CR

Name: Solution
ID #:

Instructor:
Class Time:

EE 201/201C Final Exam December 11, 1996

General Instructions:

- The exam is closed book, closed notes, no calculator.
- Do not open the exam until you are told to begin.
- Put your name, student identification number, and instructor name in the blanks above. Fill in your name, student identification number, and section number in the appropriate places on the computer scan forms.

Time	**Instructor**	**Section Number**
7:30 am	Krogmeier (EE201C)	0001
8:30 am	Nyenhuis (EE201)	0002
11:30 am	Doerschuk (EE201)	0003
2:30 pm	Krogmeier (EE201C)	0004

- The exam consists of 14 multiple choice questions (10 points each) and 4 workout problems (15 points each).
- Please keep your computer scan sheets covered while you are working on the exam.
- An official crib sheet will be handed out separately.

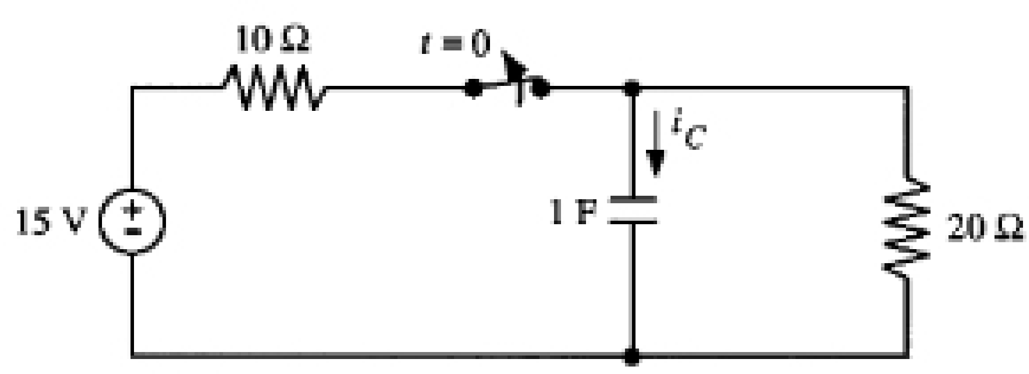
Name: ____________________

Problem 1. Consider the circuit shown. The switch has been closed for a long time before it is opened at time $t = 0$. What is the current $i_C(0^+)$ into the capacitor at time $t = 0^+$ (in Amperes)?

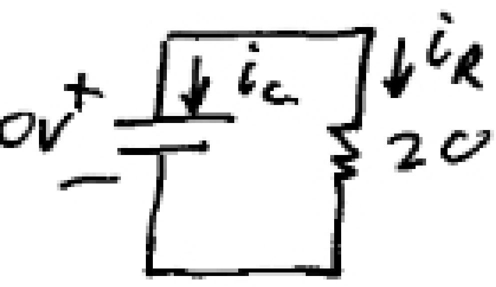
(1) 1	**(2)** 2	**(3)** 0
(4) 0.5	**(5)** -2	**(6)** -0.5
(7) 7		

$V_C(0^-) = \left(\frac{20}{20+10}\right) 15$

$V_C(0^-) = V_C(0^+) = 10\,V$



at $t = 0^+$:



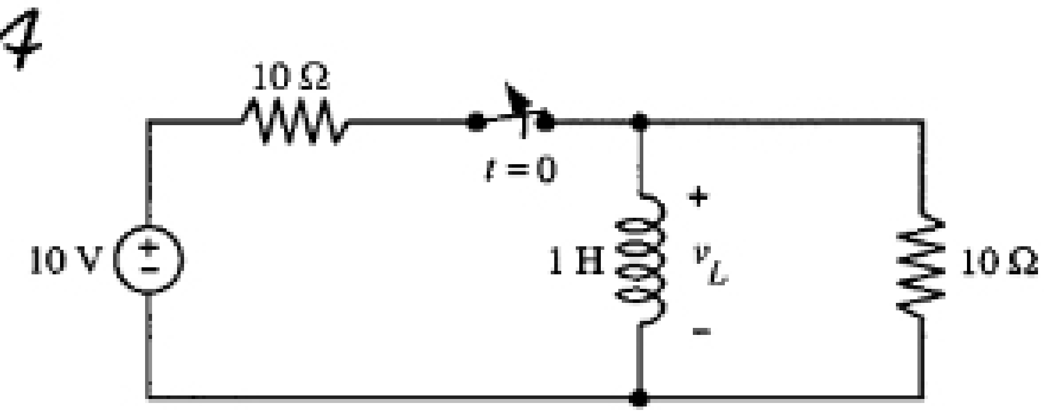
$i_R = \frac{V}{R} = \frac{10}{20} = 0.5A$

