MAE 140 HW 1. solution

1-15

$$i(t) = \begin{cases} 0 & t < 0 \\ 3e^{-2t} & t \geq 0 \end{cases}$$

for $t > 0$, $q(t) = \int_0^t 3e^{-2\tau}\, d\tau = -\frac{3}{2} e^{-2t} \Big|_0^t = \frac{3}{2}(1 - e^{-2t})$ (C)

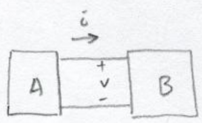
1-18

$P = i \cdot V$ (power = current × voltage)

$w = P \cdot t$ (Energy = power × time)

$$\Rightarrow t = \frac{w}{P} = \frac{w}{i \cdot V} = \frac{237.5 \times 10^3}{15 \times 10^{-3} \times 6} = 2.64 \times 10^6 \text{ (s)} = 30.5 \text{ days}$$

1-21



use passive sign convention.

$P_B = i \cdot v \qquad P_A = -i \cdot v$

			Power is transferred
(a)	$v = 11V, i = -1.1A$	$P_A = 12.1\,W$, $P_B = -12.1\,W$	$B \to A$
(b)	$v = 80V, i = 20mA$	$P_A = -1.6W$, $P_B = 1.6\,W$	$A \to B$
(c)	$v = -120V, i = -12mA$	$P_A = -1.44\,W$, $P_B = 1.44\,W$	$A \to B$
(d)	$v = -1.5V, i = -600\mu A$	$P_A = -0.9\,mW$, $P_B = 0.9\,mW$	$A \to B$

2-3

$P = i^2 \cdot R$, $i = \sqrt{\frac{P}{R}} = 1\ mA$

2-9

$P = \frac{V^2}{R} < 0.125\ W \Rightarrow |V| < \sqrt{0.125 \cdot R} = 111.8\ V$.

2-12

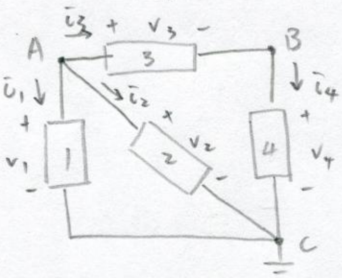
resistance	temperature
5 kΩ	25°C
340 Ω	100°C
1 kΩ	x°C

$$\frac{5000 - 1000}{25 - x} = \frac{5000 - 340}{25 - 100}$$

$\Rightarrow x = \underline{89.4}$

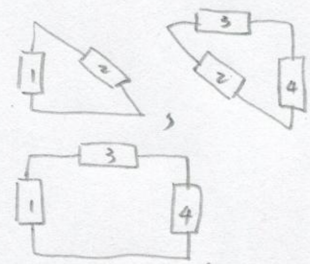
MAE 140 HW1 Solution

2-15



(a) nodes: A, B, C.

loops:



(just 2 of them will be enough)

(b) series: 3, 4

parallel: 1, 2

(c) KCL: $-i_1 - i_2 - i_3 = 0$,

$i_3 - i_4 = 0$

$i_1 + i_2 + i_4 = 0$

(just two of them will be enough)

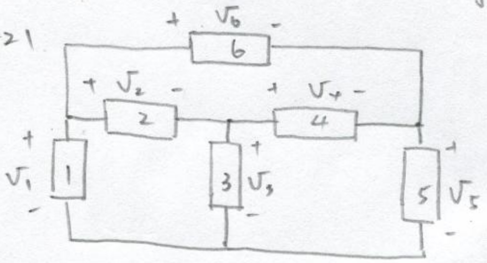
KVL: $V_1 - V_2 = 0$

$-V_2 + V_3 + V_4 = 0$

$-V_1 + V_3 + V_4 = 0$

(just two of them will be enough)

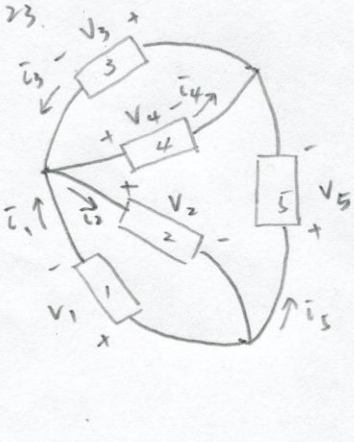
2-21



$V_2 = 10$, $V_4 = 5$, $V_5 = 15$

$$\left.\begin{aligned} V_2 + V_4 - V_6 &= 0 \\ V_4 + V_5 - V_3 &= 0 \\ V_2 + V_3 - V_1 &= 0 \end{aligned}\right\} \Rightarrow \begin{aligned} V_6 &= 15\ \text{V} \\ V_3 &= 20\ \text{V} \\ V_1 &= 30\ \text{V} \end{aligned}$$

2-23



(a) KVL:

$$\begin{cases} V_3 + V_4 = 0 \\ V_1 + V_2 = 0 \\ V_2 + V_5 - V_4 = 0 \end{cases}$$

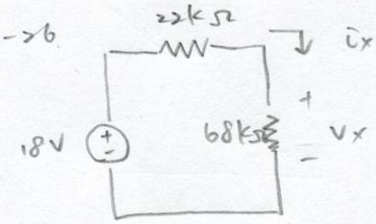
(b)

$V_4 = 0 \Rightarrow V_3 = 0$.

$V_2 = -V_5 = -V_1$.

MAE 140. HW1 Solution

2-26



$$i_x = \frac{V}{R_{total}} = \frac{18}{22k + 68k} = 0.2\ mA$$

$$V_x = 18V \cdot \frac{68k}{68k + 22k} = 13.6\ V.$$