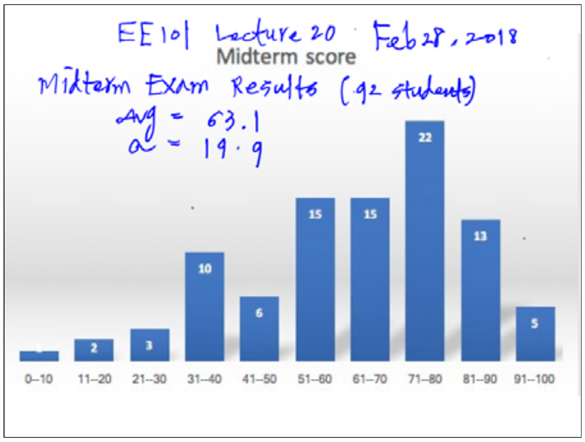
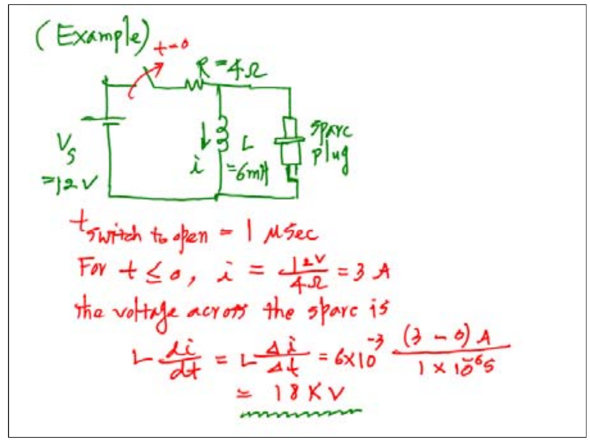
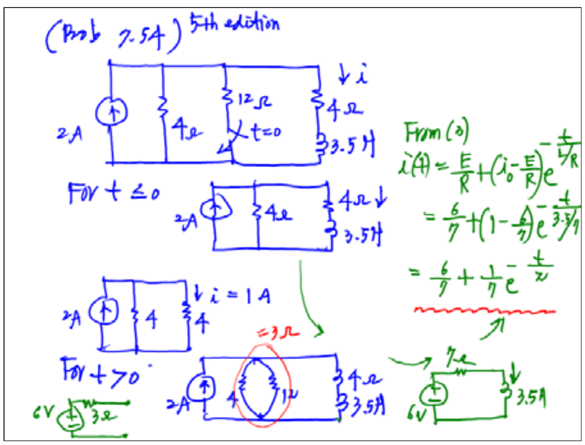
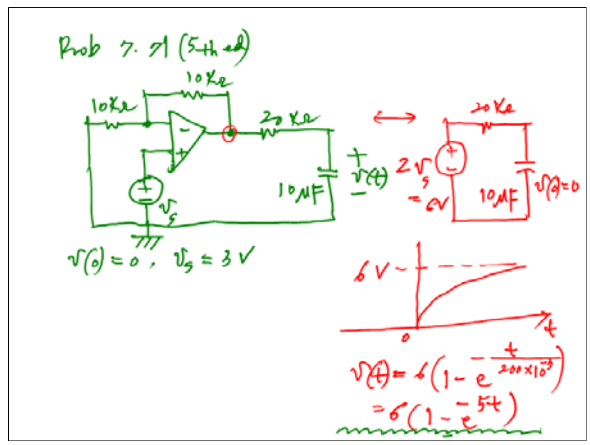
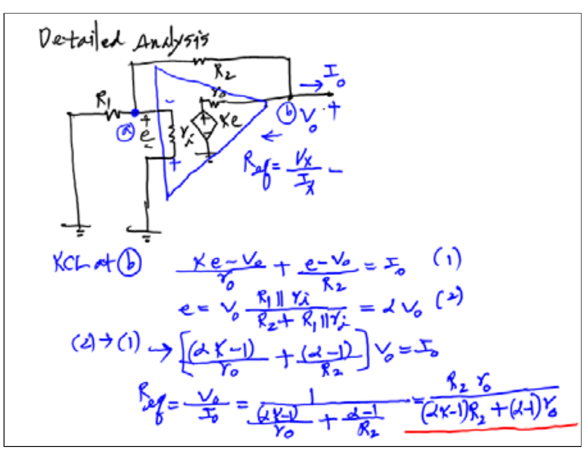
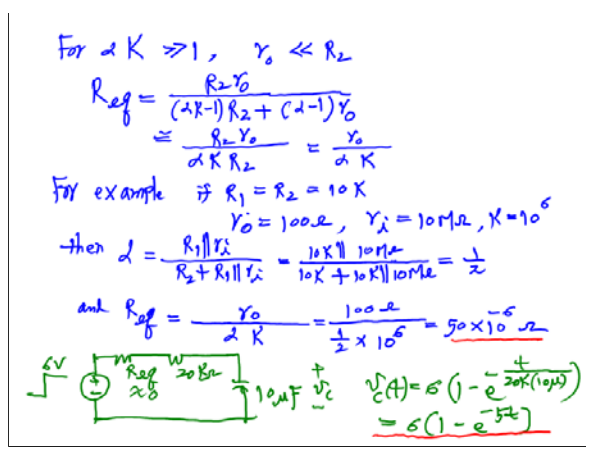

