ECE 214 — Exam #2

Estimated time for completion: $\leq$ 1.25 hour
24 April 2018

Rules of the Exam

Rule 1: The examination period begins at 11:00 am on Tuesday, 24 April 2018 and ends at 12:15 pm on Tuesday, 24 April 2018.

Rule 2: The exam is worth 15 points.

Rule 3: There are three problems, and each problem is worth 6 points. The maximum score is 18 out of 15.

Rule 4: The exam is closed book and closed notes. You may use your ECE 214 Laboratory Notebook, a ruler, and a calculator.

Rule 5: To receive credit for an answer include the units along with the numerical answer.

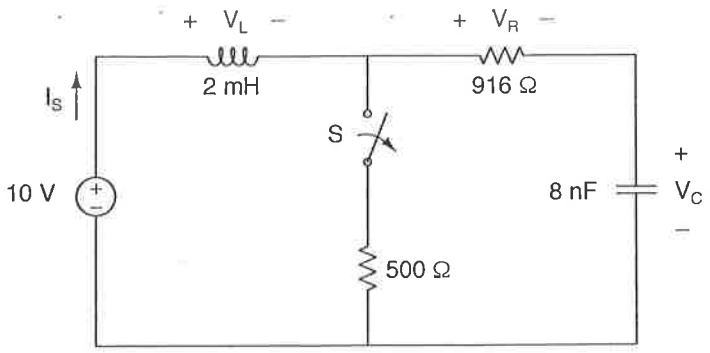
Rule 6: Show all work - answers without supporting work will not receive credit.

Rule 7: Do not leave the room until you have completed the exam.

Answer Key

Name

Problem 1: In the circuit below, switch S has been closed for a long time and then opens at $t = 0$.



Complete the table on page 3, and derive the equation describing $V_C(t)$ for $t \geq 0$.

	$t = 0^-$	$t = 0^+$	$t = \infty$
I_S	20 mA →	20 mA	0
V_L	0	-18.32 V	0
V_R	0	18.32 V	0
V_C	10 V →	10 V	10V

What is the equation for $V_C(t)$ for $t \geq 0$? $V_c(t) = 24.9e^{-\alpha t}\sin(\omega_d t) + 10$

$\alpha = \frac{R}{2L} = \frac{916}{4\times10^{-3}} = 229{,}000$ rad/s

$\omega_0 = (LC)^{-\frac{1}{2}} = 250{,}000$ rad/s

$\alpha < \omega_0$ underdamped

$\omega_d = (\omega_0^2 - \alpha^2)^{\frac{1}{2}} = 100{,}249$ rad/s

$V_c(t) = A_1 e^{-\alpha t}\cos(\omega_d t) + A_2 e^{-\alpha t}\sin(\omega_d t) + V_c(\infty)$

$V_c(0) = 10 = A_1 + 10 \Rightarrow \boxed{A_1 = 0}$

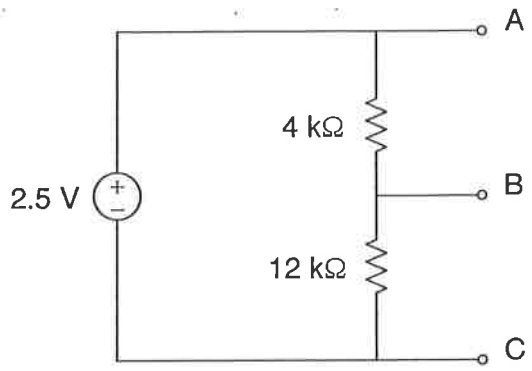
$V_c(t) = A_2 e^{-\alpha t}\sin(\omega_d t) + 10V$

$C\left.\frac{dV_c}{dt}\right|_{t=0} = i(0) = 20\times10^{-3} = 8\times10^{-9} A_2 \omega_d$

$A_2 = \frac{i(0)}{\omega_d C} = \frac{20\times10^{-3}}{\omega_d C} = 24.9$

$\boxed{A_2 = 24.9}$

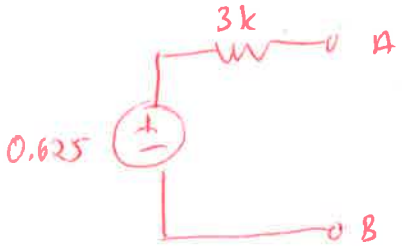
Problem 2: Consider the circuit below:



a) Draw the Thévenin equivalent circuit representing terminals **A** and **B**.

