PHYS 102:General PhysicsII **KOÇ UNIVERSITY** **Spring Semester 2013**

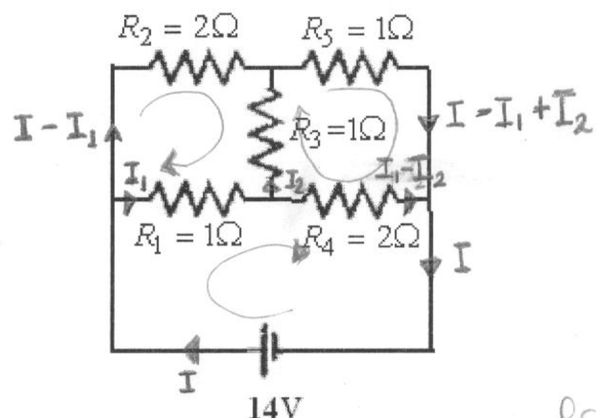
College of Sciences

Section 1 **Quiz 6** **21 March 2013**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

Find the current through each resistor in the circuit.



* Current in the loops are determined via junction rule

bottom loop:

$14V - I_1 \cdot 1\Omega - (I_1 - I_2) \cdot 2\Omega = 0$

$3I_1 + 2I_2 = 14 \quad (1)$

top left loop:

$-(I - I_1) \cdot 2\Omega + I_2 \cdot 1\Omega + I_1 \cdot 1\Omega = 0$

$-2I + 3I_1 + I_2 = 0 \quad (2)$

top right loop:

$-(I - I_1 + I_2) \cdot 1\Omega + (I_1 - I_2) \cdot 2\Omega + I_2 \cdot 1\Omega = 0$

$-I + 3I_1 - 4I_2 = 0 \quad (3)$

from (1)-(2) we get:

$2I - 3I_2 = 14 \quad (4)$

from (3)-(2) we get

$I - 5I_2 = 0$

$\Rightarrow I = 5I_2 \quad (5)$

Substitute (5) into (4):

$7I_2 = 14A \Rightarrow I_2 = 2A$

$\Rightarrow I = 5I_2 = 10A$

Solving (1) for I_1 we find: $I_1 = \frac{14A + 2I_2}{3} = 6A$

Thus,

$I_{R_1} = I_1 = 6A$

$I_{R_2} = I - I_1 = 10A - 6A = 4A$

$I_{R_3} = I_2 = 2A$

$I_4 = I_1 - I_1 = 2A$

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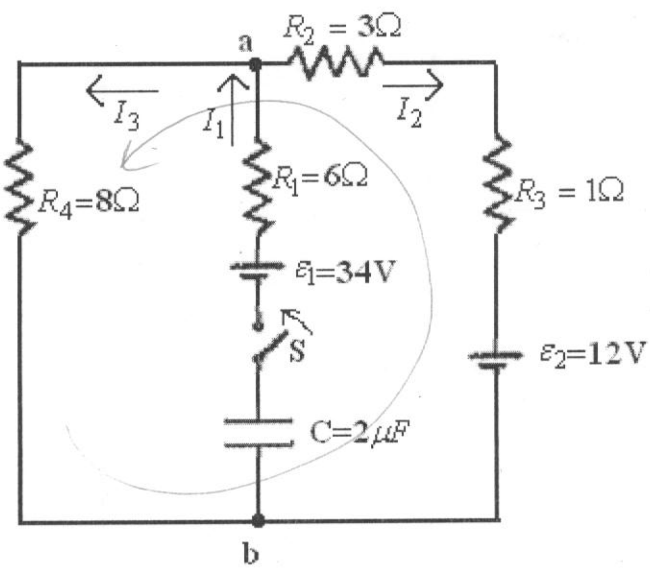
Section 6 **Quiz 6** **21 March 2013**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

Consider the circuit given in the figure. The capacitor is initially uncharged and the switch S is closed at t=0. Long time after (t goes to infinity) the switch S is closed, find the potential difference $V_a - V_b$. What is the maximum charge on the 2 μF capacitor?



If we wait enough, the capacitor is fully charged. Then, the capacitor behaves as open circuit. ($I_1 = 0$)

The current flows from the outer loop only.

$$12V + I_2 \cdot 1\Omega + I_2 \cdot 3\Omega - I_3 \cdot 8\Omega = 0$$

$$2I_3 - I_2 = 3A$$

Due to junction rule: $I_1 = I_2 + I_3$ & $I_1 = 0$

$$I_2 = -I_3$$

$$2I_3 - (-I_3) = 3A \Rightarrow I_3 = 1A,\quad I_2 = -1A,\quad I_1 = 0$$

Potential across the capacitor is: $V_{ab} = I_3 \cdot R_4 = 1A \cdot 8\Omega = 8V$

$$Q_{max} = C \cdot V = 2\mu F \cdot 8V = 16\mu C$$

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Section 2 **Quiz 6** **21 March 2013**

