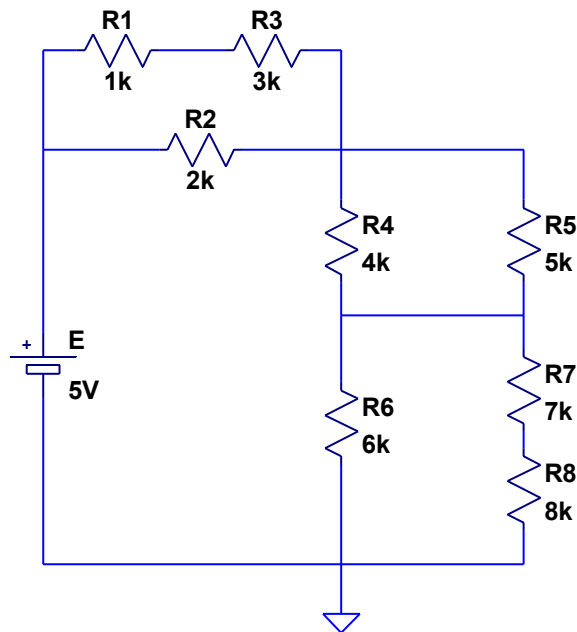


Esercizio 1

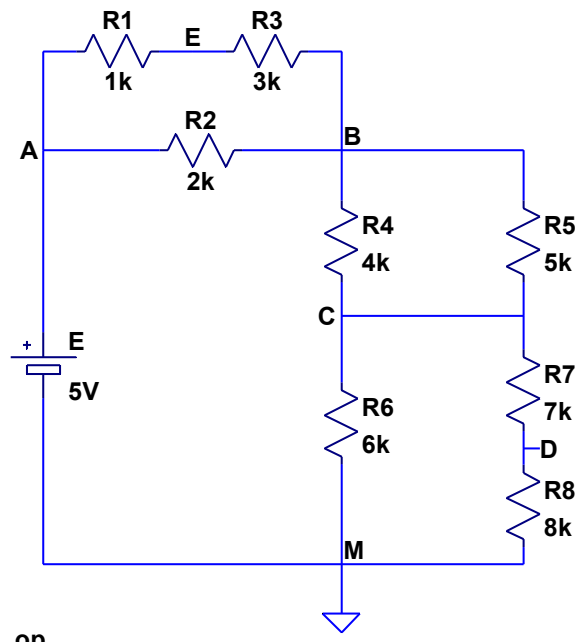
Dato il circuito di figura:

1. Mettere i nomi a ciascun nodo.
2. Identificare e indicare le correnti che scorrono nei vari rami del circuito.
3. Calcolare la resistenza equivalente a quelle indicate.
4. Calcolare le correnti che scorrono nelle resistenze e le tensioni ai loro capi.
5. Calcolare le differenze di potenziale tra ciascun nodo e la massa.
6. Calcolare le potenze dissipate da ciascuna resistenza e verificare l'equivalenza con la potenza erogata dal generatore.



Soluzione:

Per la soluzione vai alla pagina successiva



.nn
 --- Operating Point ---

V(a) :	5	voltage
V(e) :	4.78745	voltage
V(b) :	4.1498	voltage
V(c) :	2.73279	voltage
V(d) :	1.45749	voltage
I(R8) :	0.000182186	device_current
I(R7) :	0.000182186	device_current
I(R6) :	0.000455466	device_current
I(R5) :	0.000283401	device_current
I(R4) :	0.000354251	device_current
I(R3) :	0.000212551	device_current
I(R2) :	0.000425101	device_current
I(R1) :	0.000212551	device_current
I(E) :	-0.000637652	device_current

$R_{e R_1, R_2} = \frac{1}{\frac{1}{4k} + \frac{1}{2k}} = \frac{1}{\frac{1+2}{4k}} = \frac{4}{3} k = 1,33 k \text{ (A)}$

$R_{e R_4, R_5} = \frac{1}{\frac{1}{4k} + \frac{1}{5k}} = \frac{1}{\frac{5+4}{20k}} = \frac{20}{9} k = 2,22 k \text{ (B)}$

$R_{e R_6, R_7-8} = \frac{1}{\frac{1}{6k} + \frac{1}{15k}} = \frac{1}{\frac{5+2}{30}} = \frac{30}{7} k = 4,28 k \text{ (C)}$

$R_{e Tot} = \frac{4}{3} k + \frac{20}{9} k + \frac{30}{7} k = \frac{k(84 + 140 + 270)}{63} = \frac{494}{63} k = 7,84 k$

