Lecture 15 - Q/A session for MT1

- Administrivia
  - cheating on HWs [HW #6 & #7]
  - other
    - will be resolved after midterm 1
    - website was down over the weekend
    - email
      - now back up

- Midterm Thursday, check exams link (for extra office hours etc.)
Questions:
(1) Transmogther
(2) RC circuit example
(3) From practice midterm; here's an equivalent problem.

General note: When you see an EE problem, try KCL, KVL, voltage divider etc. because simple methods are "good" i.e., intuitive etc. And, reinforce the K.I.S.S (Keep it Simple Stupid) principle.
(1) Transmogrifier (from review problem set),

\( p = vi \) [note: careful if absorbing or releasing]

we need to find \( v \), find an \( i \) for the

transmogrifier.
\[ i = 1 \text{ mA} \]

\[ V = 5 \text{ V} \]

\[ I (\text{mA into terminal A}) \]

\[ \rho = V i = (5 \text{ V})(1 \text{ mA}) = 5 \text{ mW (absorbing)} \]
Note: Use: adsorption \rightarrow v^+ 
	\rightarrow \text{delivery} \rightarrow v^-

\[ i = (0.005 \text{ S} \cdot \text{m}) \]

\[ P_{\text{delivery}} = (5 \text{ \text{cm}} / \text{m} \cdot \text{A}) = 2500 \text{ mW} \]

\[ (\text{cd}) \quad P = -2500 \text{ mW} \]
\[ P_{\text{absorbed}} = (5 \text{ m}^2) (499) = 2495 \text{ mW} \]

\[ V = +2485 \text{ mV} \]

\[ \text{(a:)} \text{ Will a current source ever absorb power?} \]

\[ \text{(A:)} \text{ Yes} \]

\[ 5 \text{ V} \quad 5 \text{ mA} \]
(Q): How ideal are real batteries?

(A): Measure it yourself.

Experiment: (1) Take a battery e.g. 9V dry cell.

\[ \text{Ideal} \]

\[ 9V \]

\[ \text{Volt meter} \]

\[ \text{Measure} \]

\[ \text{A} \to \]
\[ P = \nu i = \nu (\frac{\nu}{R}) = \frac{\nu^2}{R} = \frac{4}{500 \text{ k}} \]

\[ P = 8 \mu \text{W} \]

\[ R \text{C} \text{ Circuit} \]
(a) Find $v_c$, assume capacitor is initially discharged. Sketch $v_c(t)$.

$$v_c(t) = V_i + (v_i - V_f)e^{-t/RC}$$

$t = 0^-$  \quad \mid \quad t > 0^+ \quad \mid \quad t = 5\text{ ms} \quad \mid \quad t > 5\text{ ms}$
$U_i = 0 \text{V}$

$U_f = 12 \text{V}$

Note: Ignore S3 for this calculation.

$U_c(t) = 12 \left( 1 - e^{-\frac{t}{RC}} \right)$

$T = RC = (1 \text{k}\Omega)(1 \text{ms}) = 1 \text{ms}$
\[ V_c(t) = \begin{cases} 
0 & \text{if } t \leq 0 \\
12 \left( 1 - e^{-\frac{t}{1\text{ms}}} \right) & \text{if } 0 < t \leq 5\text{ms} \\
12 \frac{t-5}{1\text{ms}} & \text{if } t \geq 5\text{ms} 
\end{cases} \]
(3) Thevenin / Norton: Sample problems.

a) Find thevenin equivalent at AB.
\[ R_m = (1k) \parallel (1k) = 0.5k \]
\[ = 500 \Omega \]

\[ U_{oc} = (I_{sc})(R_m) \]

\[ I_{sc} \text{ is probably easier!} \]
$I_{sc} = 4 \text{ mA} + 5 \text{ mA} = 9 \text{ mA}$
\[ U_{oc} = (9 \text{ mA}) \cdot \left(\frac{1}{2} \text{ k}\right) = 4.5 \text{ V} \]
$V_{oc}$, This may be harder.

Source bad form

$1k \rightarrow$ Does not really help
But, if you do it for the voltage source.
(Q1) Is this a valid circuit?

\[
V_a - V_1 - 4.5 - V_2 = 0
\]

\[
\Rightarrow V_a = 4.5 + i(7.5\)V
\]
Next time: No lecture!

C) Makeup mid term from 2-5 in 299 Corb

C) 20 mid term, 6 pm - 9 pm in 1 Pinetel
No bluebooks necessary, you may bring a page of notes and a calculator.

P.S.: I will show the end of Spaceballs sometime after spring breaks!