ECE 210
Exam 1 Review Session

HKN

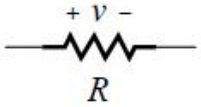
Today's agenda

- Key concepts (with examples)
- Fall 2015 Practice Exam
- Spring 2016 Practice Exam (if time allows)

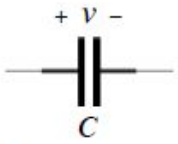
Circuit Fundamentals

Electrical Circuits

Components



Resistor



Capacitor

Inductor

Ohm's Law

$$v = iR$$

Electrical Circuits

Sources

Independent Voltage Source

Independent Current Source

Dependent Voltage Source

Dependent Current Source

Power Absorption vs. Delivery

- $P = V * I$

  V - voltage drop (defined vs. actual)

  I - current along the direction of voltage drop

- $P>0$ - absorb power

  $P<0$ - deliver power

Kirchhoff's Voltage & Current Law

Kirchhoff's Voltage Law (KVL)

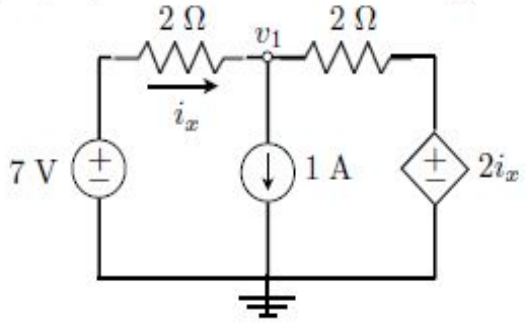
$$\sum_{all\,k} V_i = 0, \text{ around a loop}$$

Kirchhoff's Current Law (KCL)

$$\sum_{all\,k} I_k = 0, \text{ at a node}$$

Spring 2015 Exam 1

3. (13 pts) Consider the following circuit:



(a) (3 pts) Write a single equation expressing the current i_x in terms of the node voltage v_1.

(b) (8 pts) Find the node voltage v_1 and the current i_x.

$v_1 =$ _____

$i_x =$ _____

(c) (2 pts) **TRUE** or **FALSE**: The dependent voltage source is delivering power to the circuit. Justify your answer by indicating the direction of *positive* current through it on the diagram.

Complex Numbers

Rectangular Form

$$z = a + jb, \text{ where } j = \sqrt{-1} \text{ and } a, b \in \mathbb{R}$$

Polar Form

$$z = Ae^{j\phi} = A\angle\phi, \text{ where } A = |z| \text{ and } \phi = \angle z$$

Rectangular Form <-> Polar Form

$$A = |z| = \sqrt{a^2 + b^2}$$

$$\phi = \angle z = \begin{cases} \tan^{-1}(\frac{b}{a}), a \geq 0 \\ \tan^{-1}(\frac{b}{a}) + \pi, a < 0 \end{cases}$$

Complex Numbers

Euler's Identity

$$e^{j\omega t} = \cos(\omega t) + j\sin(\omega t)$$

2. (12 pts) Obtain the real and imaginary parts of Z, as well as its magnitude and phase.

$$Z = \left(\frac{j}{e^{j\frac{\pi}{3}}} - e^{-j\frac{\pi}{6}}\right) e^{j\frac{\pi}{4}}$$

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$R_e\{Z\} =$ _____

$I_m\{Z\} =$ _____

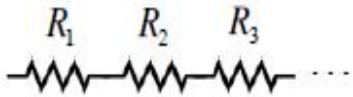
$|Z| =$ _____

$\angle Z =$ _____

Resistor Combinations

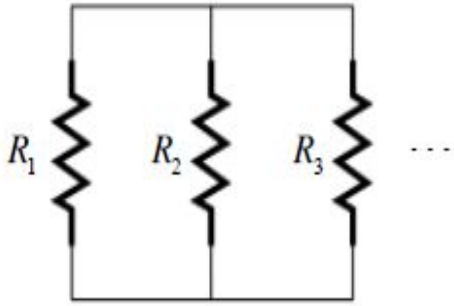
Series Combination

$$R_{eq} = \sum_i R_i = R_1 + R_2 + \cdots$$



Parallel Combination

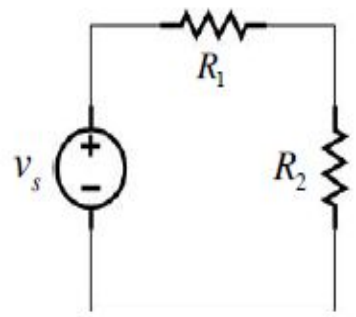
$$\frac{1}{R_{eq}} = \sum_i \frac{1}{R_i} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$$



Resistor Combinations

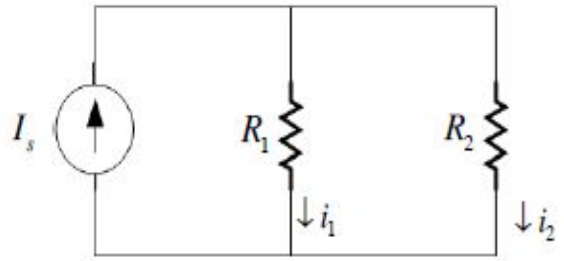
Voltage Divider Rule

$$v_1 = v_s \frac{R_1}{R_1 + R_2}, \quad v_2 = v_s \frac{R_2}{R_1 + R_2}$$

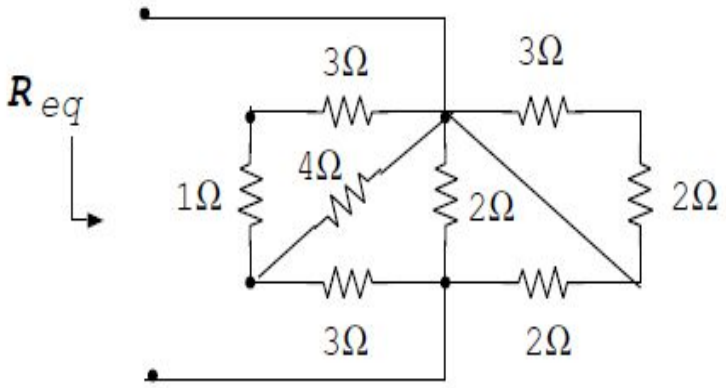


Current Divider Rule

$$i_1 = I_s \frac{R_2}{R_1 + R_2}, \quad i_2 = I_s \frac{R_1}{R_1 + R_2}$$



(b) Find the equivalent resistance between terminals a and b in the circuit below.

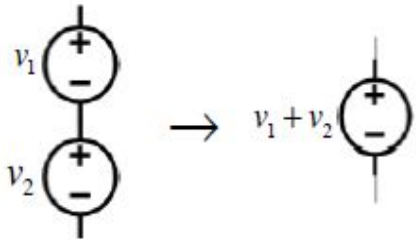


$R_{eq} =$ _____

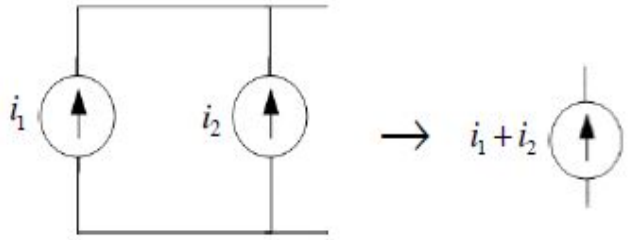
Fall 2014 Exam 1 Problem 1(b)

Source Combinations

Voltage Source



Current Source



Questions?