Module: Electricity

Tutorial Worksheet No. 6:

Duration: 3 weeks

Exercises to do in class: 1,2,4,5,7,10

Assignment to submit: 3,6,8,9

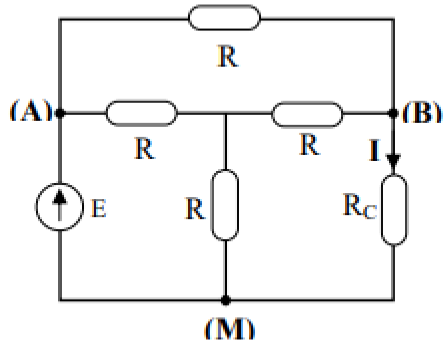
Exercise 1: (Week 1)

Given: $E = 1^{V}$, $R = 2^{k\Omega}$, $R_C = 1^{k\Omega}$

a) Determine the elements (E_{th}, R_{th}) of the Thevenin generator, as seen from terminals B and M by resistance R_C.

b) Determine the short-circuit current I_{SC} of branch BM. (R_C=0)

c) Verify the equivalence of generators (E_{th}, R_{th}) and (I_{SC}, R_{th}). Deduce the current I.



Exercise 2: (Week 1)

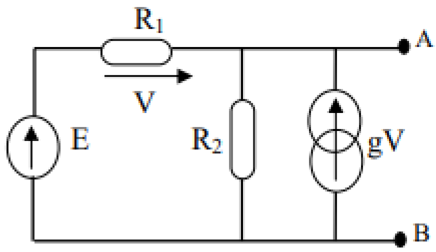
a) In the following circuit, what type of controlled source is it?

b) Determine the equivalent Thevenin circuit (E_{th}, R_{th}) as seen between poles A and B.

c) Express the current I_N of the equivalent Norton generator.

d) Verify the Thevenin-Norton equivalence.

Given: $E = 1V$; $g = 5mA/V$; $R_1 = R_2 = 2k\Omega$

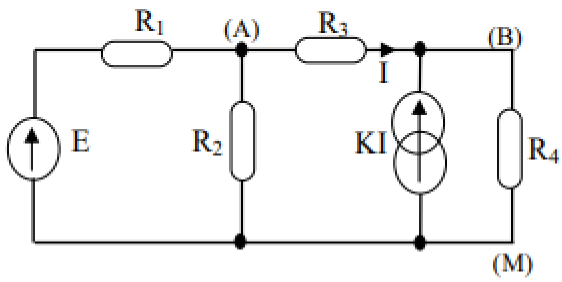


Exercise 3:

Given: $E = 1V$; $K = 50$; $R_1 = R_2 = 2k\Omega$; $R_3 = 1k\Omega$; $R_4 = 40\Omega$

Calculate the current I_4 in branch BM of the circuit using:

- The nodal analysis method
- The Thevenin-Norton theorem

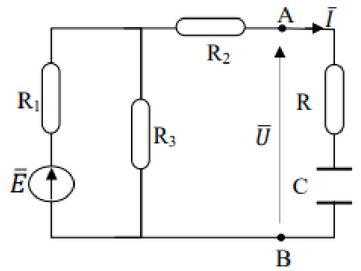


Exercise 4: (Week 2)

Given: $\underline{E} = 50^{V}\angle 0°$; $\omega = 5000rad/s$; $R_1 = 200\Omega$; $R_2 = 210\Omega$; $R_3 = R = 50\Omega$; $C = 2\mu F$

Calculate the elements (I_N, R_N) of the Norton generator as seen by dipole AB.

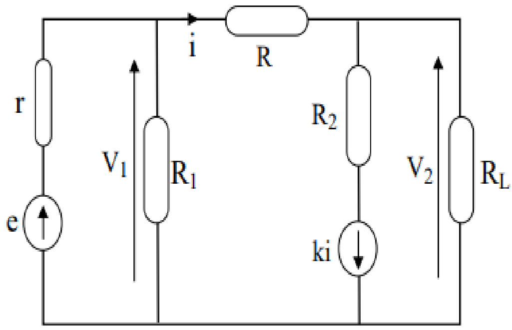
Deduce the value of current I in this dipole.