$DDP_{Tot} = R_{e Tot} \cdot I_{Tot} \Rightarrow I_{Tot} = \frac{DDP_{Totale}}{R_{e Totale}} = \frac{5V}{7,84 \cdot 1000 \text{ ohm}} = 0,0006377551 A$

$DDP_{R_1,2} = R_{e} \cdot I_T \Rightarrow 1,33 k \cdot 0,0006377551 = 1333,3 \text{ ohm} \cdot 0,0006377551 = 0,85031 \text{ Volt}$

$\Delta V_{spezifico} \Rightarrow 5V - 0,8503V = 4,14968V \text{ Volt (b)}$

Ora che so $\Delta V_{spezifico}$ e ho le resistenze specifiche mi trovo le I specifiche delle maglie (A) \Rightarrow

$I_2 = \frac{\Delta V_{R_1,2,3}}{R_{spezifico}} = \frac{0,8503V}{2000 \Omega} = 0,00042515 A \text{ Volt}$

Tra cui $I_{1,3}$ \Rightarrow considero una unica $R (3k + 1k = 4k)$

$I_{1,3} = \frac{0,8503V}{4000 \Omega} = 0,000212572 A \text{ Volt}$

$\left. \begin{aligned} DDP_{R_1} &= I_{1,3}^2 \cdot R_{1,2,3} \Rightarrow 1,33k \cdot 0,000212572^2 = 0,8503V \\ DDP_{R_2} &= R_{e spez} \cdot I_T \Rightarrow 1,33k \cdot 0,0006377551 = 0,8503V \\ DDP_{R_3} &= \dots \end{aligned} \right\}$

$\Delta V_{4,5} = DDP_{R_4,5} = R_{e spez} \cdot I_{Tot} = 2,22 k \cdot 0,0006377551 A = 1,4 V$

$2200 \text{ ohm} \cdot 0,0006377551 A = 1,4 V$

Per tanto $\Rightarrow 4,14968V - 1,4V = 2,7466 \text{ Volts (c) Volt}$

Ora da trovare $\Delta V_{4,5}$ specifico e ho R_4 ed R_5 (specifiche), trovo le I specifiche \Rightarrow

$I_4 = \frac{\Delta V_{4,5}}{4000 \Omega} = \frac{1,4V}{4000 \text{ ohm}} = 0,00035 A \text{ Volt (I R4)}$

$I_5 = \frac{\Delta V_{4,5}}{5000 \Omega} = \frac{1,4V}{5000 \text{ ohm}} = 0,00028 A \text{ Volt (I R5)}$

$\Delta V_{6,7-8} = R_{equivalente} \cdot I_{totale} = 4,28 k \cdot 0,0006377551 A = 4280 \text{ ohm} \cdot 0,0006377551 A = 2,725591828 \text{ Volts; Quindi } \Rightarrow 2,725591828 \text{ Volts (c)}$

$2,7466 \text{ Volts} - 2,729591828 \text{ Volts} = 0,017 \text{ Volts}$ **0,017 Volts** **0,017 Volt** - (maglia M)

Conoscendo ΔV specifico e conoscendo $R_{6,7-8}$ trova I_{R6} e $I_{R7-8} \Rightarrow$

$I_{R6} = \frac{\Delta V_{6,7-8}}{R_6} = \frac{2,72959 \text{ V}}{6000 \text{ ohm}} = 0,00045 \text{ A}$ (I_{R6}) ok

$I_{R7-8} = \frac{\Delta V_{6,7-8}}{R_{7-8}} = \frac{2,72959 \text{ V}}{7k + 8k} = \frac{2,72959 \text{ V}}{15000 \text{ ohm}} = 0,00018197 \text{ A}$

$\approx 0,0018197 \text{ A}$ (I_{R7-8}) - ok

Calcolo ore la potenza dissipata da ciascun resistore con la seguente formula

$V_{dissipata} = (I_{\text{specifico}})^2 \cdot Resistenza \text{ specifica} \Rightarrow$

potenza dissipata

$V_{dissipata} R_2 = (0,00042515 \text{ A})^2 \cdot 2000 \text{ ohm} \Rightarrow$ (paralelo $A^2 \cdot \Omega = \text{Watt}$) $\Rightarrow 3,6 \cdot 10^{-4}$

$V_{dissipata} R_{1-3} = (0,000212572 \text{ A})^2 \cdot 4000 \text{ ohm} \Rightarrow 1,8 \cdot 10^{-4} \text{ W}$

