Daniel Delgado Acosta
Professor Duck Chung
CSE 4030
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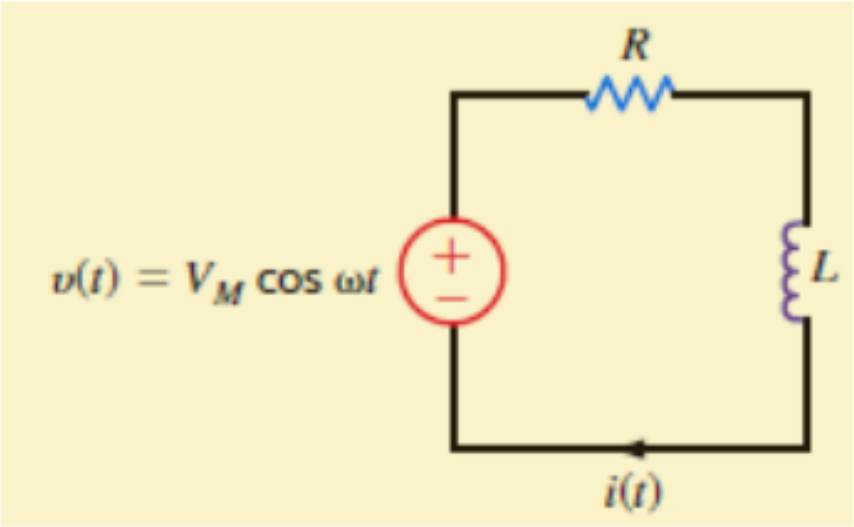
Lab 9: AC Steady State Analysis

Introduction

In this lab, we have to find the voltage and current as a function of time across two circuits that consist of resistors, inductors, and capacitors . First, we show our work by hand then use Pspice simulation software to check. The purpose of this lab is to understand the instantaneous signal in ac circuits.

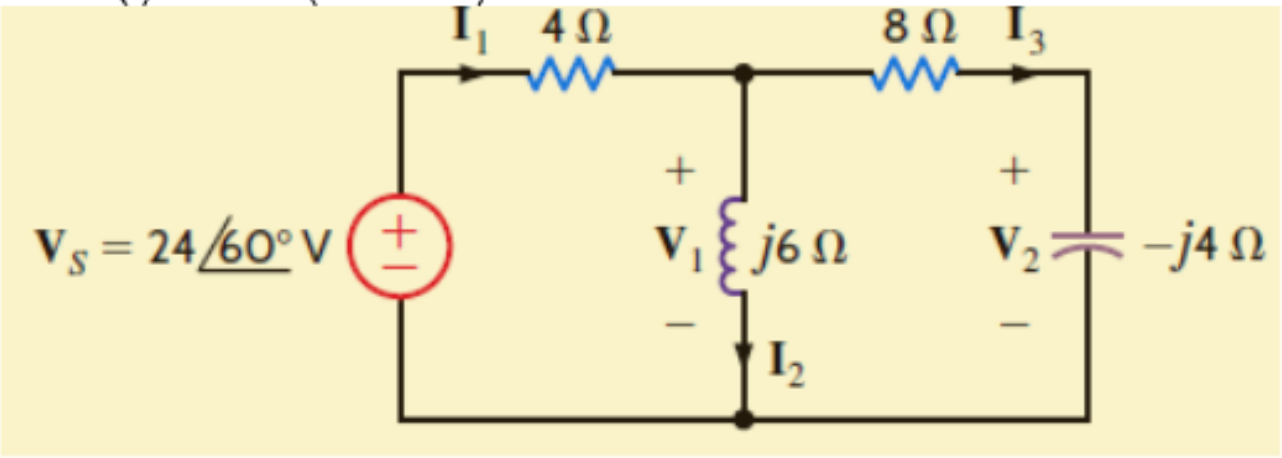
1-1 VM = 10√2V, f=60Hz, R= 2Ω, L=5.3mH



Preparation

1. Find v(t), vL(t), i(t). (.calculate by hand)
2. By using pspice simulation, find v(t),vL(t), i(t).

1-2 Vs(t) = 24cos(377t+60)



Preparation

1. Find I1, I2, and I3(calculate by hand),
2. By using pspice, find I1, I2, and I3.

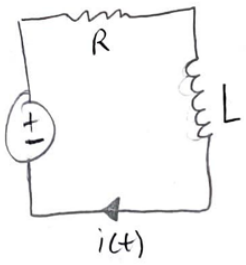
Hand Written Work

Circuit 1:

