American University of Beirut
Faculty of Engineering and Architecture
Department of Electrical and Computer Engineering

EECE 290 – Analog System Processing – Spring 2009

EXAM 1 – Friday March 27, 2009

Lama Hamandi

Name:_____ ID Number: _____

Read the following instructions carefully:

- The duration of the exam is **90 minutes**.
- The exam consists of 10 pages and 15 questions. You can use the question sheets for scratch.
- All questions have the same weight. Total achievable points: **100**.
- **No questions** will be answered during the exam.
- Programmable calculators are not allowed.
- **Provide your answers on the computer card only using a pencil.**
- Return the computer card attached to the question sheet.
- Mark with a pencil your last name.
- Mark with a pencil your ID number.
- You don't need to fill the field "Test ID".
- When using an eraser, make sure you erased well.
- When you finish the exam bring all of your belongings to the front of the room and hand in the exam. Then leave the room immediately.
- **Enjoy and Good Luck!**

$f(t)$ $(t > 0-)$	$F(s)$	$f(t)$ $(t > 0-)$	$F(s)$
$\delta(t)$	1	$\dfrac{df(t)}{dt}$	$sF(s) - f(0^-)$
$u(t)$	$\dfrac{1}{s}$		
t	$\dfrac{1}{s^2}$	$\displaystyle\int_0^t f(x)\,dx$	$\dfrac{F(s)}{s}$
e^{-at}	$\dfrac{1}{s + a}$	$f(t - a)u(t - a), a > 0$	$e^{-as}F(s)$
		$e^{-at}f(t)$	$F(s + a)$
$\sin \omega t$	$\dfrac{\omega}{s^2 + \omega^2}$	$f(at), a > 0$	$\dfrac{1}{a}F\left(\dfrac{s}{a}\right)$
$\cos \omega t$	$\dfrac{s}{s^2 + \omega^2}$	$tf(t)$	$-\dfrac{dF(s)}{ds}$