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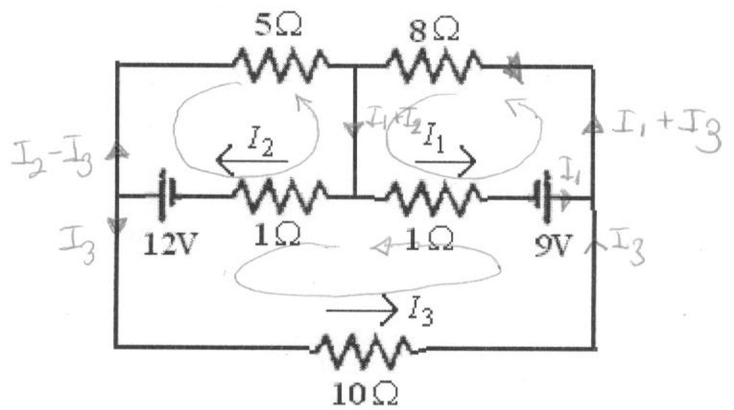
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

Calculate the three currents I_1, I_2 and I_3 indicated in the circuit diagram.



★ The currents in the branches are written due to junction rule!

Top left loop:

$$-12V + I_2 \cdot 1\Omega + (I_2 - I_3) \cdot 5\Omega = 0$$

$$6I_2 - 5I_3 = 12A \quad (1)$$

Top right loop:

$$-I_1 \cdot 1\Omega + 9V - (I_1 + I_3) 8\Omega = 0$$

$$9I_1 + 8I_3 = 9A \quad (2)$$

Bottom loop:

$$-I_3 \cdot 10\Omega - 9V + I_1 \cdot 1\Omega - I_2 1\Omega + 12V = 0$$

$$-I_1 + I_2 + 10I_3 = 3A \quad (3)$$

Solve (1) for I_2: $I_2 = 2A + \frac{5}{6} I_3$
Solve (2) for I_1: $I_1 = 1A - \frac{8}{9} I_3$ } Substitute into (3):

$$-(1A - \tfrac{8}{9}I_3) + (2A + \tfrac{5}{6}I_3) + 10I_3 = 3A$$

$$\frac{8}{9}I_3 + \frac{5}{6}I_3 + \frac{100}{10}I_3 = 2A$$

(2) (3) (1.8)

$$\left(\frac{16 + 15 + 180}{18}\right) I_3 = 2A \Rightarrow \boxed{I_3 = 0.171A}$$

Then:

$$I_2 = 2A + \frac{5}{6}(0.171A) = 2.14A$$

$$I_1 = 1A - \frac{8}{9}(0.171A) = 0.848$$

$I_1 = 8.48A$

$I_2 = 2.14A$

$I_3 = 0.171A$

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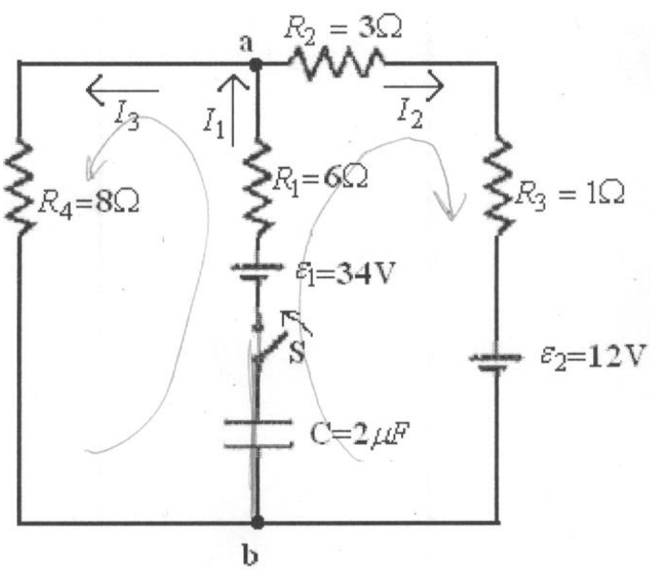
Section 3 Quiz 6 21 March 2013

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

Consider the circuit in given the figure. The capacitor is initially uncharged and the switch S is closed at t=0. Find the currents I_1, I_2 and I_3 just after the switch S is closed.



Since the capacitors are initially uncharged, just after the switch is closed the potential across the capacitor is zero; $V_c = Q/C = 0$

The capacitor behave as an short circuit.

