Voltage Divider Rule & Current Divider Rule

EGR 220, Chapter 2
Feb 6, 2020

Circuit Analysis Techniques

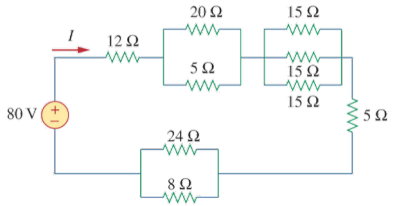
- Equivalent resistance, R_{eq}
  - Series and parallel resistors
- Current divider and voltage divider
- Mesh and nodal analysis
  - Building on KVL and KCL

- Review what we have done...
  - Bring questions to office hours

Recap Concepts

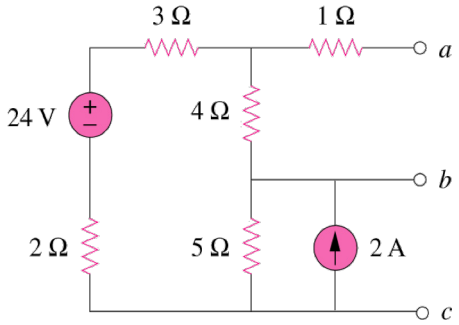
- Series Elements (draw example)
  - Exclusively share a single node and
  - Carry the same current.
- Parallel Elements (draw example)
  - Share the same two nodes and
  - Have the same voltage drop across them.

Find R_{eq} and I

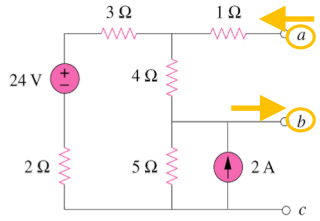


Different R_{eq} for Different Terminals

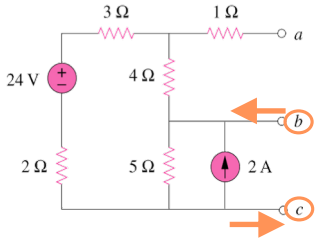
We will discuss the role of V_s and I_s later (with Thevenin equivalent)



5



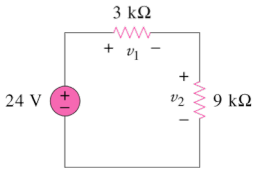
6

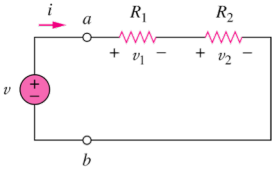


7

Voltage Divider Rule

- ***Resistors and elements in Series…***
- Current or voltage is the same for R_1 & R_2?
- Current or voltage is partitioned across R_1 & R_2?
- Prove, or demonstrate, using KCL and KVL.

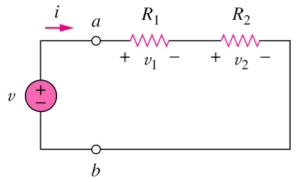




8

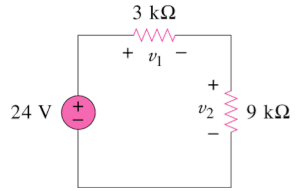
Voltage Divider: Series R

- Find v_1, v_2 in terms of v_{src}, R_1 & R_2 → derive the expression

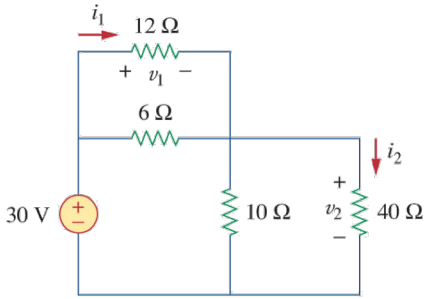


Voltage Divider: Series R

- Solve for v_1 and v_2
  - Which resistor will have the larger V drop?

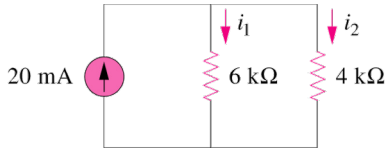


V-Divider Discussion



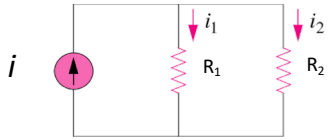
Current Divider Rule

- ***Resistors, elements and branches in Parallel…***
- Current Divider:
  - I is partitioned, flowing through these resistors
  - What is the relationship of V for each element?
  - Prove, or demonstrate, using KCL and KVL.



