

University of Arizona
Department of Electrical & Computer Engineering

ECE 220 Basic Circuits

Examination 4

April 18, 2002

Closed book/notes, calculators allowed.

Part I: 6 questions Part II: 6 questions.
Part II is worth twice as much as Part I.

On the SCANTRON write and bubble-in your:

1. **Name** (Last, first)
2. **1-3 digit ID number** which was given to you at the first exam. Write this left-justified under columns A-C under IDENTIFICATION NUMBER.
3. Write the **color of your exam paper** (IVORY or GREEN) on the top left margin of the SCANTRON.

Place your UA picture ID card on the adjacent desk where it can be easily seen.

When the 9:00 bell rings, begin the examination. All work should be done on the examination paper. Allow for reasonable amounts of roundoff error, and **carefully** mark one choice for each problem on the SCANTRON answer sheet.

e.g. 1 A B C D E
 1 2 ● 4 5 if the answer for Question 1 is C.

All answer sheets and examinations will be collected at or before 9:55. You will be asked to stop writing and hand in your papers/answer sheets. **Failure to comply promptly may result in disqualification from the exam.**

NAME: _____

SIGNATURE: _____

Neper frequency for RLC cks

$$\text{PARALLEL RLC: } \alpha = \frac{1}{2RC}$$

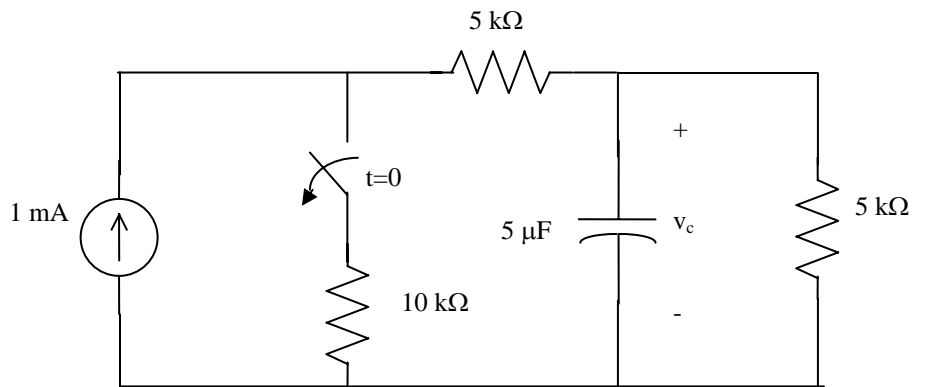
$$\text{SERIES RLC: } \alpha = \frac{R}{2L}$$

Write your ECE 220 ID number
here and on the SCANTRON:

Part I 10 min

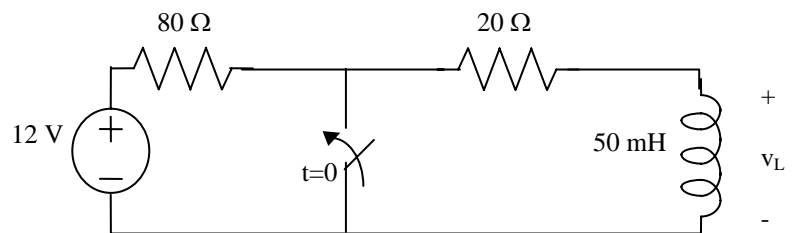
1. The switch has been closed for a long time. It is opened at $t = 0$. What is the capacitor voltage at $t = 0^+$?

- (a) 5 V
- (b) 1.25 V
- (c) 2.5 V
- (d) ∞
- (e) None of these.



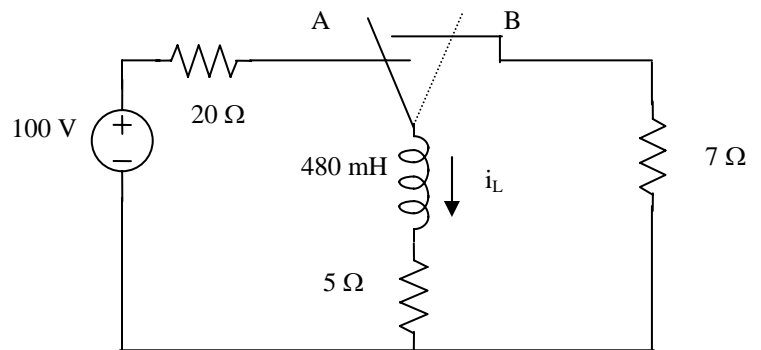
2. The switch has been open for a long time, then it is closed at $t = 0$. Find $v_L(0^+)$.

- (a) -2.4 V
- (b) 0 V
- (c) 12 V
- (d) -3.6 V
- (e) None are true.

