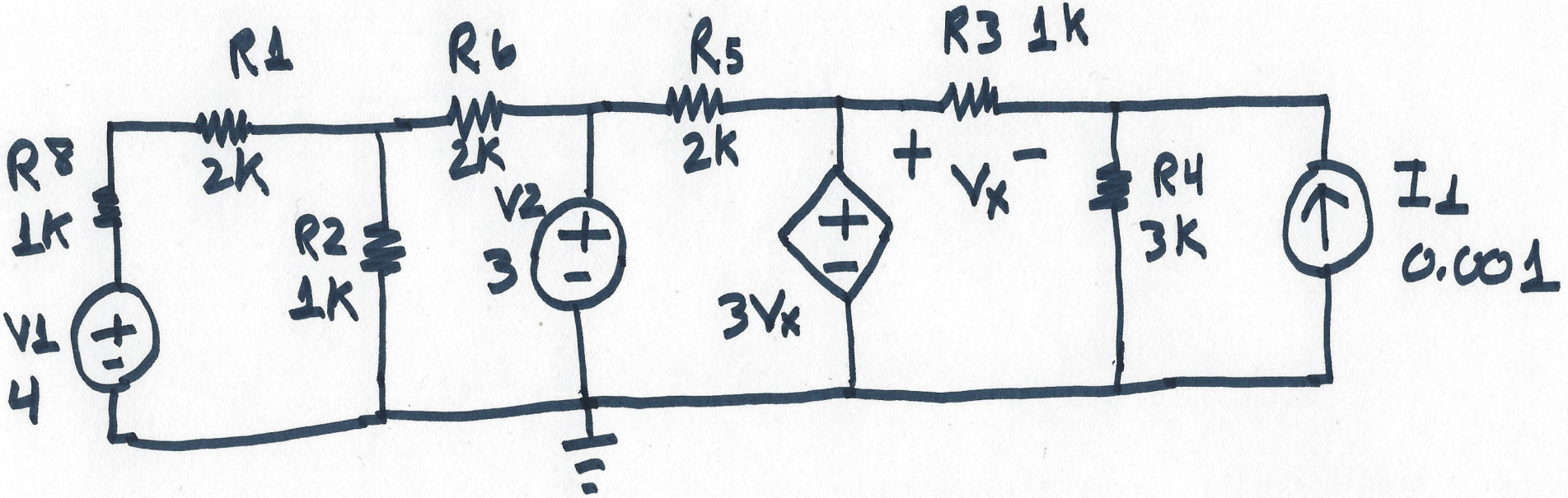
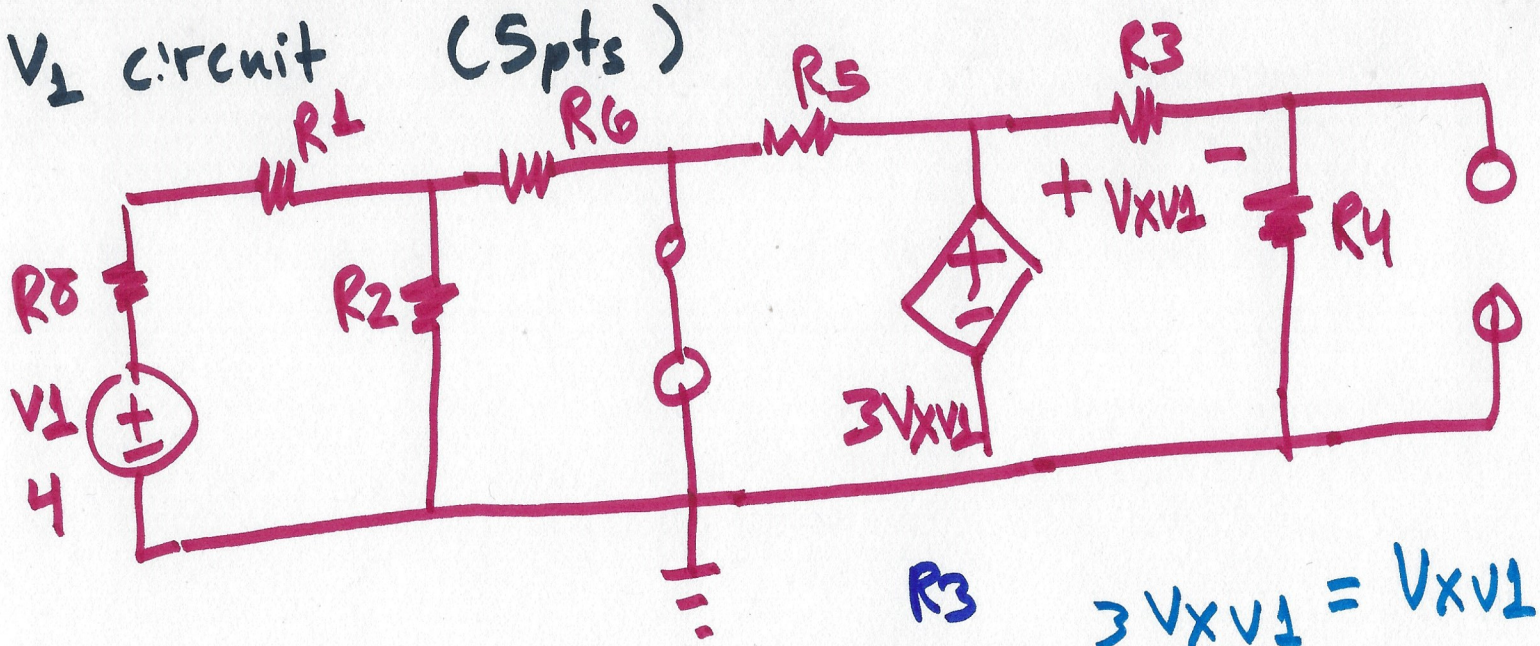
#3) Circuit Analysis II - Superposition/Dependent Sources (16 points)

