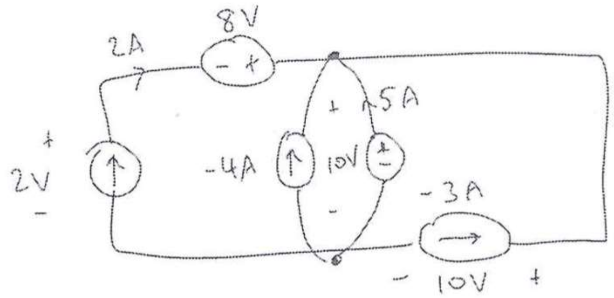
Name: Student ID:

Pre-tutorial 4 Questions (to be attempted before class on May 3rd, 2019)

Chapter 2, Ex 20: Power absorbed

Determine which of the five sources are being charged (absorbing positive power), and show that the algebraic sum of the five absorbed power values is zero.

$\xrightarrow{i}$ + −
$P = VI$ (absorbed)



2V source $P = V(-I) = 2\times(-2) = -4W$ absorbed
or 4W generated.

8V source $P = V(-I) = 8\times(-2) = -16W$ absorbed
or 16W generated.

-4A source $P = V(-I) = 10\times(-(-4)) = 40W$ absorbed.

10V source $P = V(-I) = 10\times(-5) = -50W$ absorbed
or 50W generated

-3A source $P = V(-I) = 10\times(-(-3)) = 30W$ absorbed.

$\sum$ Powers = 0

$-4 - 16 + 40 - 50 + 30 = 0$ ✓

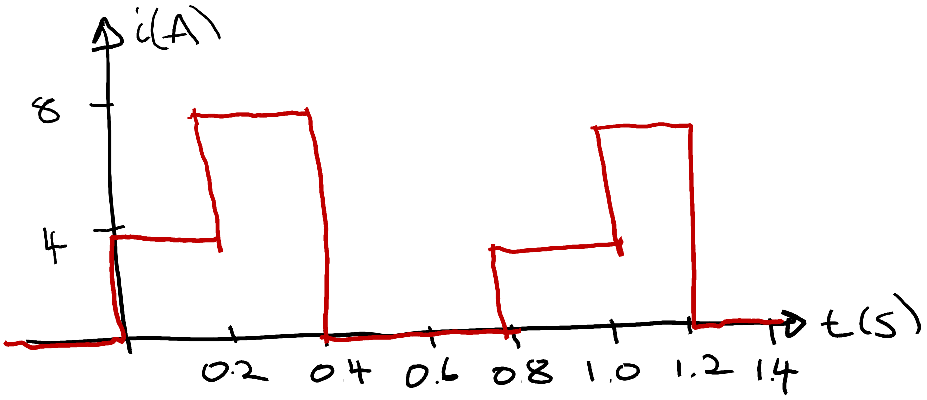
Conservation of energy.

For power absorbed problems you can also try Ex. 22.

Chapter 7, Ex 11a: Capacitors

The current flowing through a 33 mF capacitor is shown graphically below.

a) Assuming the passive sign convention, sketch the resulting voltage waveform across the device.



Q11a) $C = 33mF$

$$v = \frac{1}{C}\int_{t_0}^{t} i(\tau)\, d\tau + v(t_0)$$

⇒ integral of a horizontal straight line (ie. a constant) is a constant slope straight line. If find the end-points can just join them.

@ t = 0.2:

$$v = \frac{1}{33\times10^{-3}}\int_0^{0.2} 4\ dt + 0$$

$$= \frac{4}{33\times10^{-3}}\left[t\right]_0^{0.2}$$

$$= \frac{4\times0.2}{33\times10^{-3}}$$

$$= 24.2V$$

@ t = 0.4:

$$v = \frac{1}{33\times10^{-3}}\int_{0.2}^{0.4} 8\ dt + 24.2$$

$$= \frac{8}{33\times10^{-3}}\left[t\right]_{0.2}^{0.4} + 24.2$$

$$= \frac{8\times(0.4-0.2)}{33\times10^{-3}} + 24.2$$

$$= 72.7V$$

@ $t = 0.8$:

$$v = \frac{1}{33\times10^{-3}} \int_{0.4}^{0.8} 0 \, dt + 72.7$$
$$= 72.7\text{V}$$

