Week 5 Midterm Review ELEC275 annotated

Principles of Electrical Engineering (Concordia University)

Midterm review

MIDTERM

WHEN: WEDNESDAY FEB 19th

TIME: 6-8 PM (2 hours)

ROOMS:

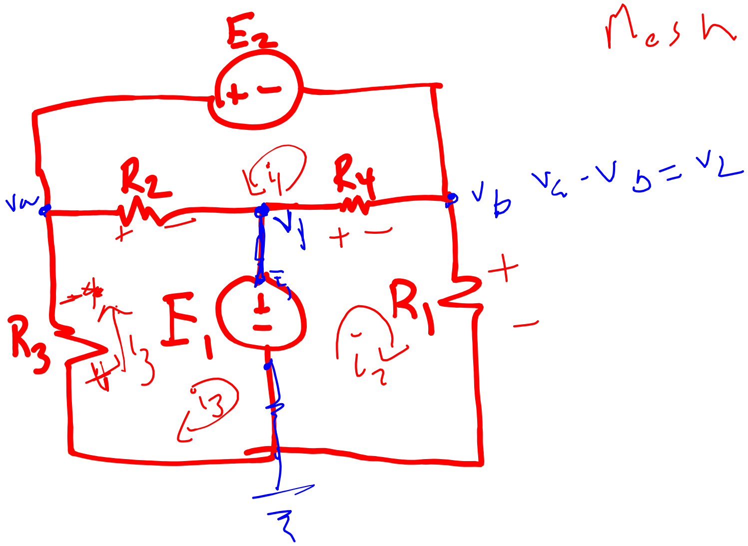
Abdouraz – Mohamed FG B050
Moreau – Znaty FG B055

ACSD students will write at the ACSD center

Note: Ensure you go to the right room or you will not be able to write. Bring 1) ENCS approved calculator, 2) student ID, 3) Pen (no pencil). This is a CLOSED book exam with NO formula sheet.

Example M1 - Use **mesh analysis** technique to calculate the current through resistance R3 and identify the direction of the flow. If E1 = 6V, E2 = 6V, R1=4 Ω, R2 = 8 Ω, R3 = 2 Ω, R4 = 1 Ω