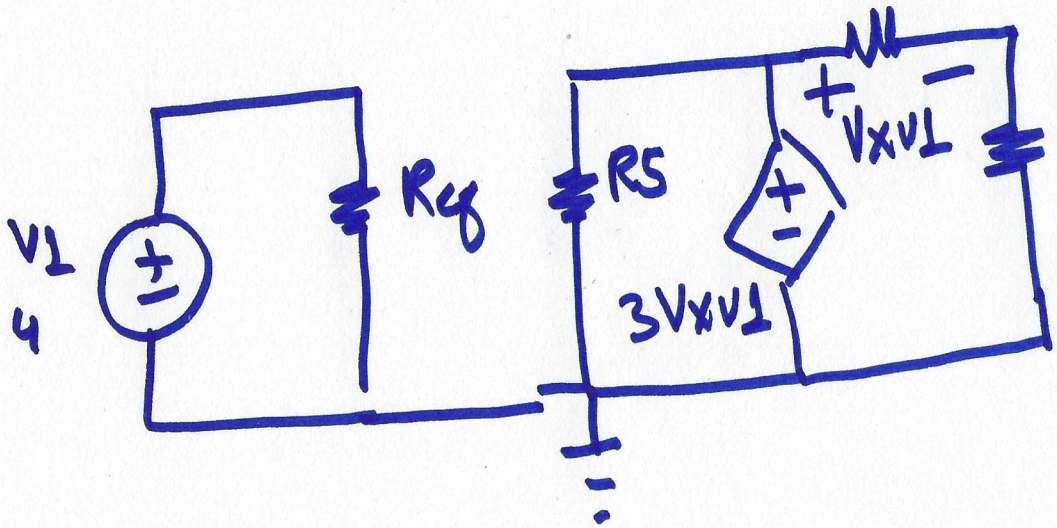


Use Superposition to determine the voltage V_x in the above circuit. Include a schematic of the circuit associated with each source.

