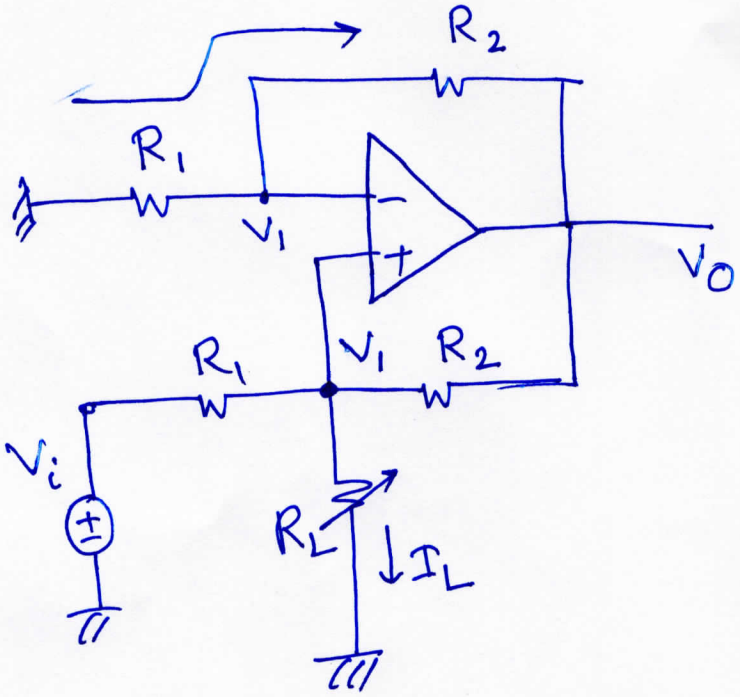
7) Voltage Source to Current Source



$$V_o = \left(1 + \frac{R_2}{R_1}\right) V_1$$

Apply KCL at node V_1

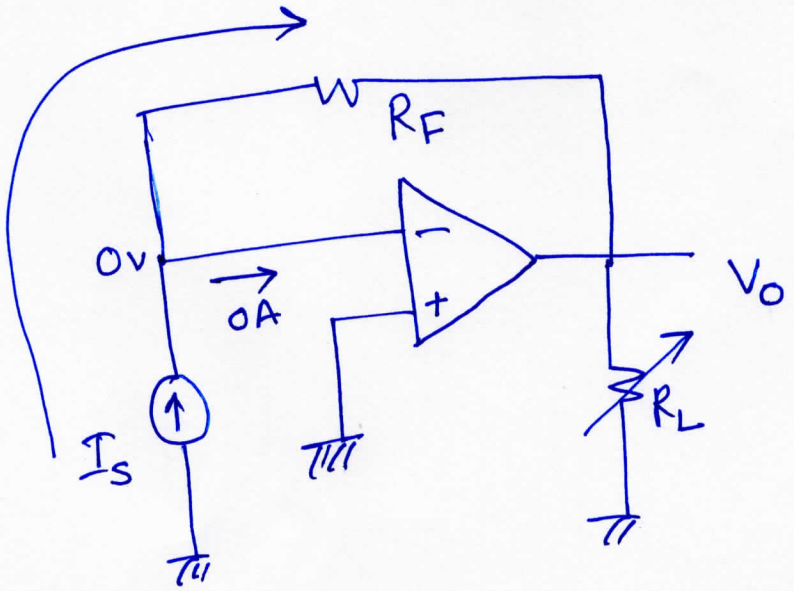
$$\frac{V_1 - V_i}{R_1} + I_L + \frac{V_1 - V_o}{R_2} = 0$$

$$\Rightarrow \frac{V_1}{R_1} - \frac{V_i}{R_1} + I_L + \frac{V_1}{R_2} - \frac{1}{R_2}\left(1 + \frac{R_2}{R_1}\right) V_1 = 0$$

$$\Rightarrow \frac{V_1}{R_1} - \frac{V_i}{R_1} + I_L + \frac{V_1}{R_2} - \frac{V_1}{R_2} - \frac{V_1}{R_1} = 0$$