1. Determine the current i_0 in mA.

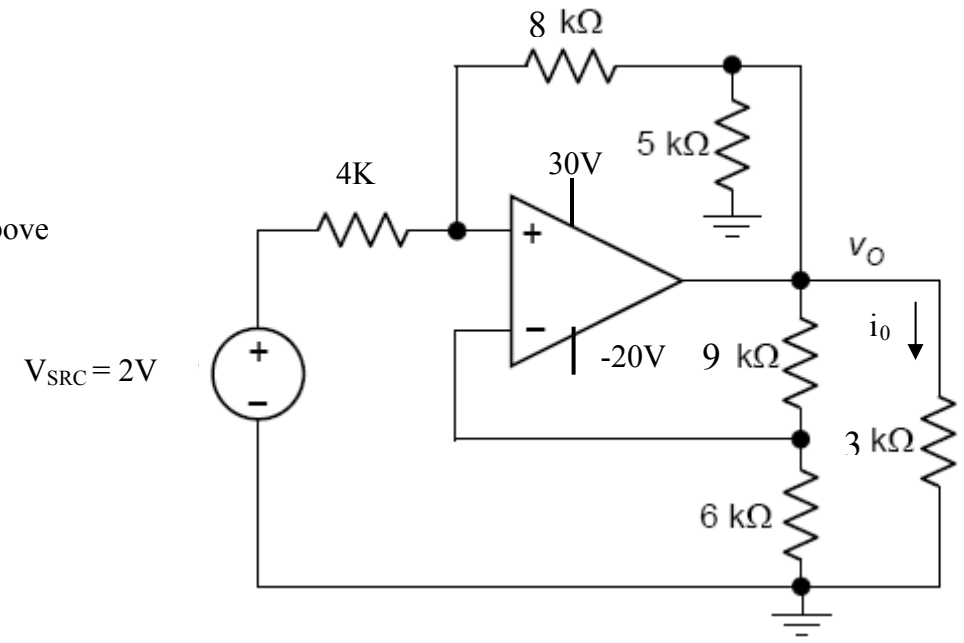
A. 4

B. 2.5

C. 6.7

D. 5

E. None of the above



2. In the previous problem, what is the range of the V_{SRC} to keep the op amp working in the linear region.

A. $-4V \le V_{SRC} \le 3V$

B. $-2V \le V_{SRC} \le 3V$

C. $-3V \le V_{SRC} \le 2V$

D. $-3V \le V_{SRC} \le 4V$

E. None of the above

3. Determine the voltage v_1 in Volts given that $v_a = 0.1V$ and $v_b = 0.2V$.

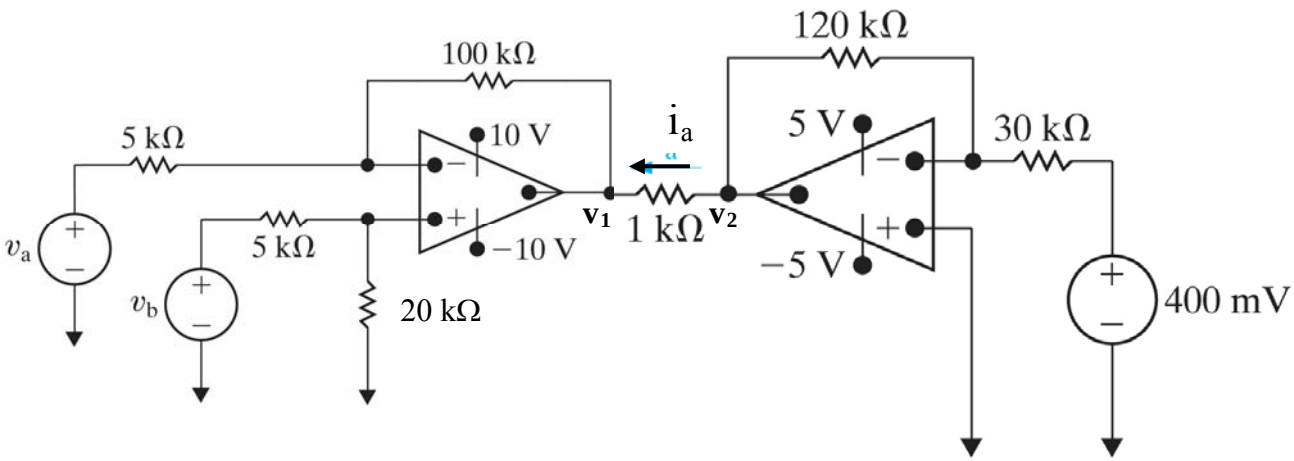
   A. 1.36 V

   B. 3.4 V

   C. 2.2 V

   D. 4.1 V

   E. None of the above



4. Determine the current i_a in mA in the previous problem. Hint: start by finding v_2

   A. 3.8mA

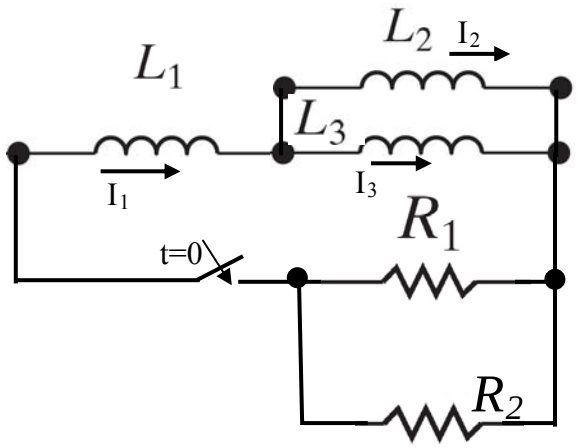
   B. -3.8mA

   C. 2.96mA

   D. -2.96 mA

   E. None of the above

5.



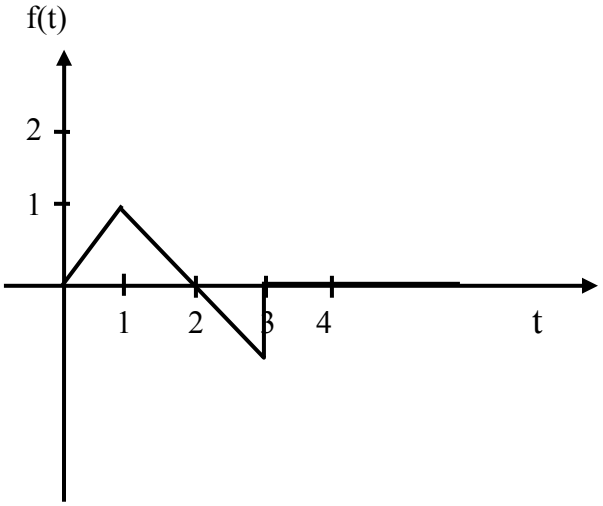
The switch closes at time t = 0, with initial currents in the inductors $I_1(0^-)$=5A, $I_2(0^-)$= 3A, $I_3(0^-)$=2A. Given that L_1 = 3mH, L_2 = 4mH, L_3 = 4mH, R_1 = 5KΩ, R_2 = 20KΩ. Find the total energy dissipated in R_1 and R_2.

