LAU
الجامعة اللبنانية الأميركية
Lebanese American University

LAU
School of Engineering

Department of Electrical
and Computer Engineering

ELE 201: Electrical Circuits I
Exam 1 – Spring 2015

Duration: **1 hour 20 minutes**
Start Time: 9:30 am

Date: 5/3/2015
Dr. Dani TANNIR

Name: SOLUTION **ID#:** _____

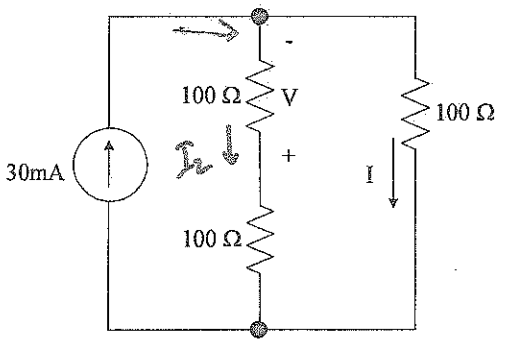
INSTRUCTIONS:

- Answer each of the following questions in the space provided.
- This is a closed-book exam.
- If something is not clear, state your assumptions.
- Programmable calculators are not allowed.
- The number of marks for each question is specified next to it.
- The total number of marks is 50.

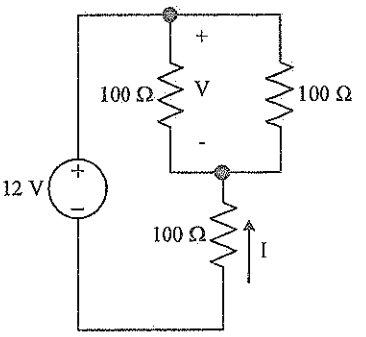
1	2	3	4	Total
/16	/11	/11	/12	/50

Question 1 (16 marks)

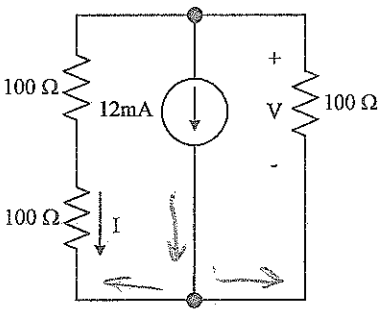
Use **current division and/or voltage division** combined with Ohm's Law to determine the values of V and I **as labeled** for the following circuits:



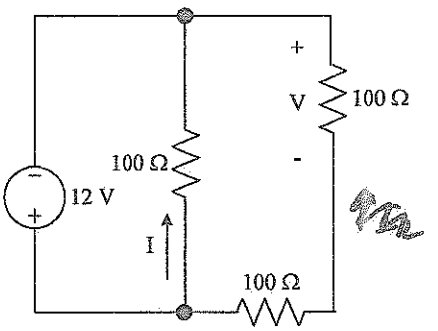
(a)



(b)



(c)



(d)