$i_c = -i_R = -0.5A$

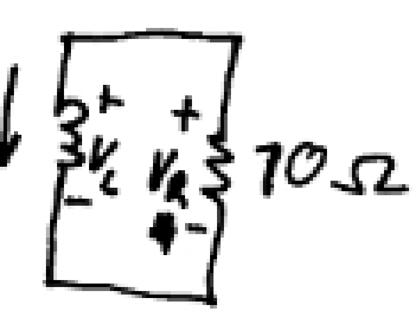
Problem 2. Consider the circuit shown below. The switch has been closed for a long time before it is opened at time $t = 0$. What is the voltage $v_L(0^+)$ across the inductor just after the switch is opened (in Volts)?

(1) -20	**(2)** -10	**(3)** 0
(4) 10	**(5)** 5	**(6)** 15
(7) 20		

$i_L(0^-) = \frac{V}{R} = \frac{10}{10} = 1A$



$t = 0^+$



$V_R = -i_L R$

$= -(1)(10)$

$= -10\,V$

$V_L(0^+) = V_R(0^+) = -10\,V$

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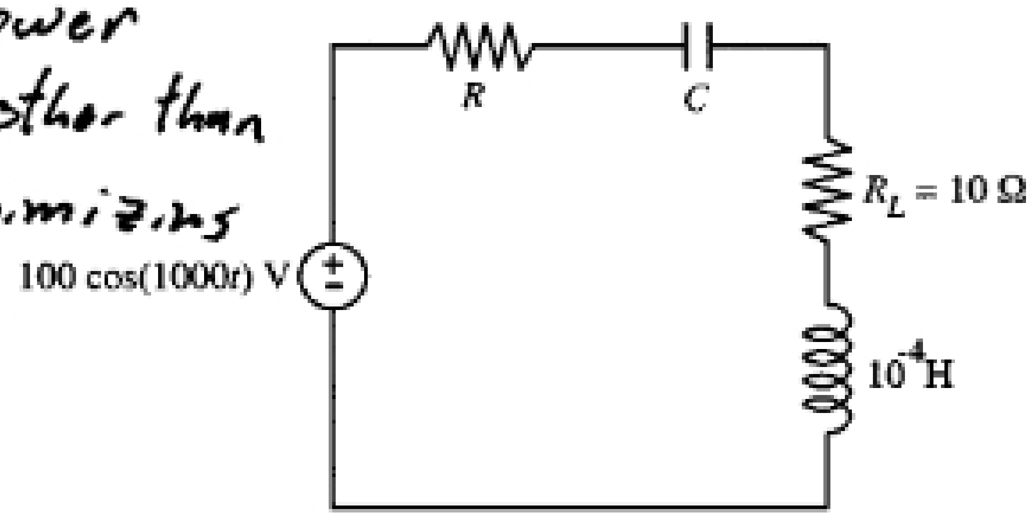
Problem 3. Consider the sinusoidal steady state circuit shown below. Choose R and C such that maximum average power is absorbed in the resistor R_L. Hint: do not try to apply the maximum power transfer theorem here.

(1) $R = 0\ \Omega$, $C = 0.01$ F (2) $R = 5\ \Omega$, $C = 0.01$ F (3) $R = 100\ \Omega$, $C = 0.1$ F
~~(4) $R = 10\ \Omega$, $C = 0.01$ F~~ (5) $R = 10\ \Omega$, $C = 1.01$ F (6) $R = 6\ \Omega$, $C = 0.001$ F
(7) $R = 0\ \Omega$, $C = 0.05$ F

Want to minimize power absorbed by elements other than R_L. Corresponds to minimizing their impedance.