$V_M = 10\sqrt{2}\,V \quad f = 60\,Hz$

$R = 2\Omega \quad L = 5.3\,mH$

$v(t) = V_M \cos(\omega t)$



$f = \frac{\omega}{2\pi} \Rightarrow \omega = (60)2\pi$

$\omega = 377$

$V_M \cos(\omega t) = L\frac{di(t)}{dt} + Ri(t)$

$i(t) = A\cos(\omega t + \phi)$

$\rightarrow i(t) = \underbrace{\frac{V_M}{\sqrt{R^2+\omega^2L^2}}}_{A} \cos\left(\omega t - \underbrace{\tan^{-1}\frac{\omega L}{R}}_{\phi}\right)$

$e^{j\omega t} = \cos(\omega t) + j\sin(\omega t)$, $V(t) = V_M e^{j\omega t}$, $I_m = A$, $V_M = RI_m e^{j0} + j\omega L I_m e^{j\phi}$

$\boxed{v(t) = 10\sqrt{2}\cos(377t)\,V}$, $i(t) = \frac{10\sqrt{2}}{\sqrt{4+377^2\,5.3m^2}} \cos\left(377t - \tan^{-1}\frac{377(5.3m)}{2}\right)$

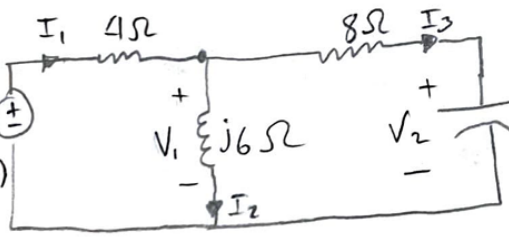
$\rightarrow \boxed{i(t) = 5\cos(377t - 0.785)\,A}$ $V_S = V_R + V_L \Rightarrow \boxed{V_L = V_S - V_R}$

Circuit 2:

$\omega = 377$

$V_s = 24\angle 60^\circ\ V$

$v_s(t) = 24\cos(377t+60)$



$L: j\omega L = j6 \Rightarrow L = \frac{6}{377} = 0.016$

$C: \frac{-j}{\omega C} = -j4 \Rightarrow C = \frac{1}{377(4)} = 0.66m$

$$Z = 4 + \frac{(j6)(8-j4)}{j6+8-j4} = 4 + \frac{24+j48}{8+j2} = 4 + 4.24 + j4.94 = 9.61\angle 30.99^\circ\ \Omega$$

$$I_1 = \frac{V_s}{Z} = \frac{24\angle 60^\circ}{9.61\angle 30.99^\circ} = \boxed{2.5\angle 29.06^\circ\ A}$$

$$V_1 = V_s - 4I_1 = 16.26\angle 78.43^\circ\ V$$

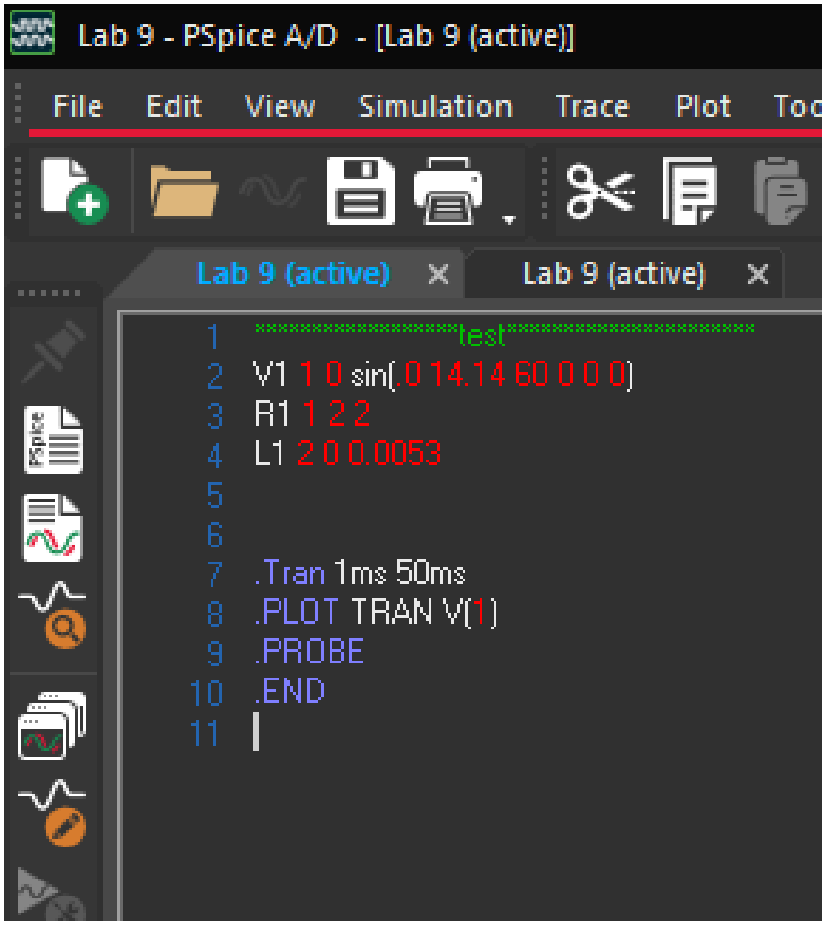
$$I_2 = \frac{V_1}{j6} = \frac{16.26\angle 78.43^\circ}{6\angle 90^\circ} = \boxed{2.71\angle -11.58^\circ\ A}$$