Left loop: $34 - 6I_1 - 8I_3 = 0 \rightarrow \boxed{3I_1 + 4I_3 = 17A}$ (1)

Right loop: $34 - 6I_1 - 3I_2 - I_2 - 12 = 0 \rightarrow \boxed{3I_1 + 2I_2 = 11}$ (2)

Junction Rule: $\boxed{I_1 = I_2 + I_3}$ (3)

Substitute (3) into (1) & (2)

$3I_2 + 3I_3 + 4I_3 = 17A \rightarrow 5/\ 3I_2 + 7I_3 = 17A$

$3I_2 + 3I_3 + 2I_2 = 11A \rightarrow 3/\ 5I_2 + 3I_3 = 11A$

$26 I_3 = 52A$

$\Rightarrow \boxed{I_3 = 2A}$

$3I_1$

$3I_1 + 4I_3 = 17A \Rightarrow \boxed{I_1 = 3A}$ & $\boxed{I_2} = I_1 - I_3 = \boxed{1A}$

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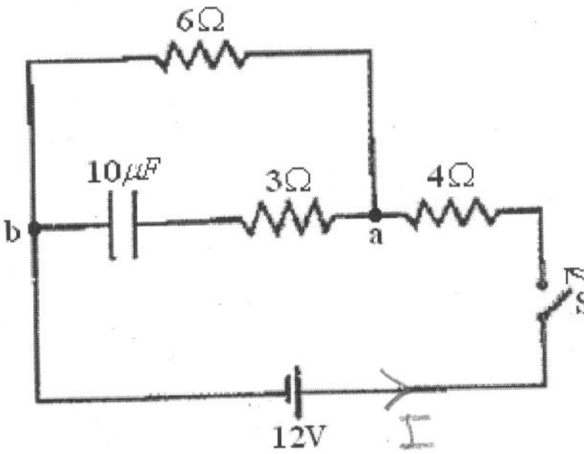
Section 4 Quiz 6 21 March 2013

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

Consider the circuit given in the figure. The capacitor is initially uncharged and the switch S is closed at t=0. Long time after (t goes to infinity) the switch S is closed, find the potential difference $V_a - V_b$. What is the maximum charge on the 10 μF capacitor?



* After we close the circuit and wait enough, the capacitor gets fully charged. The capacitor behave as open circuit.

The current flows from the outer loop (as t→∞)

$$I = \frac{12V}{6\Omega + 4\Omega} = 1,2A$$

$$V_a - V_b = IR = 1,2A \times 6\Omega = 7,2V$$ (point a is @ higher potential)

The max. charge on the capacitor is then,

$$Q_{max} = CV = 10\mu F \times 7.2V = 72\mu C$$

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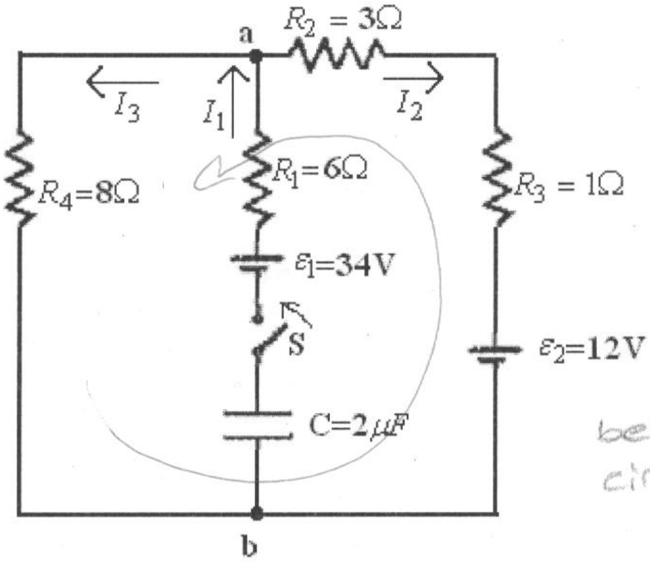
Section 5 **Quiz 6** **21 March 2013**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

Consider the circuit in the figure. The capacitor is initially uncharged and the switch S is closed at t=0. Find the currents I_1, I_2 and I_3 long time after (t goes to infinity) the switch S is closed.



If we wait enough after the switch is closed, the capacitor gets fully charged. The capacitor behaves as an open circuit then.

The current flows from the outer loop only;

$$12V + I_2 \cdot 1\Omega + I_2 \cdot 3\Omega - I_3 \cdot 8\Omega = 0$$

$$4I_2 - 8I_3 = -12V$$

$$2I_3 - I_2 = 3V$$

On the other hand, $I_1 = I_2 + I_3$ due to junction rule.
But $I_1 = 0$, since Capacitor behaves as an open circuit. Thus $I_2 = -I_3$

$2I_3 - (-I_3) = 3A \Rightarrow 3I_3 = 3A \Rightarrow$

$I_3 = 1A$
$I_2 = -1A$
$I_1 = 0A$