v_1 $\quad$ v_2

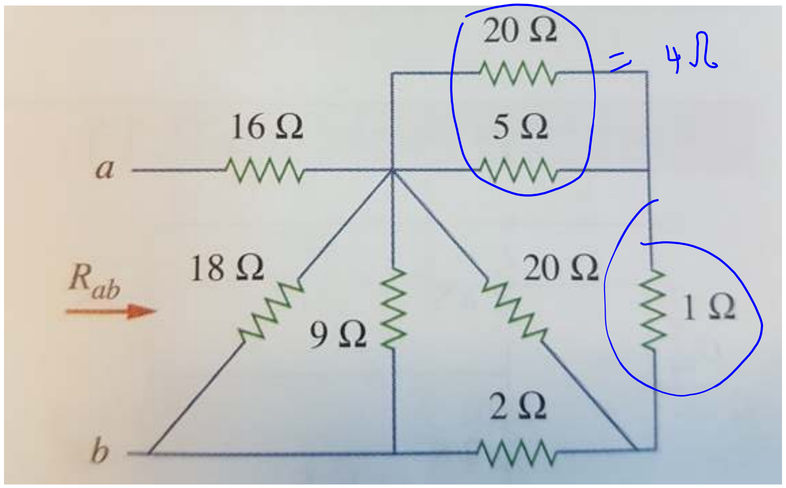


Mesh 1: $-v_2 + (i_1 + i_3) R_2 + (i_1 + i_2) R_4 = 0$

2: $-v_1 + (i_1 + i_2) R_4 + i_2 R_1 = 0$

3: $i_3 R_3 + (i_3 + i_1) R_2 + v_1 = 0$

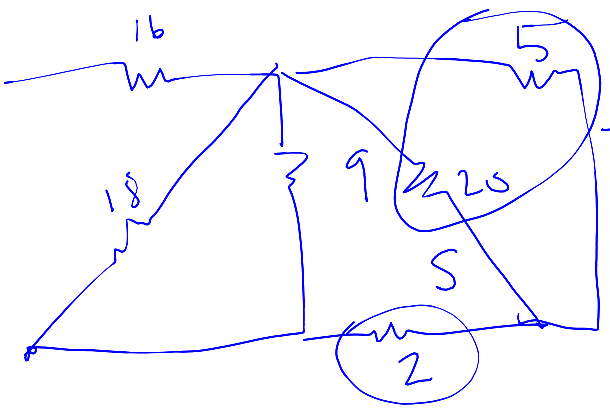
Example M2



$= 4\Omega$

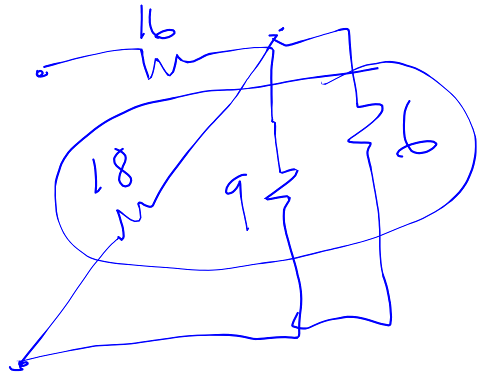
What is Rab between terminals a and b?

$$R_1 \parallel R_2 = \frac{R_1 R_2}{R_1 + R_2}$$



$= 4$

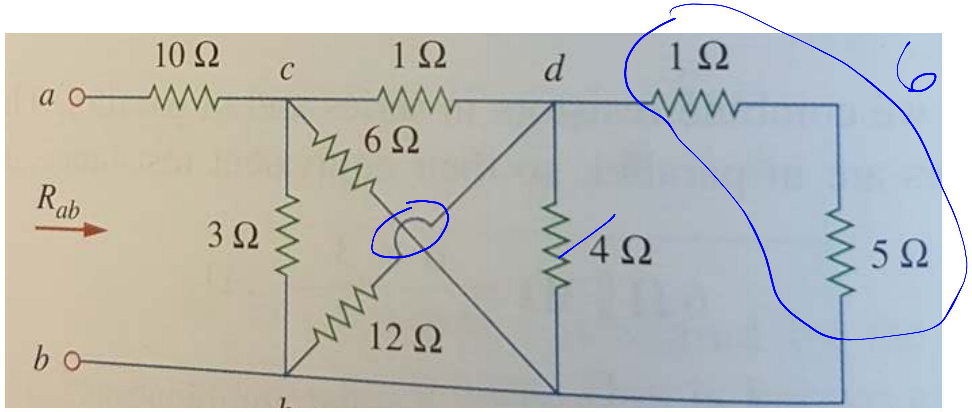
$\Rightarrow$



3Ω

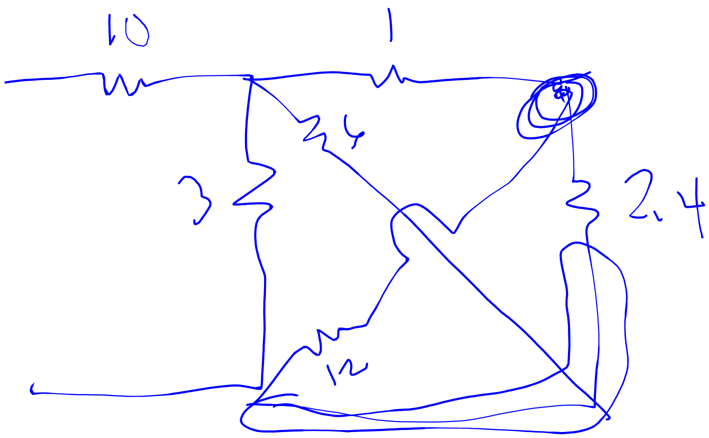
$R_{eq} = 19\Omega$

Example M3



What is Rab between terminals a and b?