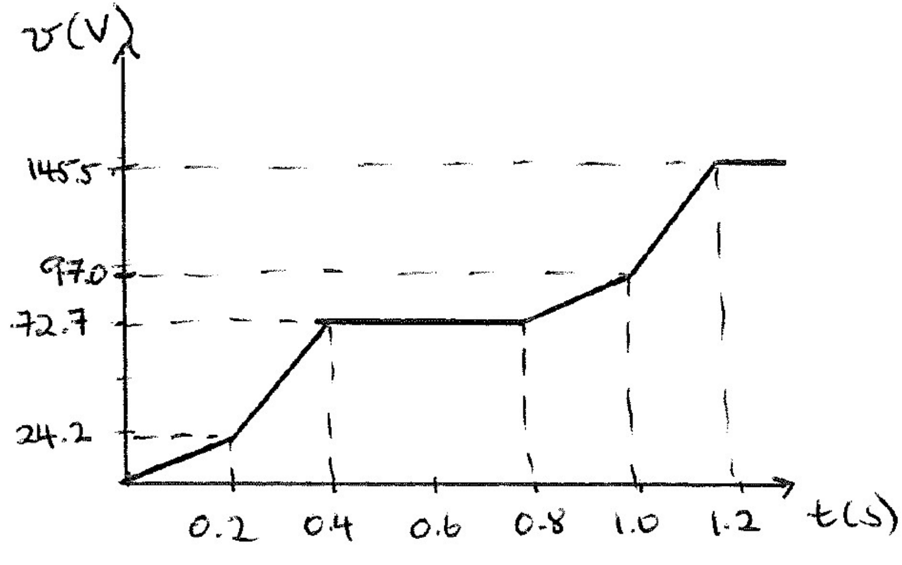
(or by inspection)

@ $t = 1$:

$$v = \frac{1}{33\times10^{-3}} \int_{0.8}^{1} 4 \, dt + 72.7$$
$$= \frac{4}{33\times10^{-3}} [t]_{0.8}^{1} + 72.7$$
$$= 97.0\text{V}$$

@ $t = 1.2$:

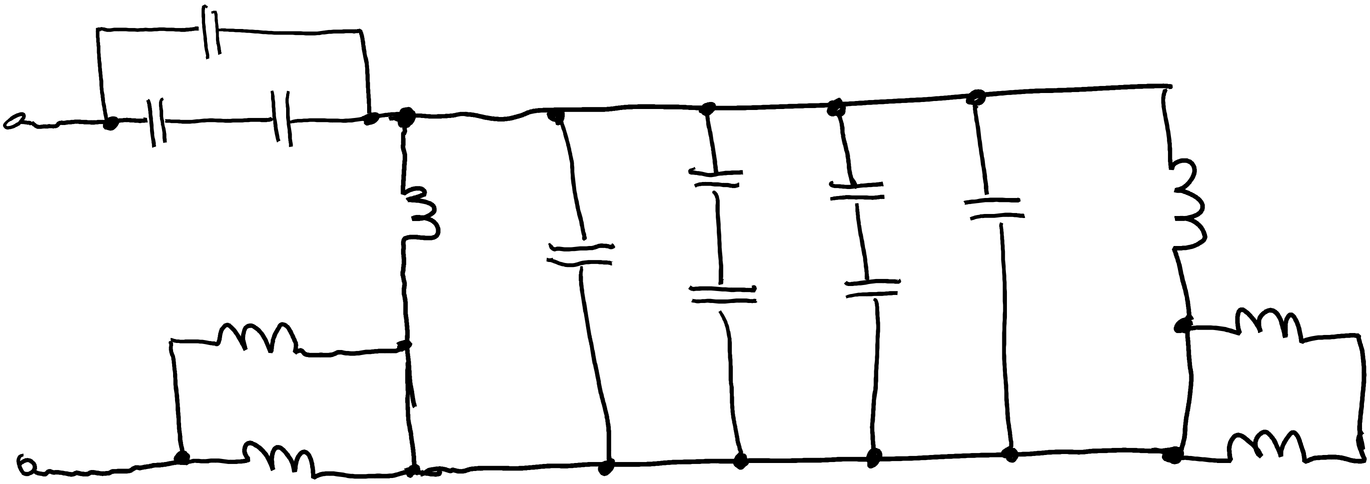
$$v = \frac{1}{33\times10^{-3}} \int_{1}^{1.2} 8 \, dt + 97$$
$$= \frac{8}{33\times10^{-3}} [t]_{1}^{1.2} + 97$$
$$= 145.5\text{ V}$$