EE101 Lecture 20 Feb 28, 2018
Midterm score
Midterm Exam Results (92 students)
Avg = 63.1
σ = 19.9
2
3
10
6
15
15
22
13
5
0–10
11–20
21–30
31–40
41–50
51–60
61–70
71–80
81–90
91–100

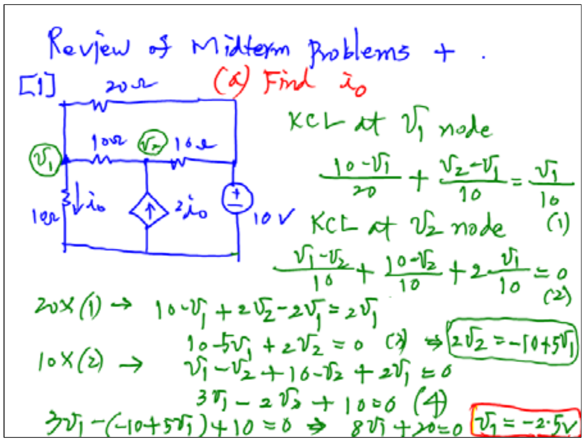

(Example)
t=0
R = 4Ω
Vs = 12V
L = 6mH
spark plug
t switch to open = 1 μsec
For t ≤ 0, i = 12V / 4Ω = 3 A
the voltage across the spark is
L di/dt = L Δi/Δt = 6×10^-3 (3 − 0) A / 1×10^-6 s
≈ 18 KV


(Prob 7.54) 5th edition
2A
4Ω
12Ω
t=0
4Ω
3.5H
For t ≤ 0
i = 1A
For t > 0
From (3)
i(t) = E/R + (i0 − E/R) e^{-t/(L/R)}
= 6/7 + (1 − 6/7) e^{-t/(3.5/7)}
= 6/7 + 1/7 e^{-t/2}
6V
3Ω
7Ω
3.5H

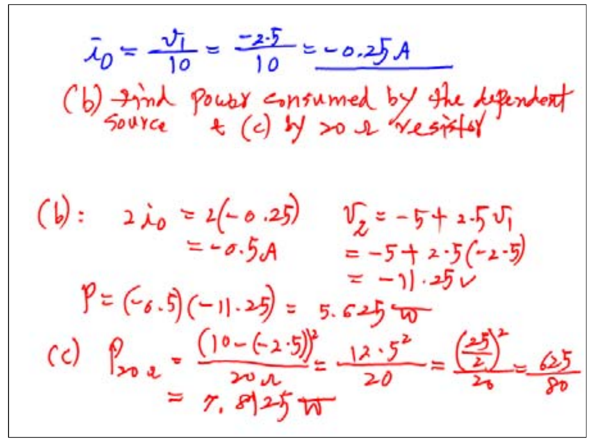

Prob 7.71 (5th ed)
10KΩ
10KΩ
20KΩ
10μF
v(t)
Vs
v(0) = 0, Vs = 3V
2Vs = 6V
v(0) = 0
6V
v(t) = 6(1 − e^{-t/(200×10^-3)})
= 6(1 − e^{-5t})


Detailed Analysis
R1
R2
r0
Ke
ri
Io
V0
Ref = Vx/Ix
KCL at (b)   (Ke − V0)/r0 + (e − V0)/R2 = I0   (1)
e = V0 (R1 ∥ ri)/(R2 + R1 ∥ ri) = α V0   (2)
(2) → (1) → [(αK − 1)/r0 + (α − 1)/R2] V0 = I0
Ref = V0/I0 = 1 / [(αK−1)/r0 + (α−1)/R2] = R2 r0 / ((αK−1)R2 + (α−1) r0)