1. $6 \parallel 4 = \frac{6 \times 4}{6+4} = 2{,}4\ \Omega$



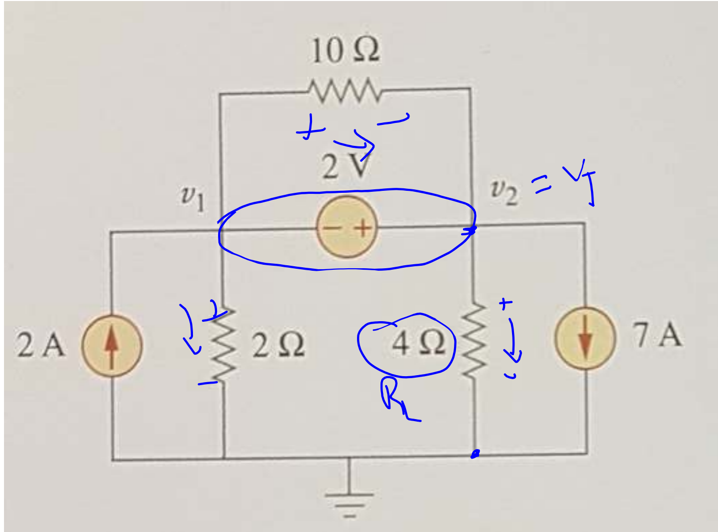
2. $2.4 \parallel 12 = 2\ \Omega$

3. $2 + 1 = 3\ \Omega$

4. $3 \parallel 6 \parallel 3 = 1{,}2\ \Omega$

5. $1{,}2 + 10 = \underline{11{,}2\ \Omega}$

Example M4



Find v1 and v2.

$V_{Thevenin}$

Find the maximum ~~power~~ delivered to the load if the load is placed between v2 and ground?

Current away is +

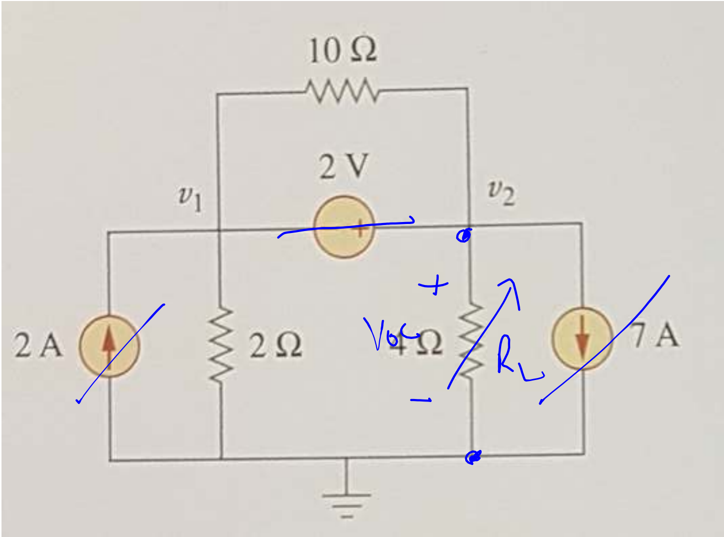
$$v_2 - v_1 = 2$$

$$-2 + \frac{v_1}{2} + \frac{v_2}{4} + 7 = 0$$

$$v_1 = -7.33\,V$$

$$v_2 = -5.33\,V$$

Example M4



Find v1 and v2.

Find the maximum power delivered to the load if the load is placed between v2 and ground?

