Student Name: _____

EE201 Quiz Dec. 09, 2013

(40 pts.) **1)** Consider the circuit given.

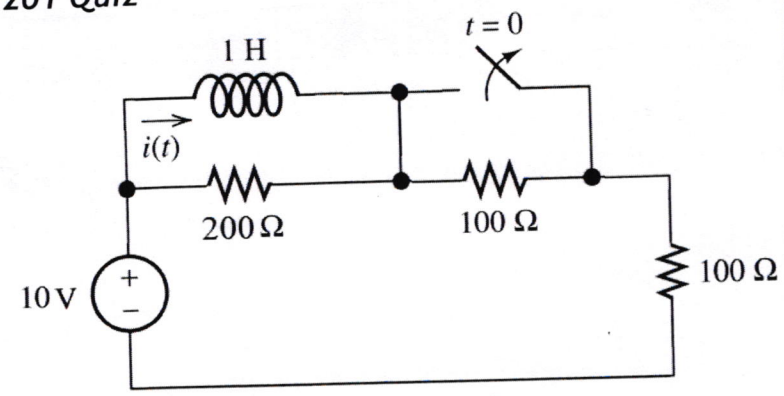
a) Find the initial current $i(0)$.

b) Find the differential equation of $i(t)$ for $t \geq 0$.

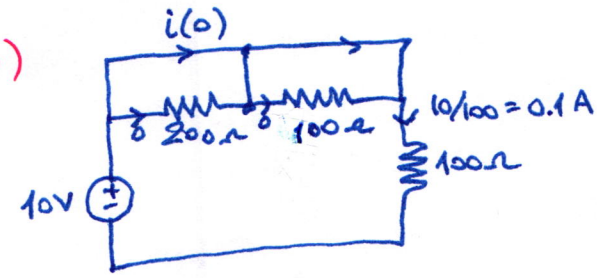
c) Solve the differential equation and find $i(t)$.

d) Sketch $i(t)$ for $t \geq 0$.

(Please show all important aspects and units)



a) (10)



$\Rightarrow i(0) = 0.1A$

v.wr → −8 w/answer

wr → −5

little math → −2

switch wrong → −5

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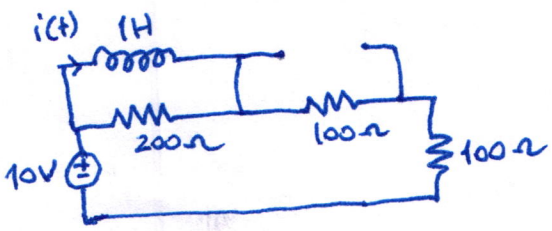
b) (20)



$$\Rightarrow 10 = 1 \cdot \frac{di}{dt} + 200 \cdot \left(i(t) + \frac{1}{200}\frac{di}{dt}\right)$$

$$\Rightarrow \frac{di}{dt} + 100\,i = 5$$

1 wr → −8

≥2 wr, v.wrong → −16

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c) (5)

$$i(t) = \left(0.1 - \frac{5}{100}\right)e^{-100t} + \frac{5}{100}$$

$$\Rightarrow i(t) = 0.05\,e^{-100t} + 0.05 \quad (A)$$

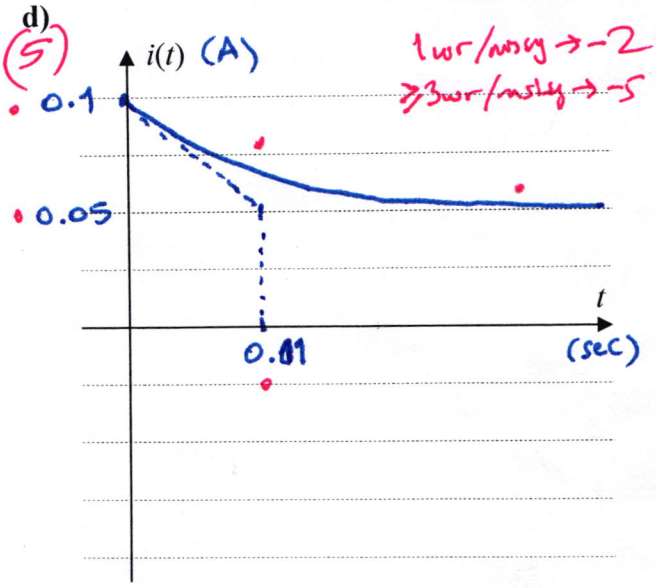
$$\tau = \frac{1}{a} = \frac{1}{100} = 0.01 \text{ sec}.$$

v. wr → −5

wr. with τ → −3

little math wr → −2

d) (5)

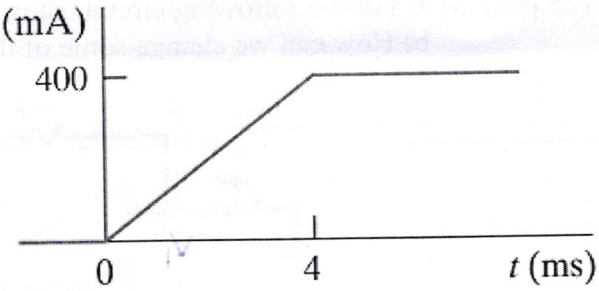


1 wr/wrng → −2

≥3 wr/wrng → −5

Note: Total time allowed is 75 min. Please show all your work and write legibly.

(35 pts.) **2)** The current shown is applied to the following components. Find the expression of the corresponding voltage for each case, and draw it carefully.



