# HW #1 solutions

**1-17.**

$i = e^{v} - 10$

$p = iv$

for $v = -2$, $P = -2 \cdot (e^{-2} - 10) =$ **19.73 W, absorbing**

for $v = 2$, $P = 2 \cdot (e^{2} - 10) =$ **-5.22 W, delivering**

for $v = 3$, $P = 3 \cdot (e^{3} - 10) =$ **30.26 W, absorbing.**

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**1-20**

$i = 2A$, $T = 4$ hrs, $v(t) = 12 - 2e^{-t}$

$$W = \int_0^T p\,dt = \int_0^T iv\,dt = 2\int_0^4 12 - 2e^{-t}\,dt$$

$$= 2 \cdot (12t + 2e^{-t})\Big|_0^4 = 2\left[48 + \frac{2}{e^4} - 2\right] = \boxed{92.1\text{ J}}$$

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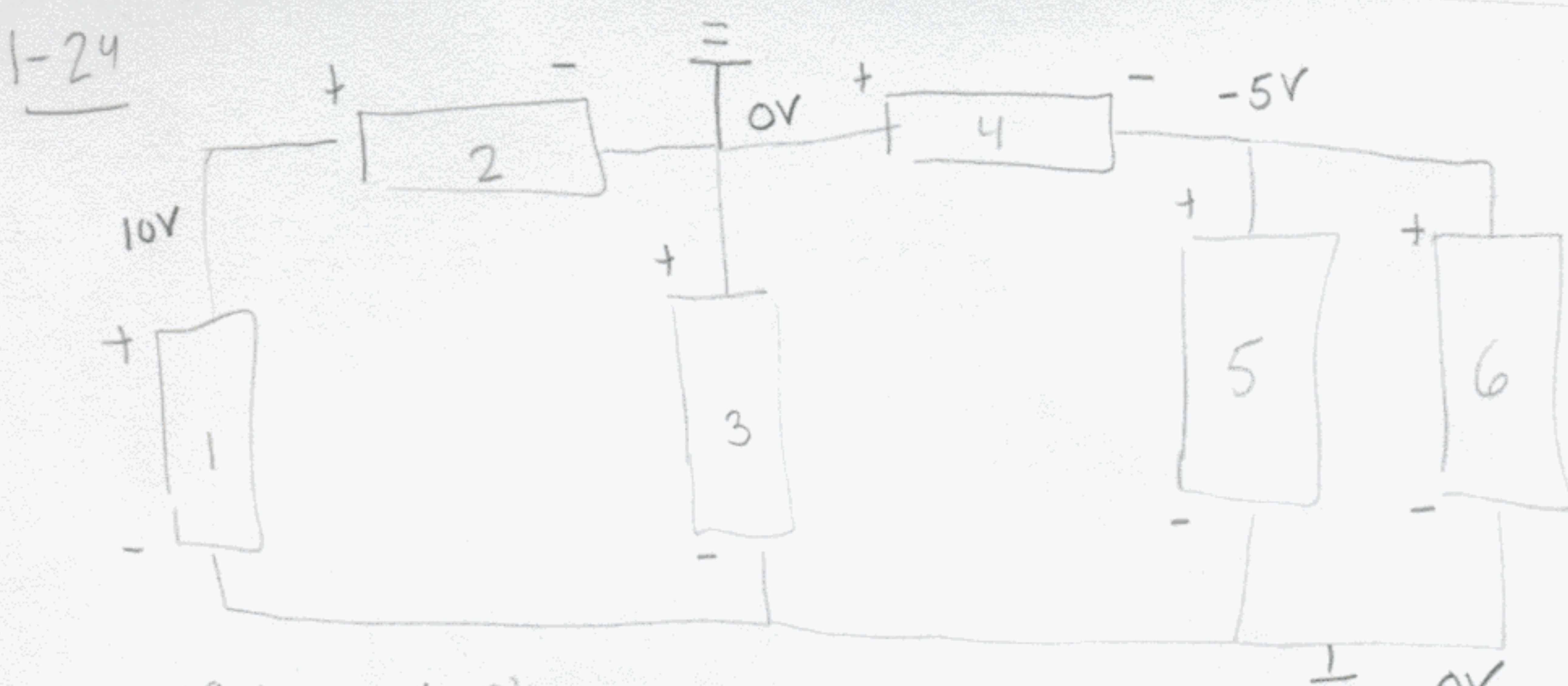
**1-24**




given: $V_4 = 5V$, $V_1 = 10V$

$V_2 = 10V$
$V_3 = 0V$
$V_5 = V_6 = -5V$

2.2

$P = I^2 R$ , $P = 12 \times 10^{-3}$ W , $R = 6.2 \times 10^3$

$$I = \sqrt{\frac{P}{R}} = \sqrt{\frac{12 \times 10^{-3}}{6.2 \times 10^{3}}} = \boxed{1.39 \text{ mA}}$$

