Analysis

Note:

We will reference the nodes in this analysis based on the pins indices of the OP-AMP found in the schematic page.

DC Analysis:

At node 3:

$$\frac{v_3 - 0}{R_1} + \frac{v_3 - v_{indc}}{R_2} = 0$$

$$\Rightarrow v_3 = \frac{R_1 v_{indc}}{R_1 + R_2}$$

$$\text{since}: \; R_1 = 3R_2$$

$$\Rightarrow v_3 = \frac{3}{4} v_{indc} \qquad (1)$$

At node 2:

$$\frac{v_2 - 0}{R_4} + \frac{v_2 - v_6}{R_5} = 0$$

$$\Rightarrow v_6 = \left(\frac{R_5}{R_4} + 1\right) v_2$$

$$\text{But}: \quad R_5 = R_4$$

$$\text{Therfore}: \quad v_6 = 2v_2 \qquad (2)$$

At the output node:

$$\frac{v_{outdc} - v_6}{R_6} + \frac{v_{out} - 0}{R_L} = 0$$

$$\Rightarrow v_{outdc} = \frac{R_L}{R_L + R_6} v_6 \qquad (3)$$

Using 1 and 2 we get:

$$v_{outdc} = \frac{3}{2} \frac{R_L}{R_L + R_6} v_{indc} \qquad (4)$$

$$\text{Note that}: \quad v_2 = v_3$$

AC analysis:

At node 3:

$$\frac{v_3 - v_{inac}}{R_1} + \frac{v_3 - 0}{R_2} = 0$$

$$\Rightarrow v_3 = \frac{R_2}{R_1 + R_2} v_{inac}$$

$$\Rightarrow v_3 = \frac{1}{4} v_{inac} \qquad (5)$$

At node 2 we get the same equations as the DC analysis.

Using 2 and the same form of equation 3, we get:

$$v_{outac} = \frac{1}{2} \frac{R_L}{R_L + R_6} v_{inac} \qquad (6)$$

Combining 6 and 3 we get te overall output voltage:

$$v_{out} = \frac{1}{2} \frac{R_L}{R_L + R_6} v_{inac} + \frac{3}{2} \frac{R_L}{R_L + R_6} v_{indc}$$

$$\text{Or}: \quad v_{out} = \left(\frac{1}{2} v_{inac} + \frac{3}{2} v_{indc}\right) \frac{R_L}{R_L + R_6}$$