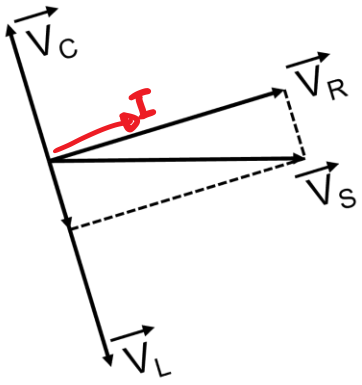
A. Options (i), (iii), (iv) are correct.
B. Options (ii), (iv), (v) are correct.
C. Options (i), (iv), (v) are correct.
D. Options (ii), (iii), (iv) are correct.

7. For a series R-L-C circuit driven by a sinusoidal voltage source, which of the following phasor diagrams correctly represent the voltages across different components?

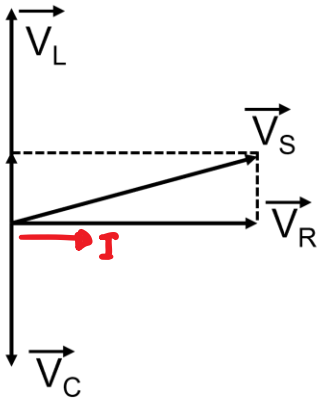
Phasor diagram 1



Phasor diagram 2



Phasor diagram 3



If the circuit is a series R-L-C driven by a sinusoidal voltage source, which of these phasor diagrams is/ are correct?

A. Phasor diagram 1 and phasor diagram 2 only

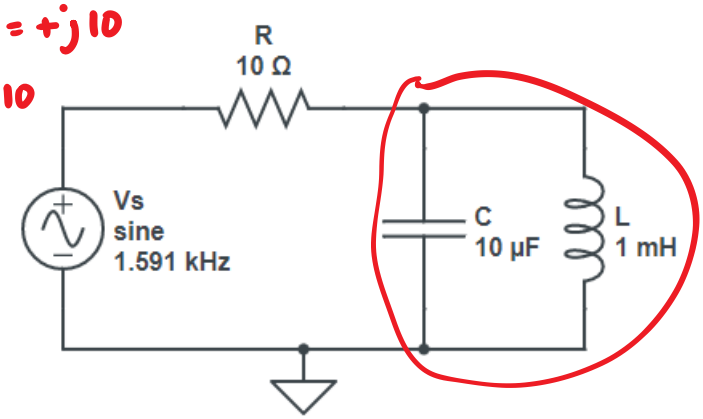
B. Phasor diagram 1 and phasor diagram 3 only

C. Phasor diagram 2 and phasor diagram 3 only

D. All three phasor diagrams

8. For the circuit below, the source voltage is

$$v_s(t) = 10\sin(\omega t), \quad \omega = 10^4 \frac{rad}{s}, \quad f = 1.591\ kHz.$$



If R = 10 Ω, L = 1 mH (milli-Henry), and C = 10 μF (micro-Farad), what is the RMS value of the source current $i_s(t)$?

A. 1 A
B. 0.707 A
C. 0 A
D. 1.41 A

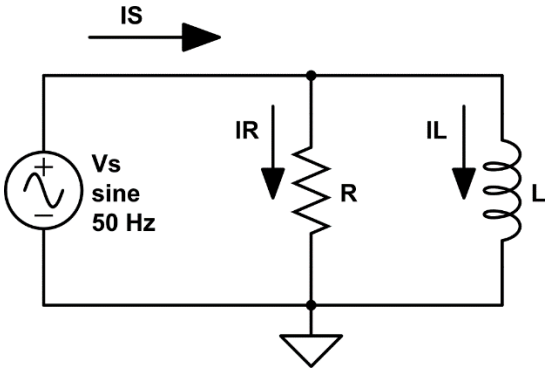
9. In a series R-L circuit driven by sinusoidal voltage source

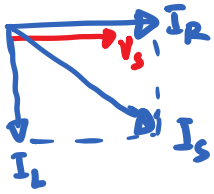
A. Voltage across L lags the source voltage but voltage across R leads the source voltage.
B. Voltage across L leads the source voltage but voltage across R lags the source voltage.
C. Voltage across L lags the source voltage but voltage across R is in-phase with the source voltage.
D. Voltage across L leads the source voltage but voltage across R is in-phase with the source voltage.