$$I_3 = \frac{V_1}{8-j4} = \boxed{1.82\angle 105^\circ\ A}$$

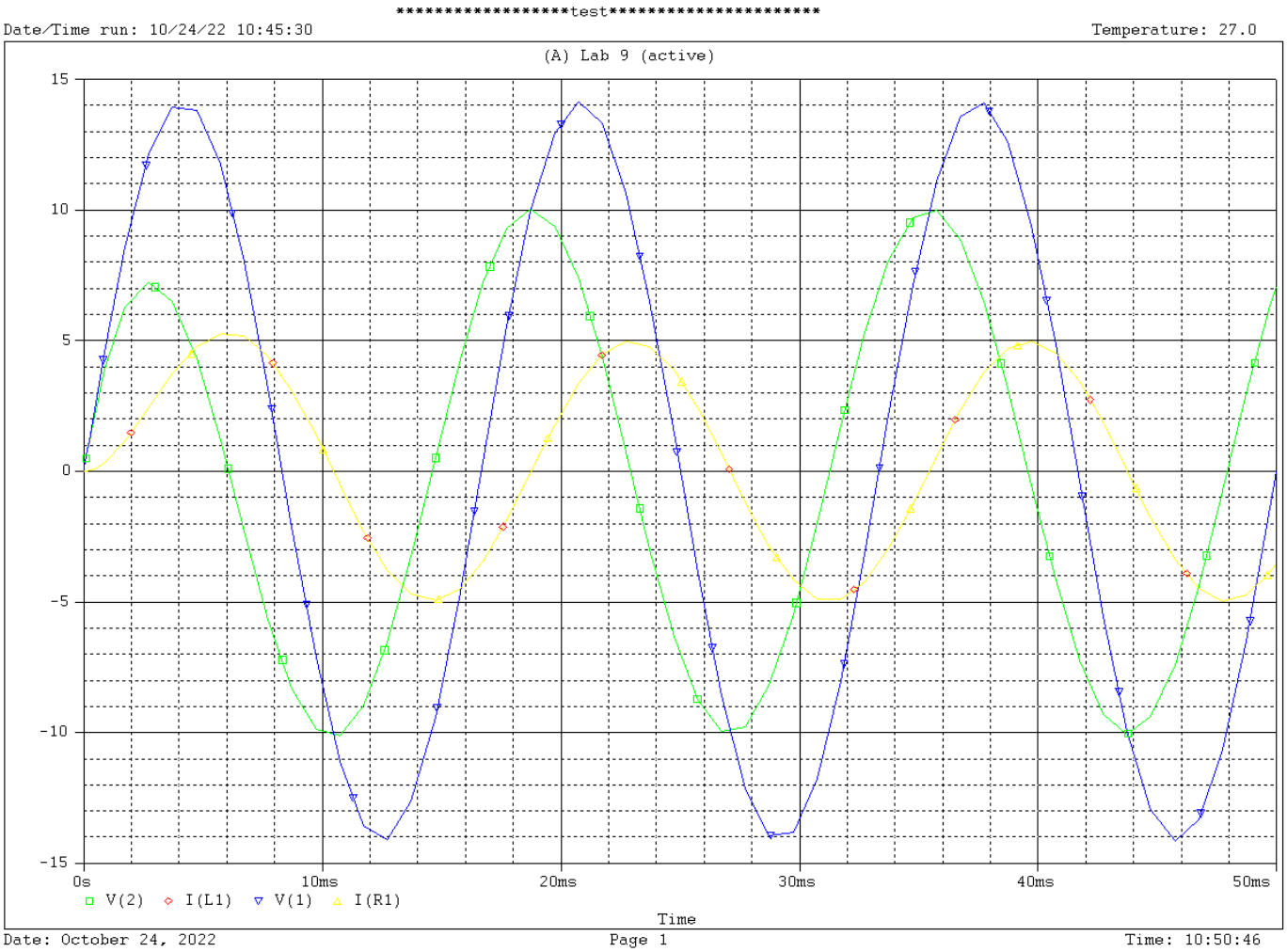
$$V_2 = I_3(-j4) = 7.28\angle 15^\circ\ V$$

