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<p>University of Arizona Department of Electrical & Computer Engineering</p> <p>ECE 220 Basic Circuits</p> <h1 style="margin: 0;">Examination 3</h1> <p>April 4, 2000</p>
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Closed book/notes, calculators allowed.

Part I: 8 questions Part II: 6 questions.
Part II is worth twice as much as Part I.

IMPORTANT: Write the color of your exam paper (IVORY or GREEN) on the top left margin of the SCANTRON.

Please mark your **name and birth date** on the **SCANTRON** answer sheet, using a #2 pencil. All information should be left justified. Also write the information below, and 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.

A B C D E

e.g. 1 (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: _____

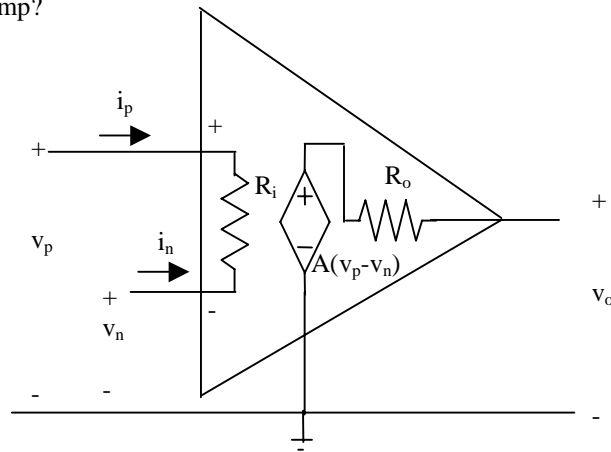
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<p>Write your ECE 220 ID number here (1-3 digits):</p> <p>_____</p>
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Part I 10 min

[1] Which set of conditions applies to an **ideal** op-amp?

- (a) $i_p = i_n, v_p = v_n = 0, R_i = \infty, A = \infty, R_o = \infty$
- (b) $i_p = i_n = 0, v_p = v_n = 0, R_i = \infty, A = \infty, R_o = 0$
- (c) $i_p = i_n = 0, v_p = v_n, R_i = \infty, A = \infty, R_o = 0$
- (d) $i_p = i_n = 0, v_p = v_n, R_i = 0, A = \infty, R_o = \infty$
- (e) None of these apply.



[2] Assuming the op-amp to be ideal, what is the value of current i in Fig. 2?

- (a) 1mA
- (b) 0.3 mA
- (c) -0.3 mA
- (d) 0
- (e) None of these.

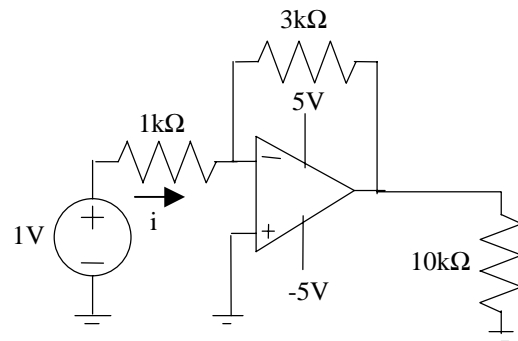


Fig. 2

[3] In an (ideal) inverting summing amplifier, the inputs are v_a and v_b and the corresponding input resistors are R_a and R_b . The feedback resistor is R_f . What is the expression for the output voltage v_o ?

- (a) $v_o = \frac{R_f}{R_a} v_a + \frac{R_f}{R_b} v_b$
- (b) $v_o = \frac{R_a}{R_f} v_a + \frac{R_b}{R_f} v_b$
- (c) $v_o = \frac{R_f}{R_a} v_a - \frac{R_f}{R_b} v_b$
- (d) $v_o = -\frac{R_f}{R_a} v_a - \frac{R_f}{R_b} v_b$
- (e) None of these.

[4] If the voltage across a capacitor is a nonzero constant, the capacitor behaves as:

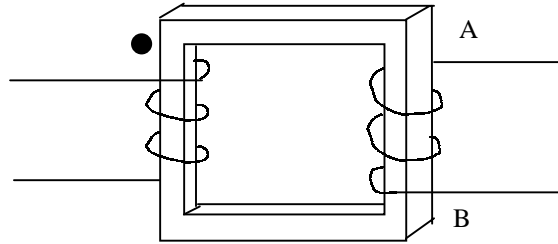
- (a) Short circuit
- (b) Open circuit
- (c) Depends on the value and polarity of the voltage
- (d) None of these.

[5] If the number of turns in a coil is doubled, what happens to the self-inductance of the coil?

- (a) Quadrupled ($\times 4$)
- (b) Doubled
- (c) Stays the same
- (d) Halved
- (e) None of these.