Exercise 5: (Week 2)

Given: $R_1 = 1k\Omega$; $R = 2k\Omega$; $R_2 = 100\Omega$; $R_L = 5k\Omega$; $k = 0.5\times10^3\ \Omega$; $e = 15V$; $r = 50\Omega$

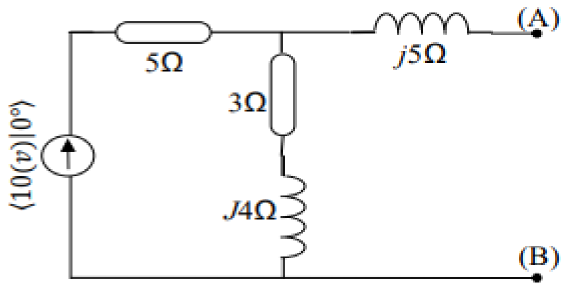
1. Write the nodal equations in ordered literal form. Deduce the values of voltages V_1 and V_2.
2. Determine E_T and resistance R_T of the Thevenin generator equivalent to the circuit as seen by load R_L.
3. Give the expression for the current I_N of the Norton generator equivalent to the circuit as seen by load R_L.
4. Use the Thevenin-Norton equivalence to verify the obtained results.



Exercise 6:

Given: E = 10∠0° V; Circuit contains impedances: 5Ω, j5Ω, 3Ω, j4Ω

Calculate the elements (E_{th}, Z_{th}) and (I_N, Z_N) of the Thevenin and Norton generators respectively, as seen by dipole AB. Verify the Thevenin-Norton equivalence.



Exercise 7: (Week 3)

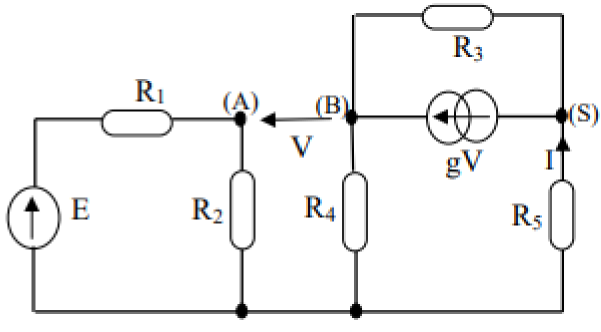


Figure 13.a

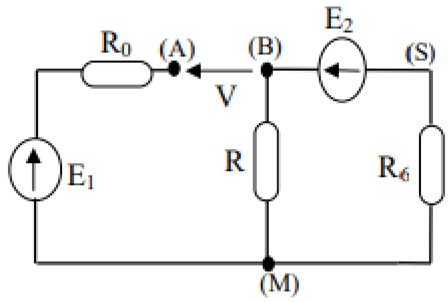


Figure 13.b

Given: E = 1V; g = 5mA/V; $R_1 = R_2$ = 2kΩ; R_3 = 2kΩ; R_4 = 200Ω; R_5 = 4.8kΩ

The circuit in figure 13.a transforms into an equivalent schematic given by figure 13.b:

a) Determine the elements E_1, E_2, R_0, R, and R_6 of the circuit.

b) Determine the current I in branch SM using:

- The mesh analysis method
- The Thevenin-Norton theorem

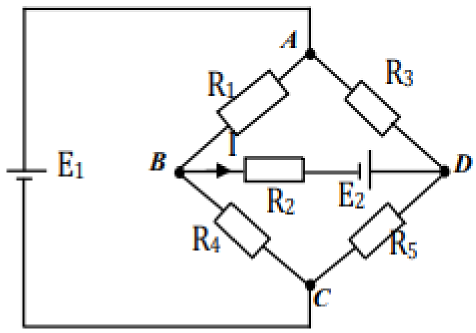
Exercise 8:

Given: E_1 = 10V; E_2 = 5V; R_1 = 6Ω; R_2 = 50Ω; R_3 = 100Ω; R_4 = 14Ω; R_5 = 46Ω

Calculate current I by applying:

a) The Thevenin theorem

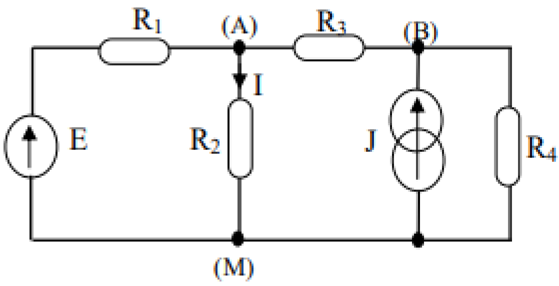
b) The superposition theorem



Exercise 9:

Given: R_1 = 1kΩ; R_3 = 2kΩ; R_2 = 100Ω; R_4 = 5kΩ; E = 15V; J = 50mA

By applying the superposition theorem, calculate the current I in branch AM.

