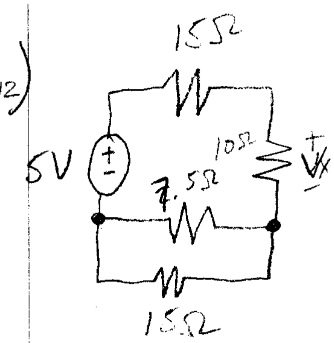
ENGR 210
Fall 2003
Homework #3
SOLUTIONS

2-42)



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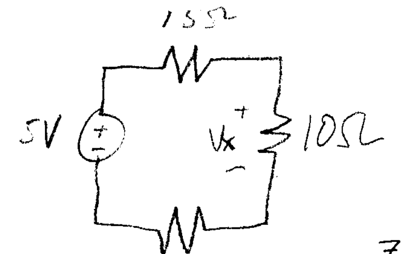


$$7.5\Omega \| 15\Omega = \frac{7.5\Omega \cdot 15\Omega}{7.5\Omega + 15\Omega} = 5\Omega$$

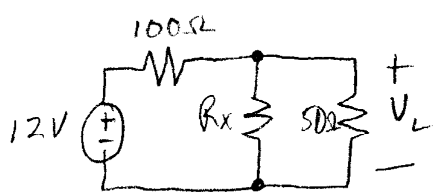
by Voltage division:

$$V_x = V_s \frac{R_x}{\Sigma R}$$

$$= 5V \cdot \frac{10\Omega}{15\Omega + 10\Omega + 5\Omega}$$

$$\boxed{V_x = 1.67V}$$

2-50)



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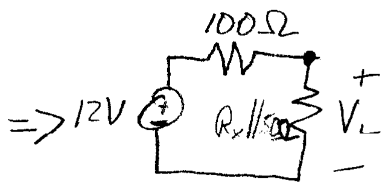


Voltage division: $V_L = 12V \cdot \frac{R_x \| 50\Omega}{100\Omega + R_x \| 50\Omega}$

need $V_L = 3V$

$$3V = 12V \cdot \frac{\frac{R_x \cdot 50\Omega}{R_x + 50\Omega}}{100\Omega + \frac{R_x \cdot 50\Omega}{R_x + 50\Omega}}$$

$$.25 = \frac{R_x \cdot 50\Omega}{100R_x + 5000(\Omega^2) + R_x \cdot 50\Omega}$$