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2.8

$R \in [10 , 100 \times 10^6]$ , $V_{max} = 500$V, $P_{max} = \frac{1}{4}$ W

$$P = \frac{V^2}{R} \qquad R_{crit} = \frac{V_{max}^2}{P_{max}} = 4 \cdot (500)^2 = 10^6 = \boxed{1 M\Omega = R_{crit}}$$

for $R < R_{crit}$, $\frac{V_{max}^2}{R} > P_{max}$ , so power is the limiting rating

for $R > R_{crit}$, $R \cdot P_{max} > V_{max}^2$ , so voltage is the limiting rating

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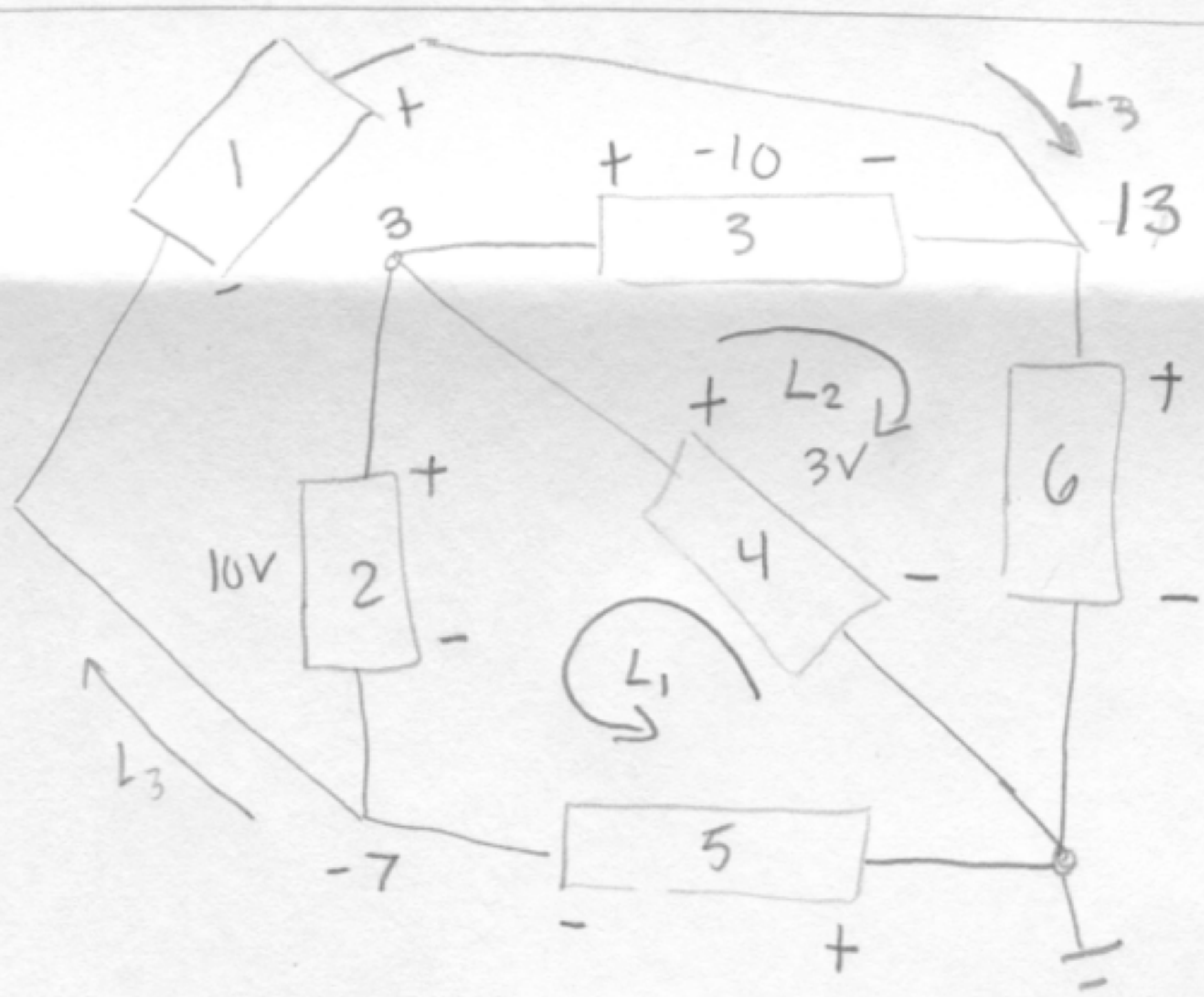
2.14