$R_{eq} = 2\,\Omega$

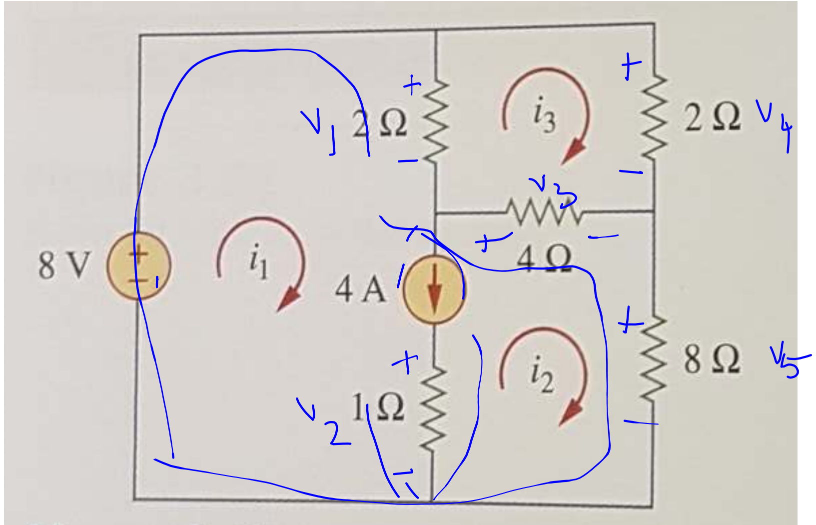
$P_{max} = \dfrac{V_{oc}^2}{4R_{TL}} =$

$-2 + \dfrac{v_1}{2} + 7 = 0$

$V_2 = ?$

$V_2 - V_1 = 2$

Example M5



What is i1, i2, and i3?

Find the maximum power delivered to the load if the load replaces the 8 ohm resistor.

① $i_1 - i_2 = 4$

① $v_4 - v_3 - v_1 = 0$

$2i_3 - 4(i_2 - i_3) - 2(i_1 - i_3) = 0$

supermesh

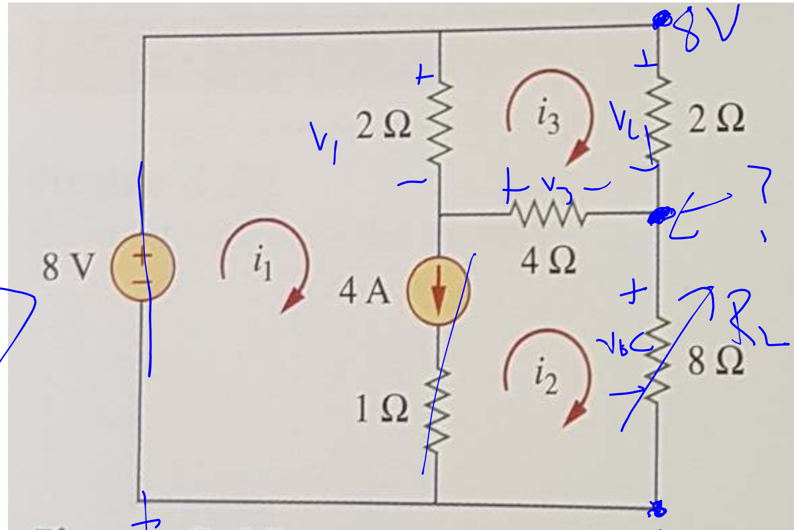
② $-8 + v_1 + v_3 + v_5 = 0$

$-8 + 2(i_1 - i_3) + 4(i_2 - i_3) + 8i_2 = 0$

$i_1 = 4.63\ A$, $i_2 = 631.6\ mA$

$i_3 = 1.47\ A$

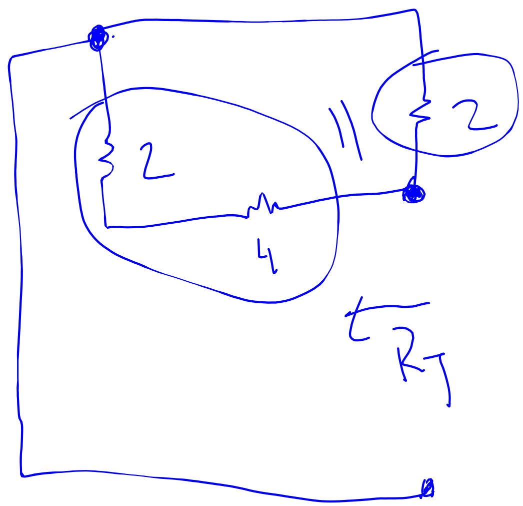
Example M5



No current source – what Req?

