**Name: ______________________________________________**

# EXAM 2: EECS 215
# Introduction to Electronic Circuits
**Wednesday, March 22, 2017. 6:00pm-8:00pm**

| **Lecture Section (circle 1):** | **001 Finelli** | **002 Phillips** |
|---|---|---|

**This test consists of five problems with points as indicated to total 60 points.**

Read through the entire exam before beginning.
**Show all work** (on the pages provided in this booklet) to earn partial credit.
Briefly explain major steps, include units, and write your final answers in the areas provided.
Do not unstaple the pages.

**No credit will be given if no work is shown.**

**Exam Policies**
- No food allowed during exam.
- No books allowed (closed book exam).
- One, 8.5 x 11 inch notes page (TWO SIDED) allowed
  ***Note the page of equations at the back of this exam***
- Only scientific calculators allowed (**graphing calculators not permitted**).
- No communication of any kind is allowed. No use of cell phones, computers, or any devices besides calculators. Violation of this will be treated as an honor code violation.
- No credit will be given for this exam without a signed honor pledge.

**Write out the honor pledge and sign below.**

"I have neither given nor received unauthorized aid on this examination, nor have I concealed any violations of the Honor Code"

______________________________________________________________

______________________________________________________________

______________________________________________________________

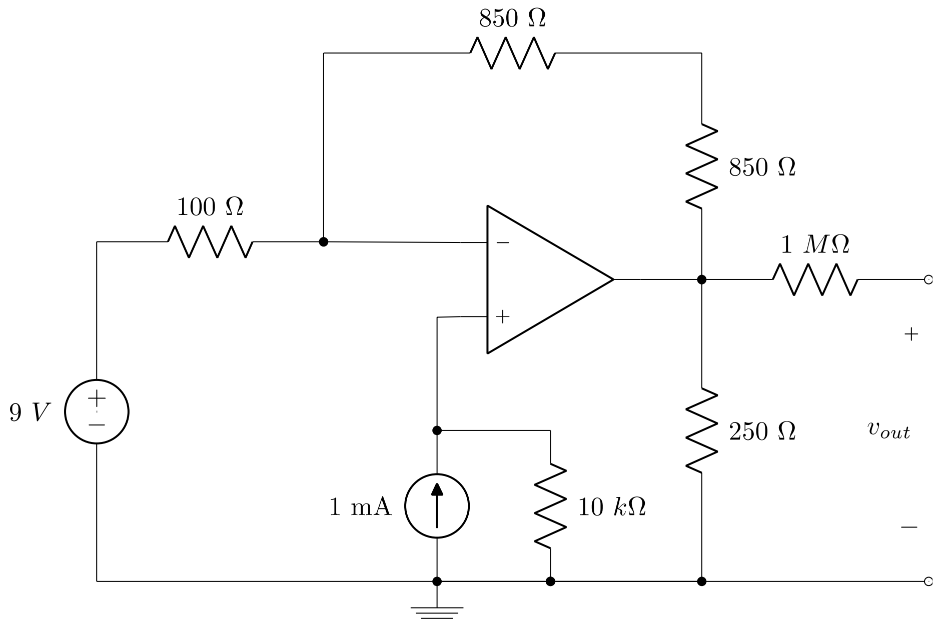
Signature: ____________________________________________

Do not write in this space

| | |
|---|---|
| Problem 1: [ ]/12 | Problem 4: [ ]/12 |
| Problem 2: [ ]/12 | Problem 5: [ ]/12 |
| Problem 3: [ ]/12 | |

**Total score [ ]/60**

1. Calculate $v_{out}$ in the circuit below

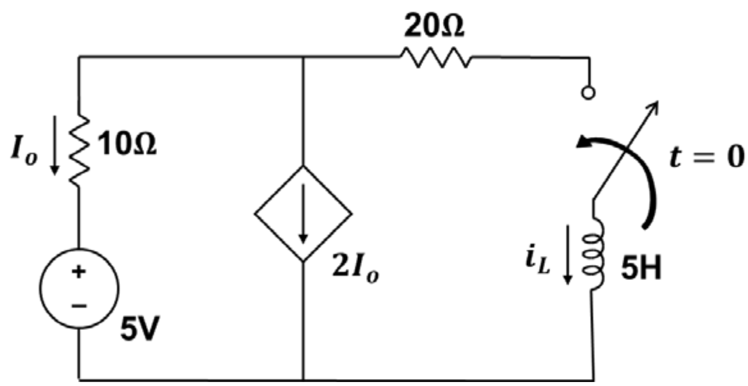



Write your answer here:

$v_{out}$ = ________________________________________

Problem 1 score: [ ]/12

2. The switch in the circuit below has been open for a very long time, and it closes at $t = 0$ seconds. Solve completely for $i_L(t), t \geq 0$.