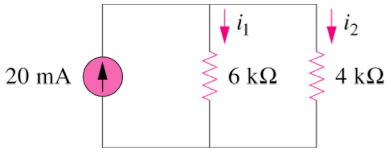
Current Divider: Parallel R

- Find i_1, i_2 in terms of i_{src}, R_1 & R_2
- Derive the expression…

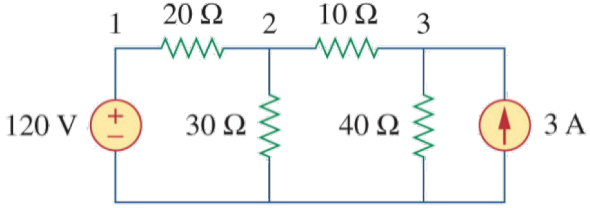


Current Divider: Parallel R

- Solve for i_1 and i_2
  - Which R will carry the larger current?

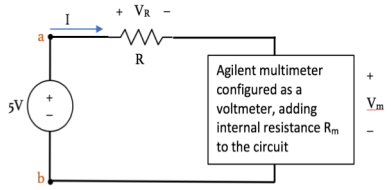


I-Divider Discussion



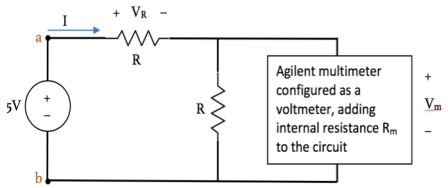
Lab Experiments – Find $R_{Multimeter}$

(1) R = 10MΩ
(2) R = 10kΩ



Lab Experiments – Find $R_{Multimeter}$

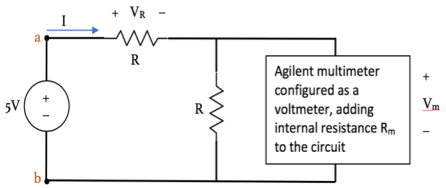
R = 10MΩ



17

Lab Experiments – Find $R_{Multimeter}$

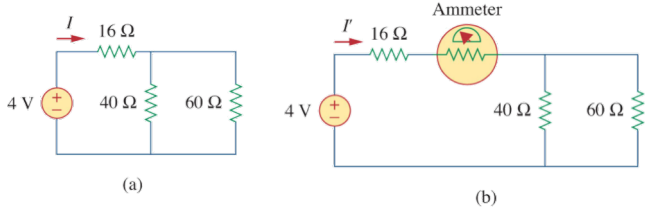
R = 10kΩ



18

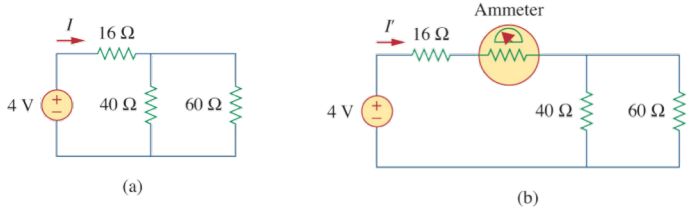
Ammeter – Introduced Error

- Find the current I in circuit (a).
- An ammeter with an internal resistance of 1Ω is inserted in the network to measure I' as shown circuit (b). Does current, I', increase or decrease relative to part (a)?



19

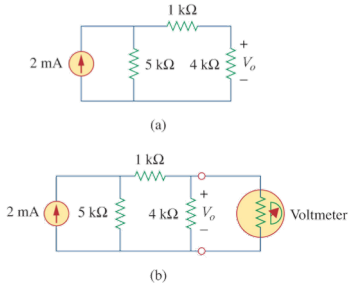
Ammeter – Introduced Error



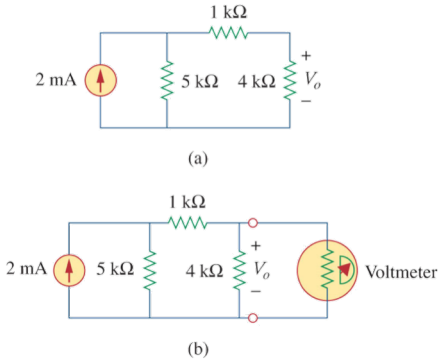
20

Voltmeter – Introduced Error

- Calculate the voltage V_o in circuit (a).
- Is the voltage V'_o, measured when a voltmeter with 6-kΩ internal resistance is connected as in figure (b), greater or less than V_o in circuit (a)?



Voltmeter – Introduced Error



Fundamental Analysis Tools for the Semester

- Basic analysis laws
  - Ohm's law
  - KVL: Kirchhoff's voltage law
  - KCL: Kirchhoff's current law
- Analysis tools using the basic laws
  - Equivalent resistance
  - Current divider
  - Voltage divider
  - **Mesh analysis**
  - **Nodal analysis**
  - **Equivalent Circuits**

Questions?