$$= \frac{R_x}{2R_x + 100\Omega + R_x}$$

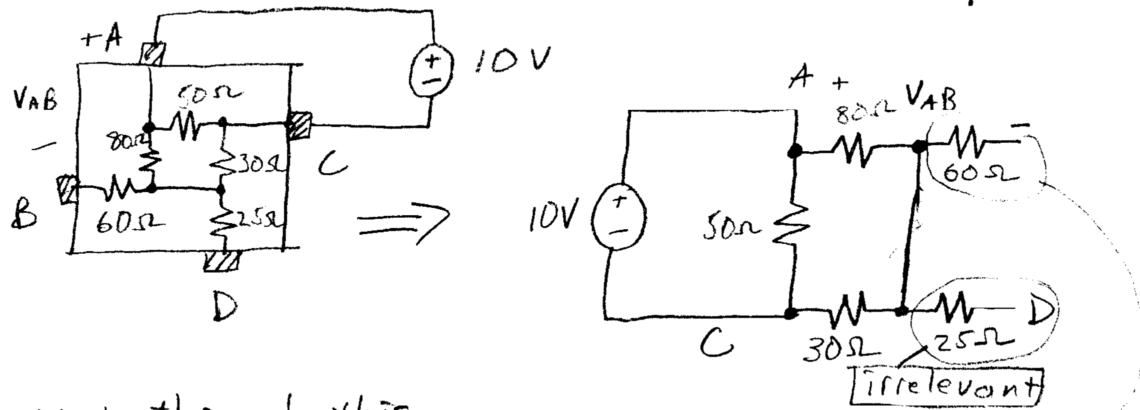
$$= \frac{R_x}{100\Omega + 3R_x}$$

$$25\Omega + .75R_x = R_x$$

$$25\Omega = .25R_x$$

$$\boxed{100\Omega = R_x}$$

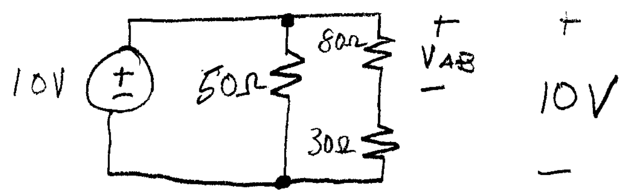
2.55 (3)



current through this resistor is 0, ∴ Voltage across it is also 0,

∴ V_{AB} is voltage across 80Ω resistor

redrawn:

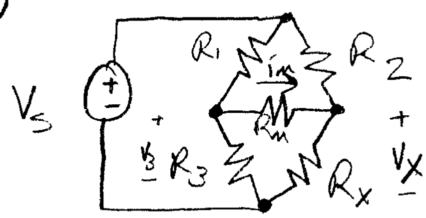


can do voltage division on right branch:

$$V_{AB} = 10\,V \cdot \frac{80\Omega}{80\Omega + 30\Omega}$$

$$\boxed{V_{AB} = 7.27\,V}$$

2-62) $\overset{4}{}$ a)



given $i_m = 0$

$\therefore V_3 = V_x$

voltage division: (ONLY works here since $i_m=0$!!!)

$V_3 = V_s \frac{R_3}{R_1+R_3}$ $\qquad$ $V_x = \frac{R_x}{R_2+R_x} \cdot V_s$

$$V_3 = V_x$$

$$V_s \frac{R_3}{R_1+R_3} = V_s \cdot \frac{R_x}{R_2+R_x}$$

$$R_2 R_3 + R_3 R_x = R_1 R_x + R_3 R_x$$

$$\boxed{R_2 R_3 = R_1 R_x}$$

b) given $R_1 = R_2 = R_{upper} = 2.2\ k\Omega$

$i_m = 0$

$T = 57.5°C$

want R_3 $\qquad$ ↳ $R_x \cong 2.2\ k\Omega$ ($2.15 k\Omega$?)

$$R_2 R_3 = R_1 R_x$$

$$R_{upper} R_3 = R_{upper} \cdot 2.2\ k\Omega$$

$$R_3 = 2.2\ k\Omega$$

2-62 (4) continued...

c) given $i_m < 0$

implies $V_x > V_3$

R_3 set to $2.2\,k\Omega$

implies $R_x > 2.2\,k\Omega$

$\therefore$ $\boxed{T > 57.5°C}$

d) $R_1 = R_2 = R_{upper} = 2.2\,k\Omega$

$R_3 = 2.4\,k\Omega$

$R_2 R_3 = R_1 R_x$

$R_{upper} \cdot 2.4\,k\Omega = R_{upper} \cdot R_x$

$R_x = 2.4\,k\Omega$

$\boxed{T = 62.5°C}$

3-2 (5) a) Node A: $V_A\left(\frac{1}{20\Omega} + \frac{1}{10\Omega} + \frac{1}{4\Omega}\right) - V_B \cdot \frac{1}{4\Omega} = 7A$

" B: $-V_A \cdot \frac{1}{4\Omega} + V_B\left(\frac{1}{8\Omega} + \frac{1}{4\Omega}\right) = 3.5A - 7A = -3.5A$

($.4v_A - .25v_B = 7A$)

($-.25v_A + .375v_B = -3.5A$)

rewrite so V_B coeff. is ± 1

A: $1.6V_A - V_B = 28V$

B: $-.667V_A + V_B = -9.33V$

Sum: $.933V_A = 18.7V$

$V_A = 20V$

$V_B = .667V_A - 9.33V = 4V$

b) $I_X = \frac{V_A}{20\Omega}$

$\boxed{I_X = 1A}$

$V_X = V_B$

$\boxed{V_X = 4V}$