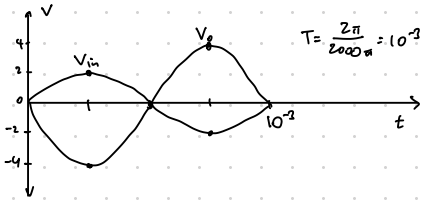
1. inverting amplifier

$V_o = A_v V_{in} = -R_2 \cdot V_{in}/R_1 = -3 \cdot 2\sin(2000\pi t) = \boxed{-6\sin(2000\pi t)}$



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2. inverting amplifier

$V_i = 0$ & $i_{i+} = i_{i-} = 0$

$i_{i-} = 2mA$, $V_2 = V_o$, $V_1 = V_i = 0V$

$(V_1 - V_2)/1k - 2m = 0 \rightarrow V_1 - V_2 = 2 \rightarrow V_o = -2 + 0 = \boxed{-2V}$

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3. $i_{i+} = i_{i-} = 0$ $V_i = V_2 = 0$

$i_{in} + i_R = i_1$

$\frac{V_1 - V_{in}}{2R} + \frac{V_1 - 0}{R} = \frac{V_2 - V_1}{R}$ & $V_{in} = 5$

$V_1 = V_{in}/5$ $A_v = \frac{V_{out}}{V_{in}} = \frac{-15R}{R} = -15$ & $A_v = \frac{V_1}{V_i}$

$\frac{V_{out}}{V_{in}} = \frac{V_2}{\frac{1}{5}V_{in}} = -15$ so $V_2 = V_{out} = -3V_{in} \rightarrow \boxed{A_v = -3}$

4. $\frac{V_x - 2}{1k} + \frac{V_x - V_o}{2k} = 0 \rightarrow 2V_x - 4 + V_x - V_o = 0$

$\downarrow$

$3V_x = 4 + V_o$

when $V_o = -10 \rightarrow \boxed{V_x = -2V}$

$V_o = 10 \rightarrow \boxed{V_x = 14/3\ V}$

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5. $V_2 = V_i = 0$ & $i_{i+} = i_{i-} = 0$

$\frac{V_i - V_{in}}{R(1-\tau)} + \frac{V_i - 0}{R\tau} + I_{i-} = 0 \rightarrow R\tau(V_i - V_{in}) + V_i(R(1-\tau)) = 0$

so $V_i = V_{in}\tau$

$\frac{V_i - V_{in}}{R} + \frac{V_i - V_o}{R} + i_{i-} = 0 \rightarrow V_i - V_{in} + V_i - V_o = 0$

so $V_o = 2V_i - V_{in}$

$A_v = \frac{V_o}{V_{in}} = \frac{2V_{in}\tau - V_{in}}{V_{in}} = \boxed{2\tau - 1}$