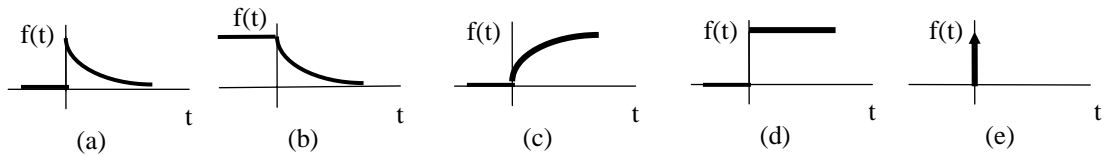


3. The switch has been in position **A** for a long time before being moved to position **B**. For all practical purposes, how long does it take after the switch is moved to **B** before for the coil current becomes negligible?

- (a) 40 ms
- (b) 200 ms
- (c) 1 s
- (d) 5 s
- (e) > 10 s



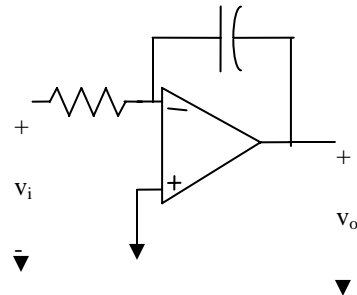
4. In an RL circuit, which of the following waveforms can represent the natural response for the inductor current?



5. The input to this ideal amplifier is of the form $v_i(t) = V_i \sin \omega t$. Assuming saturation does not occur, what is the form of the output voltage $v_o(t)$?

(Assume V_o is a positive quantity.)

- (a) $V_o \cos \omega t$
- (b) $-V_o \cos \omega t$
- (c) $V_o \sin \omega t$
- (d) $-V_o \sin \omega t$
- (e) None of these



6. A series RLC circuit is critically damped. What is the damping if the resistance is increased?

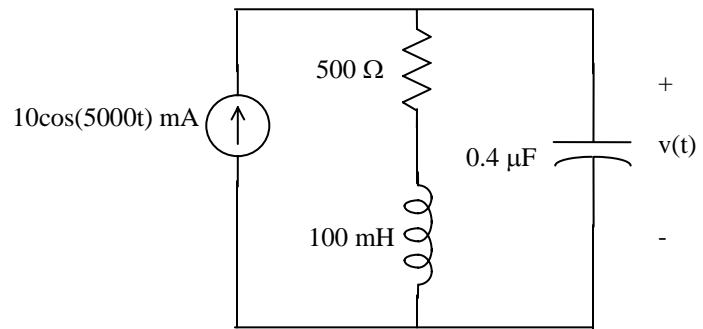
- (a) Overdamped
- (b) Critically damped
- (c) Underdamped
- (d) Undamped
- (e) None of these.

PART II

7.

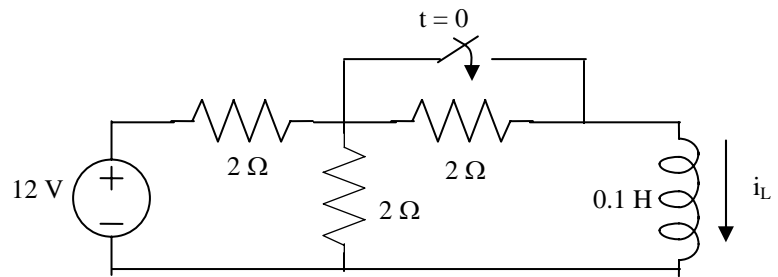
This **AC circuit** is operating in steady state. Find $v(t)$

- (a) $v(t) = 7.071 \cos(5000t - \frac{\pi}{4})$ volts
- (b) $v(t) = 1.414 \cos(5000t - \frac{\pi}{4})$ volts
- (c) $v(t) = 7.071 \cos(5000t + \frac{\pi}{4})$ volts
- (d) $v(t) = 1.414 \cos(5000t)$ volts
- (e) None of these



8. The switch has been open for a long time and is closed at $t = 0$. What is the expression for $i_L(t)$ for $t > 0$?

- (a) $8 - 6e^{-10t}$ A
- (b) $6 - 4e^{-10t}$ A
- (c) $6 - 2e^{-20t}$ A
- (d) $6 - 4e^{-20t}$ A
- (e) None of these.



