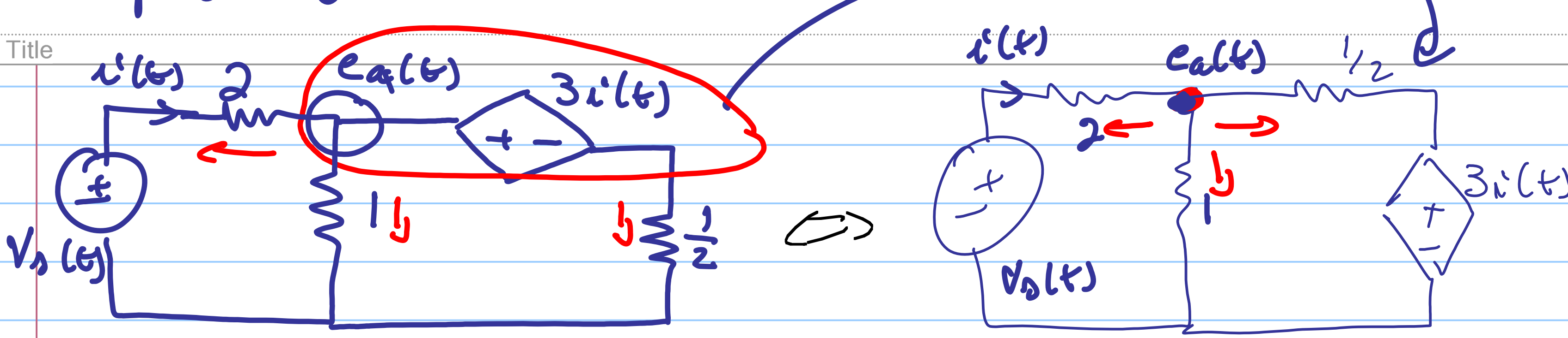
Hw # 3

P 2.36

Note Title 9/3/2006



a) $i(t) = \dfrac{V_s(t) - e_a(t)}{2}$

b) $\dfrac{e_a(t) - V_s(t)}{2} + \dfrac{e_a(t)}{1} + \dfrac{e_a(t) - 3i(t)}{1/2} = 0$

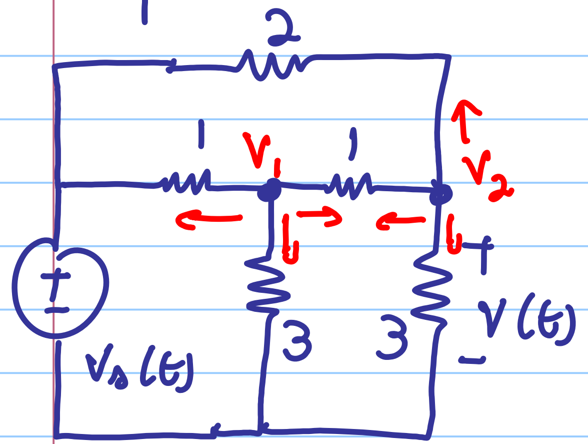
where $i(t) = \dfrac{V_s(t) - e_a(t)}{2}$

$\Rightarrow \dfrac{e_a(t) - V_s(t)}{2} + e_a(t) + 2e_a(t) - 3(V_s(t) - e_a(t)) = 0$

$\Rightarrow \dfrac{13}{2} e_a(t) = \dfrac{7}{2} V_s(t)$

c)

P 2.37



a) @ node V_1

$$\frac{V_1 - V_s}{1} + \frac{V_1}{3} + \frac{V_1 - V_2}{1} = 0$$

$$V_1(1 + 1 + 1/3) - V_2 = V_s$$

[redacted]

@ node V_2

$$\frac{V_2 - V_1}{1} + \frac{V_2 - V_s}{2} + \frac{V_2}{3} = 0$$

$$\Rightarrow -V_1 + V_2(1 + 1/2 + 1/3) = \frac{V_s}{2}$$

[redacted] (2)

