PHYS 102:General PhysicsII **KOÇ UNIVERSITY** **Spring Semester 2012**

College of Sciences

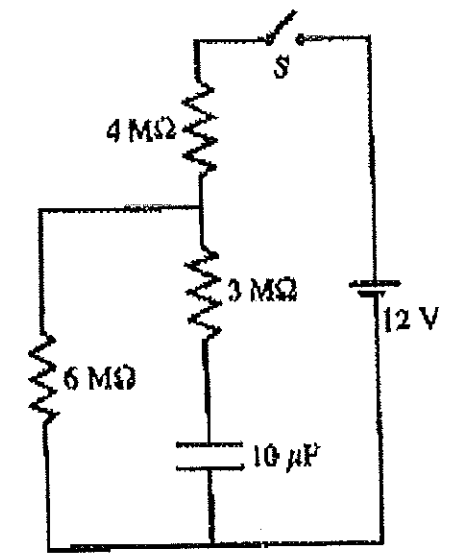
Section 1 **Quiz 6** **22 March 2012**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 15 minutes

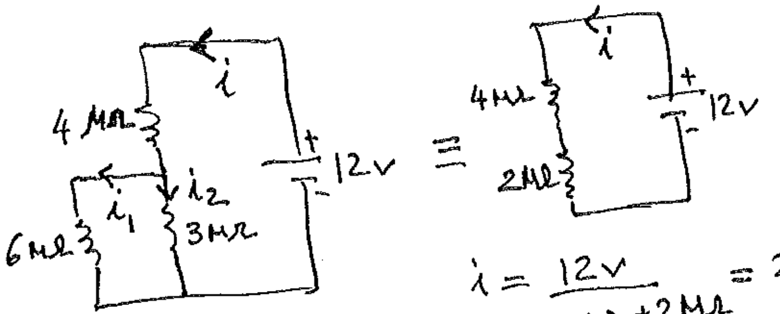
Name: **Student ID:** **Signature:**

The switch S in the given circuit is initially left open for a long time and then closed. Find the current through each resistor at the instant the switch S is closed.

$(1\text{M}\Omega = 10^6\,\Omega)$, $(1\mu F = 10^{-6}\,F)$.



The capacitor is uncharged before the switch S is closed. So, it acts as a short circuit at the instant the switch S is closed. Circuit becomes



$i_{4M\Omega} = 2\,\mu A$

$i_{6M\Omega} = \frac{2}{3}\,\mu A$

$i_{3M\Omega} = \frac{4}{3}\,\mu A$

$i = \frac{12\,V}{4M\Omega + 2M\Omega} = 2\,\mu A$

$i_1(6M\Omega) = i_2(3M\Omega)$

$2i_1 = i_2$

$i = i_1 + i_2 = 3i_1, \quad i_1 = \frac{i}{3}, \quad i_1 = \frac{2}{3}\,\mu A$

$i_2 = \frac{4}{3}\,\mu A$

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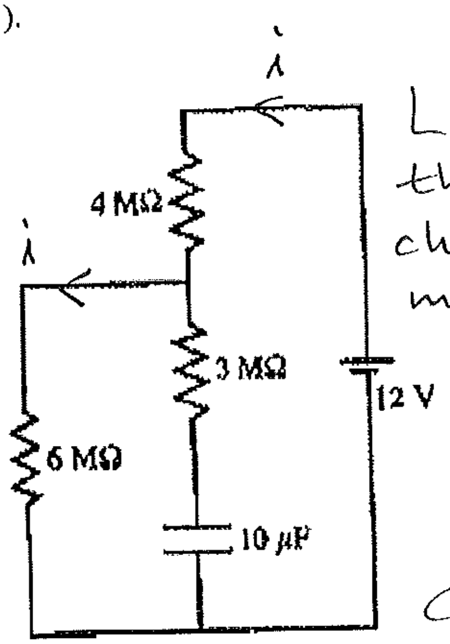
Section 2 **Quiz 6** **22 March 2012**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 15 minutes

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

In the circuit below, find the maximum charge on the capacitor.

$(1\text{M}\Omega = 10^6\,\Omega)$, $(1\mu F = 10^{-6} F)$.