A. 87.5 mW
B. 43.75 mW
C. 31.25 mW
D. 62.5 mW
E. None of the above

6. What is the energy trapped in the system of problem 5 as $t \to \infty$.

A. 1 mW
B. 1.5 mW
C. 2 mW
D. 2.5 mW
E. None of the above

7. Find the Laplace transform of **df/dt**.



A. $\dfrac{1-2e^{-2s}+(s-1)e^{-3s}}{s}$

B. $\dfrac{1-2e^{-s}+(1+s)e^{-3s}}{s}$

C. $\dfrac{0.5-1.5e^{-2s}+(1+s)e^{-4s}}{s}$

D. $\dfrac{0.5-2.5e^{-3s}+(s-1)e^{-4s}}{s}$

E. None of the above

8. Given that the hyperbolic sine is: $\sinh at = \dfrac{e^{at}-e^{-at}}{2}$. Find $\mathcal{L}\{ e^{-3t} \sinh 2t \}$.

A. $3 / (s^2 + 4s - 5)$

B. $s / (s^2 + 6s - 5)$

C. $2 / (s^2 + 6s + 5)$

D. $s / (s^2 + 4s + 5)$

E. None of the above

9. Find the Laplace transform of $f(t) = (2t + 3t^2)^2$

A. $(8s^2 + 72s + 216)/ s^5$

B. $(24s^2 + 6s + 2)/ s^5$

C. $(18s^2 + 72s + 96)/ s^5$

D. $(24s^2 + 12s + 8)/ s^5$

E. None of the above

10. Given that $F(s) = \frac{8s^2 + 4s + 6}{(2s + 3)(s + 4)}$, find f(t), the inverse Laplace of F(s).

A. $4t + (3.4\ e^{-1.5t} - 22.4\ e^{-4t})u(t)$

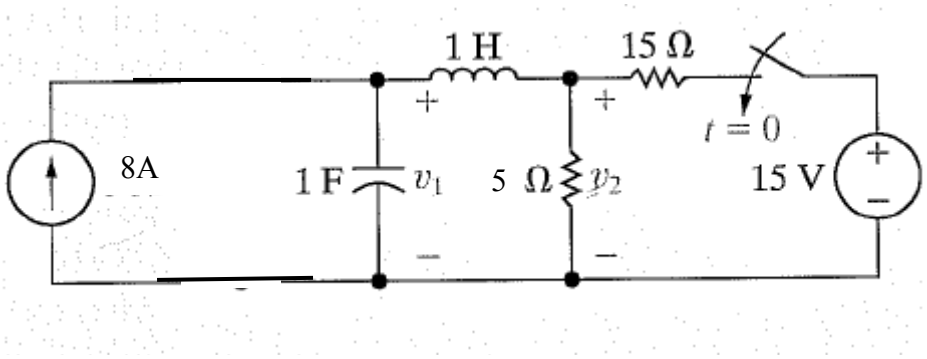
B. $4\delta(t) + (3.6\ e^{-1.5t} - 23.6\ e^{-4t})u(t)$