c) Solve f V_2 where $V_2 = v(t)$

eq 1: $\frac{7}{3} V_1 = V_s + V_2 \Rightarrow V_1 = \frac{3(V_s - V_2)}{7}$

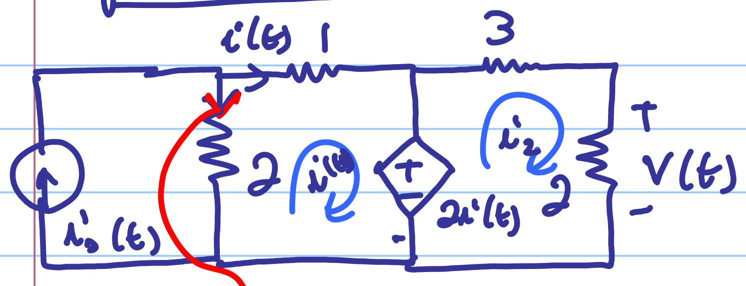
use eq 1 in eq 2 $\Rightarrow$

$$\frac{-3(V_s - V_2)}{7} + \frac{11}{6} V_2 = \frac{V_s}{2} \Rightarrow$$

$$V_2\left(\frac{3}{7} + \frac{11}{6}\right) = \frac{V_s}{2} + \frac{3}{7} V_s \Rightarrow$$

$V_2(t) =$ [redacted]

P 2-39



$\checkmark\ i'_{2n} = i'_s(t) - i'(t)$

$V(t) = 2\, i'_2(t) \Rightarrow$

$V(t) = 2\left(-\tfrac{4}{5}\right) i'_s(t)$

KVL1: $2\left(i'_s(t) - i'(t)\right) + 1\left(i'(t)\right) + 2i'(t) = 0$

$\Rightarrow 2i'_s(t) - 2i'(t) + i'(t) + 2i'(t) = 0$

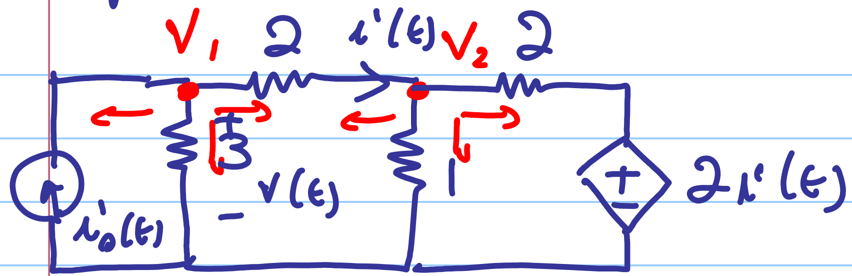
$\Rightarrow i'(t) = -2\, i'_s(t)$ ①

KVL2: $-2i'(t) + 3i'_2(t) + 2i'_2(t) = 0$

$\Rightarrow 5i'_2(t) = 2i'(t)$ ②

use eq 1 in 2 $\Rightarrow 5i'_2(t) = 2\left(-2i'_s(t)\right) \Rightarrow i'_2(t) = \frac{-4}{5} i'_s(t)$

P 2.42



$v_1 = v(t)$.

KCL @ V1

$$\frac{V_1}{3} + \frac{V_1 - V_2}{2} = i_o(t)$$

$$V_1\left(\frac{1}{3} + \frac{1}{2}\right) - \frac{V_2}{2} = i_o(t)$$

$$V_1\left(5/6\right) - \frac{1}{2} V_2 = i_o(t)$$

$$\Rightarrow 5V_1 - 3V_2 = 6 i_o(t) \quad (1)$$

KCL @ V2

$$\frac{V_2 - V_1}{2} + \frac{V_2}{1} + \frac{V_2 - 2i'(t)}{2} = 0$$

Where $i'(t) = \frac{V_1 - V_2}{2} \Rightarrow$

$$\frac{V_2 - V_1}{2} + \frac{V_2}{1} + \frac{V_2 - V_1 + V_2}{2} = 0$$

$$-V_1 + \frac{5}{2} V_2 = 0 \Rightarrow -2V_1 + 5V_2 = 0$$

$\Rightarrow$ ②

Replace eq. 2 into 1 $\Rightarrow$

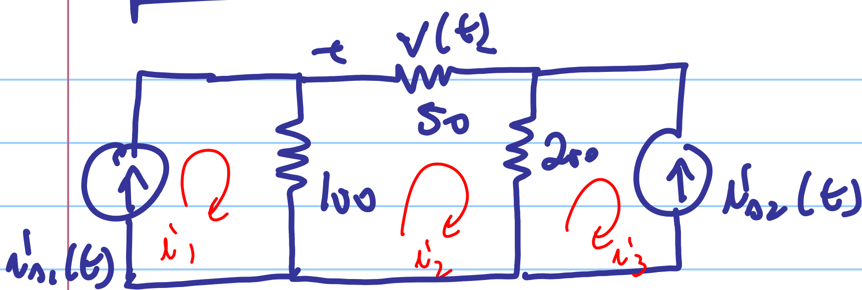
$$5V_1 - 3\left(\frac{2V_1}{5}\right) = 6 i_o(t) \Rightarrow$$

$$5V_1 - \frac{6}{5} V_1 = 6 i_o(t) \Rightarrow$$

$$25V_1 - 6V_1 = 30 i_o(t) \Rightarrow$$

$$19V_1 = 30 i_o(t) \Rightarrow$$

P 2.44



a) mesh will need one loop KVL.
nodal " " two KCL

b) loop analysis.