+ short V_{source}

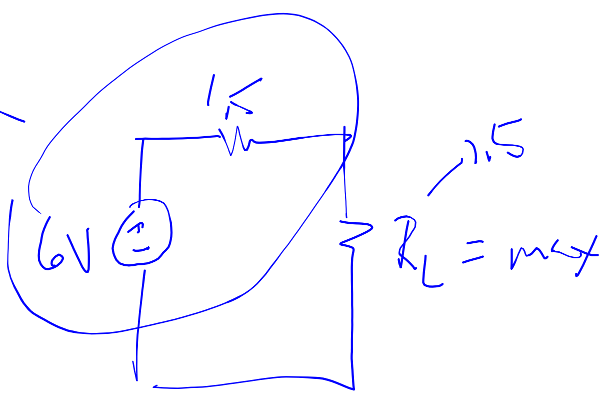
$$R_{eq} = R_T = (4+2) \| 2$$
$$= 1.5\,\Omega$$



$$i_1 = 4A$$

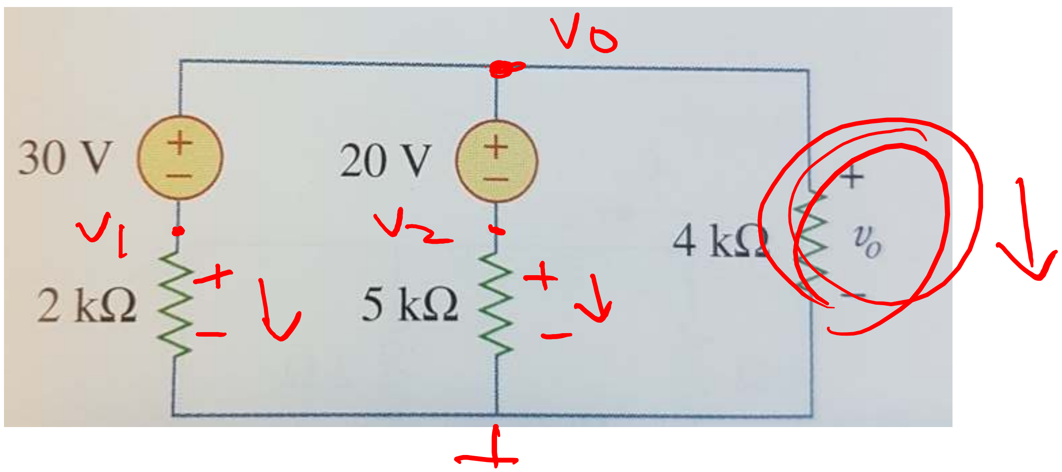
Mesh 3: $v_4 - v_3 - v_1 = 0$

$$2i_3 - 4(-i_3) - 2(i_1 - i_3) = 0$$
$$i_3 = 1A$$



$$V_{OC} = 8 - v_4$$
$$= 8 - 2 \times i_3 = 6V$$

Example M6



current away is '+'

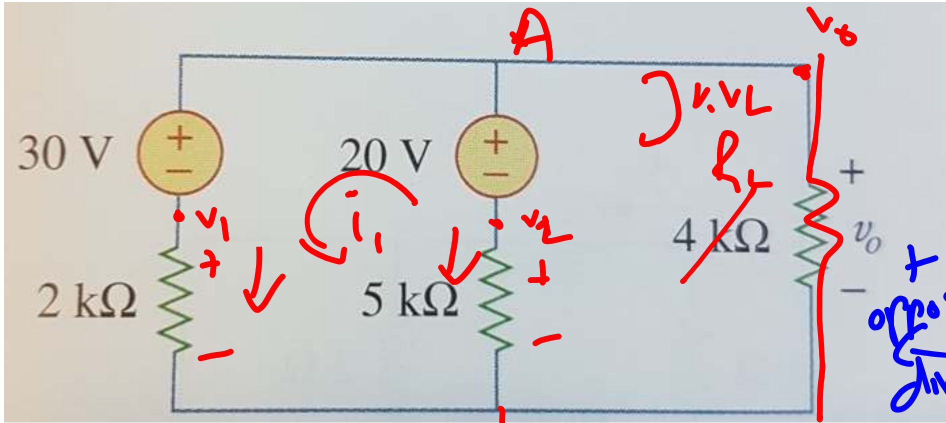
① $V_o - V_1 = 30 \Rightarrow V_o - 30 = V_1$

② $V_o - V_2 = 20 \Rightarrow V_o - 20 = V_2$

③ $\frac{V_1}{2} + \frac{V_2}{5} + \frac{V_o}{4} = 0$

$V_o = 20V$

Example M6



What is Vo for this circuit?