$V_{dissipata} R_4 = (0,00035 \text{ A})^2 \cdot 4000 \text{ ohm} \Rightarrow 4,9 \cdot 10^{-4} \text{ W}$

$V_{dissipata} R_5 = (0,00028 \text{ A})^2 \cdot 5000 \text{ ohm} \Rightarrow 3,52 \cdot 10^{-4} \text{ W}$

$V_{dissipata} R_6 = (0,00045 \text{ A})^2 \cdot 6000 \text{ ohm} \Rightarrow 1,21 \cdot 10^{-3} \text{ W}$

$V_{dissipata} R_{7-8} = (0,0018197 \text{ A})^2 \cdot (8k + 7k) \Rightarrow 0,049366 \text{ W}$
 $15k \rightarrow 15000 \text{ ohm}$

Circuit Simulator v1.5n

File Edit Scope Options Circuits

Reset

Stopped

Simulation Speed

Current Speed

Power Brightness

www.falstad.com

Current Circuit:
untitled

wire
I = 212,55 µA
V = 5 V

Circuit Simulator v1.5n

File Edit Scope Options Circuits

Reset

Stopped

Simulation Speed

Current Speed

Power Brightness

www.falstad.com

Current Circuit:
untitled

resistor
I = 212,55 µA
Vd = 212,55 mV
R = 1 kΩ
P = 45,18 µW

Circuit Simulator v1.5n

File Edit Scope Options Circuits

Reset

Stopped

Simulation Speed

Current Speed

Power Brightness

www.falstad.com

Current Circuit:
untitled

wire
I = 212,55 µA
V = 4,79 V

Circuit Simulator v1.5n

File Edit Scope Options Circuits

Reset

Stopped

Simulation Speed

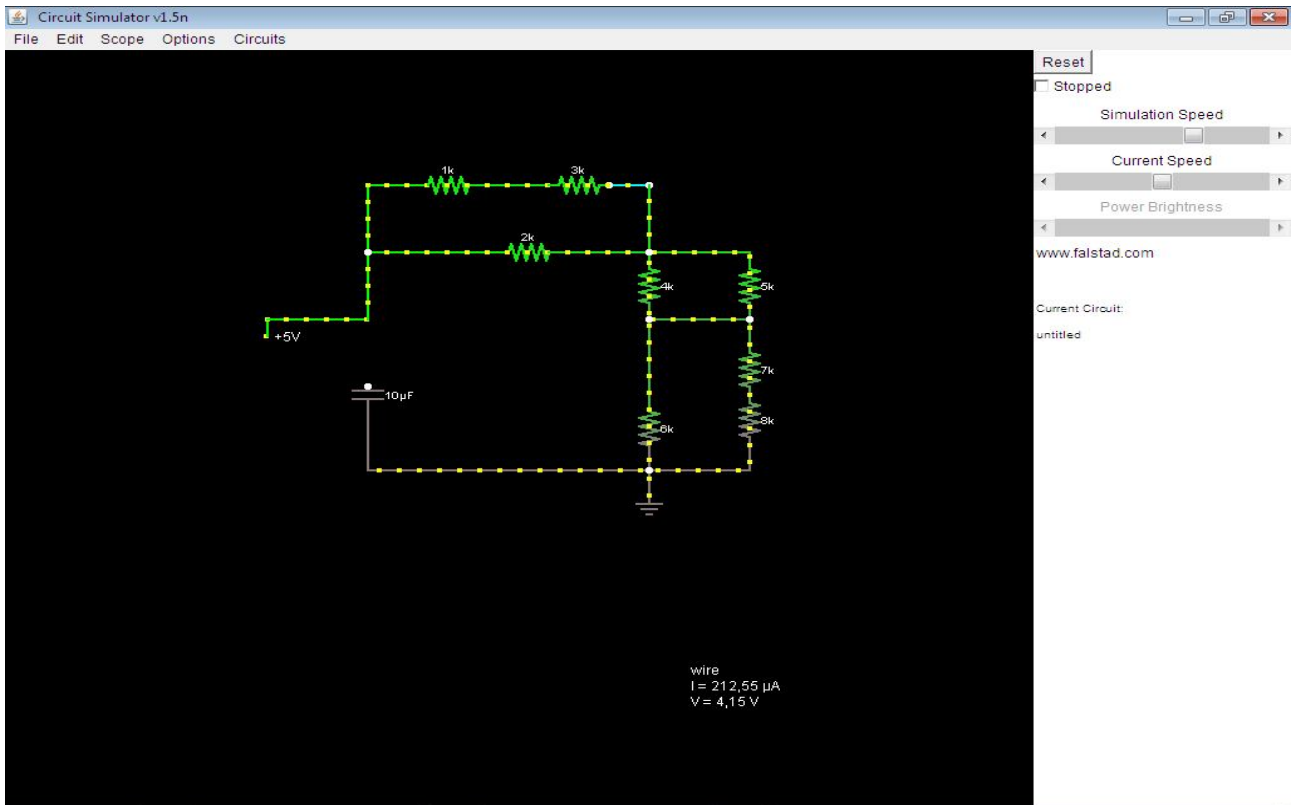
Current Speed

Power Brightness

www.falstad.com

Current Circuit:
untitled

resistor
I = 212,55 µA
Vd = 637,65 mV
R = 3 kΩ
P = 135,53 µW



Circuit Simulator v1.5n

File Edit Scope Options Circuits

Reset

Stopped

Simulation Speed

Current Speed

Power Brightness

www.falstad.com

Current Circuit:
untitled

wire
I = 293.4 µA
V = 4.15 V

Circuit Simulator v1.5n

File Edit Scope Options Circuits

Reset

Stopped

Simulation Speed

Current Speed

Power Brightness

www.falstad.com

Current Circuit:
untitled

resistor
I = 354.25 µA
Vd = 1.42 V
R = 4 kΩ
P = 501.98 µW

Circuit Simulator v1.5n

File Edit Scope Options Circuits

Reset

Stopped

Simulation Speed

Current Speed

Power Brightness

www.falstad.com

Current Circuit:
untitled

resistor
I = 283,4 µA
Vd = 1,42 V
R = 5 kΩ
P = 401,58 µW

Circuit Simulator v1.5n

File Edit Scope Options Circuits

Reset

Stopped

Simulation Speed

Current Speed

