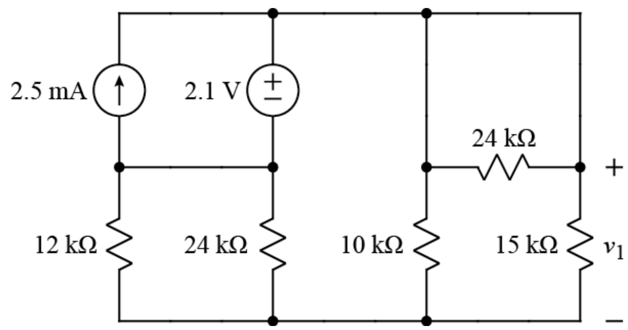
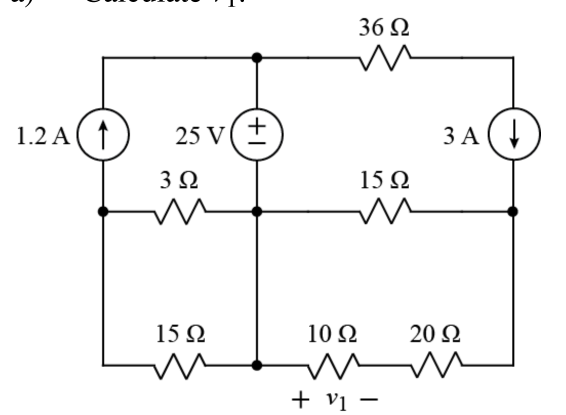
Homework 5

1.

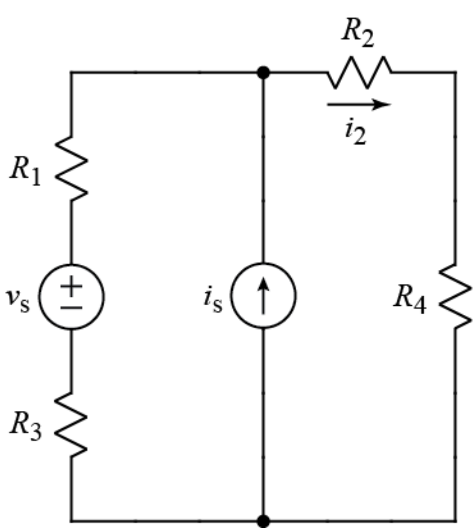


a) Calculate v_1.



b) Calculate v_1.

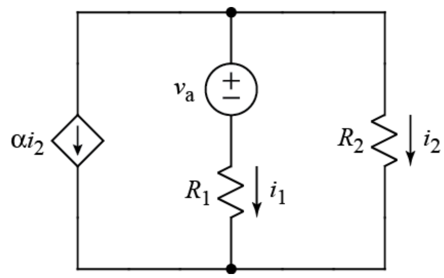
2.



a) Derive an expression for i_2. The expression must not contain more than the circuit parameters v_s, i_s R_1, R_2, R_3 and R_4.

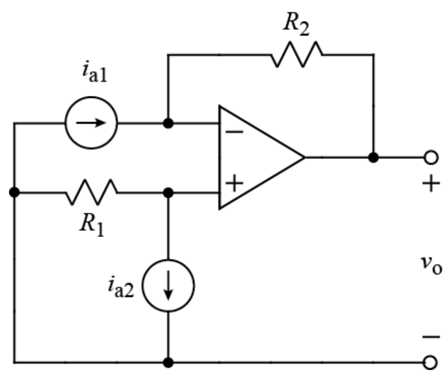
b) Derive an expressions for the power dissipated by resistor R_4. The expression must not contain more than the circuit parameters v_s, i_s R_1, R_2, R_3 and R_4.

2. (cont.)



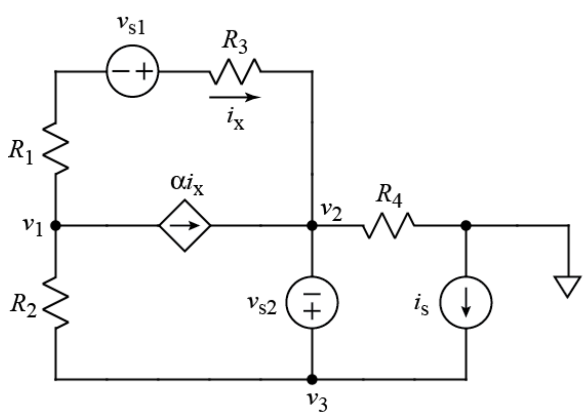
c) Derive an expression for i_1. The expression must not contain more than the circuit parameters v_a, R_1, R_2, and α. **Note:** $\alpha > 0$.

3.



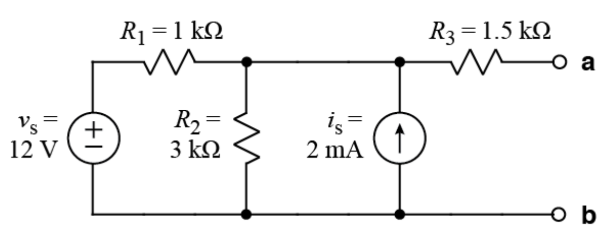
The op-amp operates in the linear mode. Using an appropriate model of the op-amp, derive an expression for v_o in terms of not more than i_{a1}, i_{a2}, R_1, and R_2.5.

4.



For the circuit shown, write three independent equations for the node voltages v_1, v_2, and v_3. The quantity i_x must not appear in the equations.

5.



Find the Thevenin equivalent circuit at terminals a-b.

Ans: 1.a) $v_1 = 0.9\text{V}$ b) $v_1 = -10\text{V}$

2.a) $i_2 = \dfrac{i_s(R_1+R_3)+v_s}{R_1+R_2+R_3+R_4}$ b) $p = \left(\dfrac{i_s(R_1+R_3)+v_s}{R_1+R_2+R_3+R_4}\right)^2 R_4$ c) $i_1 = -\dfrac{v_a}{R_1+\dfrac{R_2}{1+\alpha}}$

3. $v_o = -i_{a2}R_1 - i_{a1}R_2$

4. $$\frac{v_1+v_{s1}-v_2}{R_1+R_3}+\alpha\frac{v_1+v_{s1}-v_2}{R_1+R_3}+\frac{v_1-v_3}{R_2}=0\,\text{A}$$

$$v_2+v_{s2}=v_3$$

$$\frac{v_2-v_{s1}-v_1}{R_1+R_3}+\alpha\frac{v_2-v_{s1}-v_1}{R_1+R_3}+\frac{v_2}{R_4}+\frac{v_3-v_1}{R_2}-i_s=0\,\text{A}$$

5. $v_{Th} = 10.5\text{V}$ $R_{Th} = R_3 + R_1 \parallel R_2$