10. An appliance connected to 220 V (RMS) power source draws 5 A (RMS) current. The current lags the source voltage by $\pi/6$ radian or 30°. What is the impedance $|Z|\angle\theta$ of this appliance?

A. 44 Ω
B. $44\angle$-30° Ω
C. $44\angle$+30° Ω
D. None of the above

11. An AC sinusoidal voltage source drives a parallel R-L load as in the circuit below. Which option is correct?



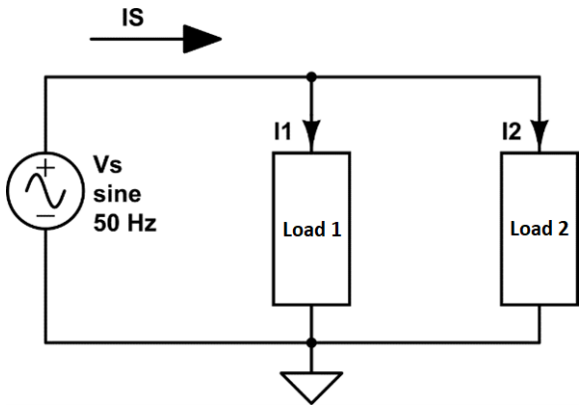


A. Current IL through L lags the source current IS but current IR through R leads the source current IS.
B. Current IL through L leads the source current IS but current IR through R lags the source current IS.
C. Current IL through L lags the source current IS but current IR through R is in-phase with the source current IS.
D. Current IL through L lags the source current IS by 90^o but current IR through R is in-phase the source current IS.

12. An AC load connected to 220V(RMS), 50Hz sinusoidal voltage source draws $22\sqrt{2}$ A (RMS) current. The current leads the source voltage by $\pi/4$ radian or 45°. If the load consists of two elements (each element is either R, L or C) connected in parallel, which option gives a possible combination?

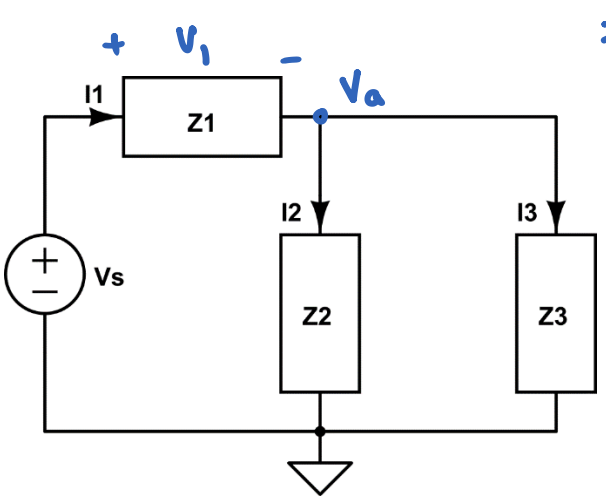
A. R=0.1 Ω, L=0.1 H
B. R=10 Ω, L=31.83 mH
C. R=0.1Ω, C=0.1 F
D. R=10 Ω, C=318.3 μF

13. An AC sinusoidal voltage source is supplying power to two loads “Load 1” and “Load 2” connected in parallel. “Load 1” draws a current of 5A (RMS) which leads source voltage by $\frac{\pi}{4}$ radian and “Load 2” draws a current of 10A(RMS) which lags source voltage by $\frac{\pi}{3}$ radian. What is the RMS value of source current IS drawn from the voltage source?



