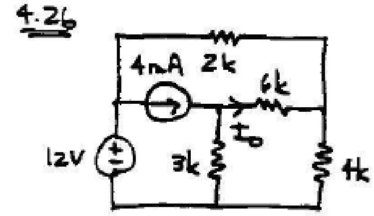
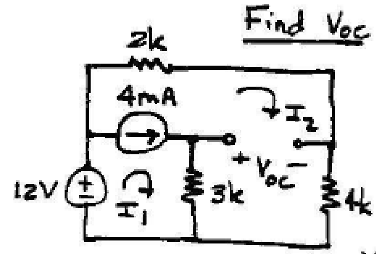
4.26



Find V_{oc}



$I_1 - I_2 = 4mA$

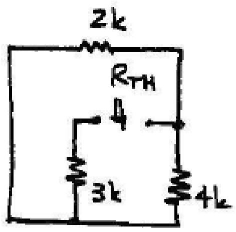
$12 = (2k) I_2 + 4k(I_2)$

So, $I_2 = 2mA$ & $I_1 = 6mA$

$V_{oc} = 3k(I_1 - I_2) - 4k(I_2)$

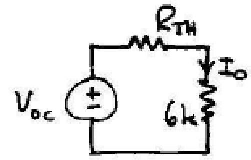
$V_{oc} = 4V$

Find R_{TH}



$R_{TH} = 3k + (2k // 4k)$

$R_{TH} = 4.33k\Omega$



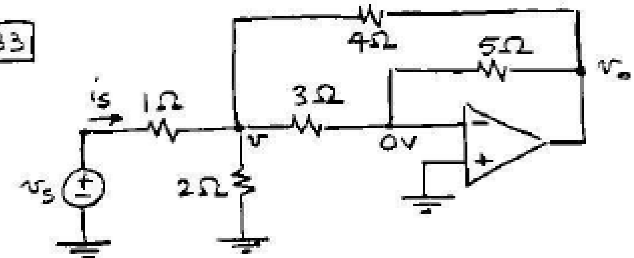
$$I_o = \frac{V_{oc}}{R_{TH} + 6k}$$

$$\boxed{I_o = 0.39mA}$$

P2.17. $R_{eq} = 6\,\Omega$ and $100 = \frac{V_T^2}{4 \times 6} \Rightarrow V_T = 49.0\,V$

$$i = \frac{49.0}{6+3} = 5.44A$$

2.33



(a)

By KCL at node v,

$$\frac{v-v_s}{1}+\frac{v}{2}+\frac{v}{3}+\frac{v-v_o}{4}=0$$

$$12v-12v_s+6v+4v+3v-3v_o=0$$

$$25v-3v_o=12v_s$$

By KCL at the inverting input of the op amp,

$$\frac{v}{3}+\frac{v_o}{5}=0$$

$$5v+3v_o=0$$

$$5v=-3v_o$$

$$v=-\frac{3}{5}v_o$$

$$25\left(-\frac{3}{5}v_o\right)-3v_o=12v_s$$

$$-15v_o-3v_o=12v_s$$

$$-18v_o=12v_s$$

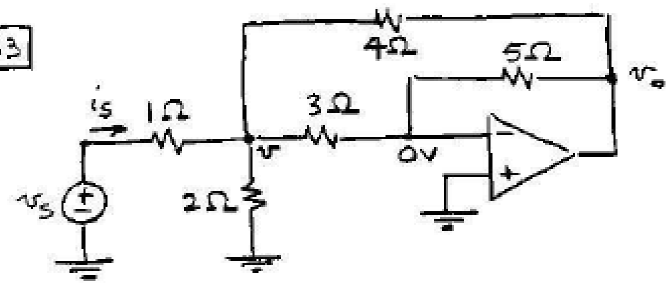
$$v_o=-\frac{12}{18}v_s=\underline{\underline{-\frac{2}{3}v_s}}$$

(b) $v=-\frac{3}{5}v_o=-\frac{3}{5}\left(-\frac{2}{3}v_s\right)=\frac{2}{5}v_s$

$$i_s=\frac{v_s-v}{1}=\frac{v_s-\frac{2}{5}v_s}{1}=\frac{3}{5}v_s$$

$$\therefore R_{in}=\frac{v_s}{i_s}=\underline{\underline{\frac{5}{3}\,\Omega}}$$

2.33



(a)

By KCL at node v,

$$\frac{v - v_s}{1} + \frac{v}{2} + \frac{v}{3} + \frac{v - v_o}{4} = 0$$

$$12v - 12v_s + 6v + 4v + 3v - 3v_o = 0$$

$$25v - 3v_o = 12v_s$$

By KCL at the inverting input of the op amp,

$$\frac{v}{3} + \frac{v_o}{5} = 0$$

$$5v + 3v_o = 0$$

$$5v = -3v_o$$

$$v = -\frac{3}{5}v_o$$

$$25\left(-\frac{3}{5}v_o\right) - 3v_o = 12v_s$$

$$-15v_o - 3v_o = 12v_s$$

$$-18v_o = 12v_s$$

$$v_o = -\frac{12}{18}v_s = \underline{\underline{-\frac{2}{3}v_s}}$$

(b) $v = -\frac{3}{5}v_o = -\frac{3}{5}\left(-\frac{2}{3}v_s\right) = \frac{2}{5}v_s$

$$i_s = \frac{v_s - v}{1} = \frac{v_s - \frac{2}{5}v_s}{1} = \frac{3}{5}v_s$$

$$\therefore R_{in} = \frac{v_s}{i_s} = \underline{\underline{\frac{5}{3}\,\Omega}}$$