[6] Following the usual dot convention, the dot on the second coil should be placed at:

- (a) Location A
- (b) Location B
- (c) Could be either location
- (d) Not enough information given




[7] From the specs given in the table, which of the following mylar caps can hold the most charge?

- (a) 2047-CL
- (b) 1165-CL
- (c) 1167-CL

MYLAR CAPS

Radial Lead Mylar caps.
Ideal for filters, or timing uses.



WT: .1/Pack

STOCK#	μF	VOLTS	DESCRIPTION	PRICE
2047-CL	.001	1000	Mylar Cap.	10/\$1.25
1165-CL	.015	100	Mylar Cap.	10/\$1.25
1167-CL	.068	100	Mylar Cap.	10/\$1.25

[8] The current applied to a capacitor has a value of zero at $t=0$ and is linearly increasing for $t > 0$. What is the shape of the voltage waveform across the capacitor for $t > 0$? (Assume the capacitor is uncharged at $t = 0$.)

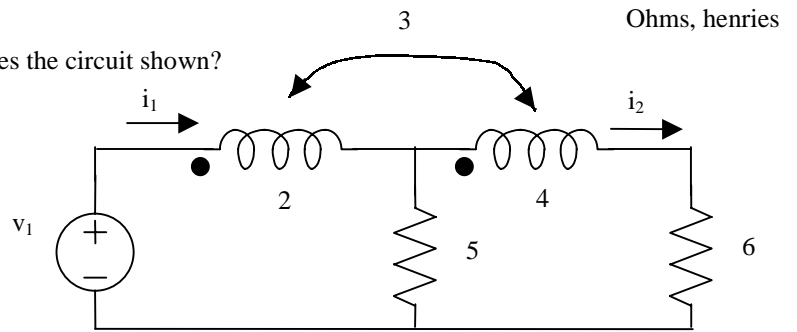
- (a) Increasing (or decreasing) linearly
- (b) Non-zero constant
- (c) Zero
- (d) Increasing (or decreasing) proportional to t^2
- (e) None of these.

Part II **40 min**

[9] Two coils are wound on a nonmagnetic core. Their parameters are $L_1 = 12.5$ mH, $M = 10$ mH, and $k = \sqrt{0.8}$. What is the value of L_2 ?

- (a) 1mH
- (b) 1.12mH
- (c) 10mH
- (d) 11.2mH
- (e) None of these.

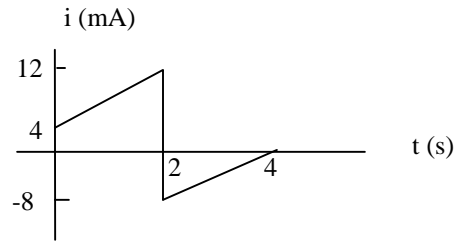
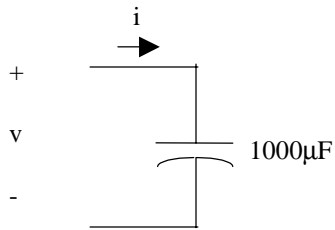
[10] Which set of mesh equations best describes the circuit shown?



<p>(a)</p> $v_1 = 5i_1 + 2 \frac{di_1}{dt} + 3 \frac{di_2}{dt}$ $0 = 3 \frac{di_1}{dt} + 11i_2 + 4 \frac{di_2}{dt}$	<p>(b)</p> $v_1 = 5i_1 + 2 \frac{di_1}{dt} - 5i_2 + 3 \frac{di_2}{dt}$ $0 = -5i_1 + 3 \frac{di_1}{dt} + 11i_2 + 4 \frac{di_2}{dt}$
<p>(c)</p> $v_1 = 5i_1 + 2 \frac{di_1}{dt} - 3 \frac{di_2}{dt}$ $0 = -3 \frac{di_1}{dt} + 11i_2 + 4 \frac{di_2}{dt}$	<p>(d)</p> $v_1 = 5i_1 + 2 \frac{di_1}{dt} - 5i_2 - 3 \frac{di_2}{dt}$ $0 = -5i_1 - 3 \frac{di_1}{dt} + 11i_2 + 4 \frac{di_2}{dt}$
<p>(e) None of these.</p>	

[11]