a) $I = \frac{200}{300}(30) = \boxed{20mA}$

$V = -I_2(100)$ $\quad I_2 = 30 - 20 = 10mA$

$\Rightarrow V = -(10m)(100) = \boxed{-1V}$

b) $100 // 100 = 50\Omega$ $\quad V = \frac{50}{150}(12) = \boxed{4V}$

$I = -\frac{12}{150} = \boxed{-80mA}$

c) $I = -\frac{100}{200}(12m) = \boxed{-4mA}$

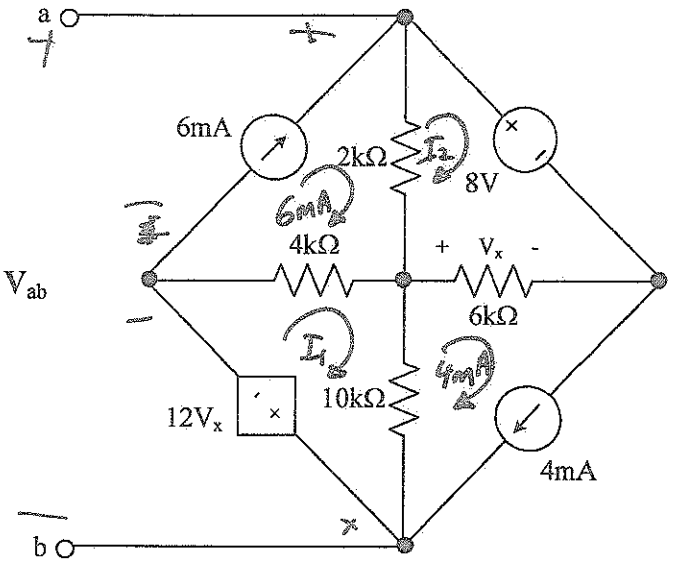
$V = I(200) = \boxed{-0.8V}$

d) $I = \frac{12}{100} = \boxed{0.12A}$

$V = -\frac{100}{200}(12) = \boxed{-6V}$

Question 2 (11 marks)

Determine the value of V_{ab} using **Mesh Analysis**



$$12V_x + 4k(I_1 - 6m) + 10k(I_1 - 4m) = 0 \quad (1)$$

$$8 + 6k(I_2 - 4m) + 2k(I_2 - 6m) = 0 \quad (2)$$

$$\Rightarrow 8kI_2 = 28$$

$$I_2 = 3.5mA$$

$$V_x = (4m - I_2)(6k) = \underline{3V}$$

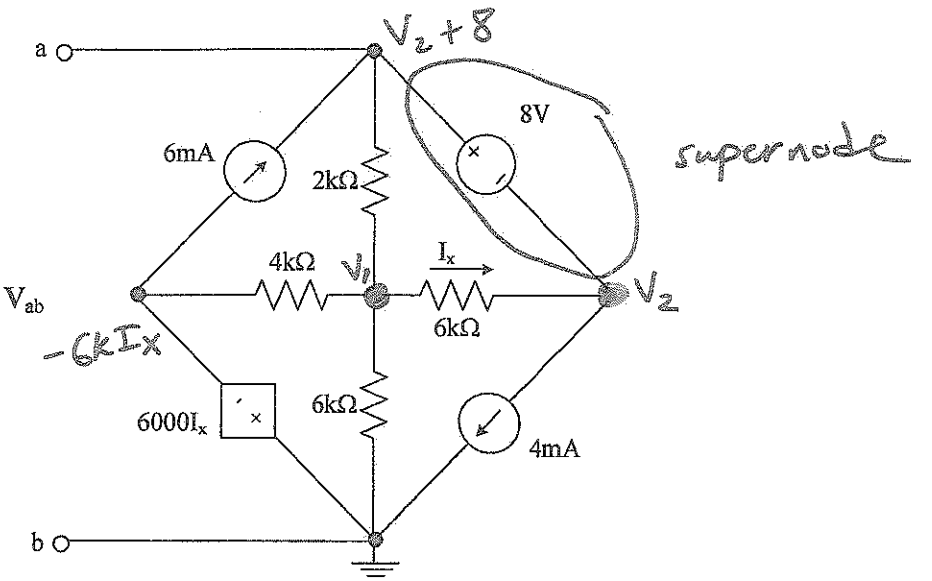
$$(1) \Rightarrow (12)(3) + 4k(I_1 - 6m) + 10k(I_1 - 4m) = 0$$

$$I_1 = 2mA$$

$$V_{ab} = 2k(6m - 3.5m) + 10k(2m - 4m) = \boxed{-15V}$$

Question 3 (11 marks)