Long after S is closed the capacitor is fully charged and has the maximum charge. No current flows through the 3 MΩ resistor and the capacitor. Capacitor acts as an open circuit.

$$i = \frac{12\,V}{4\,M\Omega + 6\,M\Omega} = 1.2\,\mu A$$

$$V_C = i(6\,M\Omega) = (1.2\,\mu A)(6\,M\Omega) = 7.2\,V$$

$$q = C V_c = (10\,\mu F)(7.2\,V) = 72\,\mu C$$

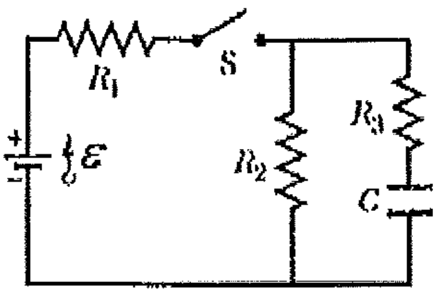
Section 3 **Quiz 6** **22 March 2012**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 15 minutes

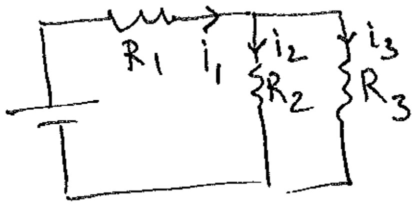
Name: **Student ID:** **Signature:**

In the circuit below, $\varepsilon = 1.2\text{kV}$, $C = 6.5\mu F$, $R_1 = R_2 = R_3 = 0.2\text{M}\Omega$. With C completely uncharged, switch S is suddenly closed (at t=0). Determine the currents I_1, I_2 and I_3 passing on the resistors R_1, R_2 and R_3.

$(1\text{M}\Omega = 10^6\,\Omega)$, $(1\mu F = 10^{-6} F)$.



At t=0



$i_1 = i_2 + i_3$

Loop rule applied to the left-hand loop:

$$\varepsilon - i_1 R_1 - i_2 R_2 = 0$$

to the righ-hand loop:

$$i_2 R_2 - i_3 R_3 = 0$$

Resistances are all the same

$$R_1 = R_2 = R_3 = R$$

$$i_1 = \frac{2\varepsilon}{3R} = \frac{2}{3}\frac{1.2\times10^3\,V}{0.2\times10^6\,\Omega} = 4\times10^{-3}\,A$$

$$i_2 = i_3 = \frac{\varepsilon}{3R} = \frac{1}{3}\frac{1.2\times10^3\,V}{0.2\times10^6\,\Omega} = 2\times10^{-3}\,A$$

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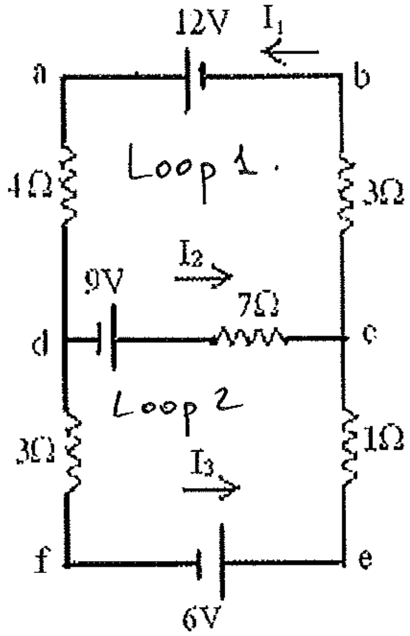
Section 4 **Quiz 6** **22 March 2012**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 15 minutes

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

In the circuit below, determine the current in each resistor.



$I_1 = I_2 + I_3$

Loop 1 :

$9 - 7I_2 - 3I_1 + 12 - 4I_1 = 0$

Loop 2 :