$$100(i_2' - i_1') + 50i_2' + 200(i_2' - i_3') = 0$$

$$-100i_1' + 350i_2' - 200i_3' = 0 \Rightarrow$$

$$350i_2' = 200i_3' + 100i_1' \text{ where}$$
$$i_3' = -i_{s2}' \ \& \ i_1' = i_{s1}'(t) \Rightarrow$$

$$350i_2' = 100i_{s1}' - 200i_{s2}'$$

$$i_2'(t) = \frac{100i_{s1}' - 200i_{s2}'}{350}$$

$$= \frac{10i_{s1}' - 20i_{s2}'}{35}$$

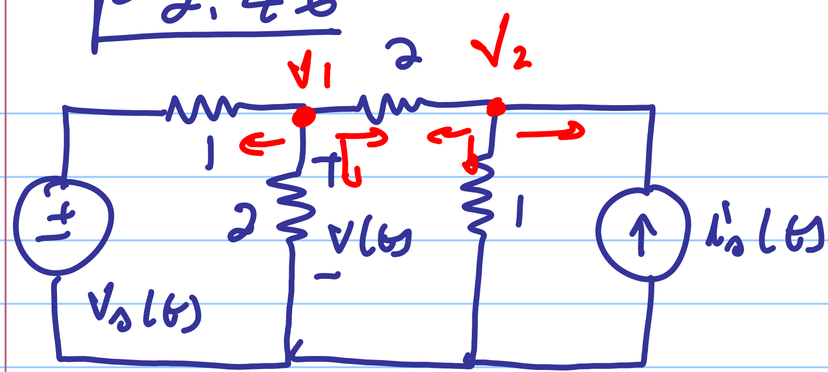
$$\because V(t) = 50i_2'(t) \Rightarrow$$

$$= 50\left(\frac{10i_{s1}' - 20i_{s2}'}{35}\right)$$

$$\left(\frac{500i_{s1}' - 1000i_{s2}'}{}\right)$$

=

P2.46



a) use nodal analysis.

@ V_1: $\frac{V_1 - V_s}{1} + \frac{V_1}{2} + \frac{V_1 - V_2}{2} = 0$

$2V_1 - \frac{1}{2}V_2 = V_s \Rightarrow \boxed{4V_1 - V_2 = 2V_s}$ ①

@ V_2: $\frac{V_2 - V_1}{2} + V_2 - i_s = 0 \Rightarrow$

$-\frac{1}{2}V_1 + \frac{3}{2}V_2 = i_s \Rightarrow \boxed{-V_1 + 3V_2 = 2i_s}$ ②

eq 1: $V_2 = 4V_1 - 2V_s$

Use eq 1. into eq 2 $\Rightarrow$

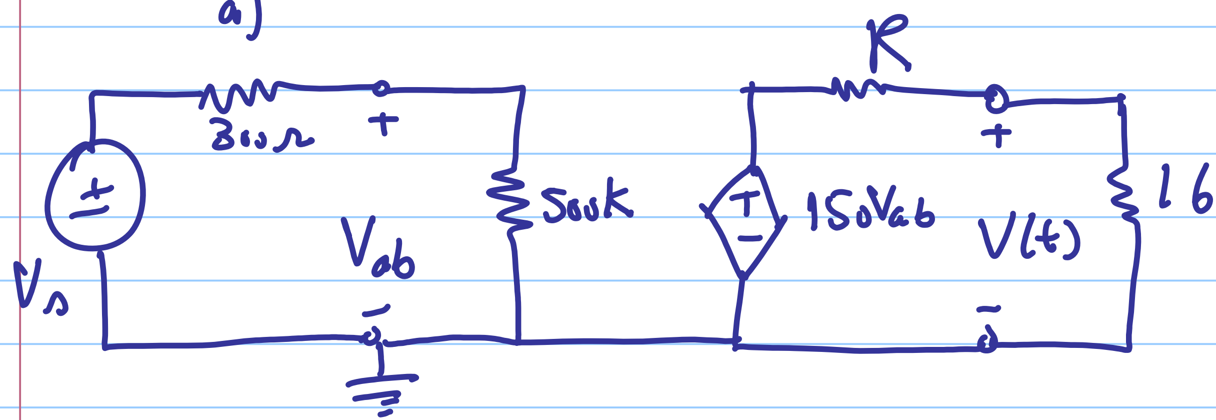
$-V_1 + 3(4V_1 - 2V_s) = 2i_s \Rightarrow$

