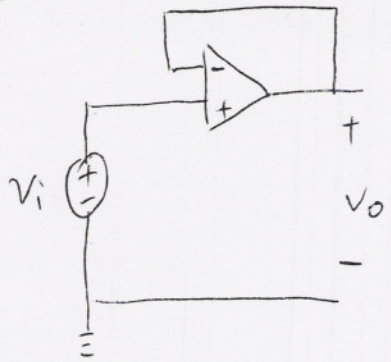
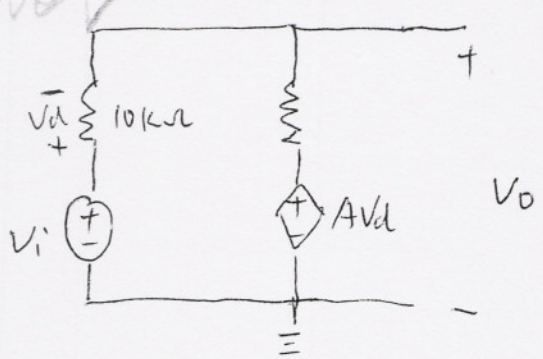
Ch5

5.



Answer



$V_i - V_d = V_o$

$V_o = AV_d$

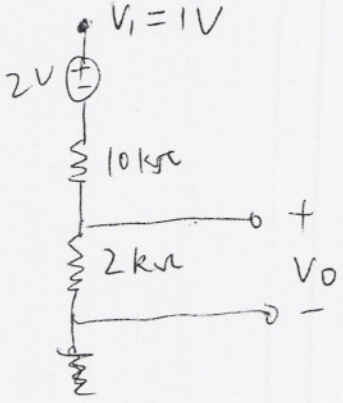
$V_i = \left(\frac{A+1}{A}\right) V_o$ $\quad \frac{V_o}{V_i} = \frac{A}{A+1} = \boxed{0.999999}$

8. a) Ideal op Amp

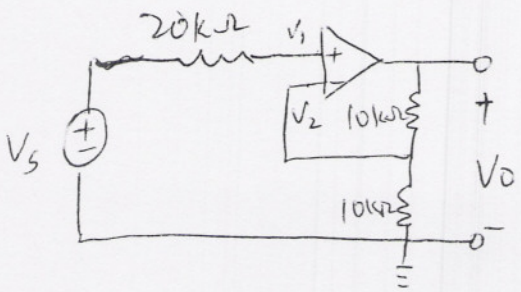
$V_1 = V_2$

$i_1 = i_2 = 0$ $\quad V_o = -2000 \times 0.001 = \boxed{-2V}$

b) $V_1 = V_2 = 1V$, $\quad V_o = (-1)\left(\frac{2}{12}\right) = \frac{1}{6} V = \boxed{167mV}$



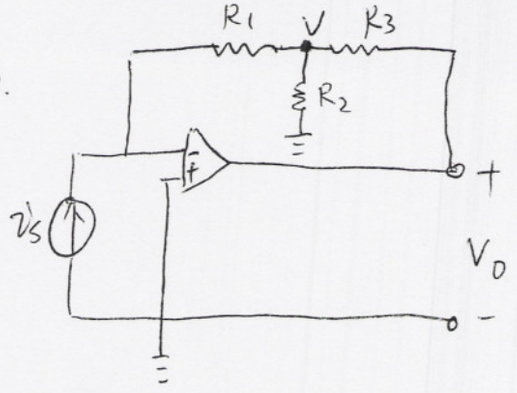
10.



$V_2 = \frac{V_o}{2}$, $\quad V_1 = V_2 = V_s$

$\frac{V_o}{V_s} = \boxed{2}$

15.



(a) $v_s' = \frac{V}{R_2} + \frac{V - V_o}{R_3}$

$V = -v_s' R_1$

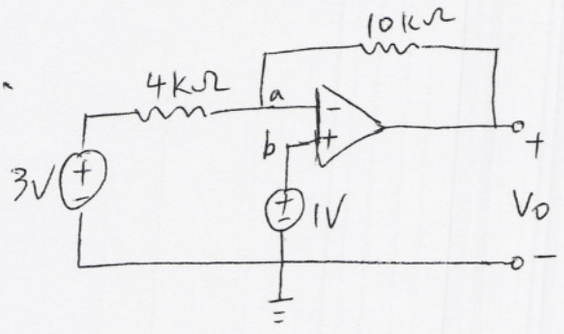
$v_s' = \frac{-v_s' R_1}{R_2} + \frac{-v_s' R_1 - V_o}{R_3}$

$\frac{V_o}{v_s'} = \boxed{-\left(R_1 + R_3 + \frac{R_1 R_3}{R_2}\right)}$

(b) $\frac{V_o}{v_s'} = -(20k\Omega + 40k\Omega + \frac{(20k\Omega)(40k\Omega)}{25k\Omega})$

$= \boxed{-92k\Omega}$

21.



$\frac{V_a - V_o}{10k\Omega} = \frac{3 - V_a}{4k\Omega}$

$\Rightarrow V_o = 3.5 V_a - 7.5$

$V_a = V_b = 1V$

$V_o = \boxed{-4V}$

34 $V_{in}' = \frac{R_3}{R_3 + R_4} V_o$

$v_+' = v_-' = 0$

~~$v_1 = v_2$~~, ~~$V_{in} = V_{in}$~~

$\frac{V_1 - V_{in}'}{R_1} + \frac{V_2 - V_{in}'}{R_2} = 0$

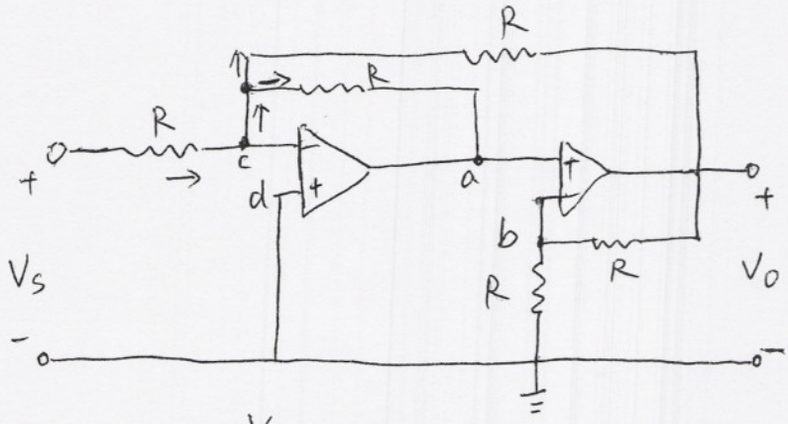
$\frac{V_1 - \frac{R_3}{R_3 + R_4} V_o}{R_1} + \frac{V_2 - \frac{R_3}{R_3 + R_4} V_o}{R_2} = 0$

$\Rightarrow V_o = \boxed{\left(1 + \frac{R_4}{R_3}\right) \frac{(V_1 R_1 + R_1 V_2)}{(R_1 + R_2)}}$

37. $V_0 = -\left[\frac{30}{10}(1) + \frac{30}{20}(2) - \frac{30}{30}(3)\right]$

$= \boxed{-3V.}$

54.



$V_a = V_b = \frac{V_0}{2}$

$V_c = V_d = 0$

$\frac{0 - V_S}{R} = \frac{V_a - 0}{R} + \frac{V_0 - 0}{R}$

$\frac{-V_S}{R} = \frac{V_a}{R} + \frac{V_0}{R}$

$\boxed{\frac{V_0}{V_S} = -\frac{2}{3}}$