Determine the value of V_{ab} using **Node Analysis**



$$I_x = \frac{V_1 - V_2}{6k}$$

Node equation at V_1

$$\frac{V_1 + 6kI_x}{4k} + \frac{V_1}{6k} + \frac{V_1 - V_2}{6k} + \frac{V_1 - (V_2+8)}{2k} = 0$$

$$\Rightarrow 16V_1 - 11V_2 = 48 \quad (1)$$

Node equation at supernode

$$\frac{(V_2+8) - V_1}{2k} - 6m + \frac{V_2 - V_1}{6k} + 4m = 0$$

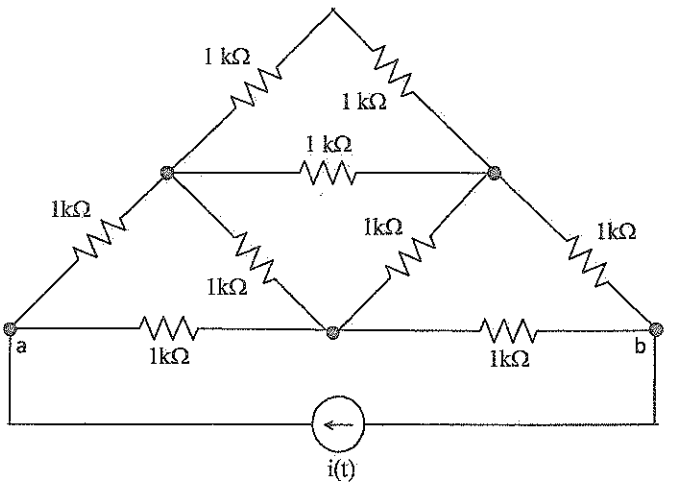
$$\Rightarrow -4V_1 + 4V_2 = -12 \quad (2)$$

(1) & (2) $\Rightarrow V_1 = 3$

$V_2 = 0$

$$V_{ab} = V_2 + 8 = 8V$$

Question 4 (12 marks)



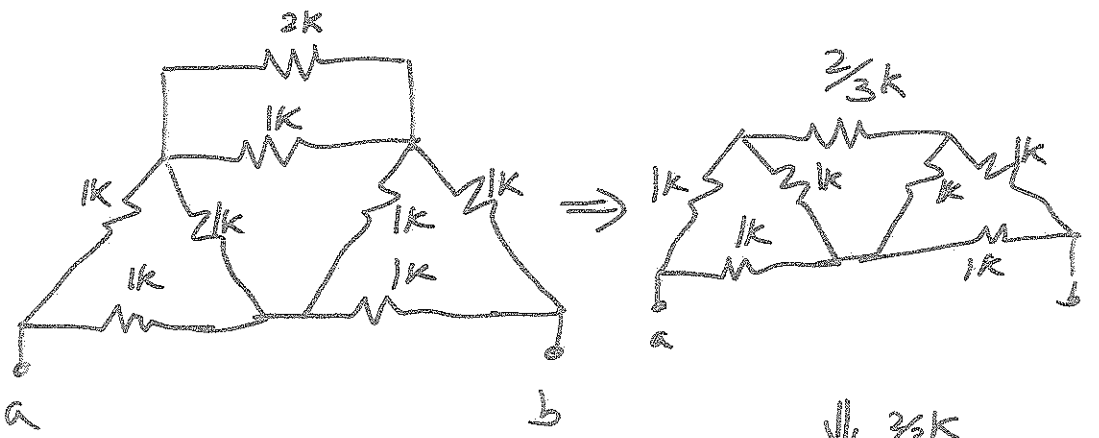
For the given circuit, determine:

a. The equivalent resistance seen by the source between terminals 'a' and 'b'

The charge supplied by the current source is given by the expression $q(t) = -12e^{-2t}$ mC. The power delivered to the equivalent resistance is $p(t) = 2.4e^{-3t}$ W. Compute:

b. The current $i(t)$ supplied by the source.
c. The voltage across the current source (across terminals 'a' and 'b').
d. The energy supplied by the source in the time interval $0 < t < 100$ms.