$6 - 3I_3 - 1I_3 + 7I_2 - 9 = 0$

$21 - 7I_2 - 7I_1 = 0$

$-3 - 4I_3 + 7I_2 = 0$

insert $I_2 = I_1 - I_3$

$21 - 7(I_1 - I_3) - 7I_1 = 0$

$-3 - 4I_3 + 7(I_1 - I_3) = 0$

$21 - 14I_1 + 7I_3 = 0$

$-3 + 7I_1 - 11I_3 = 0$

$I_1 = 2A$

$I_2 = 1A$

$I_3 = 1A$

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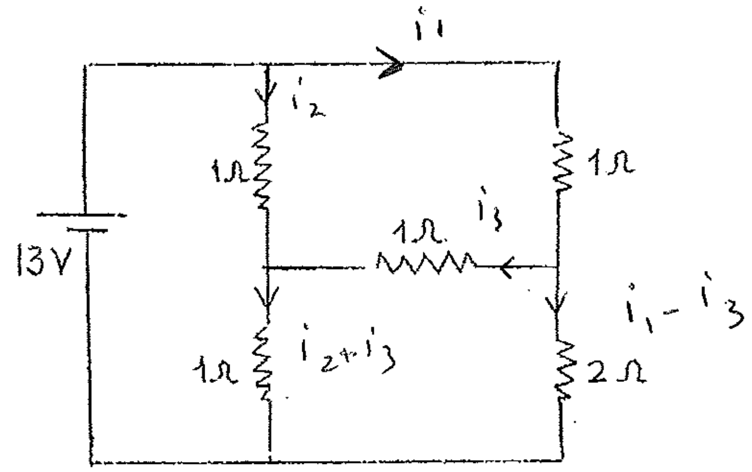
Section 5 **Quiz 6** **22 March 2012**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 15 minutes

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

In the ciruit below, determine the current in each resistor.



$-1i_1 - 1i_3 + 1i_2 = 0$

$1i_1 + 2(i_1 - i_3) = 13$

$1i_2 + 1i_3 + 1i_2 = 13$

$i_1 - 2i_2 + 2i_1 - 2i_3 - i_3 = 0$

$\Rightarrow 3i_1 - 2i_2 - 3i_3 = 0$

$3(i_2 - i_3) - 2i_2 - 3i_3 = 0$

$i_2 = 6i_3$

$i_3 = 1A$

$i_2 = 6A$

$i_1 = 5A$

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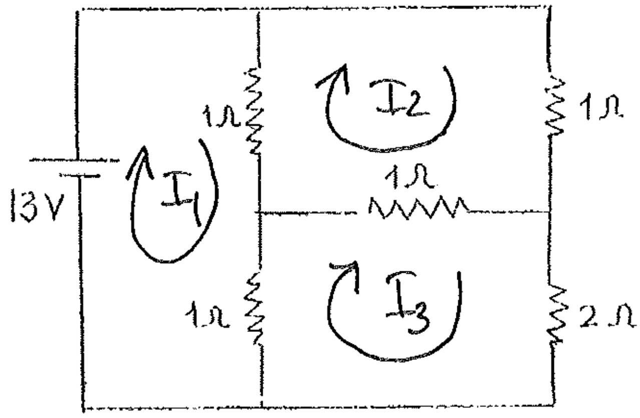
Section 5 | Quiz 6 | 22 March 2012

Closed book. No calculators are to be used for this quiz.
Quiz duration: 15 minutes

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

In the ciruit below, determine the current in each resistor.



Loop 1 :

$13 - 1I_1 + 1I_2 - 1I_1 + 1I_3 = 0$

Loop 2:

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

Loop 3 :

$-1I_3 + 1I_1 - 1I_3 + 1I_2 - 2I_3 = 0$

$13 - 2I_1 + I_2 + I_3 = 0$

$I_1 - 3I_2 + I_3 = 0$

$I_1 + I_2 - 4I_3 = 0$

$$\Delta = \begin{vmatrix} -2 & 1 & 1 \\ 1 & -3 & 1 \\ 1 & 1 & -4 \end{vmatrix} = -13$$

$\Delta = -13$

$$I_1 = \frac{1}{\Delta} \begin{vmatrix} -13 & 1 & 1 \\ 0 & -3 & 1 \\ 0 & 1 & -4 \end{vmatrix} = 11\text{ A}$$

$$I_2 = \frac{1}{\Delta} \begin{vmatrix} -2 & -13 & 1 \\ 1 & 0 & 1 \\ 1 & 0 & -4 \end{vmatrix} = 5\text{ A}$$

$$I_3 = \frac{1}{\Delta} \begin{vmatrix} -2 & 1 & -13 \\ 1 & -3 & 0 \\ 1 & 1 & 0 \end{vmatrix} = 4\text{ A}$$

$I_{1\Omega} = 11 - 5 = 6\text{ A}$ ✓

$I_{1\Omega} = I_1 - I_3 = 11 - 4 = 7\text{ A}$ ✓

$I_{1\Omega} = I_2 = 5\text{ A}$ ✓

$I_{1\Omega} = I_2 - I_3 = 5 - 4 = 1\text{ A}$ ✓

$I_{2\Omega} = 4\text{ A}$ ✓