V_1 circuit (5pts)



$\frac{R_4}{R_3+R_4} V_{xV1}$

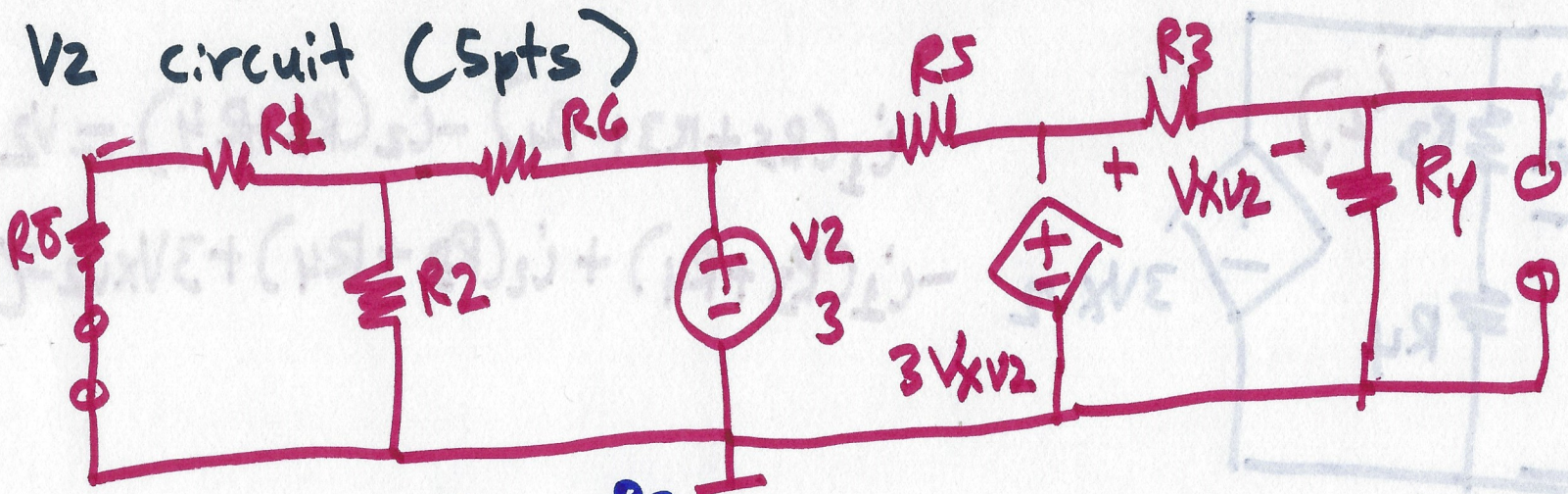


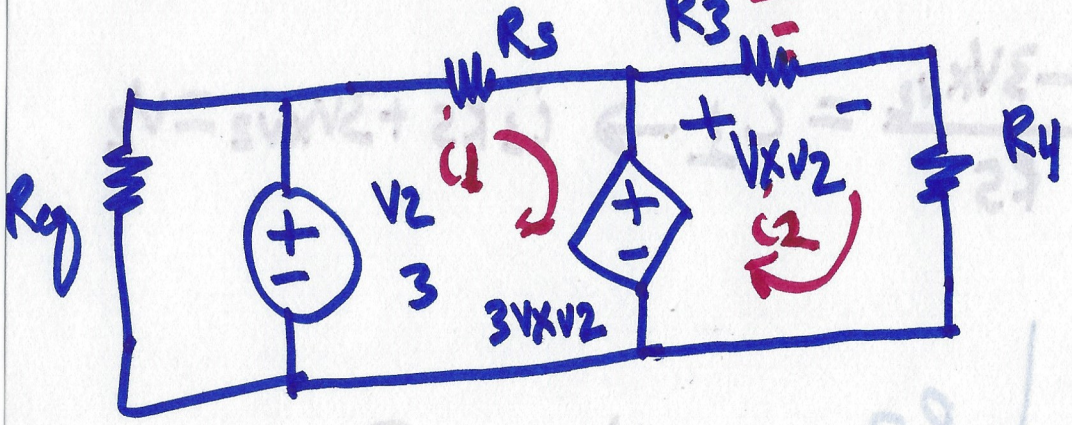
$3V_{xV1} = V_{xV1} + V_{R4}$

$R_4 = \frac{3}{4} V_{xV1}$

$V_{xV1} = 0$

V2 circuit (5pts)





$i_1 R_5 + 3V_{xv2} = V_2$ (1)

$(R_3+R_4) i_2 - 3V_{xv2} = 0$ (2)