Given: $V_2 = 10$V

$V_3 = -10$V

$V_4 = 3$V

Find: $V_1, V_5, V_6$

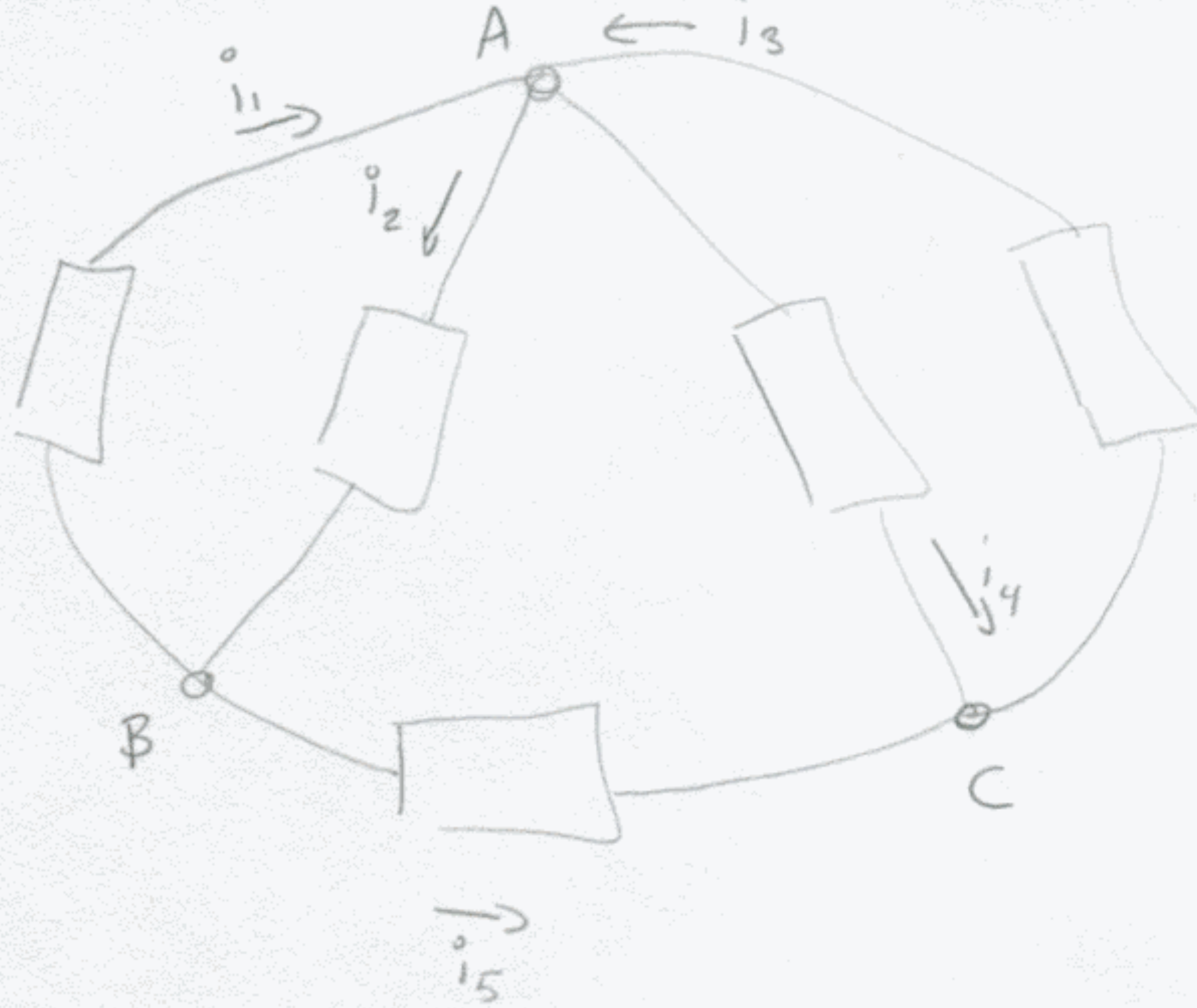
$$\boxed{V_1 = 20\text{V}, \ V_5 = 7\text{V}, \ V_6 = 13\text{V}}$$