$V_{Th} = 2.5 \times \frac{4}{16}$

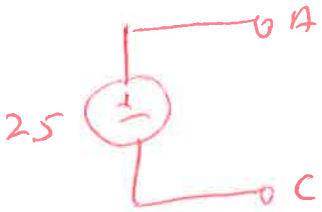
$R_{Th} = 4 \| 12 = 3K$



b) Draw the Thévenin equivalent circuit representing terminals **A** and **C**.

$V_{Th} = 2.5\ V$

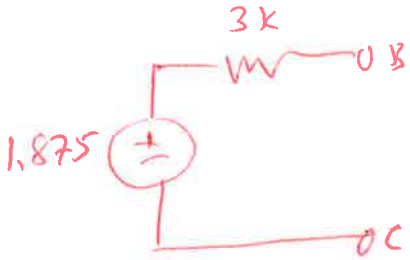
$R_{Th} = 0$



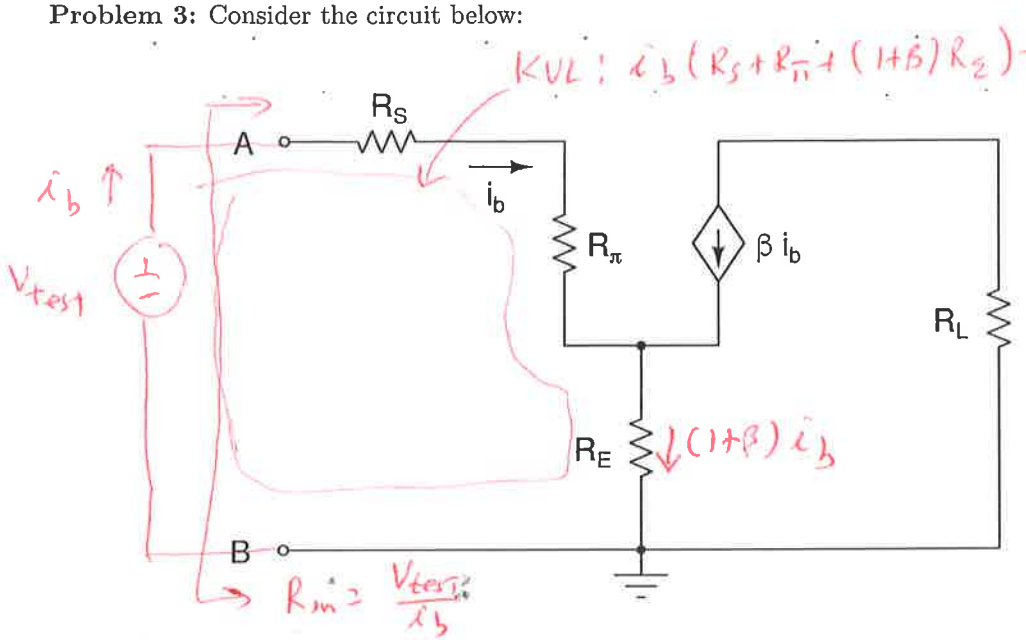
c) Draw the Thévenin equivalent circuit representing terminals **B** and **C**.

$V_{Th} = 2.5 \times \frac{12}{16}$

$R_{Th} = 4 \| 12 = 3k$



Problem 3: Consider the circuit below:



Part A: When $R_E = 0\,\Omega$, $R_S = R_\pi = R_L = 10\,\Omega$, and $\beta = 99$, what is the equivalent resistance between terminals **A** and **B**? 20Ω

Part B: When $R_S = 0\,\Omega$, $R_E = R_\pi = R_L = 10\,\Omega$ and $\beta = 99$, what is the equivalent resistance between terminals **A** and **B**? 1010Ω

C

Part B: When $R_E = R_S = R_\pi = R_L = 10\,\Omega$ and $\beta = 99$, what is the equivalent resistance between terminals **A** and **B**? 1020Ω

$$R_{in} = \frac{V_{test}}{i_b} = R_S + R_\pi + (1+\beta)R_E$$

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Name: _____

Blank page for calculations.

Name: _____