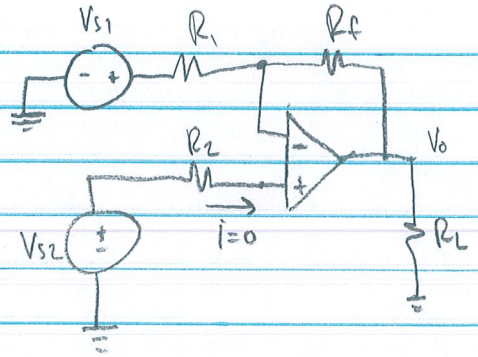
4.7

a)

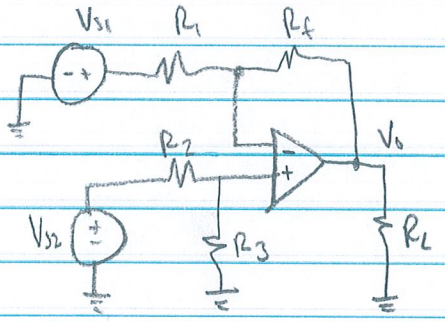


$V_+ = V_{S2} = V_-$.

KCL @ V_-: $\frac{V_{S2}-V_{S1}}{R_1} + \frac{V_{S2}-V_o}{R_f} = 0 \rightarrow \frac{(V_{S2}-V_{S1})R_f}{R_1} = (V_o - V_{S2})$

$$V_o = (V_{S2}-V_{S1})\frac{R_f}{R_1} + V_{S2} = \boxed{V_{S2}\left(1+\frac{R_f}{R_1}\right) - V_{S1}\frac{R_f}{R_1}}$$

b)



$V_+ = V_{S2}\left(\frac{R_3}{R_2+R_3}\right)$

So $\frac{V_{S2}}{R_1}\left(\frac{R_3}{R_2+R_3}\right) - \frac{V_{S1}}{R_1} + \frac{V_{S2}}{R_f}\left(\frac{R_3}{R_2+R_3}\right) - \frac{V_o}{R_f} = 0$

$$V_o = \frac{V_{S2}\,R_3R_f}{R_1(R_2+R_3)} - \frac{V_{S1}\,R_f}{R_1} + \frac{V_{S2}\,R_3}{(R_2+R_3)}$$

$$= \boxed{V_{S2}\left[\frac{R_3R_f}{R_1(R_2+R_3)} + \frac{R_3}{(R_2+R_3)}\right] - V_{S1}\left(\frac{R_f}{R_1}\right)}$$

c) $R_f = 12K\Omega$

$R_1 = 3K\Omega$

$R_3 = 4K\Omega$

$R_2 = 1K\Omega$

$V_{S1} = 1.5V\Omega$

$V_{S2} = 2V\Omega$

$R_L = 100\Omega$

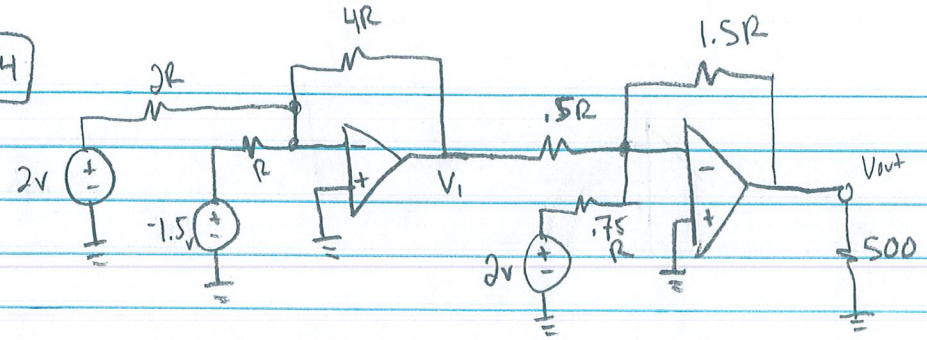
$$V_o = 2v\left[\frac{(4K)(12K)}{3K(1K+4K)} + \frac{4K}{(1K+4K)}\right] - 1.5v\left[\frac{12K}{3K}\right]$$

$$= 2v\left[3.2 + 0.8\right] - 1.5v(4)$$

$$= \underline{2v}$$

$$P_L = V_o^2/R_L = \boxed{0.04\,w}$$

4.14



a) Both are summing amplifiers.

$$V_1 = V_{S1}\left(\frac{-4R}{2R}\right) + V_{S2}\left(\frac{-4R}{R}\right) = 2(-2) + -1.5(-4) = \underline{2v}$$

$$V_{out} = V_1\left(\frac{-1.5R}{.5R}\right) + V_{S3}\left(\frac{-1.5R}{.75R}\right) = 2(-3) + 2(-2) = \boxed{-10v}$$

b) $R = 10K$, $P_{opamp1} = V_1^2/0.5R + V_1^2/4R$

$$= 2^2/5000 + 2^2/40000 = \boxed{0.9\,mW}$$

$$P_{opamp2} = V_{out}^2/500 + V_{out}^2/1.5R$$

$$= (-10)^2/500 + (-10)^2/15000 = \boxed{206.7\,mW}$$