Assume the load is placed at the 4kohms, what is the Thevenin voltage?

+ b/c opposite direction

KVL

$+v_0 - v_2 - 20 = 0$

$v_0 = v_2 + 20$

$= (1.42)(5) + 20$

$v_0 = 27.1\,V$

$R_T = 5 \parallel 2 = 1.43\,\Omega$

$V_0 = V_T$

mesh

$-30 + v_1 - v_2 - 20 = 0$

$30 + i_1(2) - (-i_1)(5) - 20 = 0$

$7i_1 = -10$

$i_1 = -1.42\,A$

$0.7 v_0 = 19$

$v_0 = 27.14\,V$

① $v_0 - v_1 = 30$

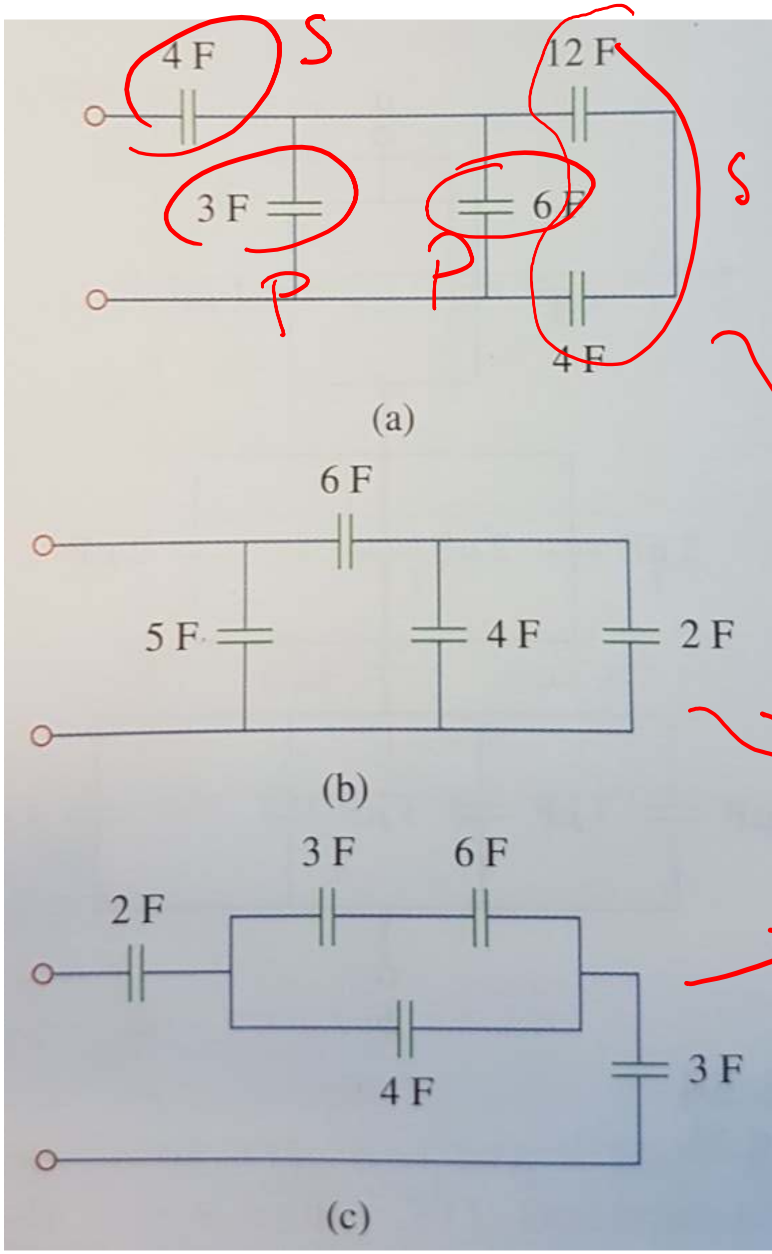
② $v_0 - v_2 = 20$

$v_0 - 30$ $\quad$ $v_0 + 20$

③ at A → $\dfrac{V_1}{2} + \dfrac{V_2}{5\,k\Omega} = 0$

$\dfrac{v_0 - 30}{2} + \dfrac{v_0 - 20}{5} = \dfrac{v_0}{2} + \dfrac{v_0}{5} - 15 - 4 = 0$