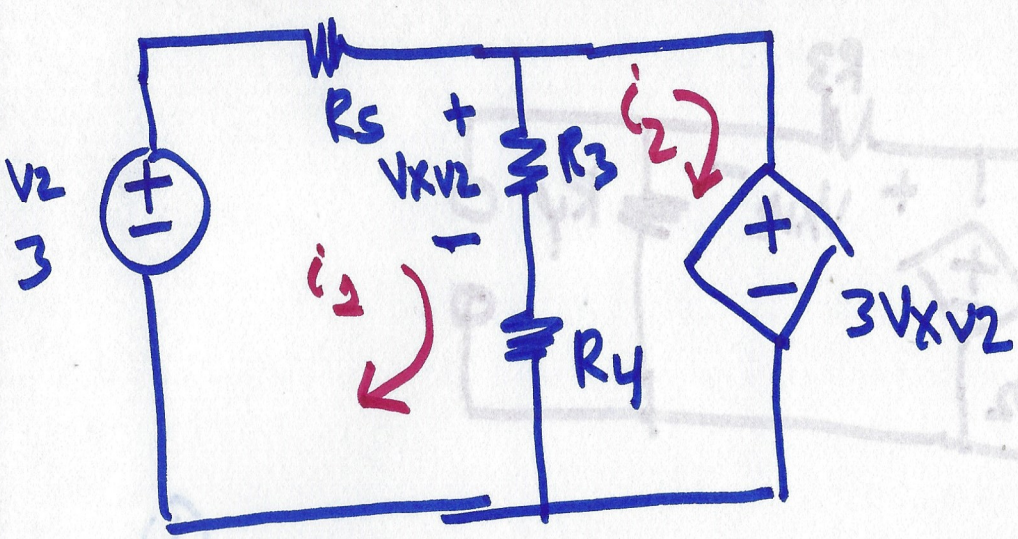
$i_2 R_3 = V_{xv2}$

$\rightarrow i_2 R_3 - 3V_{xv2} = 0$ (3)

$i_1 = 0.0015$

$i_2 = 0$

$V_{xv2} = 0$



$$i_1(R_S+R_3+R_4)-i_2(R_3+R_4)=V_2$$

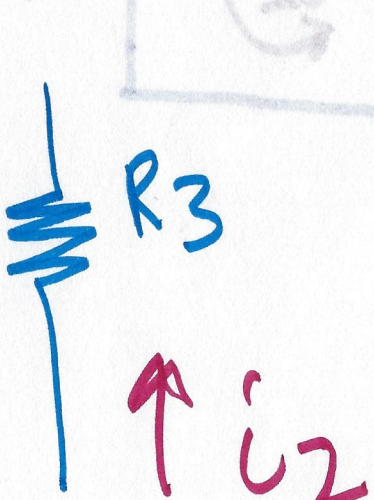
$$-i_1(R_3+R_4)+i_2(R_3+R_4)+3V_{xv2}=0$$