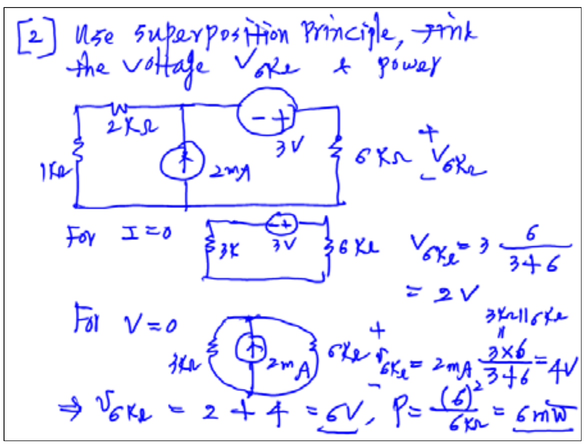

For αK ≫ 1, r0 ≪ R2
Ref = R2 r0 / ((αK−1)R2 + (α−1) r0)
≅ R2 r0 / (αK R2) = r0 / (αK)
For example if R1 = R2 = 10K
r0 = 100Ω, ri = 10MΩ, K = 10^6
then α = R1∥ri / (R2 + R1∥ri) = 10K∥10MΩ / (10K + 10K∥10MΩ) = 1/2
and Ref = r0/(αK) = 100Ω / (1/2 × 10^6) = 50×10^-6 Ω
6V
Ref ≈ 0
20KΩ
10μF
vc
vc(t) = 6(1 − e^{-t/(20K(10μ))})
= 6(1 − e^{-5t})



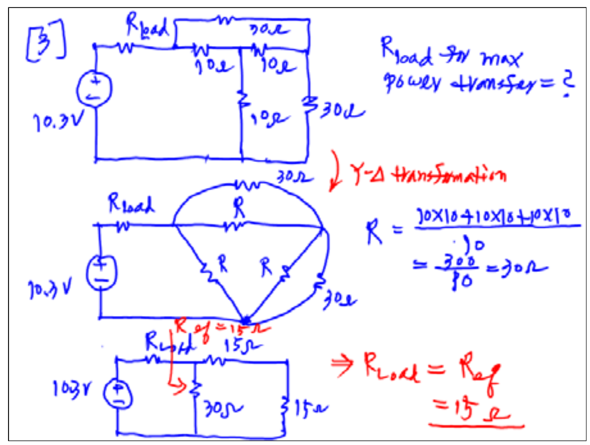
Review of Midterm Problems +
[1]
(a) Find i_0
20Ω
10Ω
10Ω
v_1
v_2
1Ω
i_0
$2i_0$
10V
KCL at v_1 node
$\frac{10-v_1}{20} + \frac{v_2-v_1}{10} = \frac{v_1}{10}$ (1)
KCL at v_2 node
$\frac{v_1-v_2}{10} + \frac{10-v_2}{10} + 2\cdot\frac{v_1}{10} = 0$ (2)
$20\times(1) \rightarrow 10 - v_1 + 2v_2 - 2v_1 = 2v_1$
$10 - 5v_1 + 2v_2 = 0$ (3) $\Rightarrow 2v_2 = -10 + 5v_1$
$10\times(2) \rightarrow v_1 - v_2 + 10 - v_2 + 2v_1 = 0$
$3v_1 - 2v_2 + 10 = 0$ (4)
$3v_1 - (-10 + 5v_1) + 10 = 0 \Rightarrow 8v_1 + 20 = 0$
$v_1 = -2.5V$



