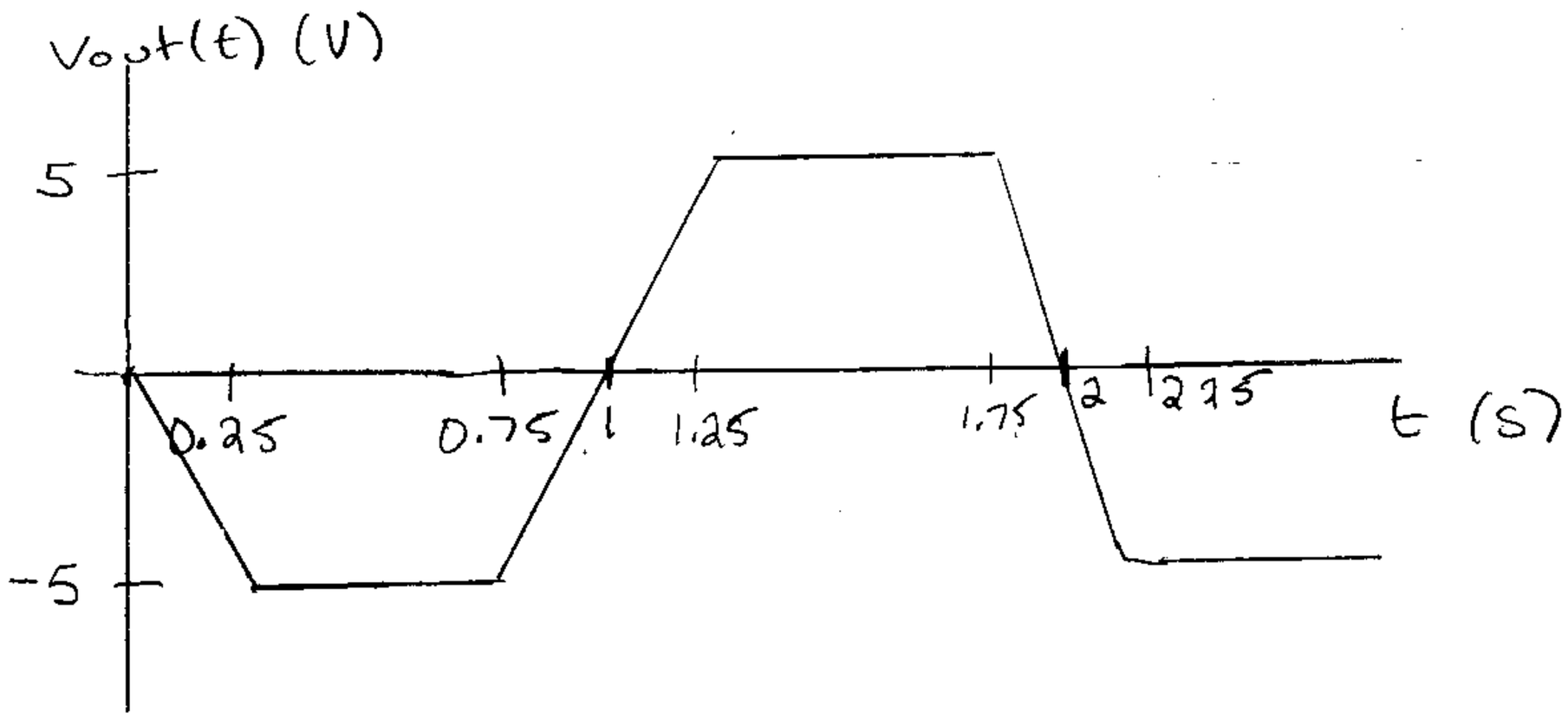
EE 40
Homework #4
Solutions

Problem 1:

Inverting amplifier has relationship

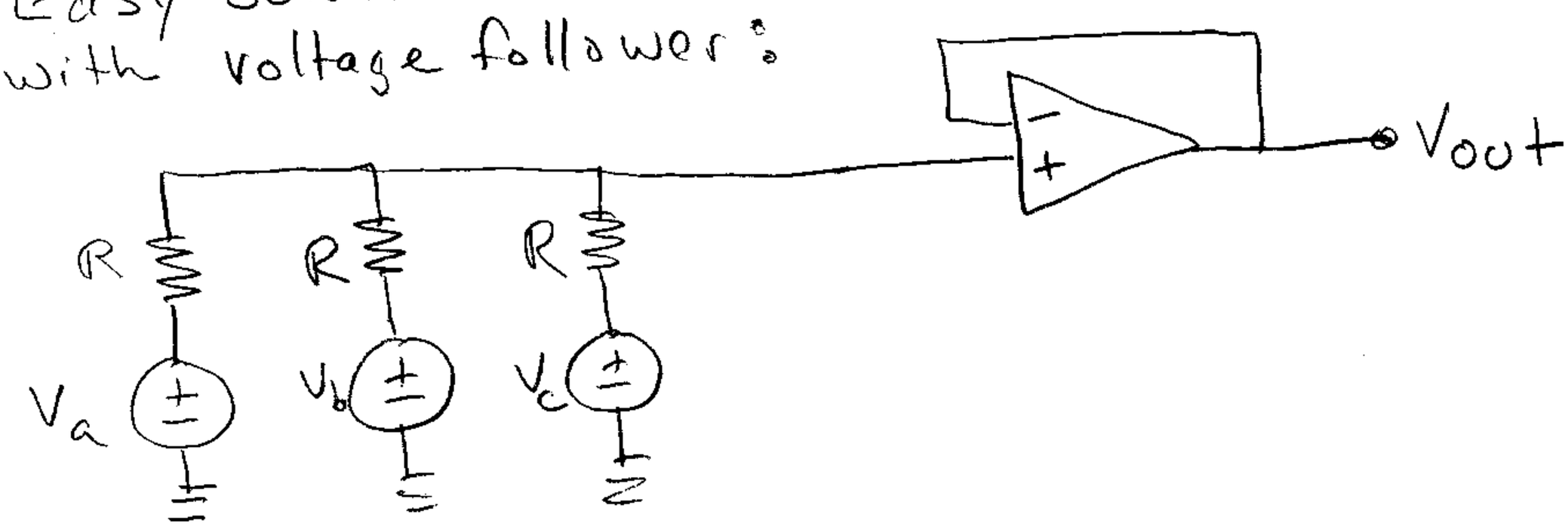
$$V_o(t) = -\frac{R_F}{R_1} V_S(t) = \frac{-150\,k\Omega}{7.5\,k\Omega} V_S(t) = -20\,V_S(t)$$

Rails limit $V_o(t)$ to the interval $-5\,V$ to $5\,V$

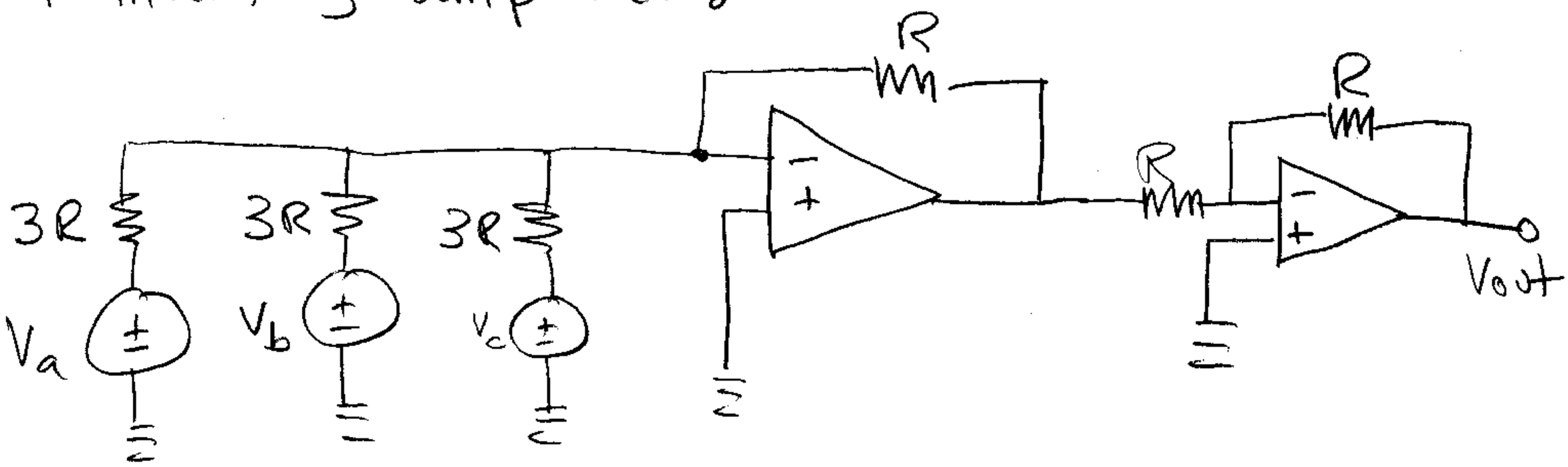


Problem 2:

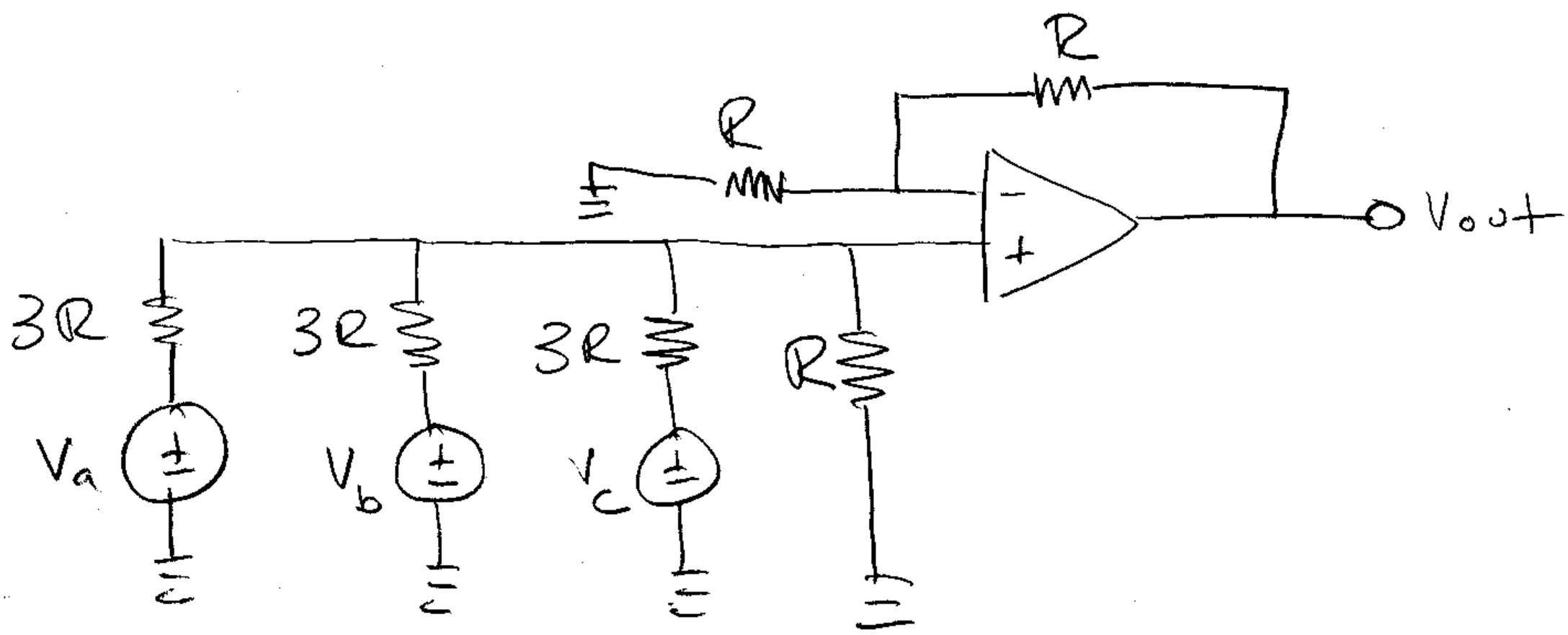
Easy solution combines Exam 1 Review answer with voltage follower:



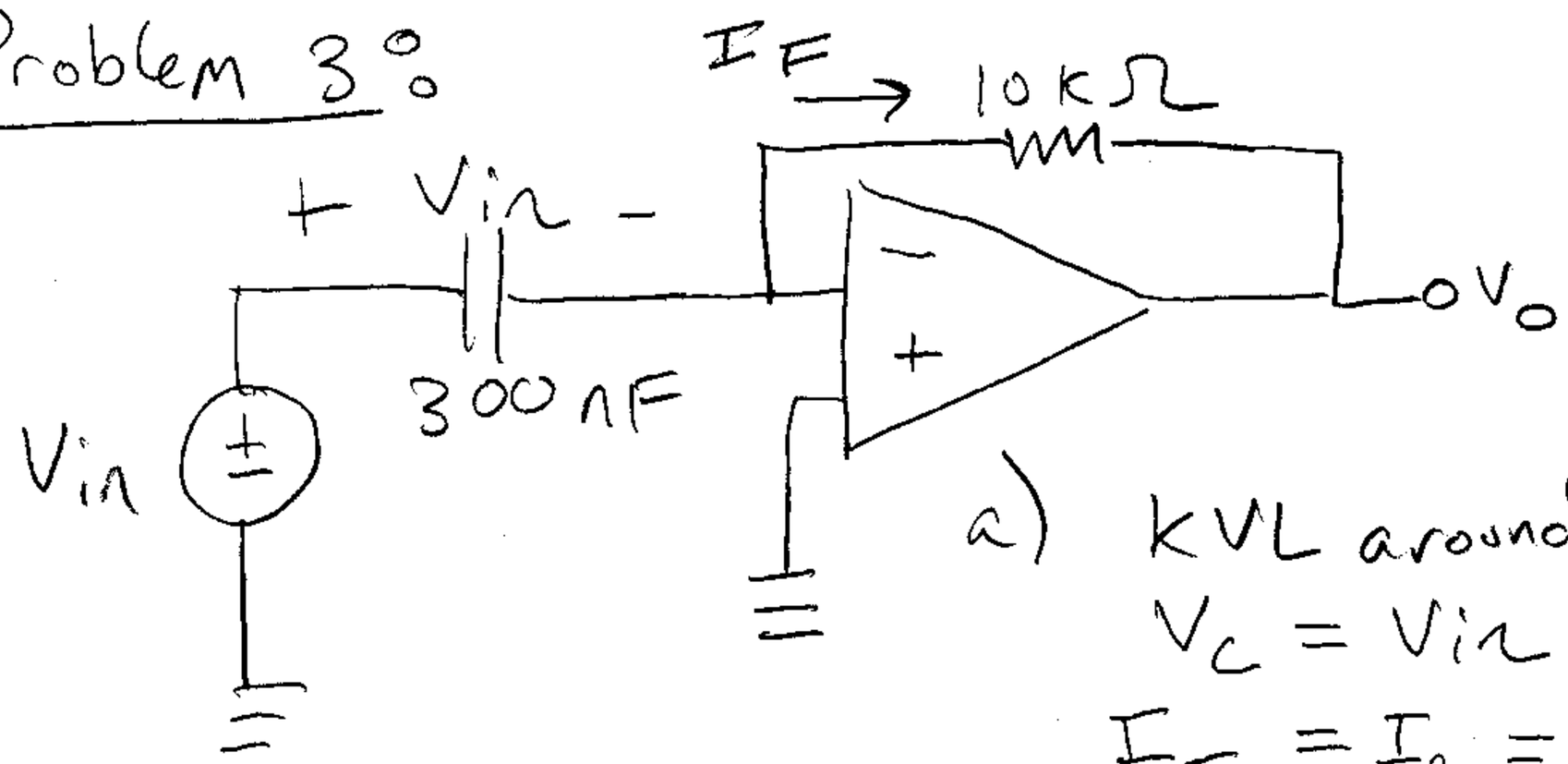
Other solutions involve inverting-summing + inverting amplifier:



Or even the somming amplifier:



Problem 3:



a) KVL around input loop:

$$V_C = V_{in}$$

$$I_F = I_C = C\frac{dV_C}{dt} = C\frac{dV_{in}}{dt}$$

KVL around output loop: $V_O + R I_F = 0$

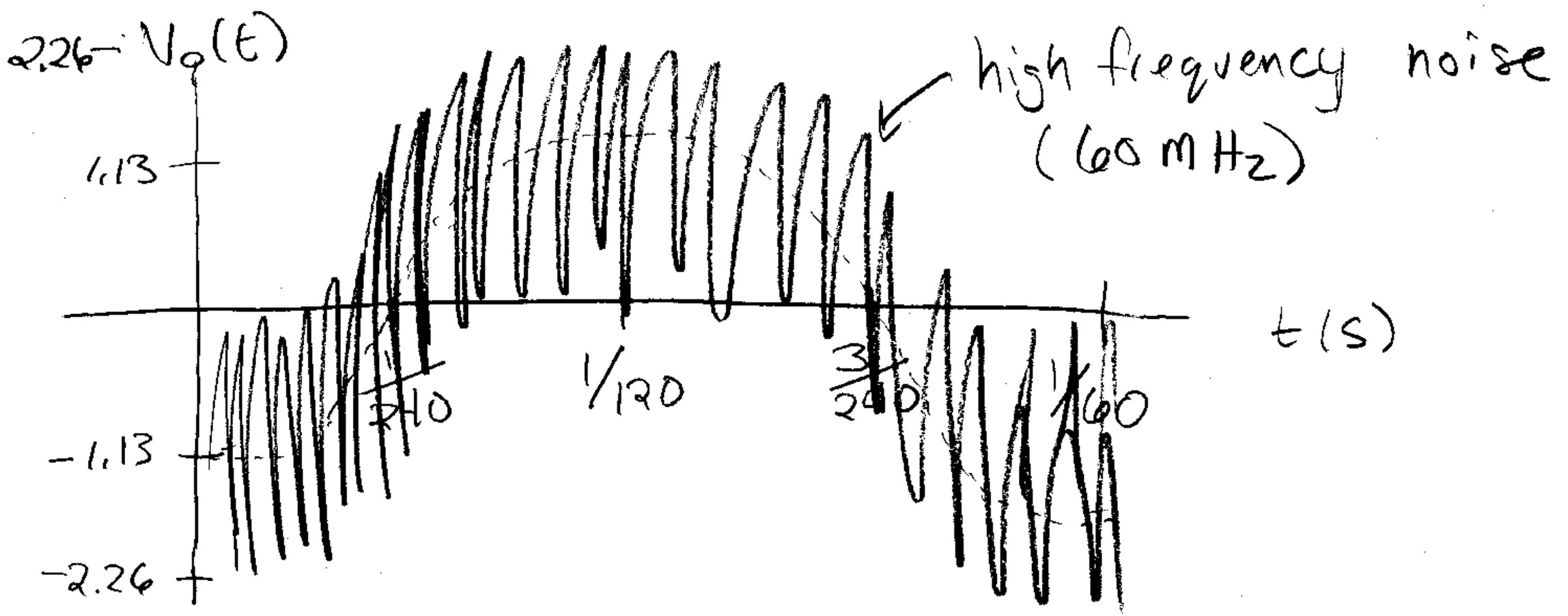
$$V_o = -R I_F = -RC \frac{dv_{in}}{dt} = -3 \times 10^{-3} \frac{dv_{in}}{dt}$$

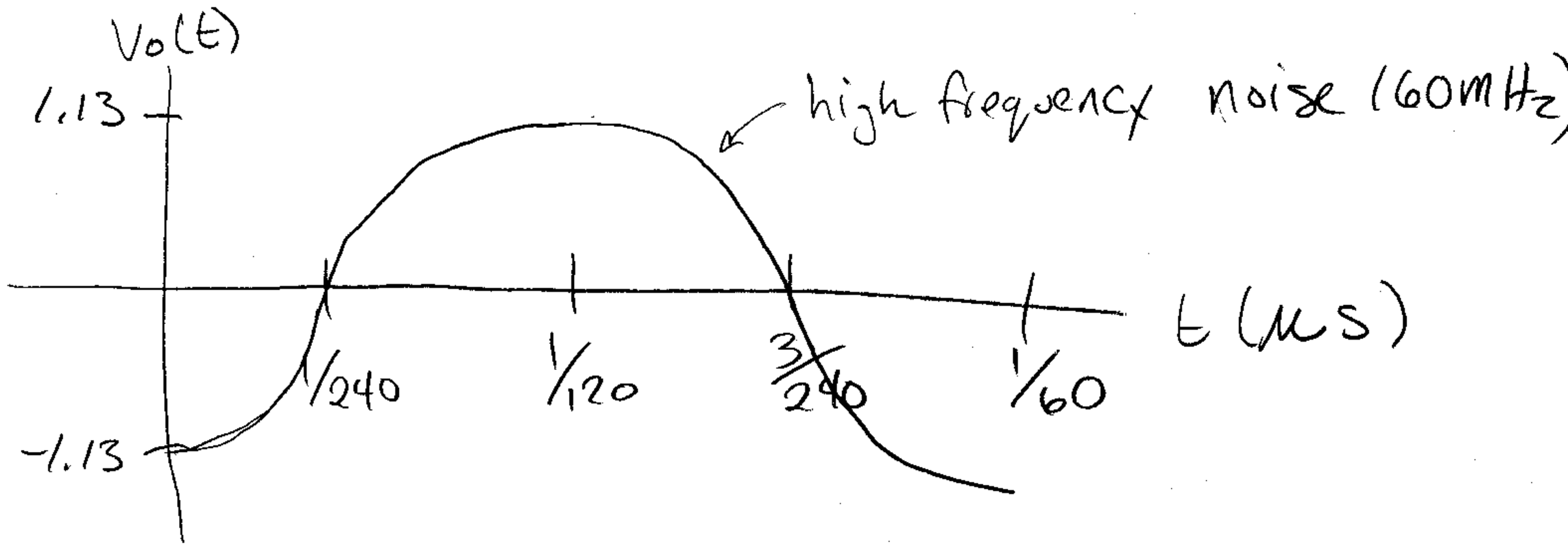
b)