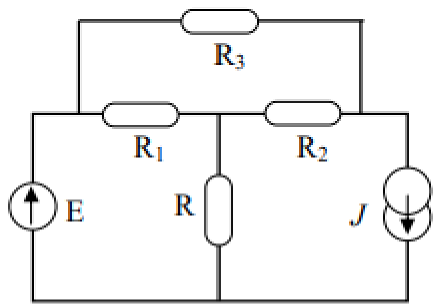


Exercise 10: (Week 3)

Given: $R_1 = R_2$ = 1kΩ; R_3 = 2kΩ; R = 250Ω; E = 10V; J = 100mA

a) Using Kennelly's theorem, transform the delta connection of R_1, R_2, and R_3 into a wye (star) connection.

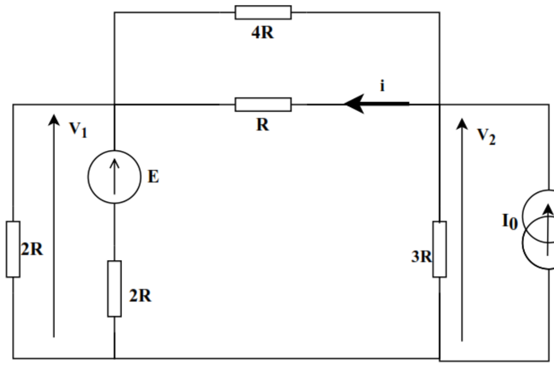
b) Calculate the current through resistance R using the principle of superposition.

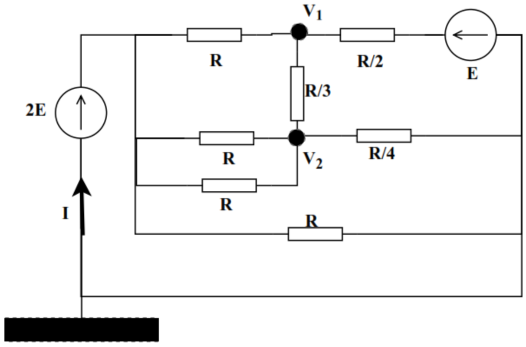


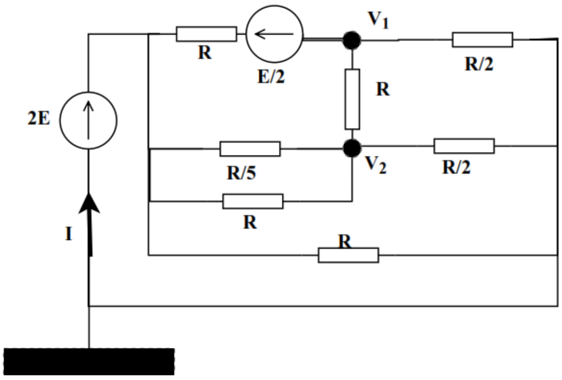
Exercise 11:

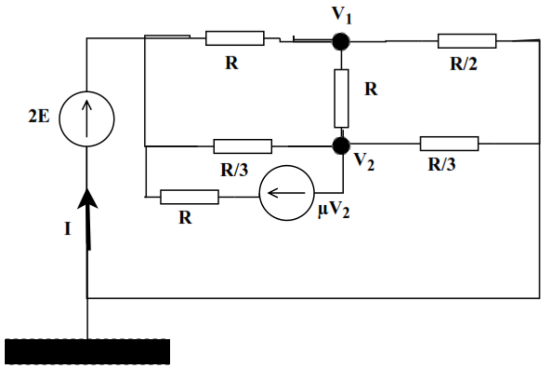
Given the 13 circuits below to analyze. Calculate the current i for each circuit using:

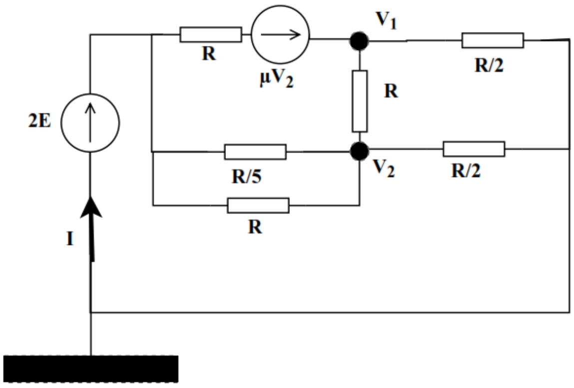
1. Thevenin method
2. Norton method

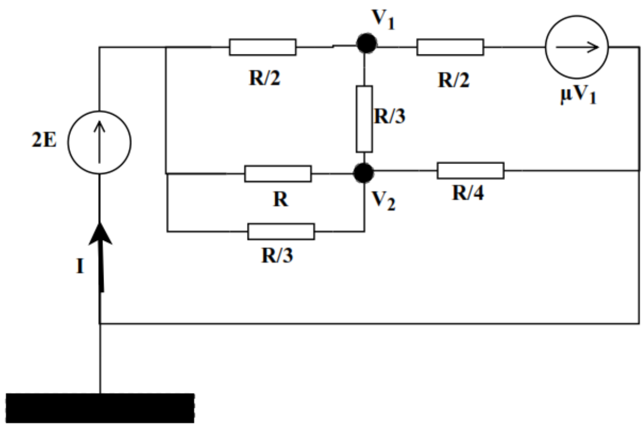


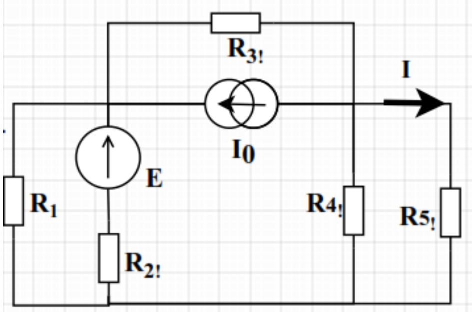


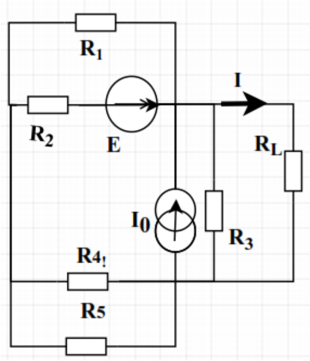


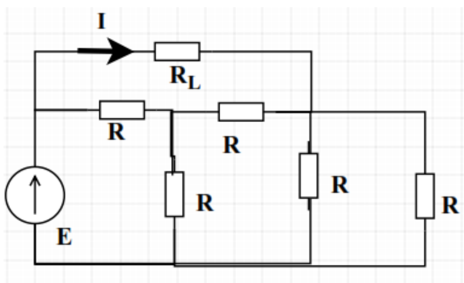


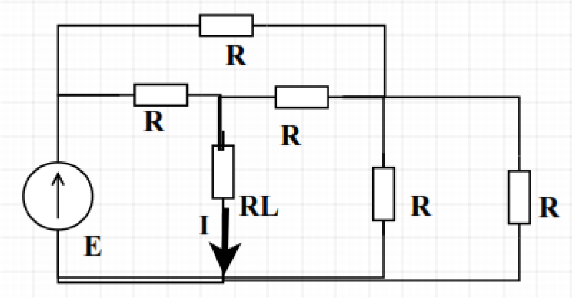


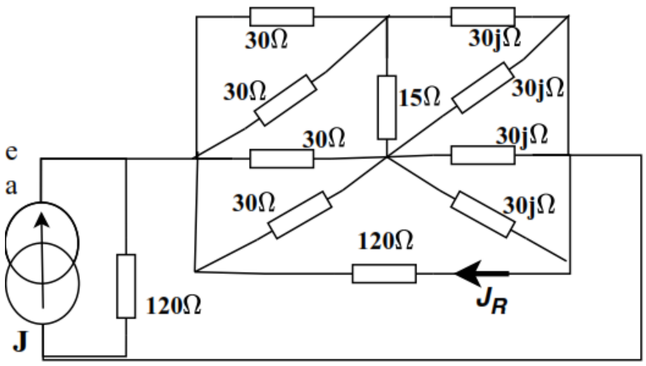


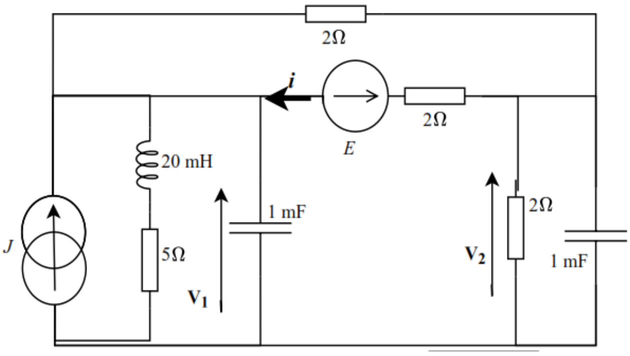