$11V_1 = 2i_s + 6V_s \Rightarrow$

[redacted]

2.60

a)



① $V_{ab} = V_s \left(\frac{500{,}000}{500{,}000+300}\right) \Rightarrow V_{ab} \approx V_s$

② Second half of the circuit $\Rightarrow$

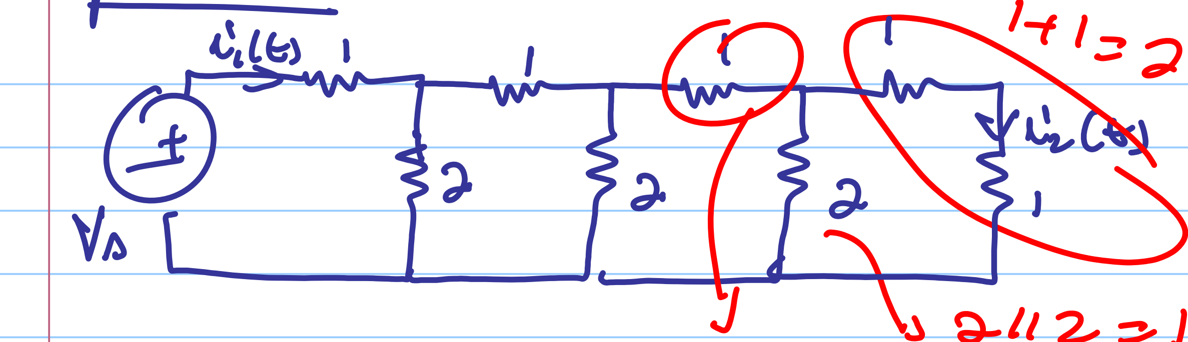
$V(t) = 150V_{ab}\left(\frac{16}{16+R}\right) \Rightarrow$ we know that $V_{ab} = V_s \Rightarrow$

$20\cos(1000t) = 150 \times 0.2\cos(1000t)\left(\frac{16}{16+R}\right) \Rightarrow 20 = 30\left(\frac{16}{16+R}\right)$

$\Rightarrow \frac{2}{3} = \frac{16}{16+R} \Rightarrow 2(16+R) = 3 \times 16 = 48 \Rightarrow$

$32 + 2R = 48 \Rightarrow 2R = 48 - 32 = 16 \Rightarrow$ [redacted]

P 3.14



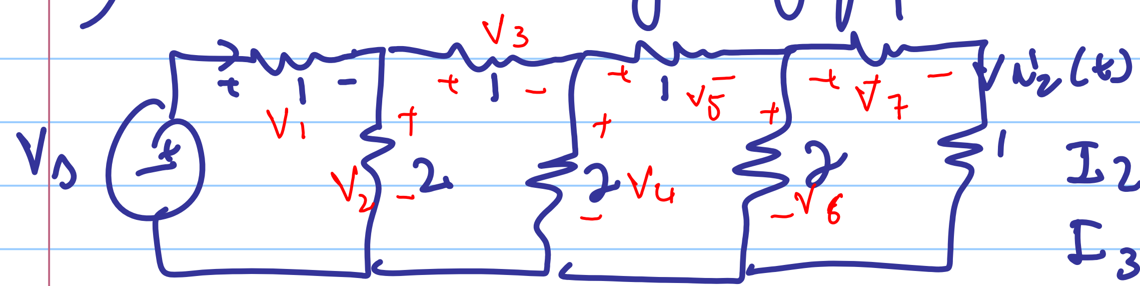
1+1=2
2‖2=1
1+1=2

2‖2=1
1+1=2
2‖2=1
1+1=2

a)

$i_1(t) = \frac{V_s}{2} = \frac{1}{2} V_s(t)$

b) take advantage of part a, we know $i_1(t) = \frac{V_s}{2} \Rightarrow V_{1\Omega} = \frac{V_s}{2}$



$V_1 = \frac{V_s}{2} \Rightarrow V_2 = \frac{V_s}{2} \Rightarrow$

$I_2 = \frac{V_s/2}{2} = V_s/4$

$I_3 = I_1 - I_2 = \frac{V_s}{2} - \frac{V_s}{4} = \frac{V_s}{4}$

$\Rightarrow V_3 = \frac{V_\Delta}{4}$ $\therefore V_4 = V_2 - V_3 = \frac{V_\Delta}{2} - \frac{V_\Delta}{4} = \frac{V_\Delta}{4}$.