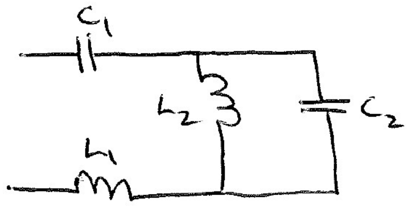
At Tutorial 4 – Marked Question (3rd May 2019)

Chapter 7, Ex 41: Equivalent capacitance/inductance

Reduce the network below to the smallest possible number of components if each inductor is 1 nH and each capacitor is 1 mF.



$\Rightarrow$



$$C_1 = \frac{(1\times10^{-3})^2}{1\times10^{-3}+1\times10^{-3}} + 1\times10^{-3}$$

$$= 1.5\times10^{-3}\ \text{F}$$

$$C_2 = \left(\frac{(1\times10^{-3})^2}{2\times10^{-3}}\right)\times 2 + 2\times10^{-3}$$

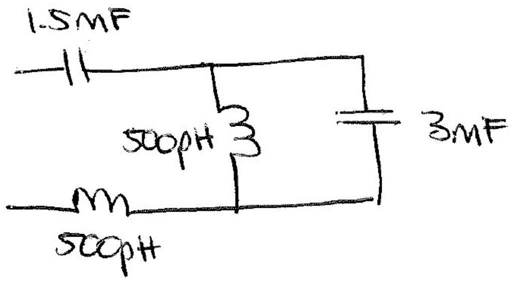
$$= 3\ \text{mF}$$

$$L_2 = 500\times10^{-12}\ \text{H}$$

$$L_1 = \frac{(1\times10^{-9})^2}{1\times10^{-9}\times 2}$$

$$= 500\times10^{-12}\ \text{H}$$

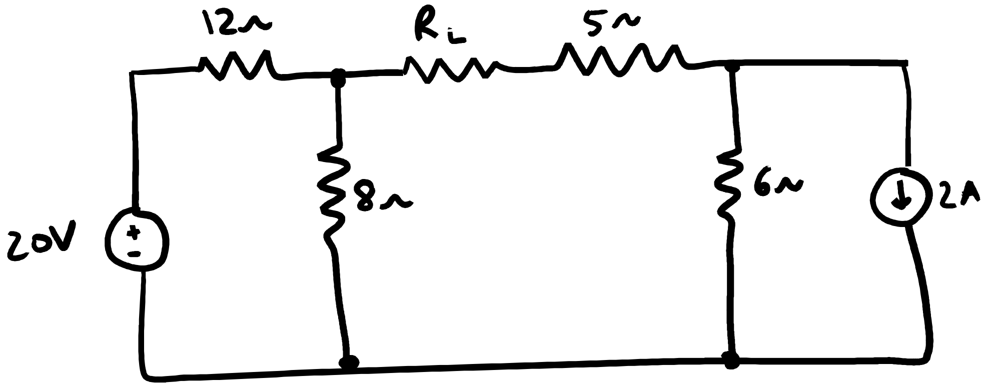
$\Rightarrow$



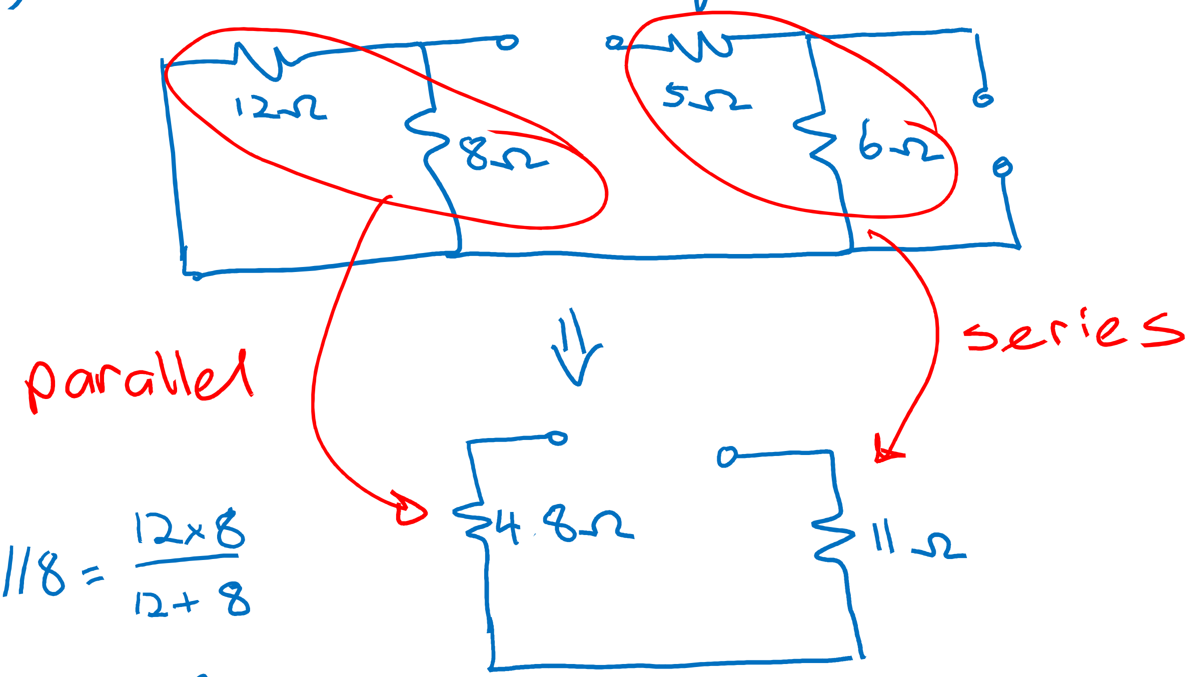
At Tutorial 4 – Unmarked Questions (3rd May 2019)

Ch 5 ex 61: Maximum power transfer

Given you can select any value of R_L, what is the maximum power that could be delivered to R_L?



1) Find Thévenin equivalent resistance:

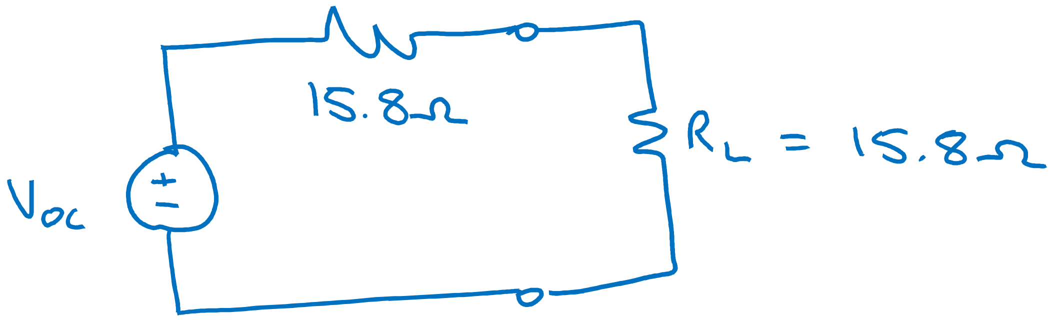


$$12 // 8 = \frac{12 \times 8}{12 + 8}$$

$$= 4.8\Omega$$

$$R_{TH} = 11 + 4.8$$

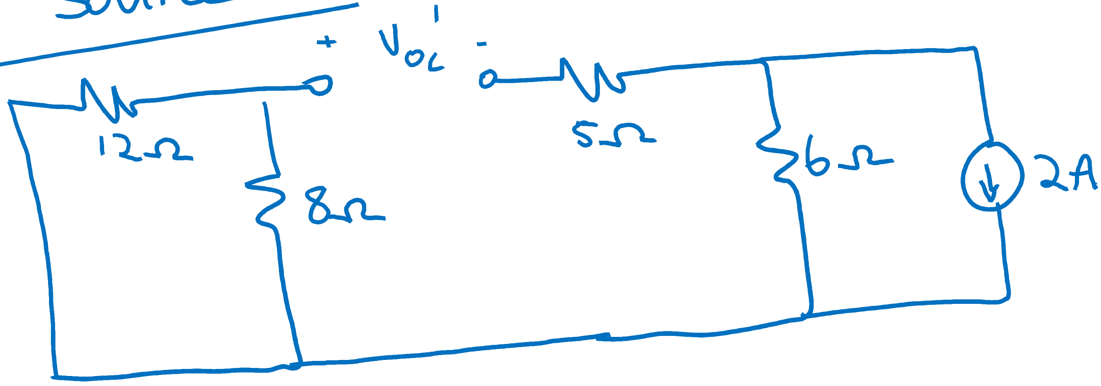
$$= 15.8\Omega$$



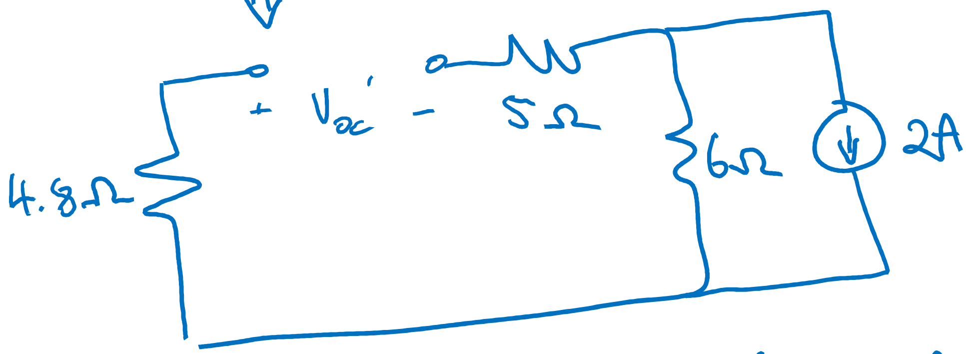
For max pwr transfer, $R_L = R_{TH}$

2) Find V_{oc} using superposition:

20V source off



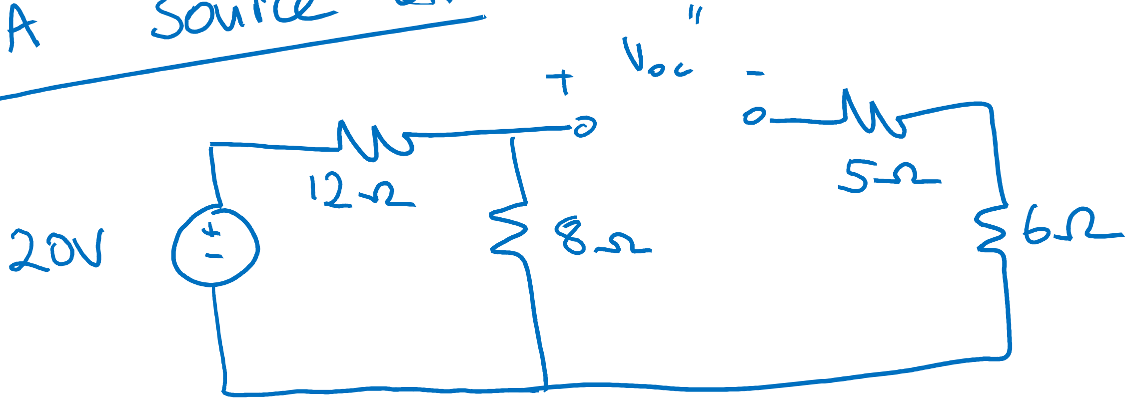
⇓



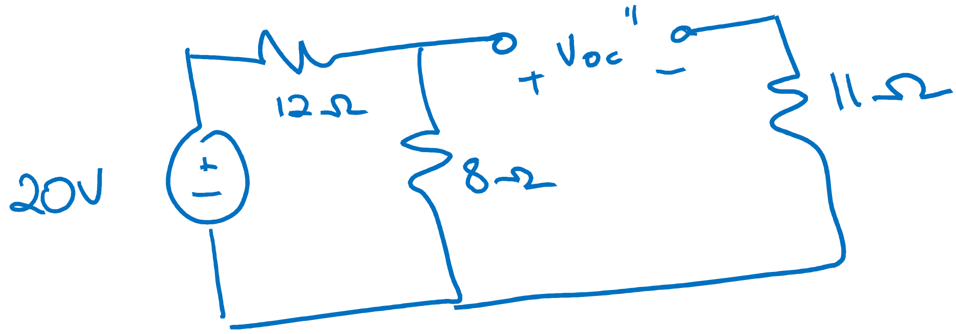
All current goes through 6Ω resistor,

$\therefore V_{oc}' = 6 \times 2 = 12V$

2A source off

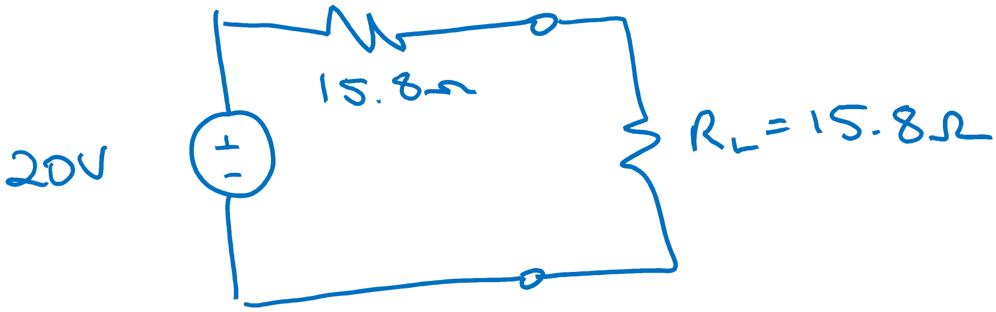


⇓



$$V_{8\Omega} = V_{oc}'' = \frac{20 \times 8}{12+8} = 8V$$

$$\therefore V_{oc} = V_{oc}' + V_{oc}'' = 12+8$$