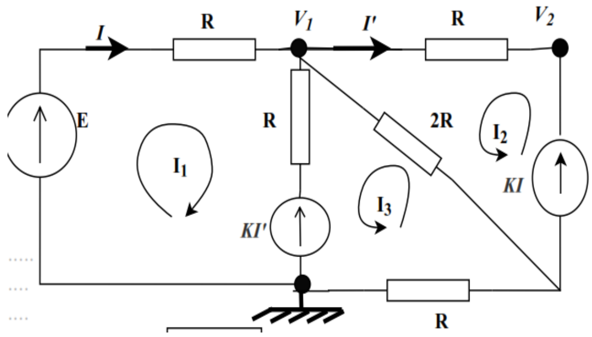












Exercise 12:

Find the current I using the following methods:

- Thevenin method
- Norton method

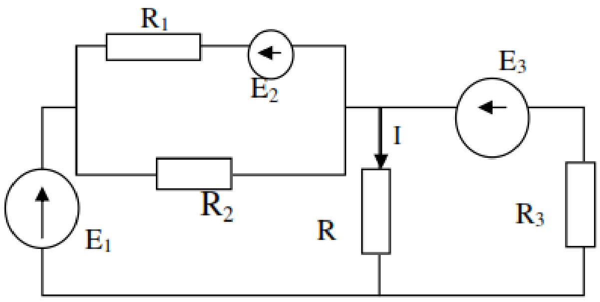
Circuit 1

$E_1 = E_2 = 10V$

$R_1 = R_3 = 10\ k\Omega$

$R = R_2 = 5\ k\Omega$

$E_3 = 5V$



Circuit 2

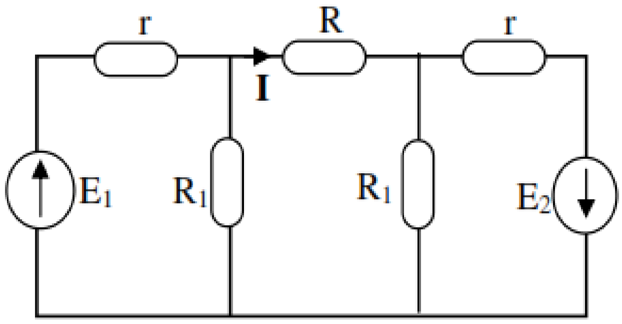
$E_1 = 1$ V,

$E_2 = 2V$,

$r = 500\Omega$,

$R = 1\ k\Omega$,

$R_1 = 1{,}5\ K\Omega$;