$$\frac{V_2-3V_{xv2}}{R_S}=i_1 \rightarrow i_1R_S+3V_{xv2}=V_2$$

$i_1 = 0.0015$

$i_2 = 0.0015$

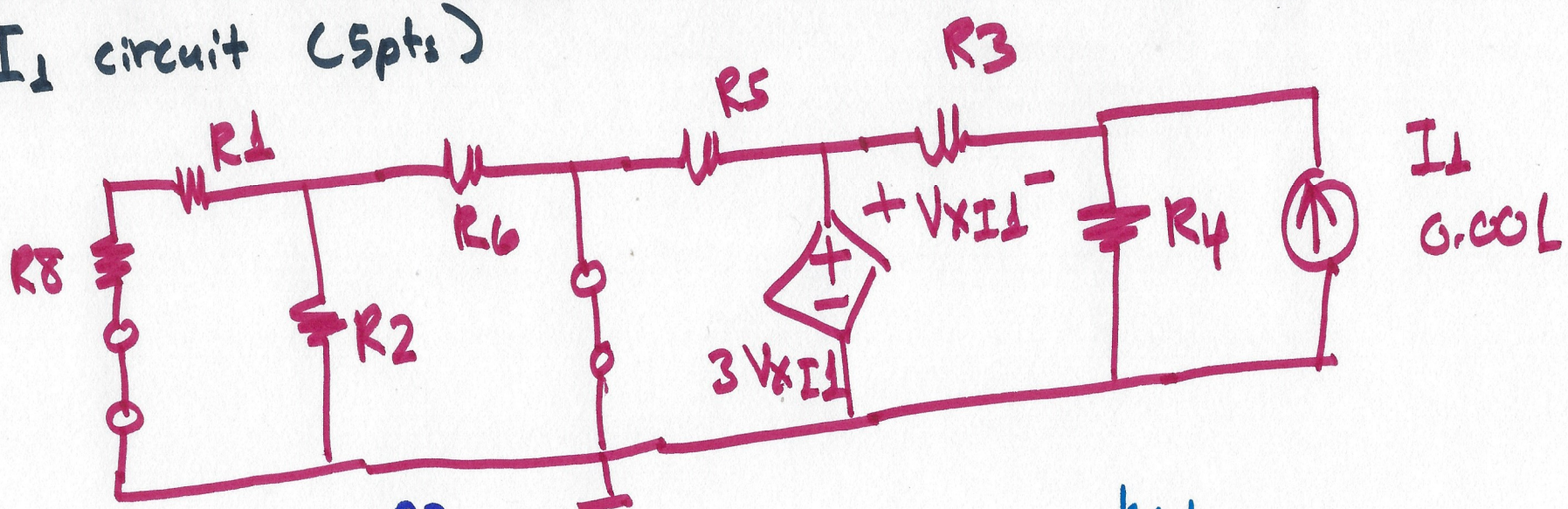
$V_{xv2} = 0$

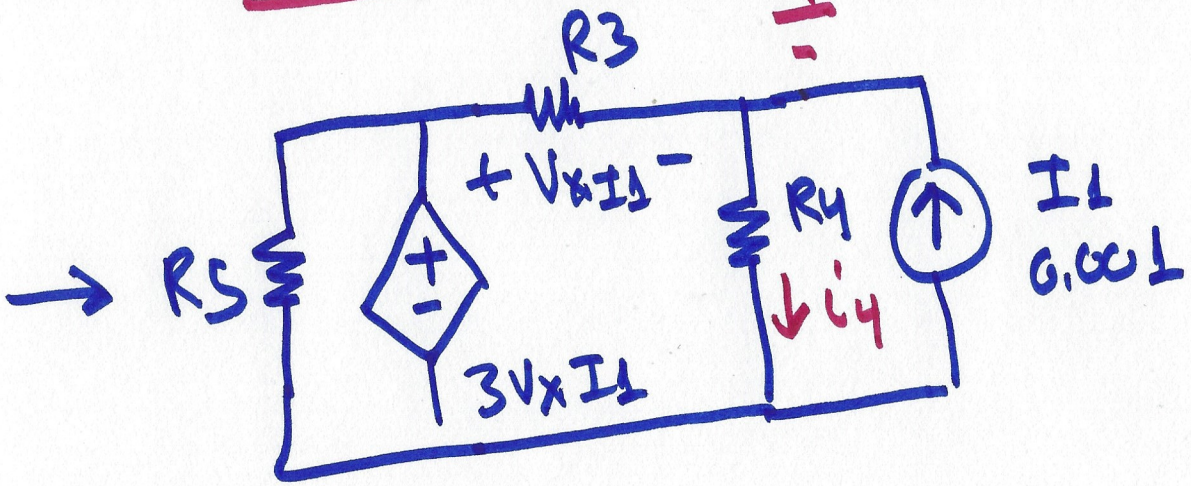


$V_3 = 0$

$V_{xv2} = 0$

I_1 circuit (5pts)





KCL

$$I_1 + \frac{V_x I_1}{R_3} = i_4$$

KVL: $3V_x I_1 = V_x I_1 + i_4 R_4 = V_x I_1 + R_4\left[I_1 + \frac{V_x I_1}{R_3}\right]$

$$\rightarrow \quad V_x I_1 = \frac{R_4 I_1}{3 - \left(1 + \frac{R_4}{R_3}\right)} = -3V$$

$$2V_x I_1 = R_4\left[I_1 + \frac{V_x I_1}{R_3}\right]$$

$$\boxed{V_x I_1 = -3V}$$

Voltage across V_x (include polarity) (1pt)

$$V_x = V_{xv1} + V_{xv2} + V_{xI_1}$$

$$= -3V$$