$$\Rightarrow \boxed{I_L = \frac{V_i}{R_1}}$$

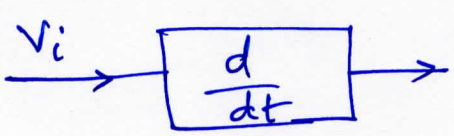
8) Current Source to Voltage Source



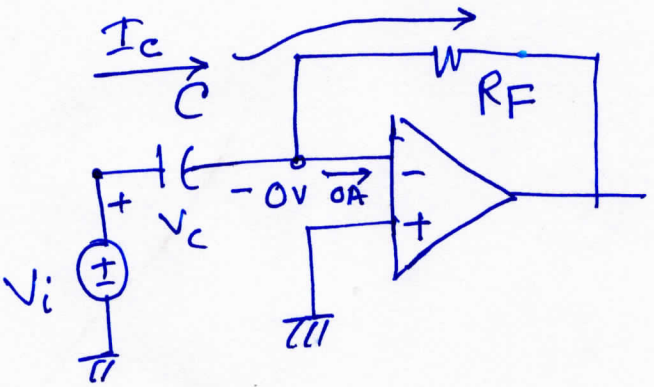
$$I_s = \frac{0 - V_o}{R_F}$$

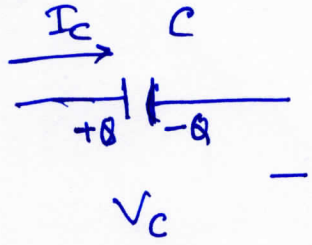
$$\Rightarrow \boxed{V_o = -I_s R_F}$$

9) Differentiator :-



$$V_o = K \frac{dV_i}{dt}$$





$$Q = C V_c$$

$$I_c = \frac{dQ}{dt} = C \frac{dV_c}{dt}$$

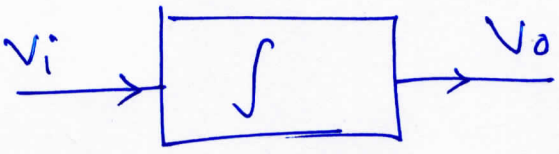
$$I_c = \frac{0 - V_o}{R_F} \qquad V_c = V_i - 0 = V_i$$

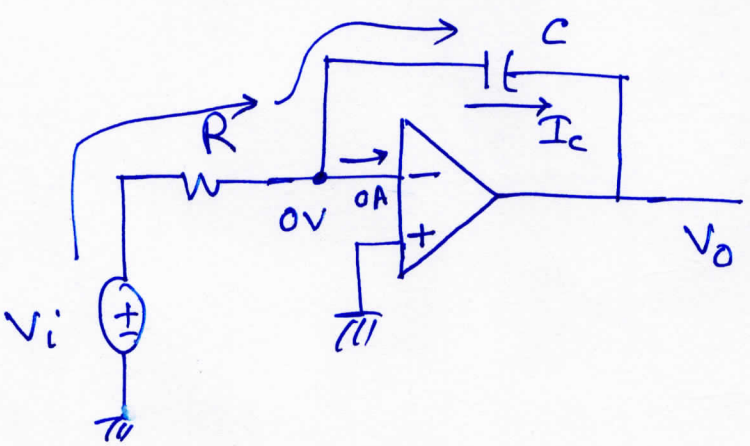
$$\Rightarrow I_c = C\frac{dV_c}{dt} = C\frac{dV_i}{dt}$$

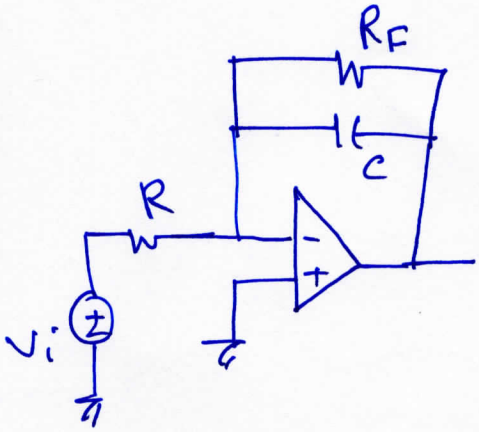
$$\Rightarrow \quad C\frac{dV_i}{dt} = -\frac{V_o}{R_F}$$

$$\Rightarrow \quad \boxed{V_o = -R_F C \frac{dV_i}{dt}}$$

10) **Integrator**







$$\frac{V_i - 0}{R} = I_c = C\frac{d}{dt}[0 - V_o]$$

$$\Rightarrow \frac{V_i}{R} = -C\frac{dV_o}{dt}$$

$$\Rightarrow \quad \boxed{V_o = -\frac{1}{RC}\int V_i\,dt}$$

1) Slew Rate $\rightarrow \left.\frac{dv_o}{dt}\right|_{max}$

2) CMRR

(Common Mode Rejection Ratio)

$A_c \rightarrow$ gain for common input

$A_d \rightarrow$ gain for difference input

$$CMRR = \frac{A_d}{A_c}$$

Ideal Op-Amp $\Rightarrow$ CMRR $\rightarrow \infty$

3) Off-set Currents / Bias Current

4) Off-set Voltage