Example M7



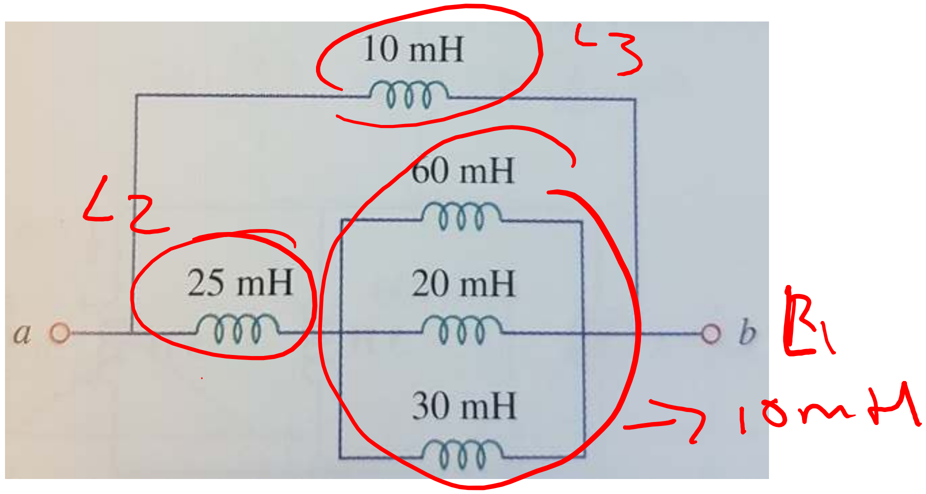
Series	Parallel
$C_{eq} = \left(\frac{1}{C_1} + \frac{1}{C_2} + \dots + \frac{1}{C_n}\right)^{-1}$	$C_{eq} = C_1 + C_2 + \dots + C_n$
$Z_{eq} = Z_1 + Z_2 + \dots + Z_n$	$Z_{eq} = \left[\frac{1}{Z_1} + \frac{1}{Z_2} + \frac{1}{Z_3} + \dots + \frac{1}{Z_n}\right]^{-1}$

(a) $\rightarrow C_{eq} = 3F$

(b) $\rightarrow C_{eq} = 8F$

(c) $\rightarrow 1F$

Example M8



Series

$$L_{eq} = L_1 + L_2 + L_3 + \dots + L_n$$

$$Z_{eq} = Z_1 + Z_2 + \dots + Z_n$$

Parallel

$$L_{eq} = \left[\frac{1}{L_1} + \frac{1}{L_2} + \dots + \frac{1}{L_n}\right]^{-1}$$

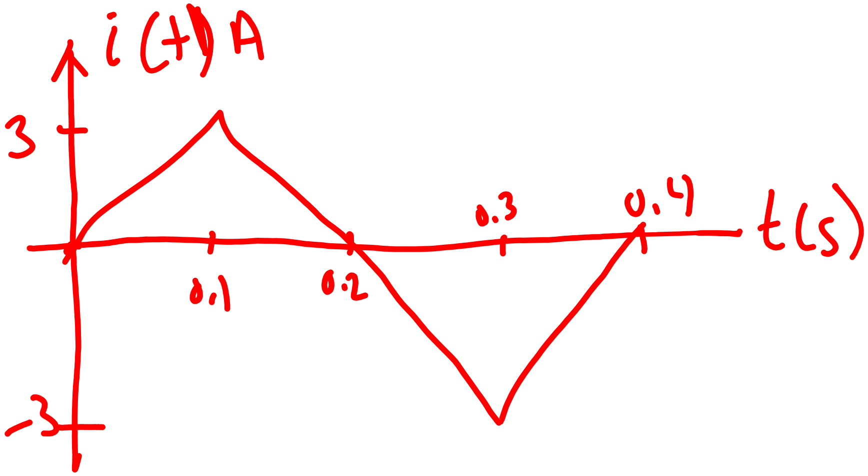
$$Z_{eq} = \left[\frac{1}{Z_1} + \frac{1}{Z_2} + \dots + \frac{1}{Z_n}\right]^{-1}$$

$$L_1 + L_2 = 35\,mH$$

$$L_3 \parallel (L_1 + L_2) = 7.78\,mH$$

Example M9

The current flowing through a 2-H inductance is shown below. Sketch the voltage, power, and stored energy versus time.



