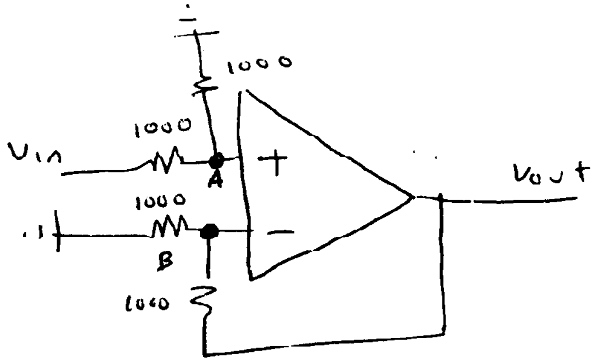
OPAMP Solutions 1/2

1.



nodal analysis @ A: $\frac{A - V_{in}}{1000} + \frac{A}{1000} = 0$

$A = V_{in}/2$

(no current flows in)

nodal analysis @ B: $\frac{B - 0}{1000} + \frac{B - V_{out}}{1000} = 0$

$V_{out} = B \cdot 2$

but $A = B$, so $V_{out} = V_{in}$

$$\boxed{\frac{V_{out}}{V_{IN}} = 1}$$

2. Do this in two steps:

For the first opamp, we find

$V_a = -V_{in}$

For the second, we find

$V_{out} = -V_A$,

or $V_{out} = V_{in}$

$$\boxed{\frac{V_{out}}{V_{in}} = 1}$$

(two inverting amplifiers with gain = 1)

3. First opamp

$$V_- = V_+ = V_1$$

$$\frac{V_1 - 0}{1000} + \frac{V_1 - V_a}{2000} = 0$$

$$\underline{V_a = 3V_1}$$

Second opamp

$$\frac{0 - V_a}{2000} + \frac{0 - V_2}{2000} + \frac{0 - V_{out}}{1000} = 0$$

$$-V_A - V_2 - 2V_{out} = 0$$

$$V_{out} = -\frac{1}{2}(V_A + V_2)$$

$$\underline{V_{out} \quad -\frac{1}{2}(3V_1 + V_2)}$$

4. Top opamp $V_A = -2V_{in}$

bottom opamp $V_B = -V_{in}$

nodal analysis shows $V_{out} = \underline{-0.5\ V_{in}}$

at $V_{in} = 12$, $V_{out} = -6$

5. $V_{out} = -2V_{in}$, but rail voltages are ± 10 volts:

V_{in}	V_{out}
-10 v	10 v
-6 v	10 v
-2 v	4 v
2 v	-4 v
6 v	-10 v
10 v	-10 v