Pspice simulation

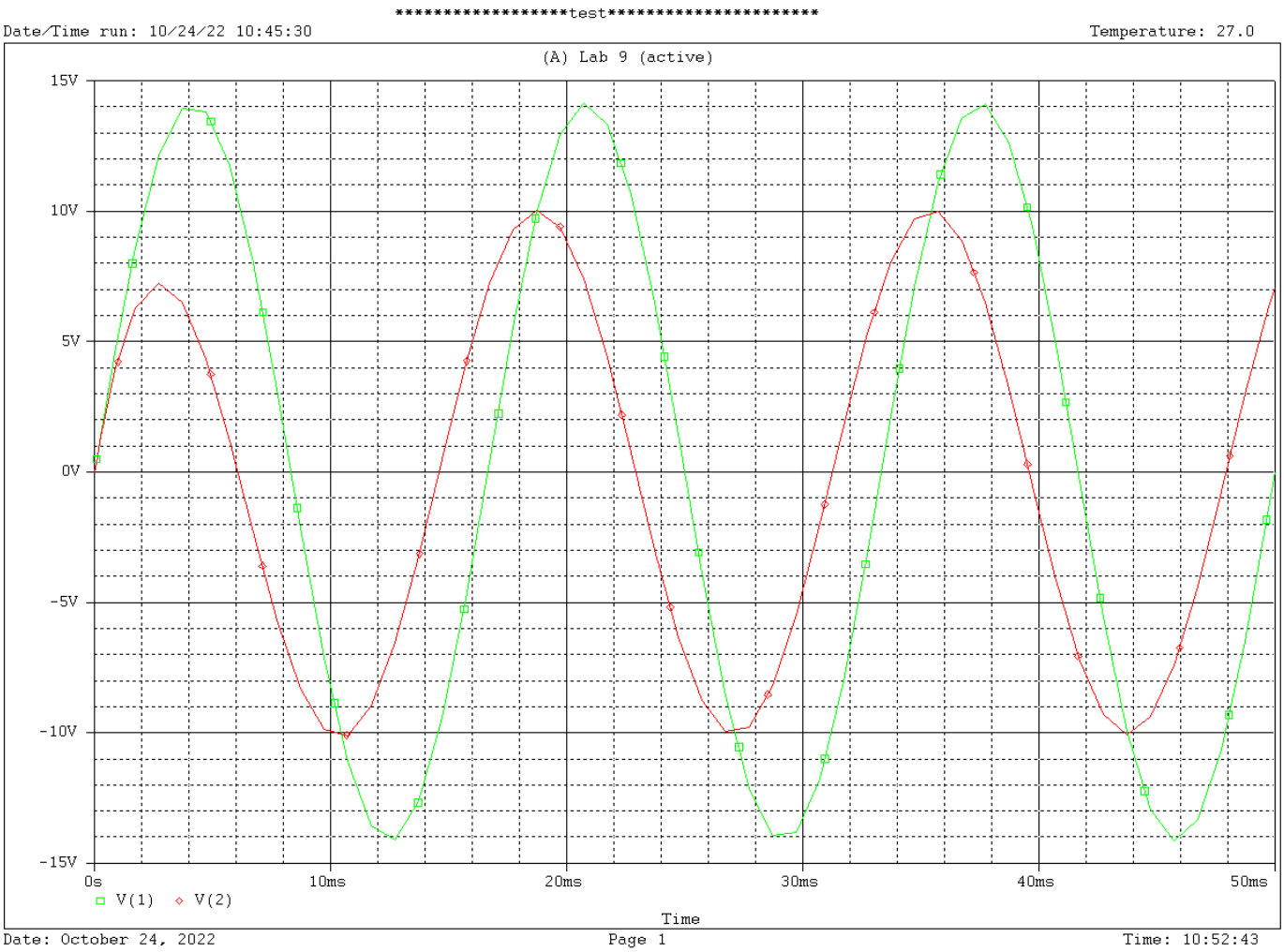
Circuit 1:
Code used



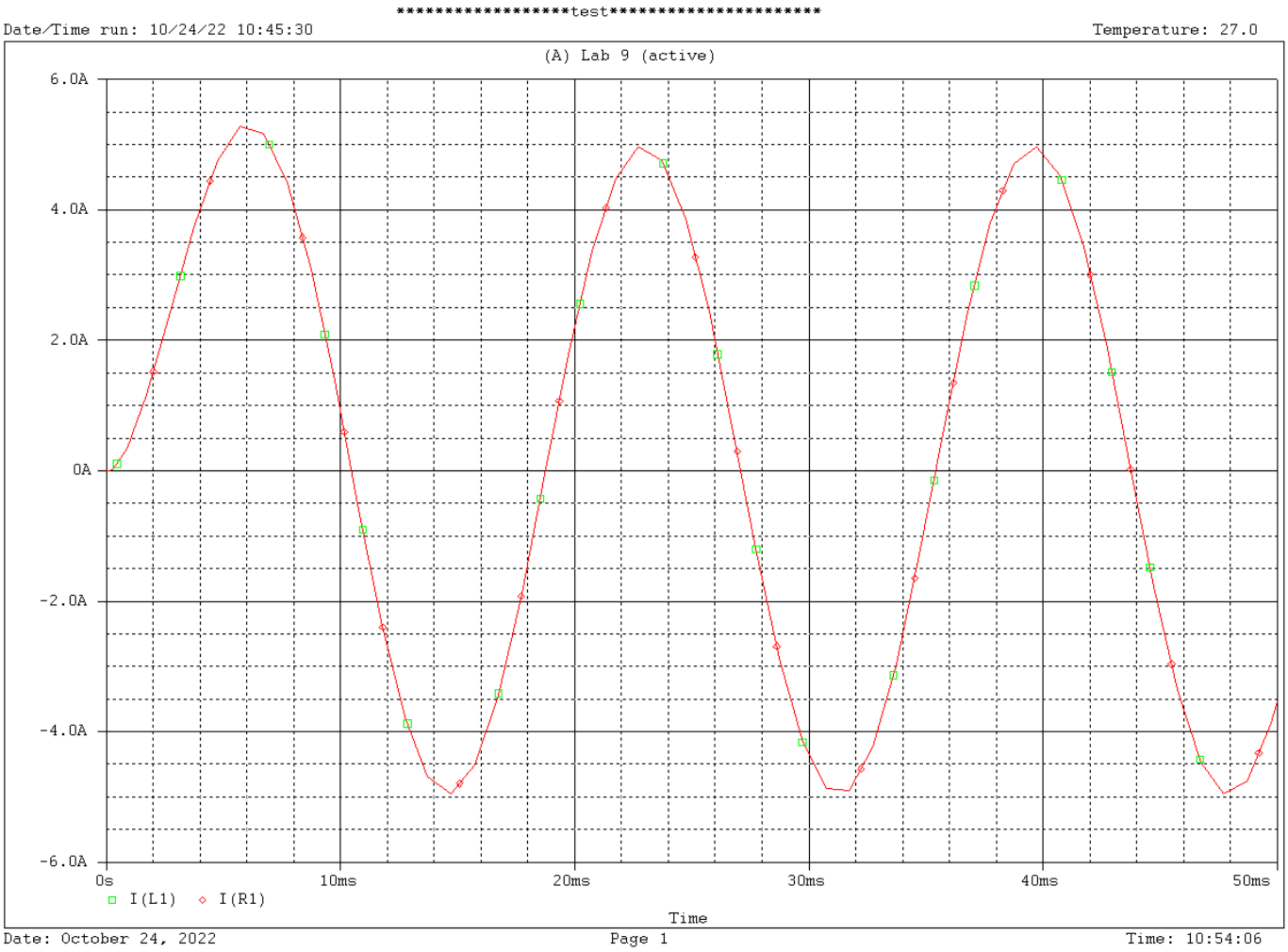
All traces


**********test**********
Date/Time run: 10/24/22 10:45:30
Temperature: 27.0
(A) Lab 9 (active)
15
10
5
0
-5
-10
-15
0s
10ms
20ms
30ms
40ms
50ms
V(2)
I(L1)
V(1)
I(R1)
Time
Date: October 24, 2022
Page 1
Time: 10:50:46