with $V_{in}(t) = \sin(120\pi t) + 10^{-6} \sin(10^6 \cdot 120\pi t)$,

$$\frac{dv_{in}}{dt} = 120\pi \cos(120\pi t) + 120\pi \cos(10^6 120\pi t)$$

$$V_o(t) = -360\pi \cdot 10^{-3} \left(\cos(120\pi t) + \cos(10^6 120\pi t)\right)$$





Problem 4:

The non-inverting amplifier has

$$V_o = \left(1 + \frac{R_F}{R_1}\right) V_{in} = \left(1 + \frac{\alpha \cdot 5000\,\Omega}{1000\,\Omega}\right)(1V)$$

$$= 1 + 5\alpha \quad V$$

V_o must be between 5V and −5V:

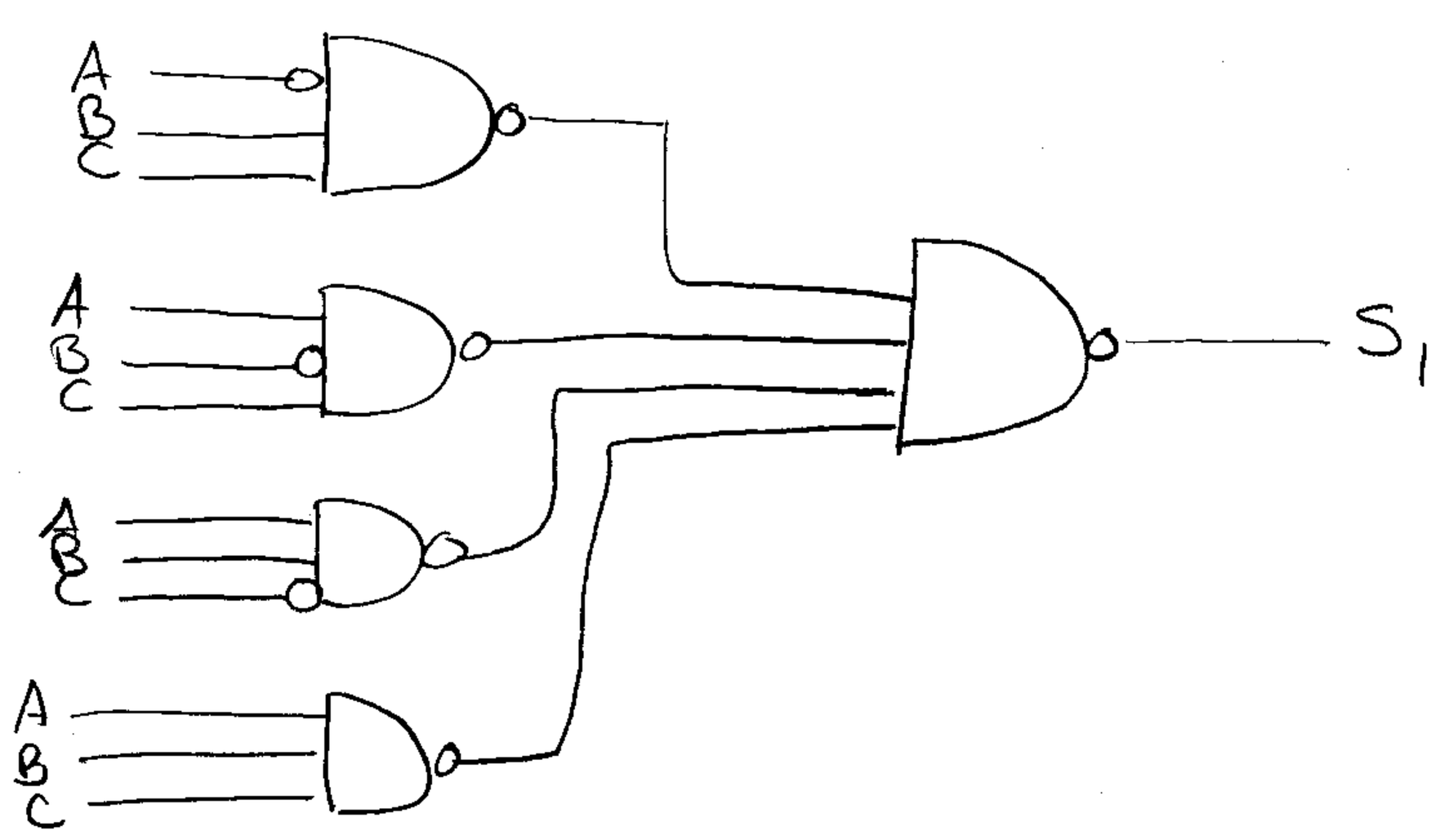
$1 + 5\alpha \leq 5 \qquad \alpha \leq 4/5$