Circuit 3

$E = 10V$,

$I_0 = 0.1$ A,

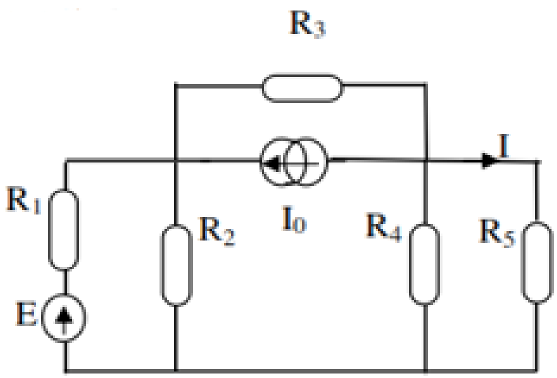
$R_1 = 10\Omega$,

$R_2 = 15\Omega$,

$R_3 = 8\Omega$,

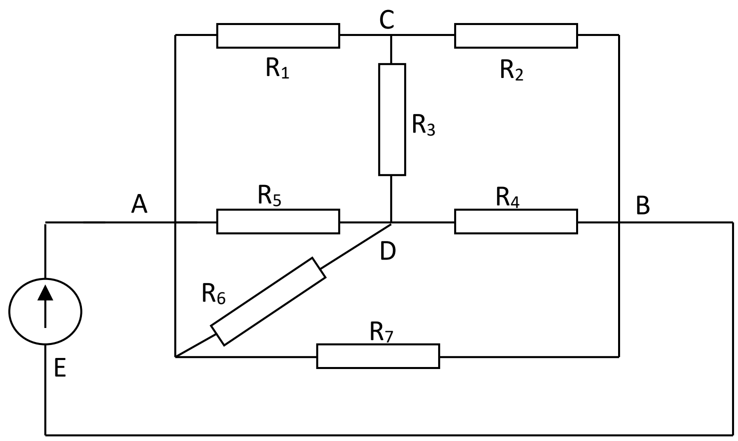
$R_4 = 14\Omega$,

$R_5 = 5\Omega$



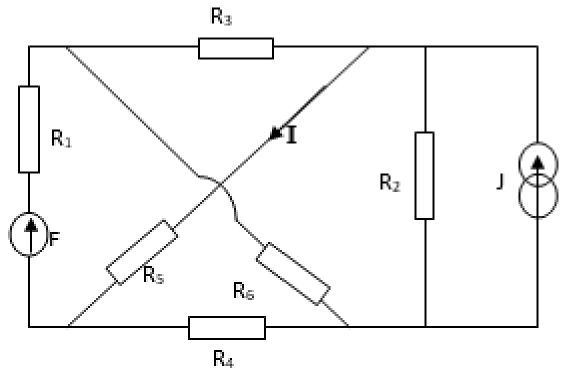
Circuit 4

E= 12 [V]
Ri = R
I_{R3} = ?



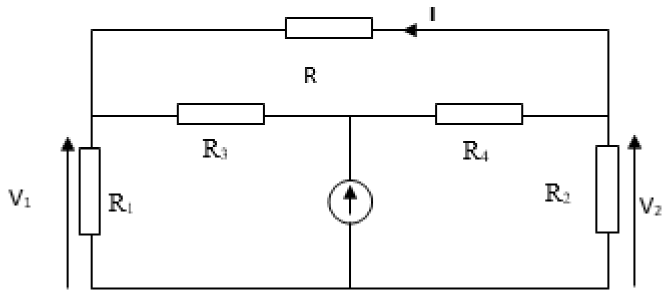
Circuit 5

$R_1 = 0{,}2\ k\Omega$ $E = 0{,}1 mV$
$R_2 = R_6 = 1\ k\Omega$ $J = 10\ mA$
$R_3 = 2\ k\Omega$
$R_4 = 0{,}5\ k\Omega$
$R_5 = 3\ k\Omega$



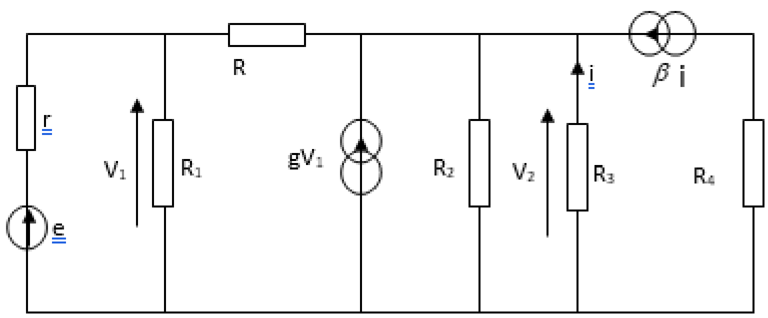
Circuit 6

$R_1 = 1\ k\Omega$ $R_2 = 0{,}5\ k\Omega$, $R_3 = 0{,}33\ k\Omega$, $R_4 = 0{,}25\ k\Omega$
$R = 0{,}1\ k\Omega$, $e = 12{,}4$ V



Circuit 7

$r = 10\ \Omega$, $R_1 = 2\ k\Omega$, $R_2 = R_3 = 5\ k\Omega$,
$R = 1/g = 1\ k\Omega$, $e = 1$ V, $\beta = 50$



Circuit 8