$$= 20V$$



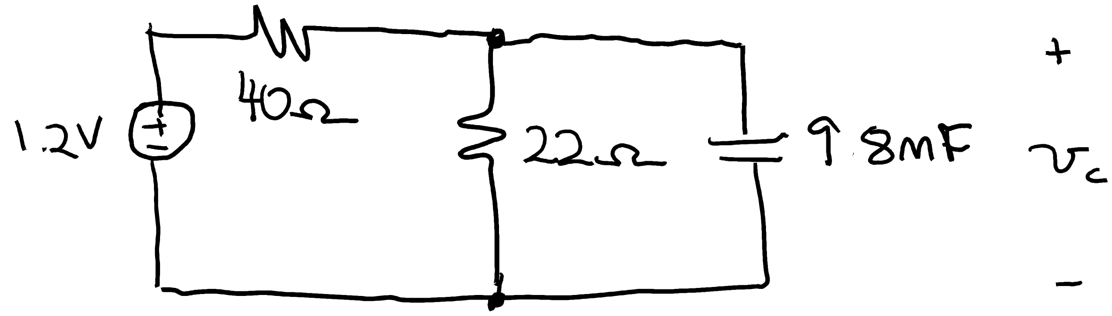
$$P = V^2/R = (20/2)^2/15.8$$

$$= 6.33 W$$

Chapter 7, Ex 14: Power

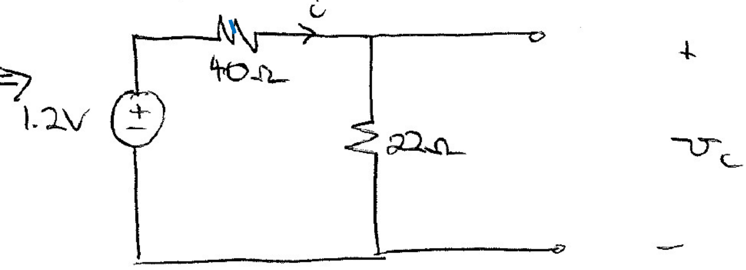
Assume the circuits below have been connected for a long time. Calculate the power dissipated in the 40 Ω resistor and the voltage labeled v_C in the circuits below:

a)



