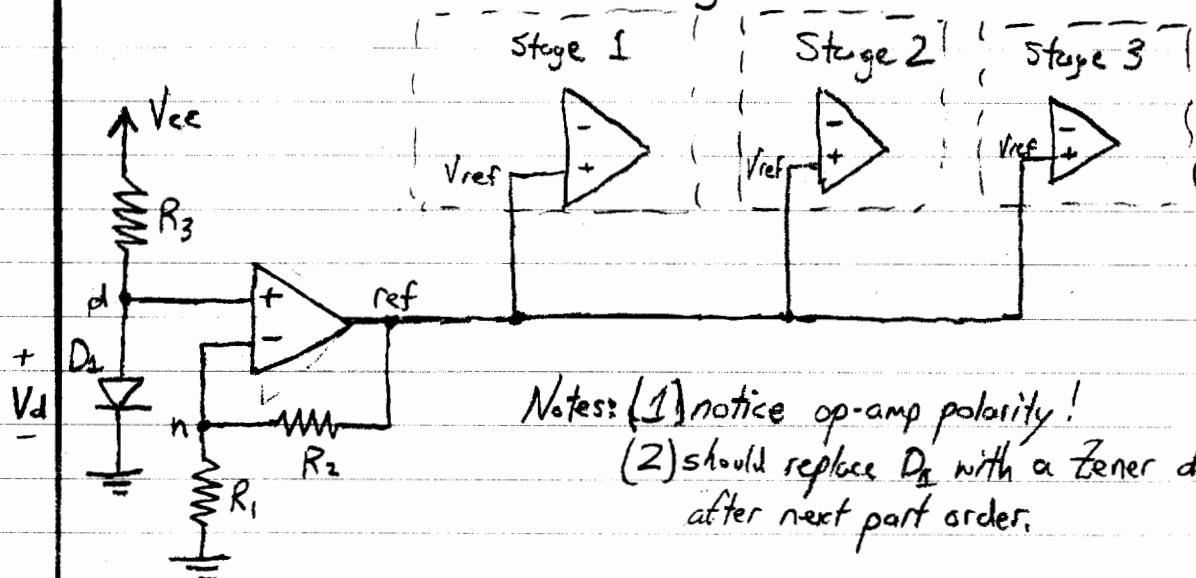# Reducing Noise and Feedback of Op Amp Stages with a constant voltage reference

Notes: (1) notice op-amp polarity!
(2) should replace D_1 with a Zener diode after next part order.

For ideal opamp, $V_d = V_n$.
Taking KCL at node n:

$$\frac{V_n}{R_1} = \frac{V_{ref} - V_n}{R_2}$$

rearranging and replacing $V_n = V_d$

$$V_d\left[\frac{1}{R_1} + \frac{1}{R_2}\right] = V_{ref}\left[\frac{1}{R_2}\right]$$

$$\boxed{V_{ref} = \left[1 + \frac{R_2}{R_1}\right]V_d}$$

Designing R_{1-3}: $R_1 = \frac{R_1 + R_2}{V_{ref}}V_d$

Let $R_1 + R_2 = 5k$ for 1mA bias.

$$\boxed{R_1 = 5k\Omega\left(\frac{V_d}{V_{ref}}\right)}$$

$$\approx 5k \cdot \frac{0.7}{2.5V} = 1.4k\Omega$$

$$\boxed{R_2 = 5k\Omega\left(1 - \frac{V_d}{V_{ref}}\right)}$$

$$\approx 5k\left(1 - \frac{0.7}{2.5}\right) = 3.6k\Omega$$

Choose R_3 to not waste to much current.

$$\boxed{R_3 = 10k\Omega}$$