KVL for $L_1$: $-V_4 + V_2 - V_5 = 0 \Rightarrow V_5 = 7$V

KVL for $L_2$: $-V_4 + V_3 + V_6 = 0 \Rightarrow V_6 = 13$V

KVL for $L_3$ (perimeter): $-V_1 + V_6 + V_5 = 0 \Rightarrow V_1 = 20$V

2-17




$i_2 = 10mA$, $i_3 = -15mA$, $i_4 = 5mA$ Find $i_1$ + $i_5$

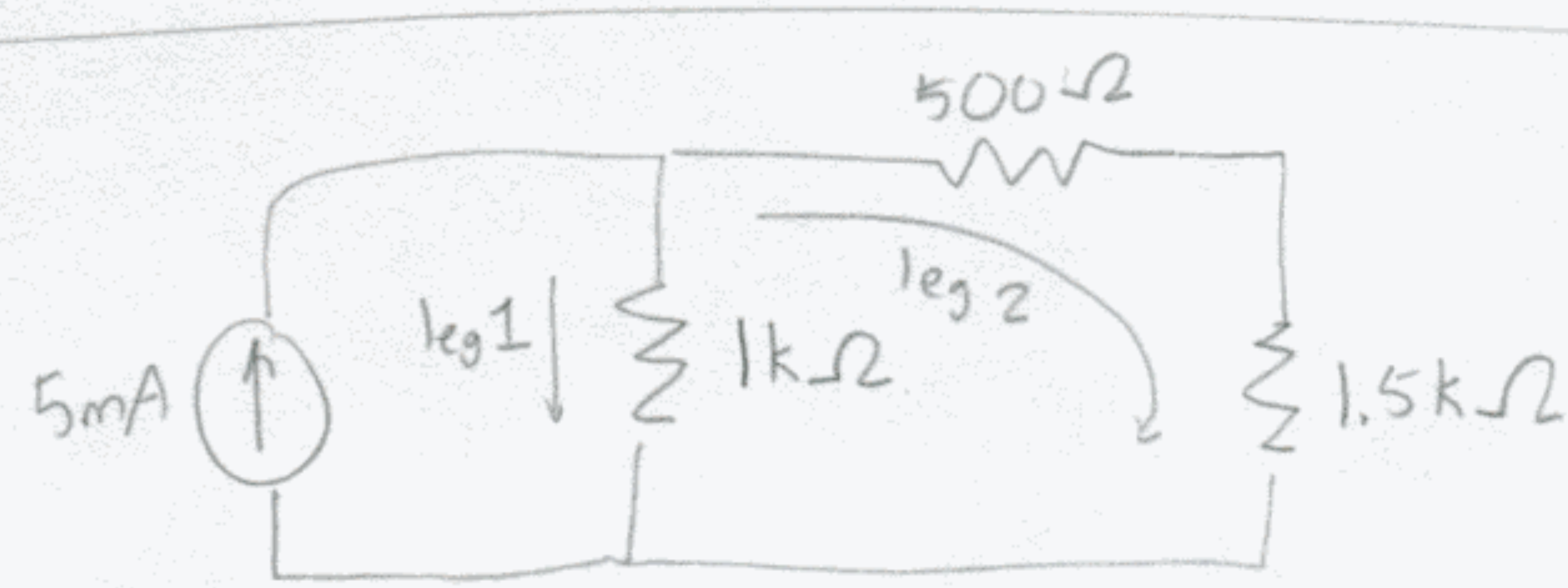
at A: $i_{in} = i_{out}$ $i_1 + i_3 = i_2 + i_4$

$i_1 - 15 = 10 + 5 \Rightarrow \boxed{i_1 = 30mA}$

at B: $i_{in} = i_{out}$ $i_2 = i_1 + i_5$

$10 = 30 + i_5 \Rightarrow \boxed{i_5 = -20mA}$

2-23




Find the power dissipated in the 1.5kΩ resistor.