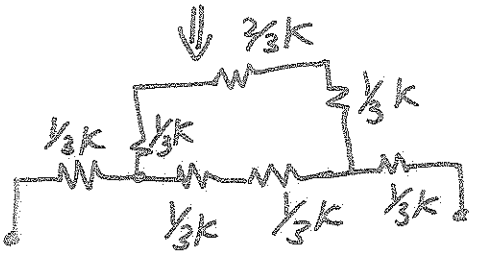
a)

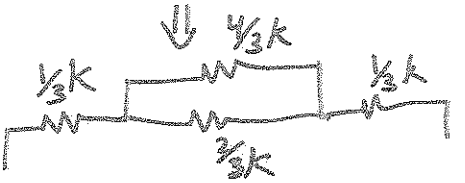


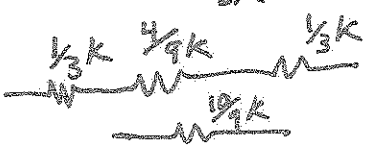
For balanced Y-Δ

$$Z_Y = \frac{Z_\Delta}{3}$$

$$Z_\Delta = 1K \Rightarrow Z_Y = \frac{1}{3}K$$







$$R_{eq} = \frac{10}{9}k\Omega$$

b) $i(t) = \frac{dq}{dt} = 24e^{-2t}$ mA

c) $p = 2.4e^{-3t}$ $\qquad i = 24e^{-2t}$

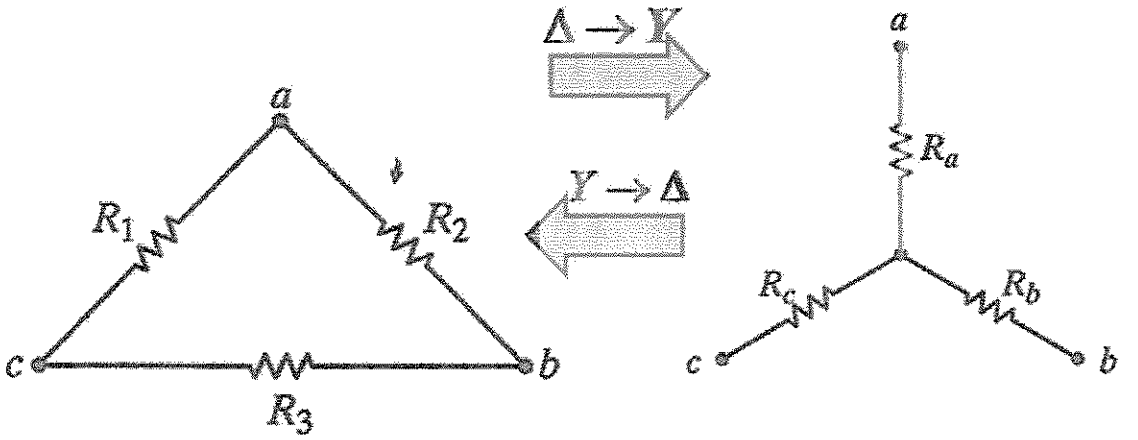
$$v = \frac{p}{i} = \frac{2.4e^{-3t}}{24e^{-2t}\,m} = 100e^{-t} \text{ V}$$

d) $E = \int_0^{100m} 2.4e^{-3t}\,dt$

$$= \left[-0.8\,e^{-3t}\right]_0^{100m} = ~~-5.33 + 0.8~~ \quad ~~1.866\text{ J}~~$$

0.207

Useful Equations:



$$R_a = \frac{R_1 R_2}{R_1 + R_2 + R_3}$$

$$R_b = \frac{R_2 R_3}{R_1 + R_2 + R_3}$$

$$R_c = \frac{R_1 R_3}{R_1 + R_2 + R_3}$$

$$R_1 = \frac{R_a R_b + R_b R_c + R_a R_c}{R_b}$$

$$R_2 = \frac{R_a R_b + R_b R_c + R_a R_c}{R_c}$$

$$R_3 = \frac{R_a R_b + R_b R_c + R_a R_c}{R_a}$$