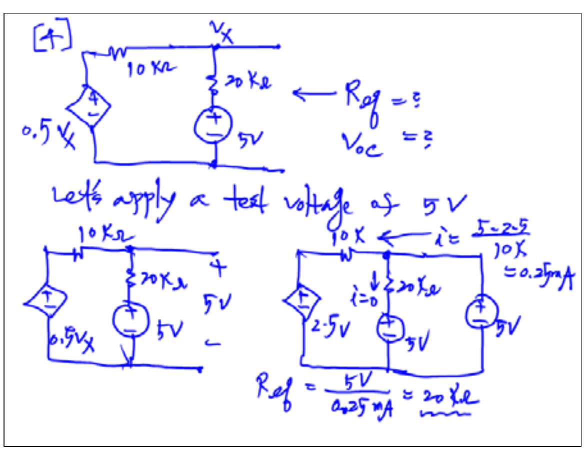
$i_0 = \frac{v_1}{10} = \frac{-2.5}{10} = -0.25A$
(b) Find power consumed by the dependent source & (c) by 20Ω resistor
(b): $2i_0 = 2(-0.25) = -0.5A$
$v_2 = -5 + 2.5v_1 = -5 + 2.5(-2.5) = -11.25V$
$P = (-0.5)(-11.25) = 5.625W$
(c) $P_{20\Omega} = \frac{(10-(-2.5))^2}{20\Omega} = \frac{12.5^2}{20} = \frac{(\frac{25}{2})^2}{20} = \frac{625}{80} = 7.8125W$



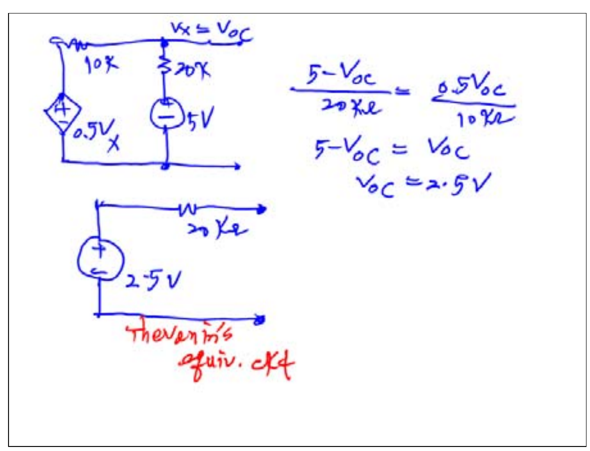
[2] Use superposition principle, find the voltage $V_{6k\Omega}$ & power
2kΩ
3V
1kΩ
2mA
6kΩ
$V_{6k\Omega}$
For I=0
3K
3V
6kΩ
$V_{6k\Omega} = 3\,\frac{6}{3+6} = 2V$
For V=0
3kΩ
2mA
6kΩ
3kΩ||6kΩ
$V_{6k\Omega} = 2mA\,\frac{3\times6}{3+6} = 4V$
$\Rightarrow V_{6k\Omega} = 2 + 4 = 6V,\ P = \frac{(6)^2}{6k\Omega} = 6mW$



[3]
Rload
30Ω
10Ω
10Ω
10Ω
30Ω
10.3V
R_{load} for max power transfer = ?
Y-Δ transformation
$R = \frac{10\times10+10\times10+10\times10}{10} = \frac{300}{10} = 30\Omega$
$R_{eq} = 15\Omega$
15Ω
30Ω
15Ω
$\Rightarrow R_{Load} = R_{eq} = 15\Omega$

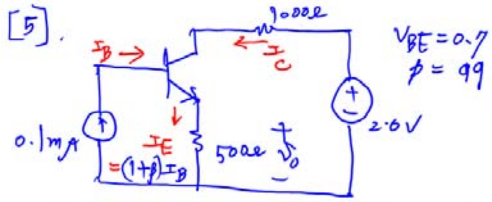


[4]
v_x
10kΩ
20kΩ
$0.5V_x$
5V
← R_{eq} = ?
V_{oc} = ?
Let's apply a test voltage of 5V
10kΩ
20kΩ
5V
$0.5V_x$
10K
$i = \frac{5-2.5}{10K} = 0.25mA$
$i=0$
2.5V
5V
$R_{eq} = \frac{5V}{0.25mA} = 20k\Omega$



$V_x = V_{oc}$
10K
20K
$0.5V_x$
5V
$\frac{5-V_{oc}}{20k\Omega} = \frac{0.5V_{oc}}{10k\Omega}$
$5 - V_{oc} = V_{oc}$
$V_{oc} = 2.5V$
20kΩ
2.5V
Thevenin's equiv. ckt

[5].



$I_B = 0.1\,mA \quad (1+\beta)I_B = (1+99)0.1\,mA = 10\,mA$

$v_o = 500\Omega \times 10\,mA = \underline{5V}$

$V_{CE} = 20 - \beta I_B (1\,k\Omega) - 5V$

$= 20 - 5 - 9.9\,mA \times 1\,k\Omega = \underline{6.1\ V}$