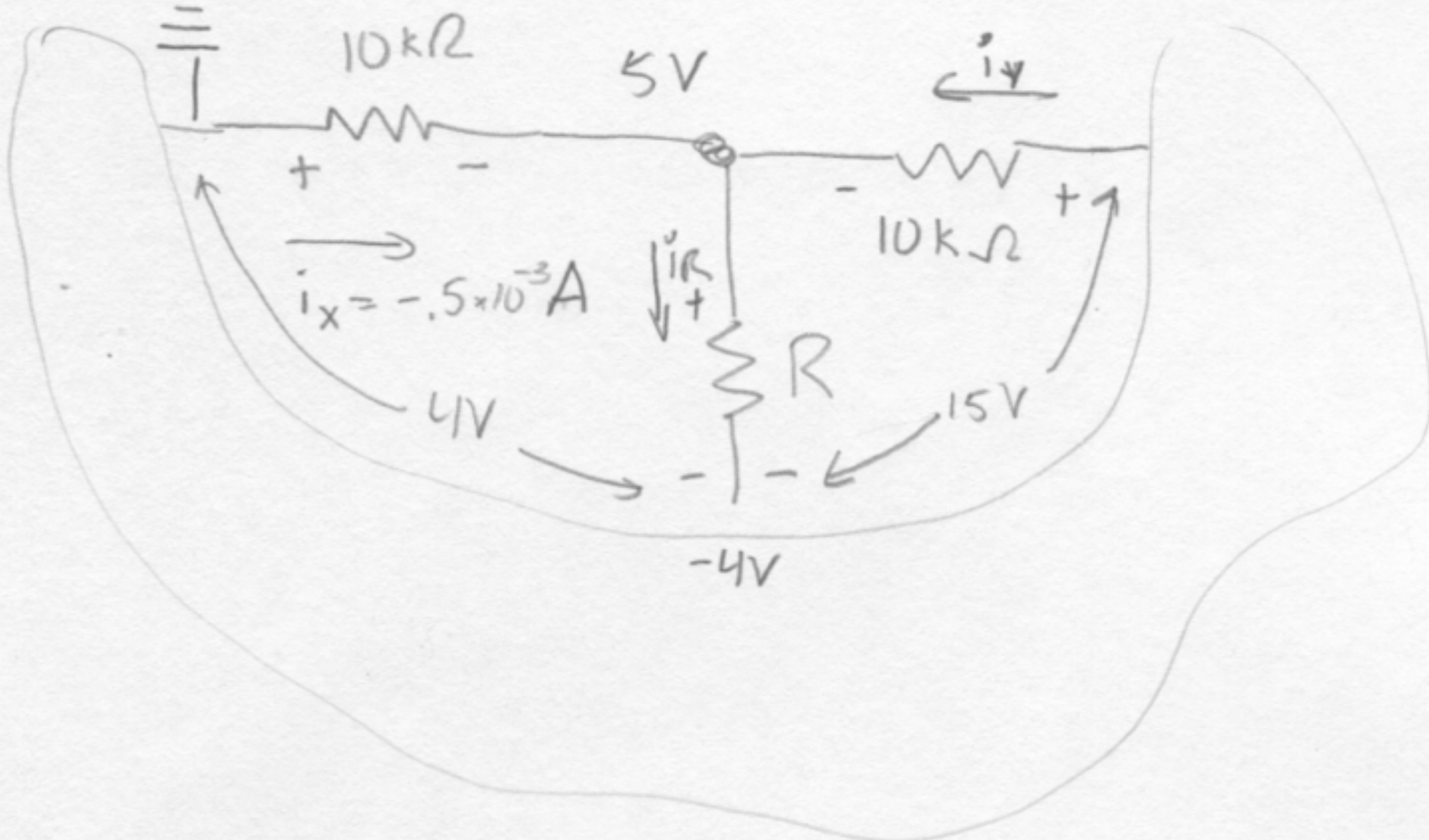
$$R_{eq} = \frac{1}{\frac{1}{1000} + \frac{1}{2000}} = \frac{1}{\frac{2}{2000} + \frac{1}{2000}} = \frac{2000}{3} = 666.67\Omega$$

$V = IR = 5\times10^{-3} \cdot 666.67 = 3.33V$ dropped across each leg

current through leg 2: $I = \frac{V}{R} = \frac{3.33}{2000} = 1.67mA$

power through resistor: $P = I^2R = (1.67\times10^{-3})^2 \cdot 1.5\times10^3 = \boxed{4.167mW}$

## 2-25




Find R

voltage across left resistor $V = iR = -.5\times10^{-3}\ 10\times10^{3} = -5V$ (OHm's)