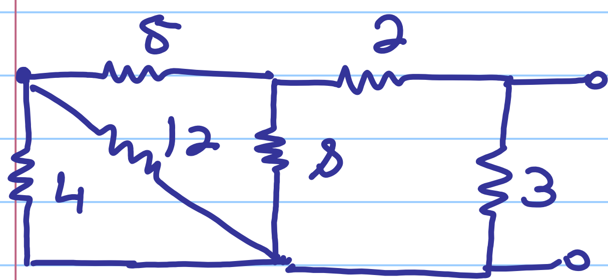
$\Rightarrow I_4 = \frac{V_\Delta}{8}$ $\therefore I_5 = \frac{V_\Delta}{4} - \frac{V_\Delta}{8} = \frac{V_\Delta}{8} \Rightarrow V_5 = \frac{V_\Delta}{8}$.

$V_6 = V_4 - V_5 = \frac{V_\Delta}{4} - \frac{V_\Delta}{8} = \frac{V_\Delta}{8} \Rightarrow I_6 = \frac{V_\Delta}{16}$

$\Rightarrow I_7 = i_2(t) = I_5 - I_6 = \frac{V_\Delta}{8} - \frac{V_\Delta}{16} = \boxed{\frac{V_\Delta}{16}}$

You can see the pattern after we calculated V_4; all voltages across are multiple of 2.

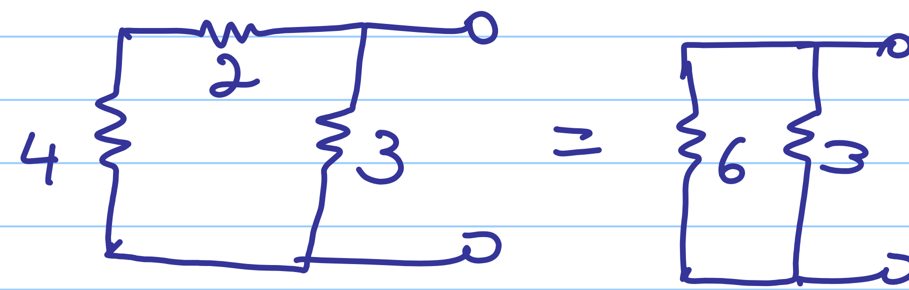
P 3.45



$4 \parallel 12 = \frac{4 \times 12}{4+12} = \frac{48}{16} = 3$

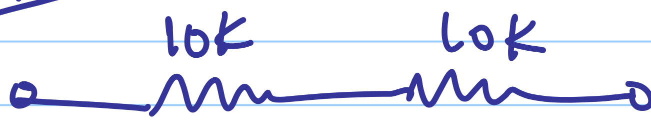
3 in series with 5 ⇒ $3+5 = 8\Omega$

$8 \parallel 8 = 4$

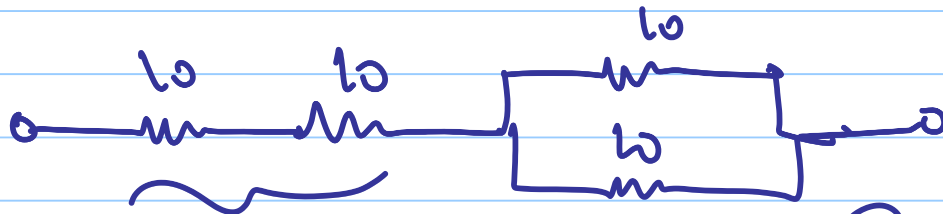


⇒

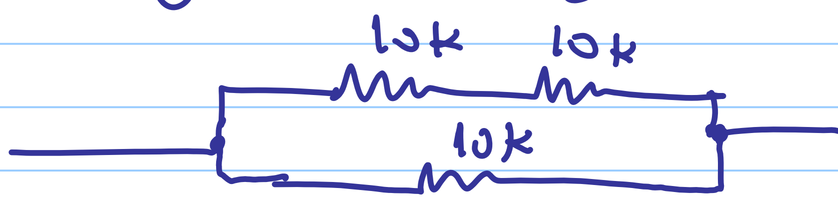
3.47

a) 

$\Rightarrow 10 + 10 = 20k.$

b) 

$20 + 5 = 25k.$

c) 

$= 20 \parallel 10 = 6667\Omega.$