A. 15 A
B. 9.95 A
C. 5 A
D. -5 A

14. In the AC circuit below, the source phasor and the impedances are given as follows $V_s = 220\angle 0^o V, Z_1 = 10 + j\,110\ \Omega, Z_2 = 100 + j100\ \Omega$ and $Z_3 = 100 - j100\ \Omega$.



$Z_{eq} = Z_1 + (Z_2 \| Z_3)$

$I_1 = \frac{V_s}{Z_{eq}}$

$V_a = V_s - V_1$

$I_2 = \frac{V_a}{Z_2}$

$I_3 = \frac{V_a}{Z_3}$

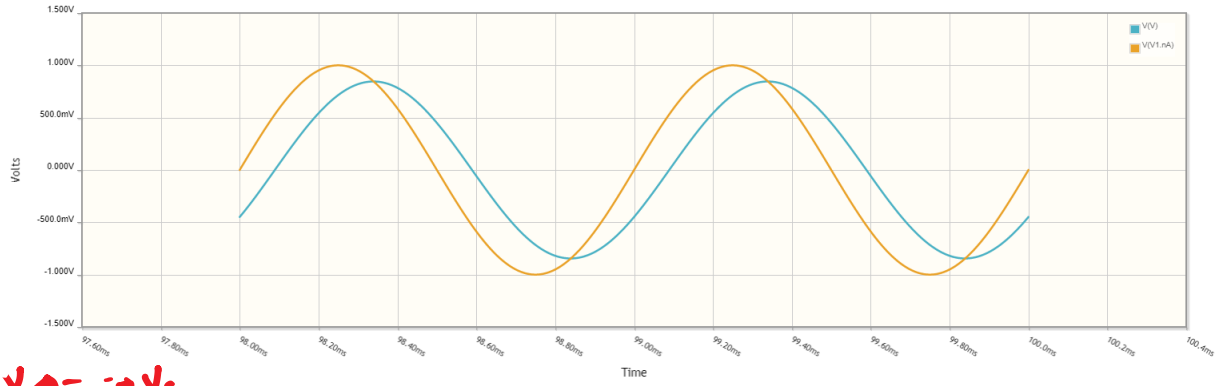
A. $I_1 = \sqrt{2}A, I_2 = 1A, I_3 = 1A$

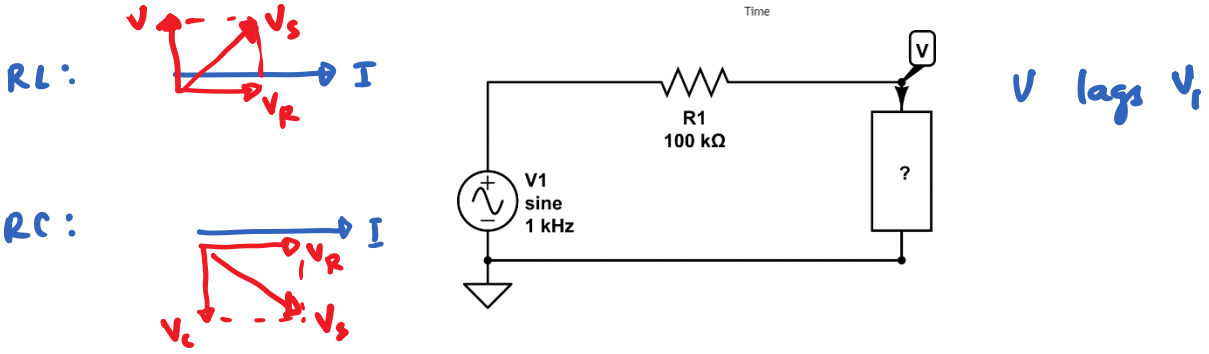
B. $I_1 = \sqrt{2}A, I_2 = \frac{1}{\sqrt{2}}A, I_3 = \frac{1}{\sqrt{2}}A$

C. $I_1 = \frac{1}{2}A, I_2 = \frac{1}{4}A, I_3 = \frac{1}{4}A$

D. $I_1 = 2A, I_2 = 1A, I_3 = 1A$

15. The waveforms given below were obtained from CircuitLab simulation of the circuit with a sinusoidal source of 1kHz.





Which of the following options is correct?