(KVL)

voltage across R is $5 - -4 = 9V$ (KVL)

voltage across right resistor $V_R + V_{right} = 15$ $V_{right} = 6$ (Ohm's)

current through right resistor: $i = \frac{V}{R} = \frac{6}{10\times10^3} = 6\times10^{-4}$ A (KCL)

current through R: $i_{in} = i_{out}$

$$i_R = i_y + i_x$$
$$= -.5\times10^{-3} + .6\times10^{-3}$$
$$= .1\times10^{-3} A$$

$$\boxed{R = \frac{V}{I} = \frac{9}{.1\times10^{-3}} = 90k\Omega}$$

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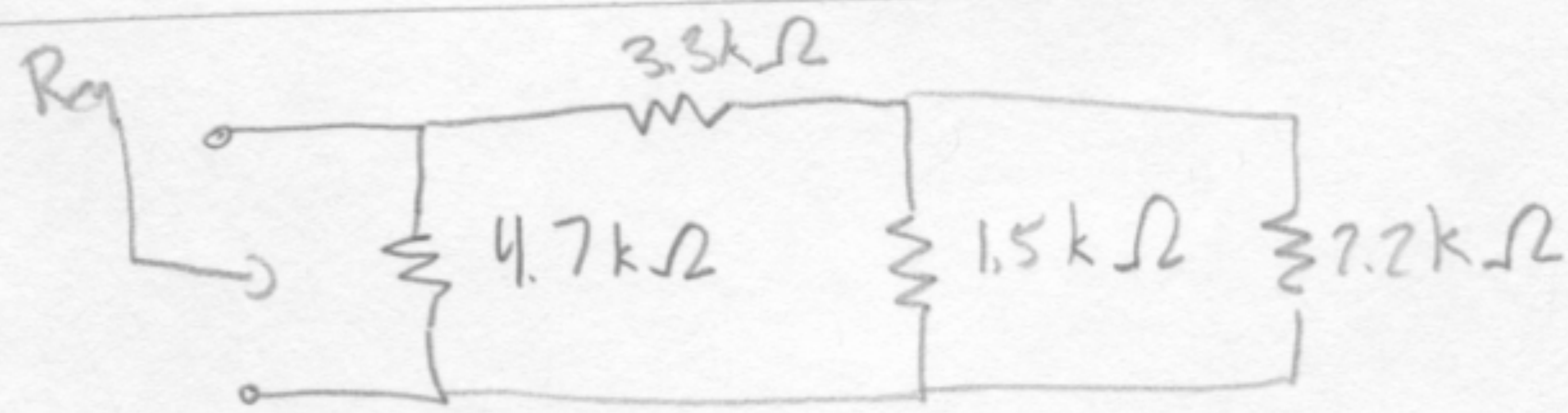
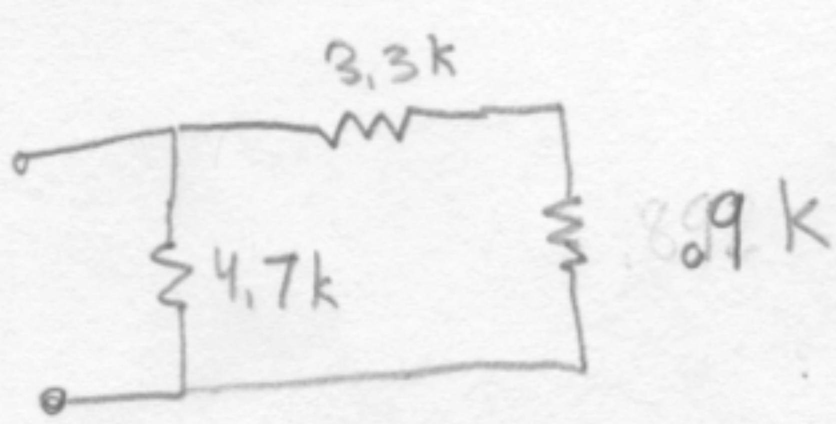
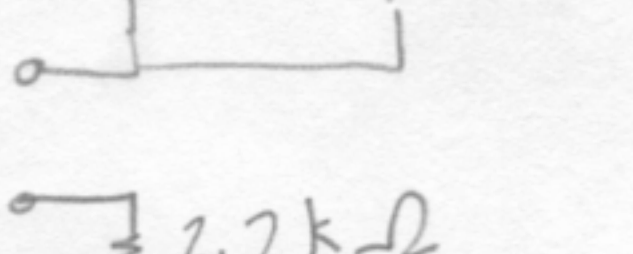
## 2-28 Find Req




$$\frac{1}{\frac{1}{1.5k} + \frac{1}{2.2k}}$$




3.3k + .9k

$$R_{eq} = \frac{1}{\frac{1}{4.2k} + \frac{1}{4.7k}} = \boxed{2.2k\Omega}$$