Boise State University
Electrical Engineering Department

EE 210: Circuits I

Solution 1

Let the voltage at the input of the op amp be v_a.

$$v_a = 1\,\text{V}, \quad \frac{3 - v_a}{4k} = \frac{v_a - v_o}{10k} \longrightarrow \frac{3-1}{4} = \frac{1 - v_o}{10}$$

v_o = **<u>–4 V</u>**.

Solution 2

At the inverting terminal, v=0 so that KCL gives

$$\frac{v_s - 0}{R_1} = \frac{0}{R_2} + \frac{0 - v_o}{R_f} \longrightarrow \underline{\frac{v_o}{v_s} = -\frac{R_f}{R_1}}$$

Solution 3

$$v_o = -\left[\frac{R_f}{R_1} v_1 + \frac{R_f}{R_2} v_2 + \frac{R_f}{R_3} v_3\right]$$

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

v_o = **<u>–3V</u>**

Solution 4

This is a summing amplifier.

$$v_o = -\left(\frac{R_f}{R_1} v_1 + \frac{R_f}{R_2} v_2 + \frac{R_f}{R_3} v_3\right) = -\left(\frac{50}{10}(2) + \frac{50}{20} v_2 + \frac{50}{50}(-1)\right) = -9 - 2.5 v_2$$

Thus,

$$v_o = -16.5 = -9 - 2.5 v_2 \longrightarrow \underline{v_2 = 3\,\text{V}}$$

Solution 5

Using eq. (5.18), $R_1 = 2k\Omega,\ R_2 = 30k\Omega,\ R_3 = 2k\Omega,\ R_4 = 20k\Omega$

$$v_o = \frac{30(1+2/30)}{2(1+2/20)}v_2 - \frac{30}{2}V_1 = \frac{32}{2.2}(2) - 15(1) = \underline{14.09\ V}$$