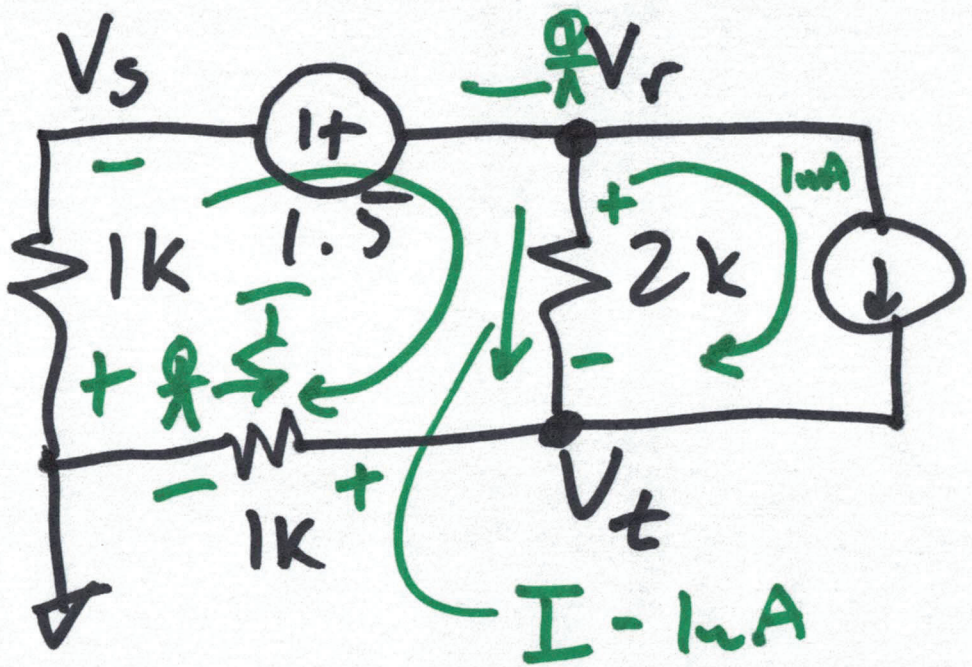
EE 220 Circuits I

Lecture 11

October 4, 2023



$V_t = +1k\,I$

$V_s = -1k\,I$

$V_r = +1k\,I + 2k(I - 1mA)$

$= -1k\,I + 1.5V$

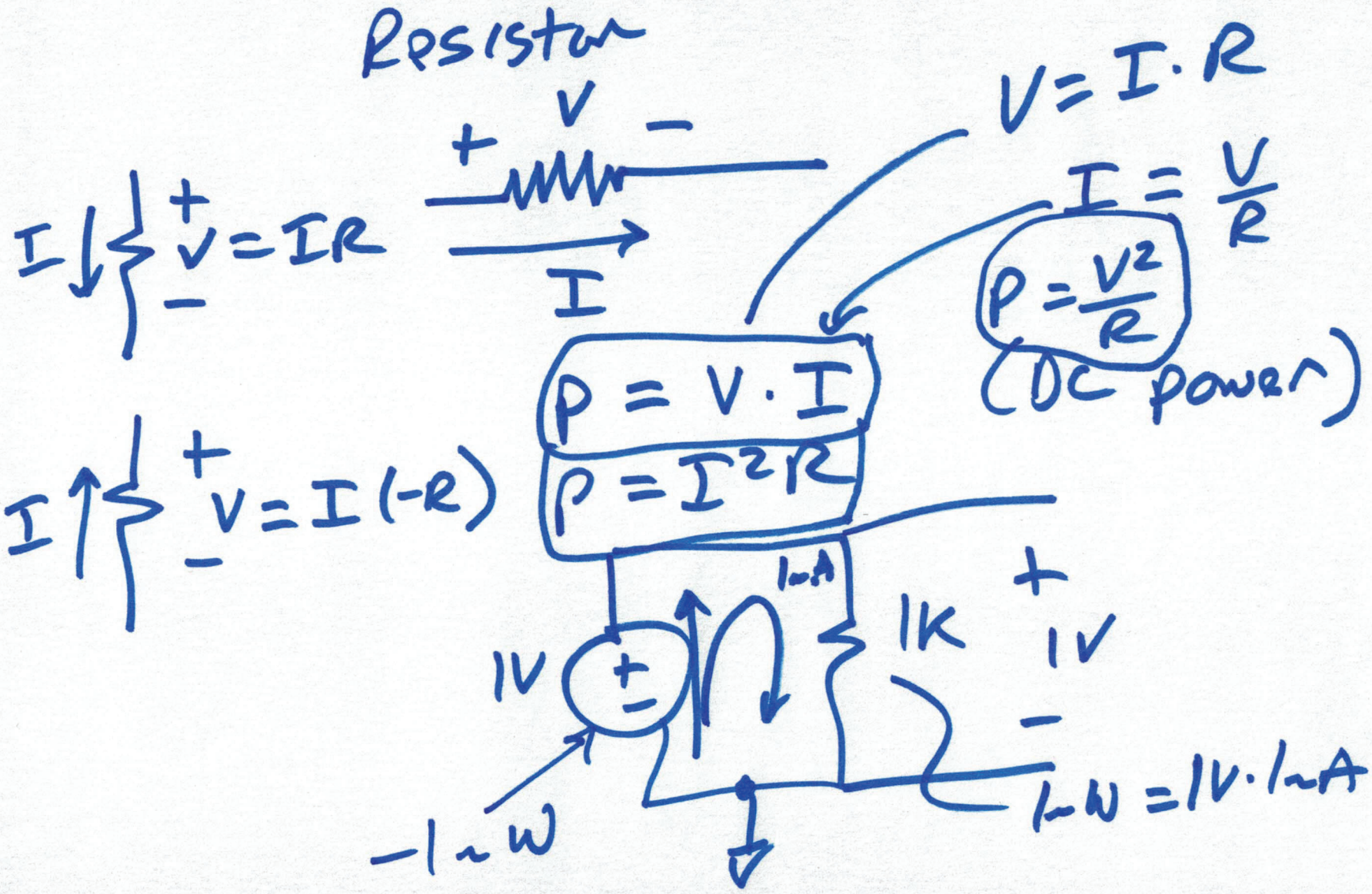
$+1k\,I + 1k \cdot I + 2k(I - 1mA) - 1.5 = 0$

