Ex:

$R_1 = 390\ \Omega$ $R_2 = 110\ \Omega$ $R_3 = 2\ k\Omega$

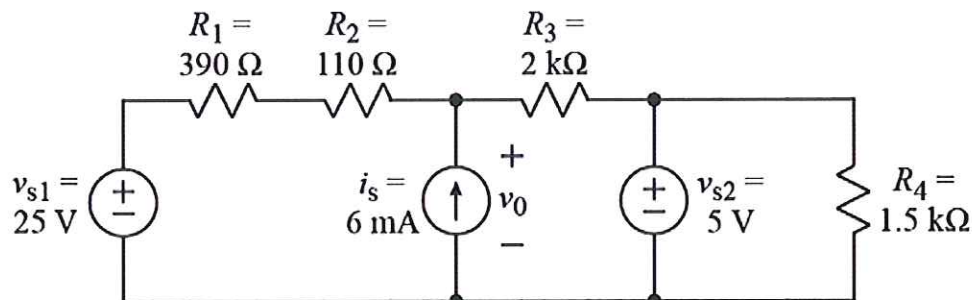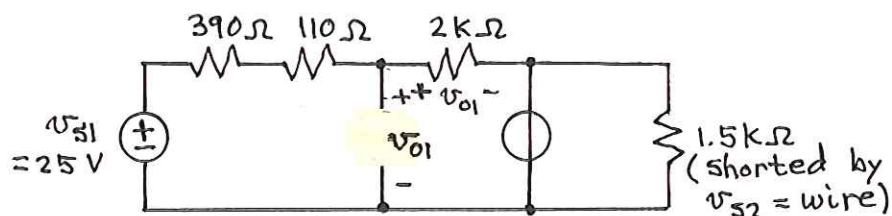$v_{s1} = 25\ V$ $i_s = 6\ mA$ v_0 $v_{s2} = 5\ V$ $R_4 = 1.5\ k\Omega$

Using superposition, find the numerical value for v_0. Note: you must show enough work to demonstrate your understanding of superposition.

sol'n: We turn on one source at a time.
 v-src off = wire (for 0V)
 i-src off = open (for 0A)

case I: v_{s1} on, v_{s2} off, i_s off

$390\,\Omega$ $110\,\Omega$ $2\,k\Omega$

$+ \, ^+ v_{o1} \, ^-$

$v_{s1} = 25\,V$ v_{o1}

$1.5\,k\Omega$ (shorted by v_{s2} = wire)

Inspection reveals that v_{o1} is across the $2k\Omega$. The circuit is a v-divider.

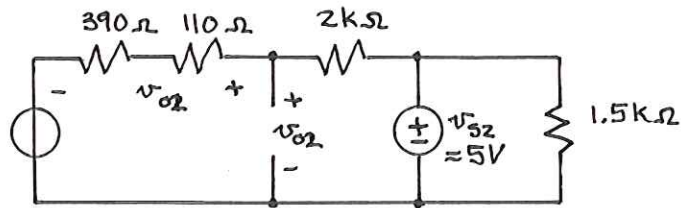$$v_{o1} = v_{s1} \cdot \frac{2k\Omega}{390\,\Omega + 110\,\Omega + 2k\Omega} = 25V \cdot \frac{2k\Omega}{2.5\,k\Omega}$$

or

$$v_{o1} = 25V \cdot \frac{4}{5}$$

or

$$v_{o1} = 20\,V$$

case II: v_{S1} off, v_{S2} on, i_s off

The 1.5 kΩ resistor on the right is across v_{S2} and plays no role in v_{o2}.
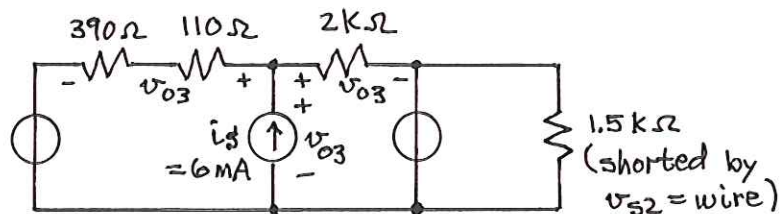
Inspection reveals that v_{o2} is across the resistors on the top left. The circuit is a v-divider.

$$v_{o2} = v_{S2} \cdot \frac{390\,\Omega + 110\,\Omega}{390\,\Omega + 110\,\Omega + 2\,k\Omega} = 5V \cdot \frac{500\,\Omega}{2.5\,k\Omega}$$

or

$$v_{o2} = 1V$$

case III: v_{S1} off, v_{S2} off, i_s on

The $390\,\Omega + 110\,\Omega$ on the left and $2\,k\Omega$ on the right are in parallel with v_{o3} across them. The parallel resistance is driven by i_s.

$$v_{o3} = i_s \cdot (390\,\Omega + 110\,\Omega) \| 2\,k\Omega = 6mA \cdot 400\,\Omega$$

or

$$v_{o3} \approx 2.4\,V$$

Sum the v_o's: $v_o = v_{o1} + v_{o2} + v_{o3} = 20V + 1V + 2.4V = 23.4V$