capacitor acts as an open circuit to DC

∴ circuit is ⟹

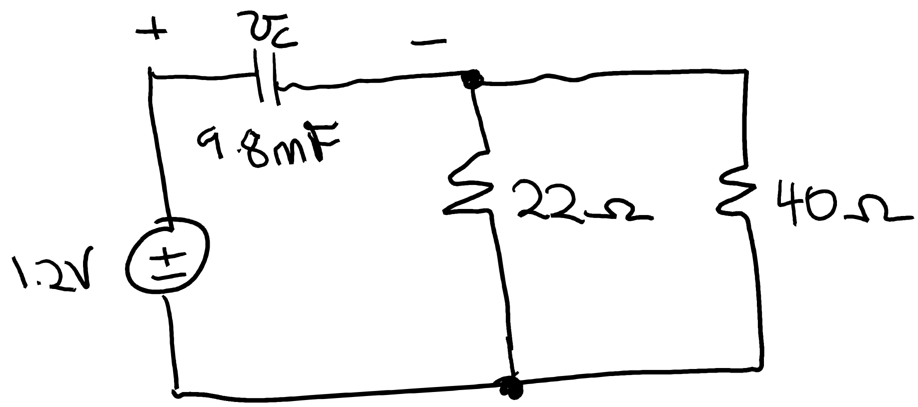


$$i = \frac{1.2}{(40+22)} = 19\,mA$$

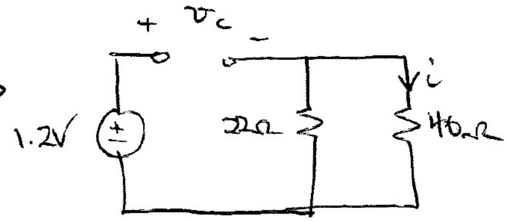
$$P_{40\Omega} = i^2 R = (19 \times 10^{-3})^2 \times 40 = 14.98\,mW$$

$$v_c = iR = 19 \times 10^{-3} \times 22 = 0.43\,V$$

b)



as above. ∴ circuit becomes ⇒



$P_{40\Omega} = 0W$ ($i = 0A$)

$v_c = 1.2V$

Chapter 7, Ex 27: Inductors

Determine the amount of energy stored in a 33 mH inductor at t = 1 ms as a result of a current i_L given by:

a) 7 A

$i = 7A$

$w_L = \frac{1}{2} L i^2$

$= \frac{1}{2} \times 33 \times 10^{-3} \times 7^2$

$= 808.5 \, mJ$

b) $3 - 9e^{-1\ ^{3}t}$ mA

$$i = 3 - 9e^{-10^3 t} \text{ mA}$$
$$\omega_L = \tfrac{1}{2} L i^2$$
$$= \tfrac{1}{2} \times 33\times10^{-3} \times (3\times10^{-3} - 9e^{-10^3 t} \times 10^{-3})^2$$
$$= 16.5\times10^{-3} \, (3\times10^{-3} - 3.3\times10^{-3})^2$$
$$= 16.5\times10^{-3} \times 96.67\times10^{-9}$$
$$= 1.595 \text{ nJ}$$

Chapter 7, Ex 25: Inductors

The voltage across a 2 H inductor is given by v_L = 4.3t, -0.1 s ≤ t ≤ 50 ms. Knowing that i_L (-0.1) = 100 μA, calculate the current (assuming it is defined consistent with the passive sign convention) as t equal to:

a) 0
b) 1.5 ms
c) 45ms

$$i(t) = \frac{1}{L} \int_{t_0}^{t} v(\tau)\, d\tau + i(t_0)$$
$$= \frac{1}{2}\left[\int_{-0.1}^{t} 4.3\tau\, d\tau\right] + 100\times10^{-6}$$
$$= \frac{1}{2}\times 4.3 \int_{-0.1}^{t} \tau\, d\tau + 100\times10^{-6}$$
$$= 2.15\left[\frac{1}{2}\tau^2\right]_{-0.1}^{t} + 100\times10^{-6}$$
$$= 2.15\left(\tfrac{1}{2}t^2 - 5\times10^{-3}\right) + 100\times10^{-6}$$

a) $i(0) = -2.15 \times 5\times10^{-3} + 100\times10^{-6} = -10.65\text{mA}$

b) $i(1.5\text{ms}) = 2.15(\tfrac{1}{2}\times(1.5\times10^{-3})^2 - 5\times10^{-3}) + 100\times10^{-6}$
$= -10.65\text{mA}$

c) $i(45\text{ms}) = 2.15(\tfrac{1}{2}(45\times10^{-3})^2 - 5\times10^{-3}) + 100\times10^{-6}$
$= -8.47\text{mA}$