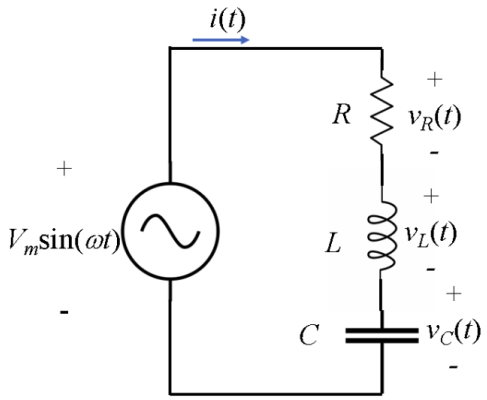
A. Blue waveform is leading the orange waveform and the unknown element is a purely inductive element.

B. Blue waveform is lagging the orange waveform and the unknow element is purely capacitive in nature.

C. Blue waveform is leading the orange waveform and the unknown element is a purely capacitive element.

D. Blue waveform is lagging the orange waveform and the unknow element is purely inductive in nature.

16. In a series RLC circuit shown below, which of the following statements is false?



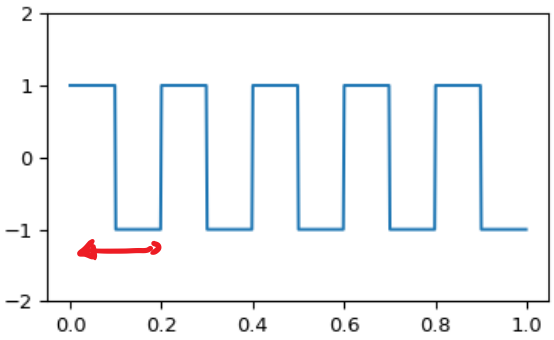
A. The only component that consumes power is the resistor R.

B. At resonance, the circuit behaves as if the inductor L and capacitor C were not present in the circuit.

C. The instantaneous voltages obey KVL: $V_m sin(\omega t) = V_R(t) + V_L(t) + V_C(t)$.

D. At resonance, the voltages V_R, V_L and V_C are in phase with each other.

17. For a square-wave signal as shown below (x-axis is in seconds, y-axis is in Volts), which of the following statements is true?



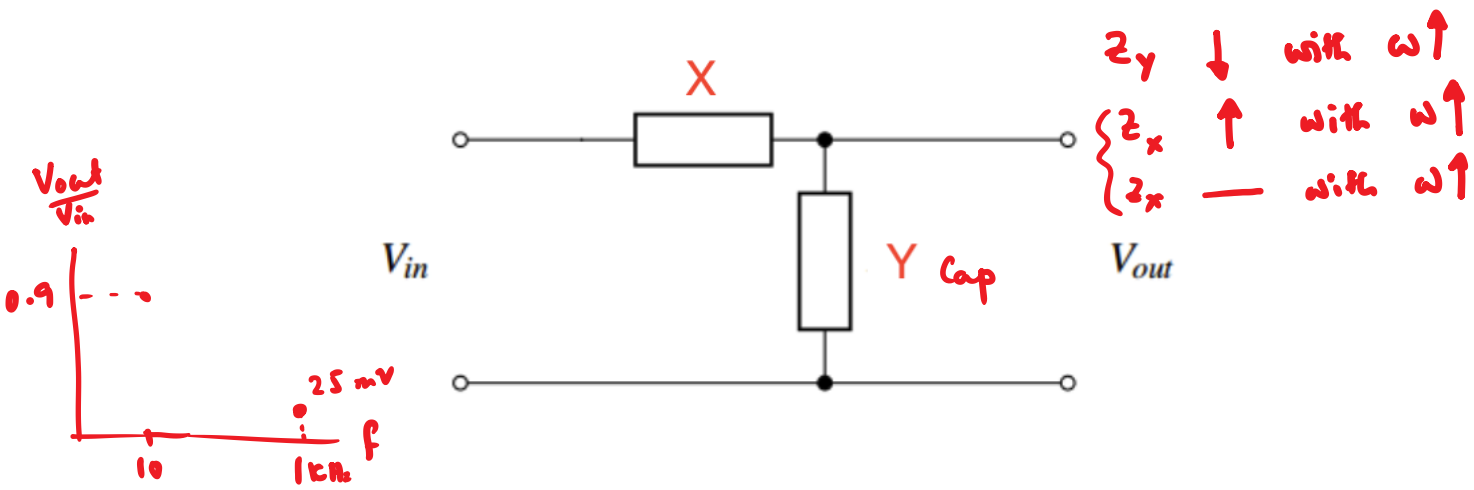
A. The peak-to-peak voltage is 1 Volt.