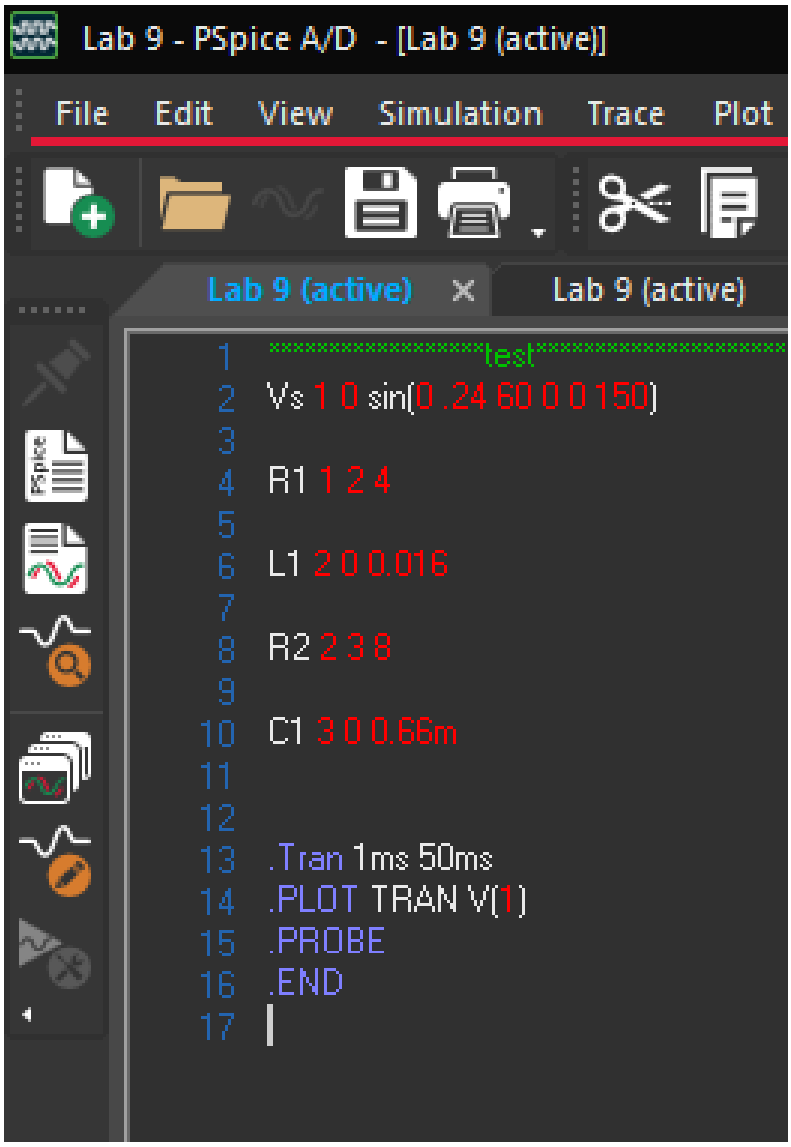
Voltage traces



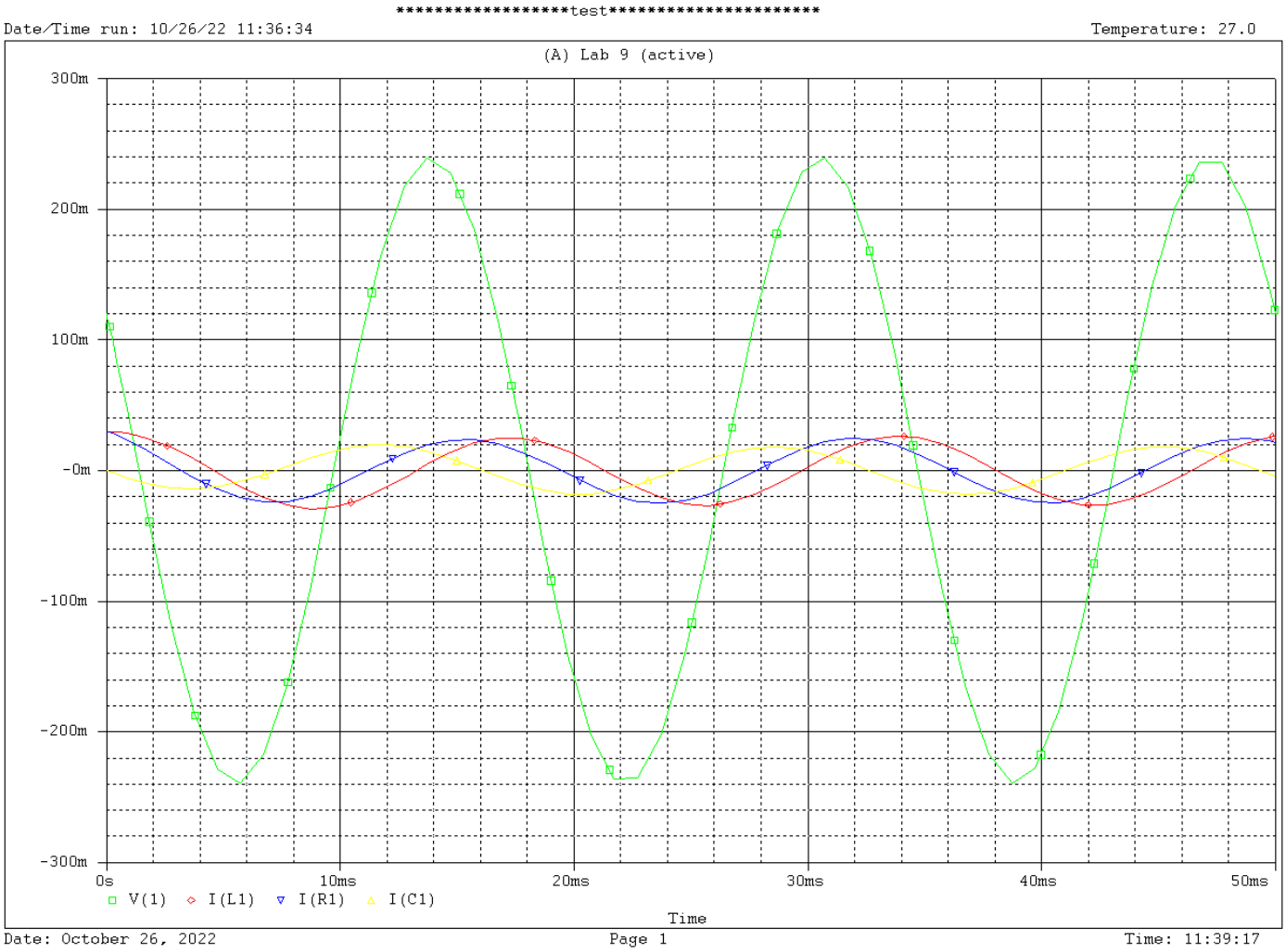
Current traces:



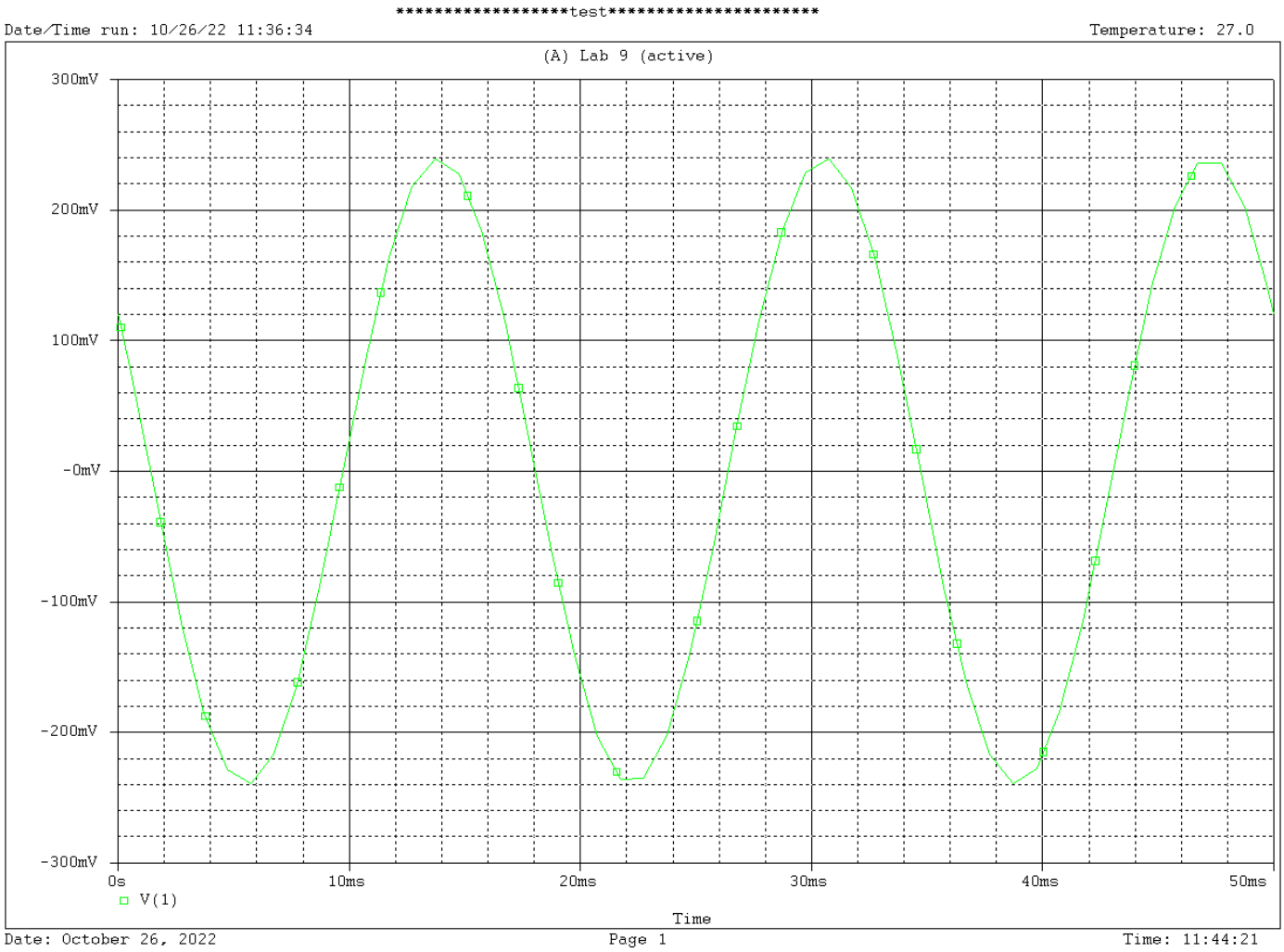
Circuit 2:
Code used



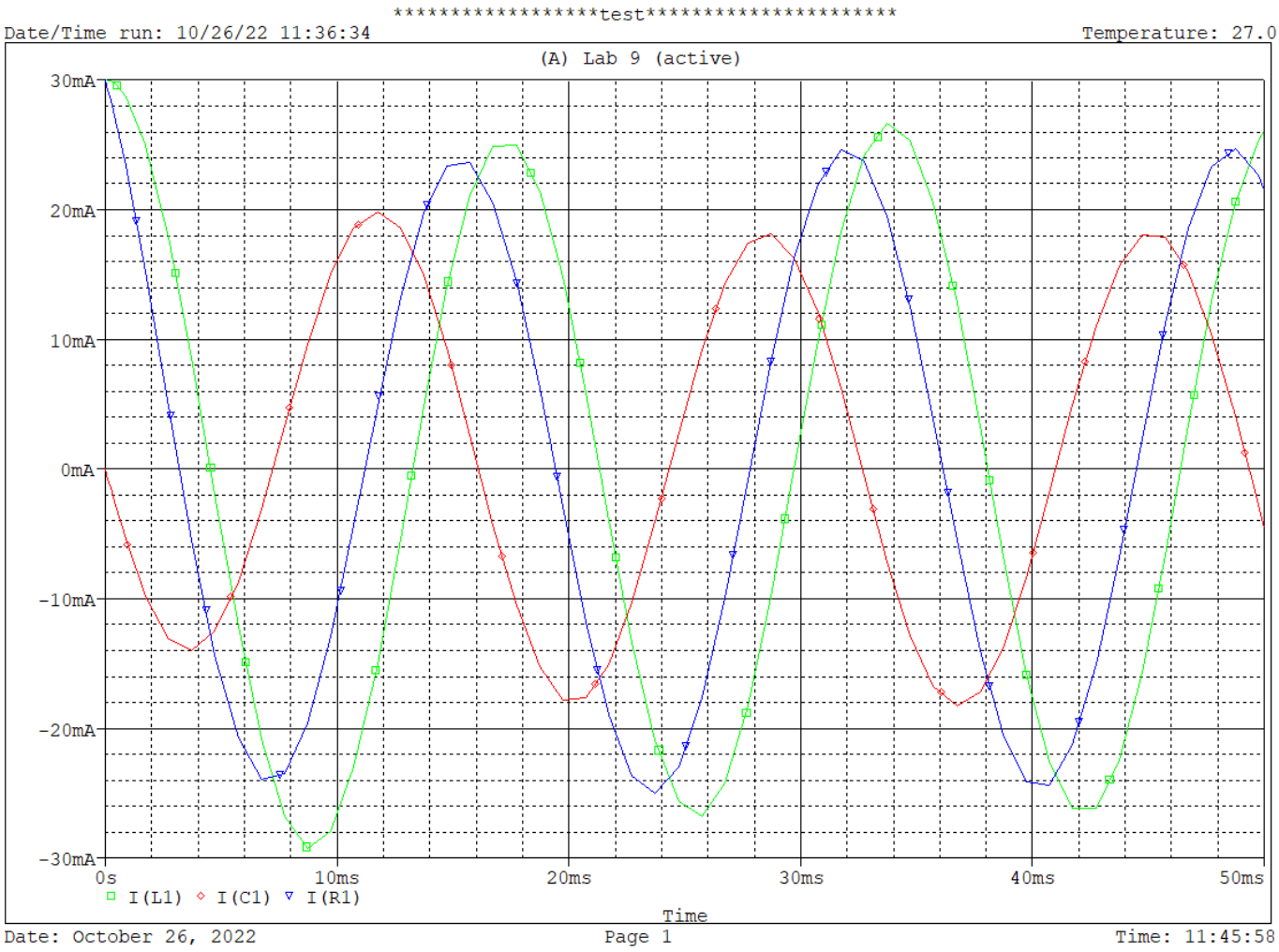
All traces:


**********test**********
Date/Time run: 10/26/22 11:36:34
Temperature: 27.0
(A) Lab 9 (active)
300m
200m
100m
-0m
-100m
-200m
-300m
0s
10ms
20ms
30ms
40ms
50ms
V(1)
I(L1)
I(R1)
I(C1)
Time
Date: October 26, 2022
Page 1
Time: 11:39:17

Voltage trace:



Current traces:



Conclusion

In this lab, I learned how to find the voltage and current as a function of time over two different circuits. After reviewing the answers obtained from handwritten work and pspice, I can conclude the answers concur and are correct.