C. $(7.2\ e^{-1.5t} - 23.6\ e^{-4t})u(t)$

D. $4\delta(t) + (3.4\ e^{-1.5t} - 22.4\ e^{-4t})u(t)$

E. None of the above

11. The switch has been open for a long time. It closes at t=0. Find $v_2(0^+)$.



A. 22.5V

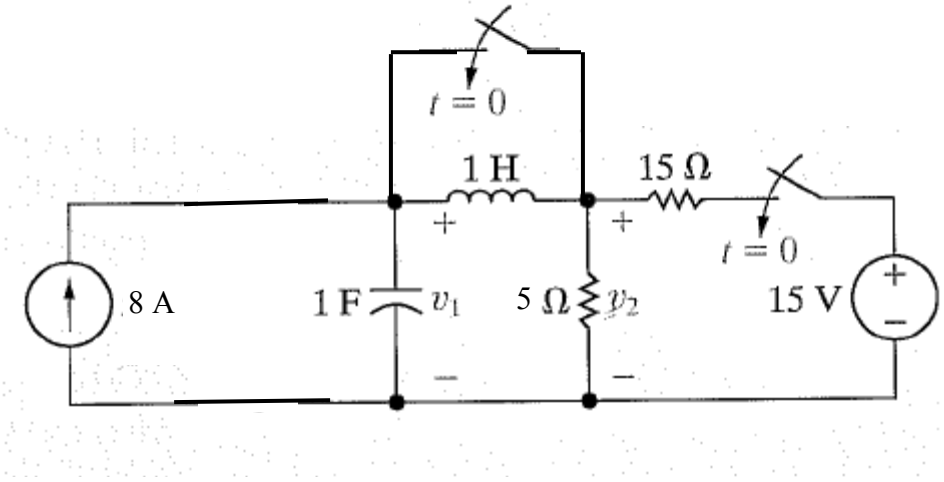
B. 15 V

C. 40 V

D. 33.75V

E. None of the above

12. The switches have been open for a long time. They close at t=0. Find $V_1(s)$.



A. $(40s + 5) / (s^2 + 3.75\ s)$

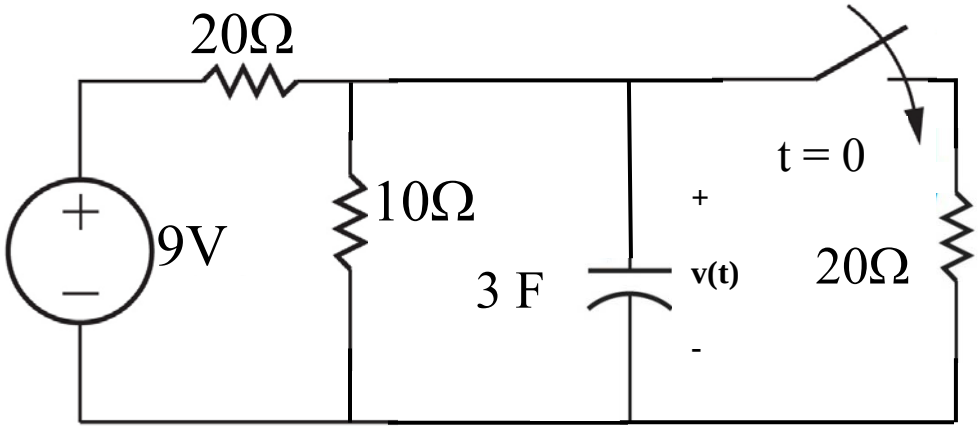
B. $(25s + 6) / (s^2 + 0.27\ s)$

C. $(40s + 6) / (s^2 + 0.27\ s)$

D. $(25s + 5) / (s^2 + 3.75\ s)$

E. None of the above

13. The switch closes at t=0. Find v(t) in volts for $t \geq 0$, t is in seconds..



A. $2.25 + 0.75e^{-0.067t}$

B. $2.75 + 0.5e^{-0.033t}$

C. $2.5 + 1.5\ e^{-0.05t}$

D. $3 + 2\ e^{-0.1t}$

E. None of the above

14. The switch opens again at t = 10sec. Find v(t) for $t \geq 10$sec.

A. $2 - 0.63\ e^{-0.067(t-10)}$

B. $4 - 0.6\ e^{-0.038(t-10)}$

C. $2.5 - 0.5\ e^{-0.067(t-10)}$

D. $3 - 0.37\ e^{-0.05(t-10)}$

E. None of the above

15. For the following circuit, L = 8H, C = 2F, R = 10Ω. Choose the right answer:

A. The response is overdamped

B. The response is critically damped.

C. The response is underdamped.

D. This is the natural response of parallel RLC circuit.

E. None of the above.