9. The value of the voltage source $v_s(t)$ changes from -9V to 9V at $t = 0$, as follows:

$$v_s(t) = -9\text{V}, \quad t < 0$$

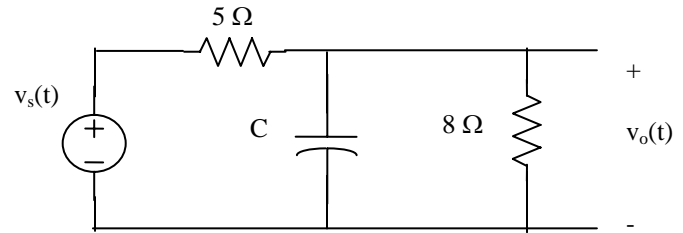
$$v_s(t) = 9\text{V}, \quad t > 0$$

The output voltage $v_o(t)$ is found to be:

$$v_o(t) = 5.53 - 11.07e^{-3.60t} \text{ Volts}$$

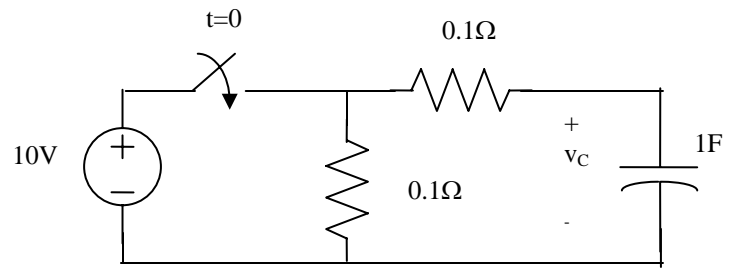
What is the value of the capacitor?

- (a) 90.3 mF
- (b) 72.3 mF
- (c) 45.7 mF
- (d) 119.4 mF
- (e) None of these



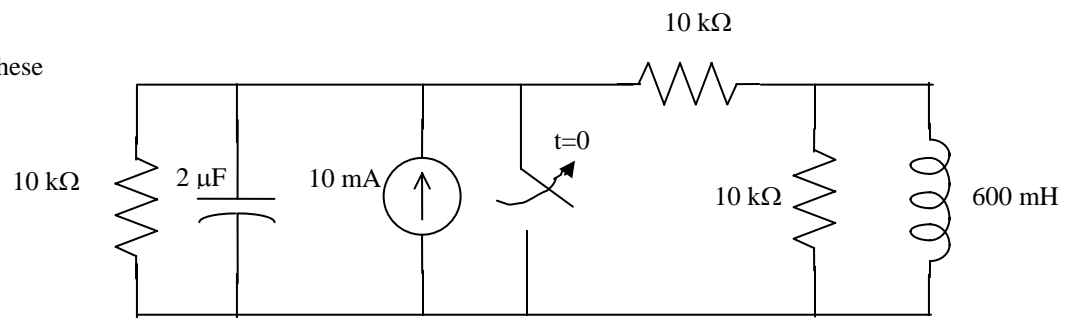
10. The switch has been open for a long time before being closed at $t = 0$. What is the expression for the capacitor voltage for $t > 0$?

- (a) $v_c(t) = 10(1 - e^{-5t})$ V
- (b) $v_c(t) = 10(1 - e^{-10t})$ V
- (c) $v_c(t) = 5(1 - e^{-5t})$ V
- (d) $v_c(t) = 5(1 - e^{-10t})$ V
- (e) None of these



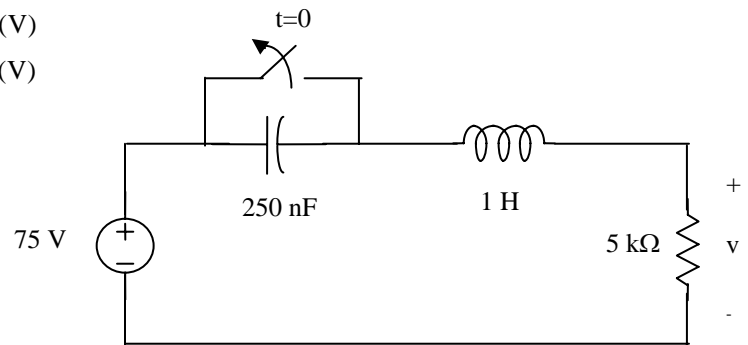
11. Find the energy stored in the coil at $t = \infty$.

- (a) $9 \mu\text{J}$
- (b) $12.5 \mu\text{J}$
- (c) $22 \mu\text{J}$
- (d) $7.5 \mu\text{J}$
- (e) None of these



12. The switch has been closed for a long time before being opened at $t = 0$. Find $v(t)$, $t > 0$.

- (a) $v(t) = 60e^{-1000t} + 15e^{-4000t}$ (V)
- (b) $v(t) = 100e^{-1000t} - 25e^{-2000t}$ (V)
- (c) $v(t) = 100e^{-1000t} - 25e^{-4000t}$ (V)
- (d) $v(t) = 100e^{-1000t} + 25e^{-2000t}$ (V)
- (e) None of these



Answer Key

1c	2a	3b	4b	5a	6a
7a	8b	9a	10b	11d	12c