Power Brightness

www.falstad.com

Current Circuit:
untitled

V = 2,73 V

Circuit Simulator v1.5n

File Edit Scope Options Circuits

Reset

Stopped

Simulation Speed

Current Speed

Power Brightness

www.falstad.com

Current Circuit:
untitled

wire
I = 283,4 μ A
V = 2,73 V

Circuit Simulator v1.5n

File Edit Scope Options Circuits

Reset

Stopped

Simulation Speed

Current Speed

Power Brightness

www.falstad.com

Current Circuit:
untitled

resistor
I = 455,47 μ A
Vd = 2,73 V
R = 6 k Ω
P = 1,24 mW

Circuit Simulator v1.5n

File Edit Scope Options Circuits

Reset
 Stopped

Simulation Speed
Current Speed
Power Brightness

www.falstad.com

Current Circuit:
untitled

V = 0 V

Circuit Simulator v1.5n

File Edit Scope Options Circuits

Reset
 Stopped

Simulation Speed
Current Speed
Power Brightness

www.falstad.com

Current Circuit:
untitled

wire
I = 182,19 µA
V = 2,73 V

Circuit Simulator v1.5n

File Edit Scope Options Circuits

Reset
 Stopped
Simulation Speed
Current Speed
Power Brightness
www.falstad.com
Current Circuit:
untitled

resistor
I = 182,19 µA
Vd = 1,28 V
R = 7 kΩ
P = 232,34 µW

Circuit Simulator v1.5n

File Edit Scope Options Circuits

Reset
 Stopped
Simulation Speed
Current Speed
Power Brightness
www.falstad.com
Current Circuit:
untitled

wire
I = 182,19 µA
V = 1,48 V

Circuit Simulator v1.5n

File Edit Scope Options Circuits

Reset

Stopped

Simulation Speed

Current Speed

Power Brightness

www.falstad.com

Current Circuit:
untitled

resistor
I = 182,19 µA
Vd = 1,46 V
R = 8 kΩ
P = 265,53 µW

Circuit Simulator v1.5n

File Edit Scope Options Circuits

Reset

Stopped

Simulation Speed

Current Speed

Power Brightness

www.falstad.com

Current Circuit:
untitled

wire
I = 182,19 µA
V = 0 V

Circuit Simulator v1.5n

File Edit Scope Options Circuits

Reset
 Stopped

Simulation Speed
Current Speed
Power Brightness

www.falstad.com

Current Circuit:
untitled

wire
I = 455.47 μ A
V = 0 V

Circuit Simulator v1.5n

File Edit Scope Options Circuits

Reset
 Stopped

Simulation Speed
Current Speed
Power Brightness

www.falstad.com

Current Circuit:
untitled

wire
I = 182.19 μ A
V = 0 V