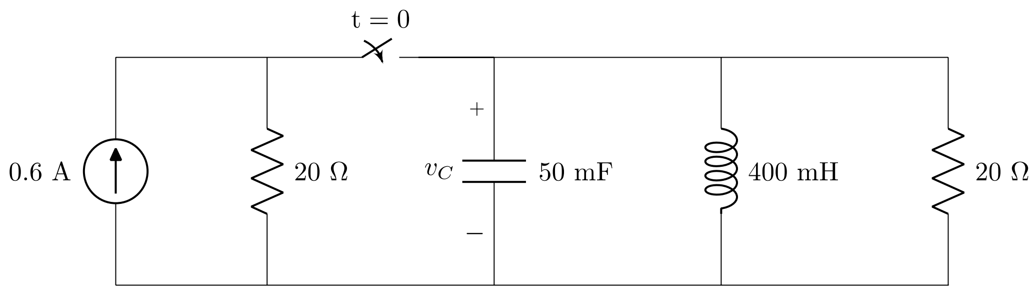



Write your answer here:

$i_L(t) =$ ____________________________________________

Problem 2 score: [ ]/12

3. The circuit below had the switch open for a very long time before it is closed at time $t = 0$. Find the voltage across the capacitor $v_C(t)$ for $t \geq 0$.



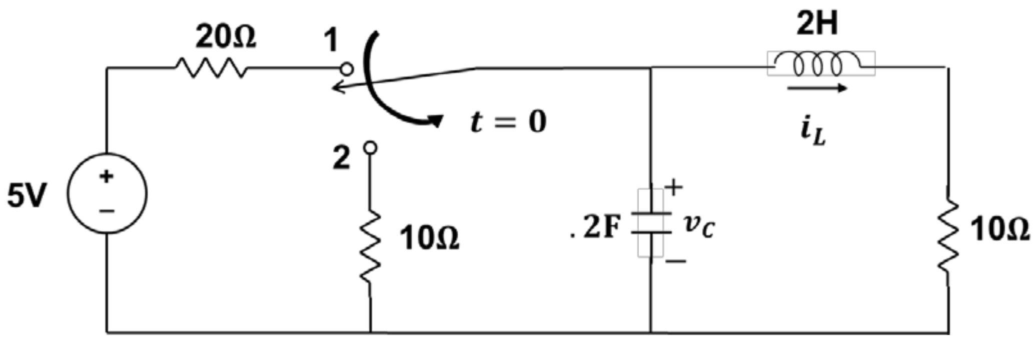

Write your answer here:

$v_C(t) =$______________________________________________

Problem 3 score: [ ]/12

4. The switch in in the circuit below has been in position (1) for a very long time. At $t = 0$ seconds, it moves to position (2). Determine:

   a. $i_L(0^+)$ and $v_C(0^+)$
   b. $i_L'(0^+)$ and $v_C'(0^+)$




Write your answer here:

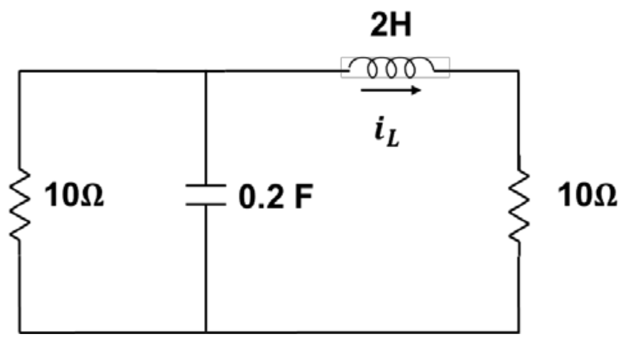
$i_L(0^+) =$____________________ $v_C(0^+) =$____________________

$i_L'(0^+) =$____________________ $v_C'(0^+) =$____________________

Problem 4 score: [ ]/12

5. For the circuit below, determine the second order differential equation for $i_L(t)$. Do not solve the equation. Rather, compute the constants $K_1$ and $K_2$ for the equation:

$$\frac{d^2 i_L(t)}{dt^2} + K_1 \frac{d i_L(t)}{dt} + K_2 i_L(t) = 0$$




Write your answer here:

$K_1 =$____________________ $K_2 =$____________________

Problem 5 score: [ ]/12

## Capacitors and Inductors

$i = C\frac{dv}{dt}$ $\qquad$ $v = L\frac{di}{dt}$

## First Order Circuits

Step Response:

$v(t) = v(\infty) + [v(0) - v(\infty)]e^{-\frac{t}{\tau}}$

$i(t) = i(\infty) + [i(0) - i(\infty)]e^{-\frac{t}{\tau}}$

$\tau = RC\ (RC\ circuit)$

$\tau = L/R\ (RL\ circuit)$

## Second Order Circuits

$$\frac{d^2x(t)}{dt^2} + 2\alpha\frac{dx(t)}{dt} + \omega_0^2 x(t) = f(t)$$

$$s_{1,2} = -\alpha \pm \sqrt{\alpha^2 - \omega_0^2}$$

**Series RLC**: $\alpha = R/(2L)$ $\quad \omega_0 = 1/\sqrt{LC}$

**Parallel RLC**: $\alpha = 1/(2RC)$ $\quad \omega_0 = 1/\sqrt{LC}$

**Over Damped ($\boldsymbol{\alpha > \omega_0}$):**

$$x(t) = A_1 e^{s_1 t} + A_2 e^{s_2 t} + x(\infty)$$

**Critically Damped ($\boldsymbol{\alpha = \omega_0}$):**

$$x(t) = (A_1 t + A_2)e^{-\alpha t} + x(\infty)$$

**Under Damped ($\boldsymbol{\alpha < \omega_0}$):**

$$x(t) = e^{-\alpha t}(B_1 \cos\omega_d t + B_2 \sin\omega_d t) + x(\infty)$$

$$\omega_d = \sqrt{\omega_0^2 - \alpha^2}$$