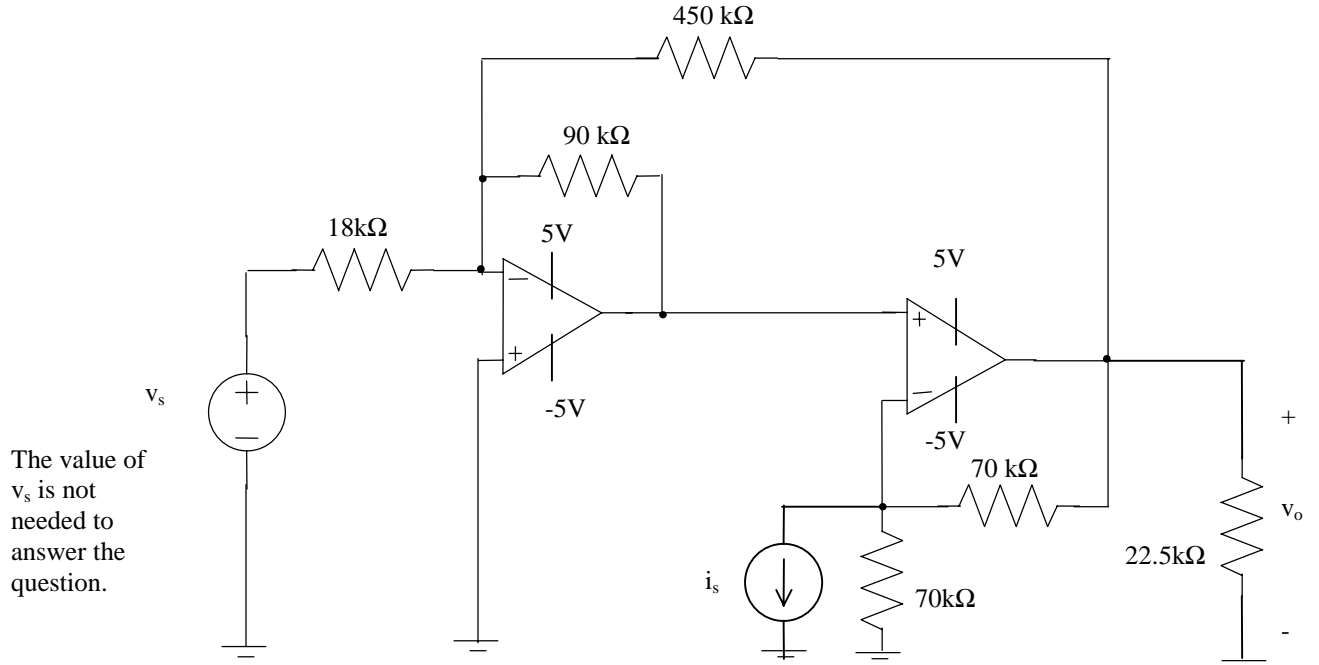
The $1000\mu\text{F}$ capacitor is initially charged to -6V at $t = 0$. The current flowing through the capacitor is shown for $t > 0$. Find the value of the maximum energy stored in the capacitor in the time interval $0 \leq t \leq 4\text{s}$.



- (a) 10 mJ
- (b) 18 mJ
- (c) 36 mJ
- (d) 50 mJ
- (e) None of these.

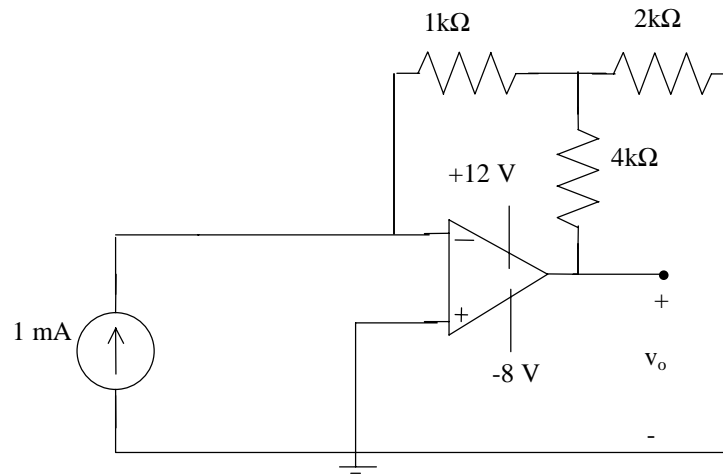
[12] With the input voltage v_s applied and the input current $i_s = 0$, the output voltage $v_o = -5V$. What is the output voltage when v_s is applied (same value as before) and $i_s = 100 \mu A$? (Assume ideal op-amps.)

- (a) $-3.2V$ (b) $1.8V$ (c) $-5V$ (d) $0V$ (e) None of these.



[13] What is the value of the output voltage v_o ? Assume the op-amp is ideal.

- (a) -7V
- (b) -5V
- (c) 5V
- (d) -2V
- (e) None of these.



[14] These two circuits are equivalent at terminals a-b when:

- (a) $C = 16 \text{ pF}$, $v = 16 \text{ V}$
- (b) $C = 3.75 \text{ pF}$, $v = 6 \text{ V}$
- (c) $C = 8.4 \text{ pF}$, $v = 6 \text{ V}$
- (d) $C = 3.75 \text{ pF}$, $v = 16 \text{ V}$
- (e) None of these.