$$v(t) = L\frac{di}{dt}$$

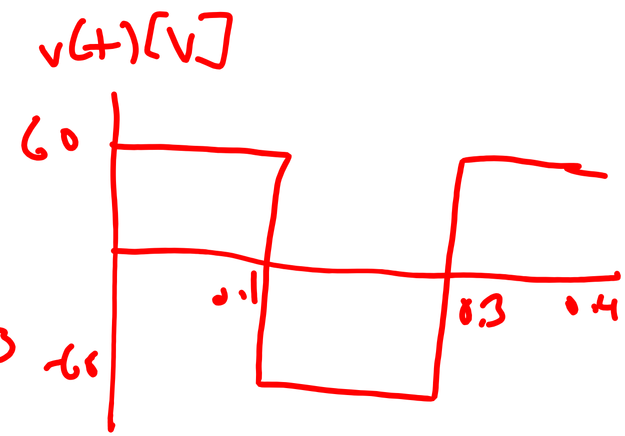
$$p(t) = v(t)\cdot i(t)$$

$$= 1800t \qquad 0<t<0.1$$

$$i(t) = \begin{cases} 30t & 0<t<0.1 \\ -30t+6 & 0.1<t<0.2 \\ -30t+6 & 0.2<t<0.3 \\ 30t-12 & 0.3<t<0.4 \end{cases}$$

$$W(t) = \frac{1}{2}L\,i(t)^2$$

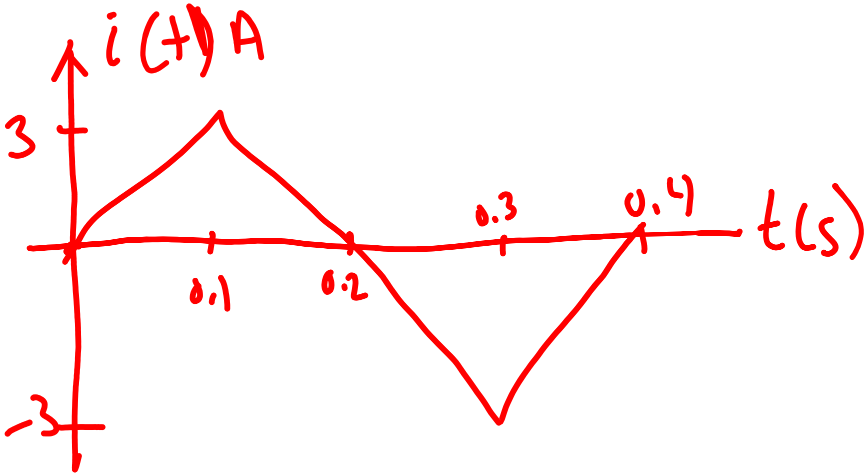
$$= \frac{1}{2}(2)(30t)^2$$



$$v(t) = \begin{cases} 2\times 30 = 60\ \text{V} & 0<t<0.1 \\ 2\times -30 = -60\ \text{V} & 0.1<t<0.3 \\ 2\times 30 = 60\ \text{V} & 0.3<t<0.4 \end{cases}$$

Example M9

The current flowing through a 2-H inductance is shown below. Sketch the voltage, power, and stored energy versus time.



$$W(t) = \frac{1}{2} L i(t)^2$$

$$W(t) = i(t)^2$$

$$= (30t)^2 = 900t^2$$

$$= (-30t+6)^2 = 900t^2 - 360t + 36$$

$$= (30t - 12)^2 = 900t^2 - 720t + 144$$