$R = 0$

$$\frac{1}{j\omega C} + j\omega L = 0$$

$$\Rightarrow C = \frac{1}{\omega^2 L} = \frac{1}{(1000)^2(10^{-4})} = \underline{0.01\ F}$$

Problem 4. Consider the circuit shown below which appears in the equivalent circuit for a common collector transistor amplifier. What is an expression for the Thevenin equivalent resistance seen between the two terminals shown?

(1) $r_\pi + (\beta_0 + 1)R_E$ (2) $r_\pi + R_E/(\beta_0 + 1)$ (3) r_π
~~(4) $r_\pi + R_E$~~ (5) $\beta_0 r_\pi + R_E$ (6) R_E
(7) $\frac{r_\pi R_E}{r_\pi + (\beta_0+1)R_E}$

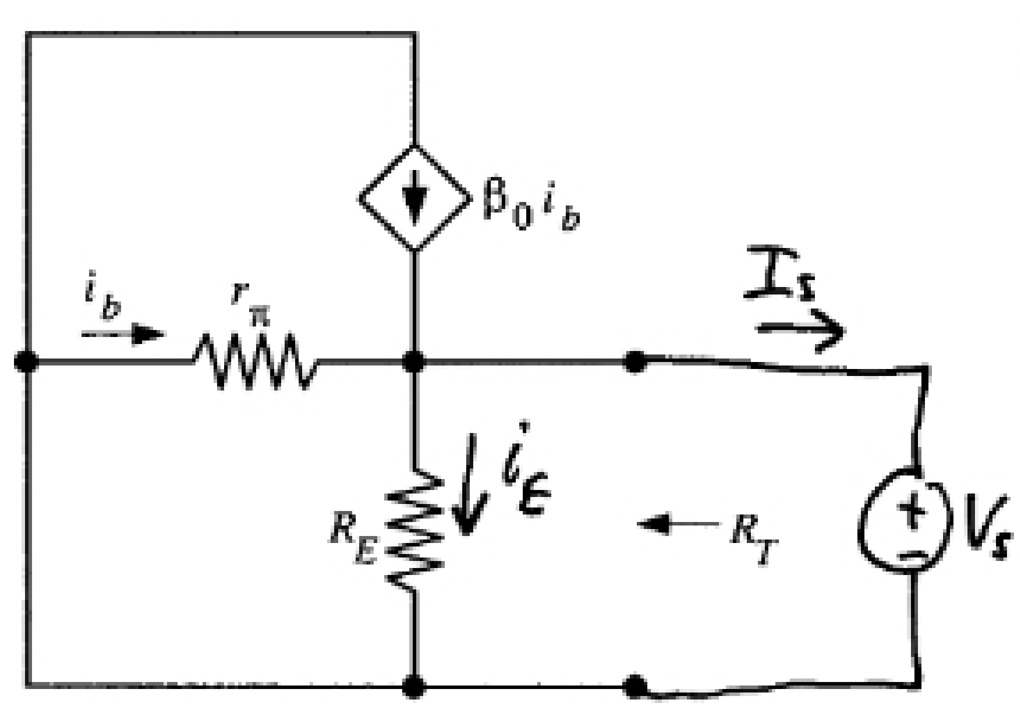
let $V_s = 1$ V

$$i_b = \frac{-V_s}{r_\pi} = -\frac{1}{r_\pi}$$

$$i_E = \frac{V_s}{R_E} = \frac{1}{R_E}$$

$$I_s = i_b + \beta_0 i_b - i_E$$

$$= \frac{-1}{r_\pi} - \frac{\beta_0}{R_\pi} - \frac{1}{R_E}$$



$$R_T = \frac{-V_s}{I_s} = \frac{+1}{\frac{1}{r_\pi} + \frac{\beta_0}{r_\pi} + \frac{1}{R_E}}$$

$$= \frac{r_\pi R_E}{r_\pi + (\beta_0 + 1)R_E}$$