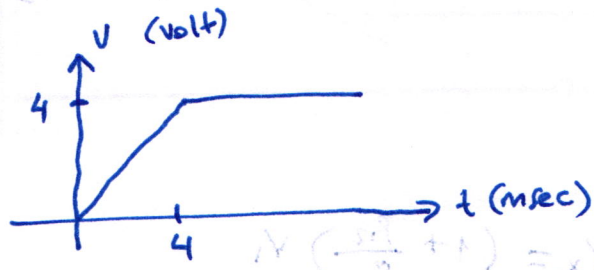
$$i = \begin{cases} 0 & t<0 \\ 100t & 0\le t\le 0.004 \\ 0.4 & t>0.004 \end{cases}$$

Answer 2:

a) 10 Ω Resistance

(6)

$$V = R\cdot i = 10\cdot i$$



	$t<0$	$0<t<4$	$t>4$
Exp.	1	1	1
Draw	1	1	1

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b) 10 μF Capacitance

(17)

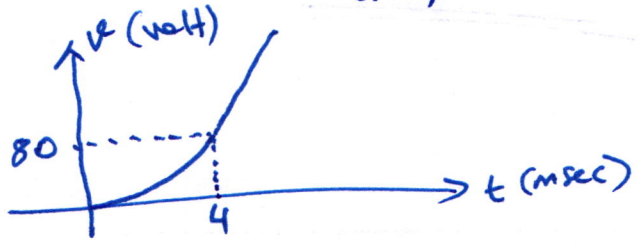
$$V = \frac{1}{10\cdot 10^{-6}} \int_{-\infty}^{t} i\, dt$$

For $t\le 0 \Rightarrow V(t) = 0$

For $0<t<0.004 \Rightarrow V(t) = 10^5 \cdot \int_0^t 100\, t\, dt = 5\cdot 10^6 t^2$

For $t>0.004 \Rightarrow V(t) = 10^5 \cdot \int_{0.004}^{t} 0.4\, dt + 80 = 40\cdot 10^3\cdot (t-0.004) + 80$

$= 40\cdot 10^3 t - 80$



	$t<0$	$0<t<4$	$t>4$
Exp.	1	6/3	4/2
Draw.	1	3	2

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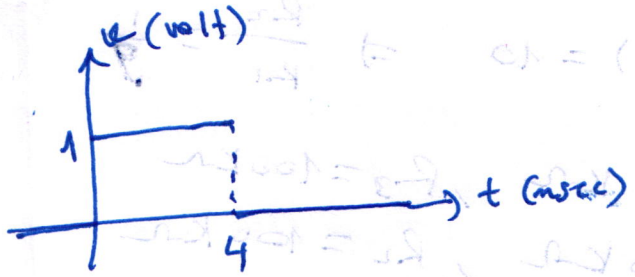
c) 10 mH Inductance

(12)

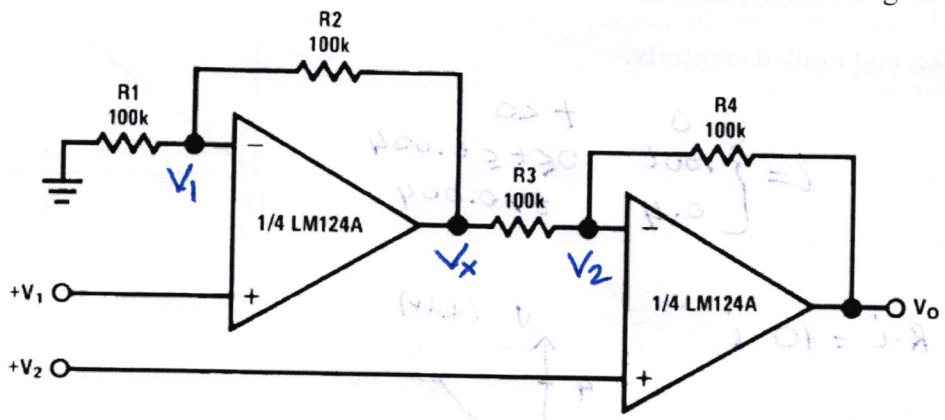
$$V = 10\cdot 10^{-3}\frac{di}{dt} = \begin{cases} 0 & t<0 \\ 1 & 0<t\le 0.004 \\ 0 & t>0.004 \end{cases}$$



	$t<0$	$0<t<4$	$t>4$
Exp.	1	4/2	2
Draw.	1	2	2

(Question 3)➔

(25 pts.) **3)** a) For the following circuit, show that $V_o=2(V_2-V_1)$.
b) How can we change some of the resistor values to make the difference gain as 10?



Answer 3:

a)

(10)

$$V_x = \left(1+\frac{R_2}{R_1}\right) V_1$$

$$\frac{V_2-V_x}{R_3} + \frac{V_2-V_o}{R_4} = 0$$

$$\Rightarrow V_o = V_2\cdot\left(1+\frac{R_4}{R_3}\right) - \frac{R_4}{R_3} V_x$$

$$\Rightarrow V_o = V_2\cdot\left(1+\frac{R_4}{R_3}\right) - \frac{R_4}{R_3}\cdot\left(1+\frac{R_2}{R_1}\right) V_1$$

$$\Rightarrow V_o = \underline{2\cdot V_2 - 2 V_1}$$

b)

(15)

$$1+\frac{R_4}{R_3} = 10 \Rightarrow \frac{R_4}{R_3} = 9$$

$$\frac{R_4}{R_3}\left(1+\frac{R_2}{R_1}\right) = 10 \Rightarrow \frac{R_2}{R_1} = \frac{1}{9}$$

Choose $\Rightarrow$ $R_4 = 900\,k\Omega$, $R_3 = 100\,k\Omega$

$R_1 = 900\,k\Omega$, $R_2 = 100\,k\Omega$