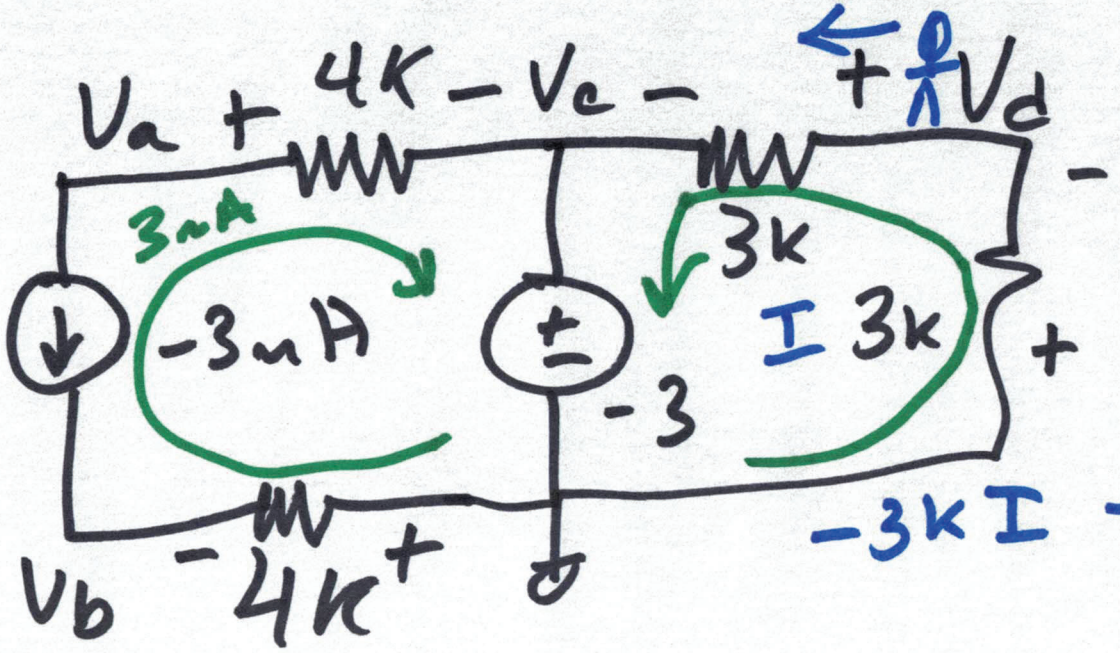
$I(1k + 1k + 2k) - 3.5 = 0$

$I = \frac{3.5}{4K}$

$V = \frac{3.5}{4}\,mA$

Power & Energy





Q1

$-3kI - (-3) - 3kI = 0$

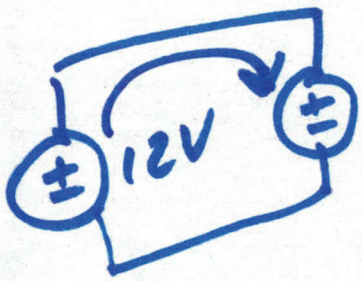
$I = \frac{3}{6k}$

$I = \frac{1}{2}mA$

4K power

$P = I^2R$

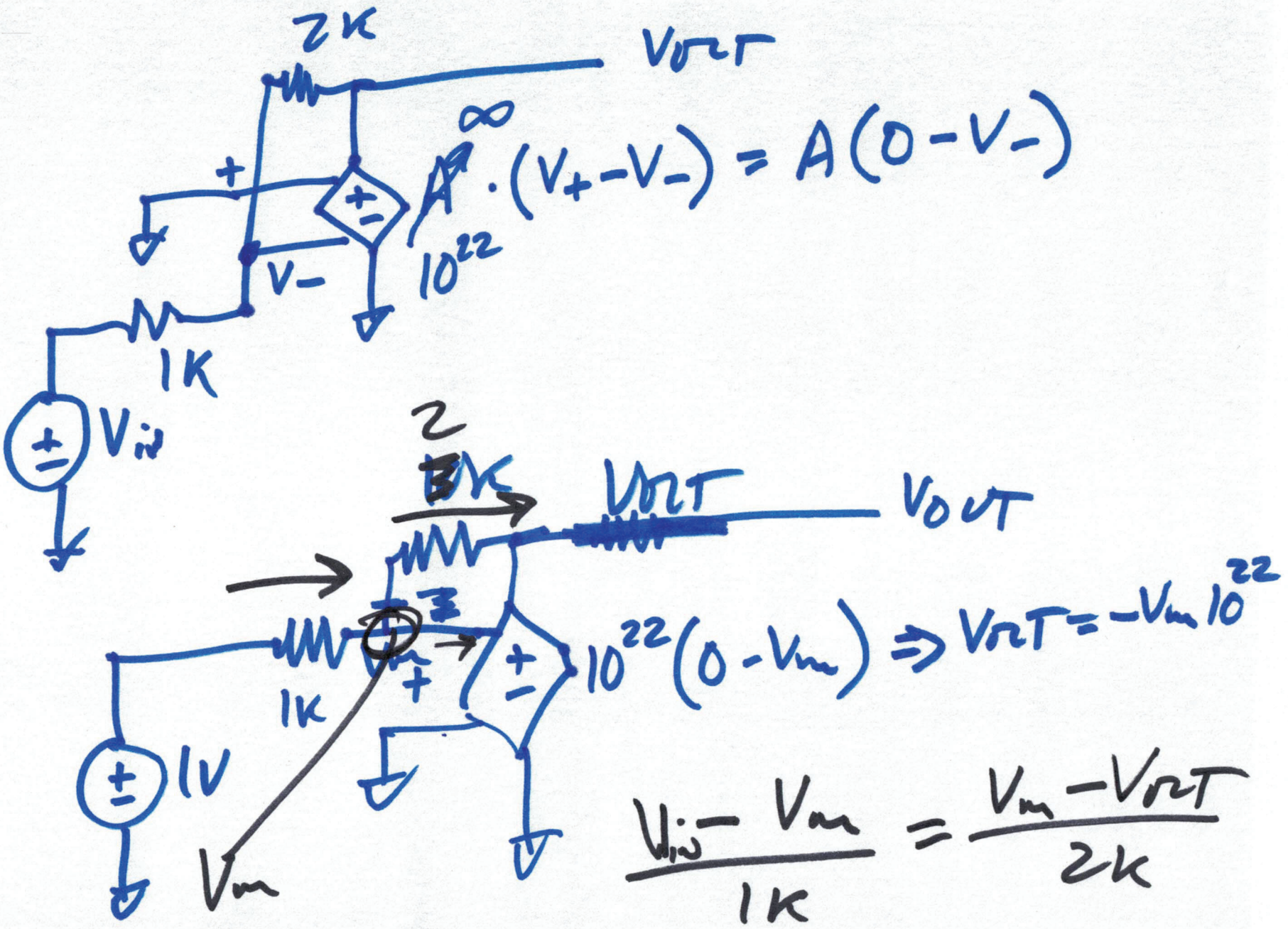
$V = (3mA)^2 4k = 36mW$



3K

$P = I^2R \rightarrow (\frac{1}{2}mA)^2 \cdot 3k = \frac{1}{2}\frac{1}{2}mA \cdot 3$

$= \frac{3}{4}mW$


2K
V_{OUT}
∞
$A \cdot (V_+ - V_-) = A(0 - V_-)$
+
V_-
10^{22}
1K
V_{in}
2K
V_{OUT}
V_{OUT}
$10^{22}(0 - V_m) \Rightarrow V_{OUT} = -V_m 10^{22}$
1K
1V
V_m
$\frac{V_{in} - V_m}{1K} = \frac{V_m - V_{OUT}}{2K}$

$$\left(\frac{V_{IN}-V_m}{1K}\right)^{2K} = \left(\frac{V_m - V_{OUT}}{2K}\right)^{2K}$$

$$V_{OUT} = -10^{22} \cdot V_m$$

$$2V_m + 2V_{IN} - 2V_m = V_m - V_{OUT} + 2V_m \qquad V_m = \frac{V_{OUT}}{-10^{22}}$$

$$2V_{IN} = 3V_m - V_{OUT}$$

$$V_{OUT} = 3\left(\frac{V_{OUT}}{-10^{22}}\right) - 2V_{in} \qquad \left(\frac{V_{OUT}}{-10^{22}} \to 0\right)$$

$$V_{OUT} = -2V_{in}$$

Operational - Amplifier (Op-Amp)