B. The period is 0.1 seconds.

C. The RMS voltage is ½ Volts.

D. The RMS voltage is equal to the maximum voltage.

18. Consider the following filter circuit with unknown components X and Y

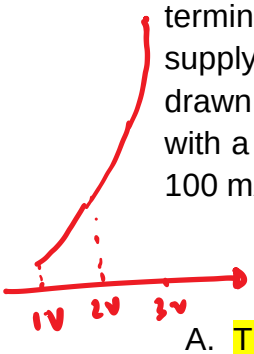


We measure the RMS output voltage V_{out} by providing several different sinusoidal input signals at V_{in}. When we provide V_{in} as 1V RMS 10 Hz, we measure V_{out} to be 0.9 V RMS. When we provide V_{in} as 1V RMS 1 kHz, we measure V_{out} to be 25 mV RMS.

What are the possible components X and Y?

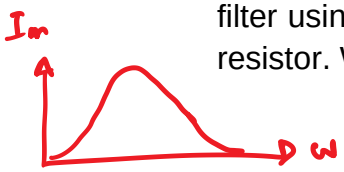
A. X is a resistor and Y is a resistor. All pass
B. X is a capacitor and Y is a resistor. HPF
C. X is a resistor and Y is an inductor. HPF
D. X is an inductor and Y is a capacitor. LPF

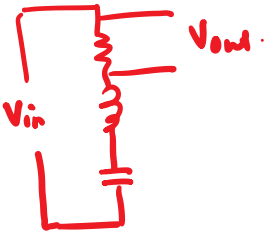
19. Bob gives Allice a box with an electronic circuit inside it and two exposed terminals. While Allice cannot see the circuit inside the box, she can probe it by supplying various input voltages across the terminals and measuring the current drawn by the circuit. She observes that the circuit draws 1 mA when supplied with a 1V DC input. It draws 10 mA when supplied with a 2V DC input. It draws 100 mA when supplied with a 3V DC input. Which of the following is true?



A. The circuit could be composed of a few resistors and an LED.
B. The circuit could be composed of one resistor, one capacitor and one inductor.
C. The circuit cannot contain a capacitor or an inductor.
D. The circuit cannot contain an LED.

20. In a series RLC circuit, the current flowing through the circuit is maximum when the input frequency is equal to the resonant frequency of the circuit. We build a filter using this circuit, such that the output of the filter is the voltage across the resistor. Which of the following is true for this circuit?





A. The filter built using this circuit is a low-pass filter.
B. The filter built using this circuit is a high-pass filter.
C. The filter built using this circuit is a band-pass filter.
D. The circuit cannot be used as a filter.

- END OF QUIZ -