$1 + 5\alpha \geq -5 \qquad \alpha \geq -6/5$

Problem 5:

a) $\bar{A}BC + A\bar{B}C + AB\bar{C} + ABC = S_1$

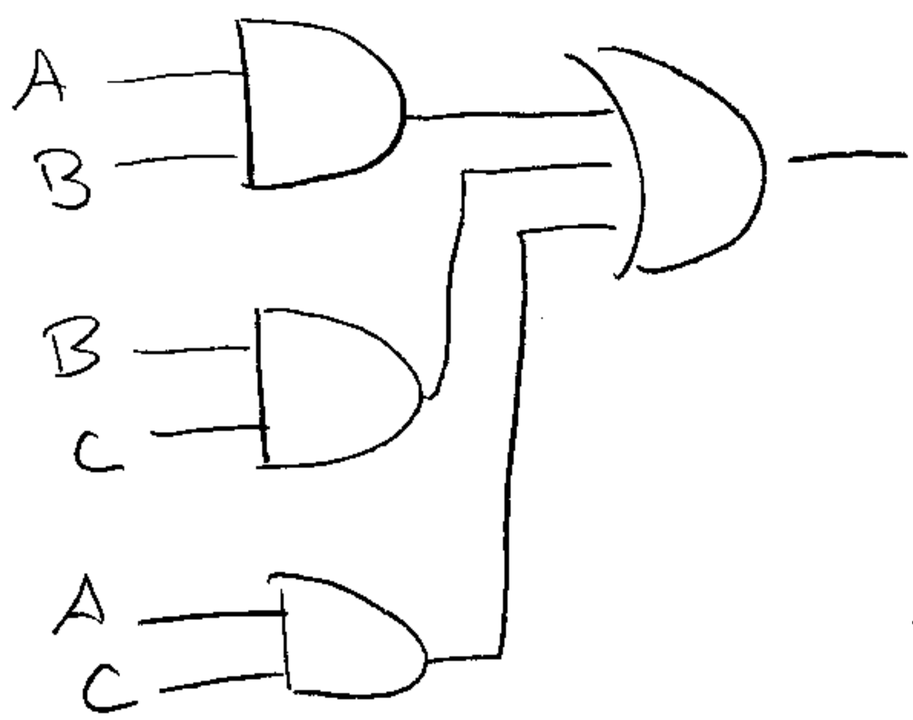
b)



c) Using Karnaugh map technique (see lecture!)

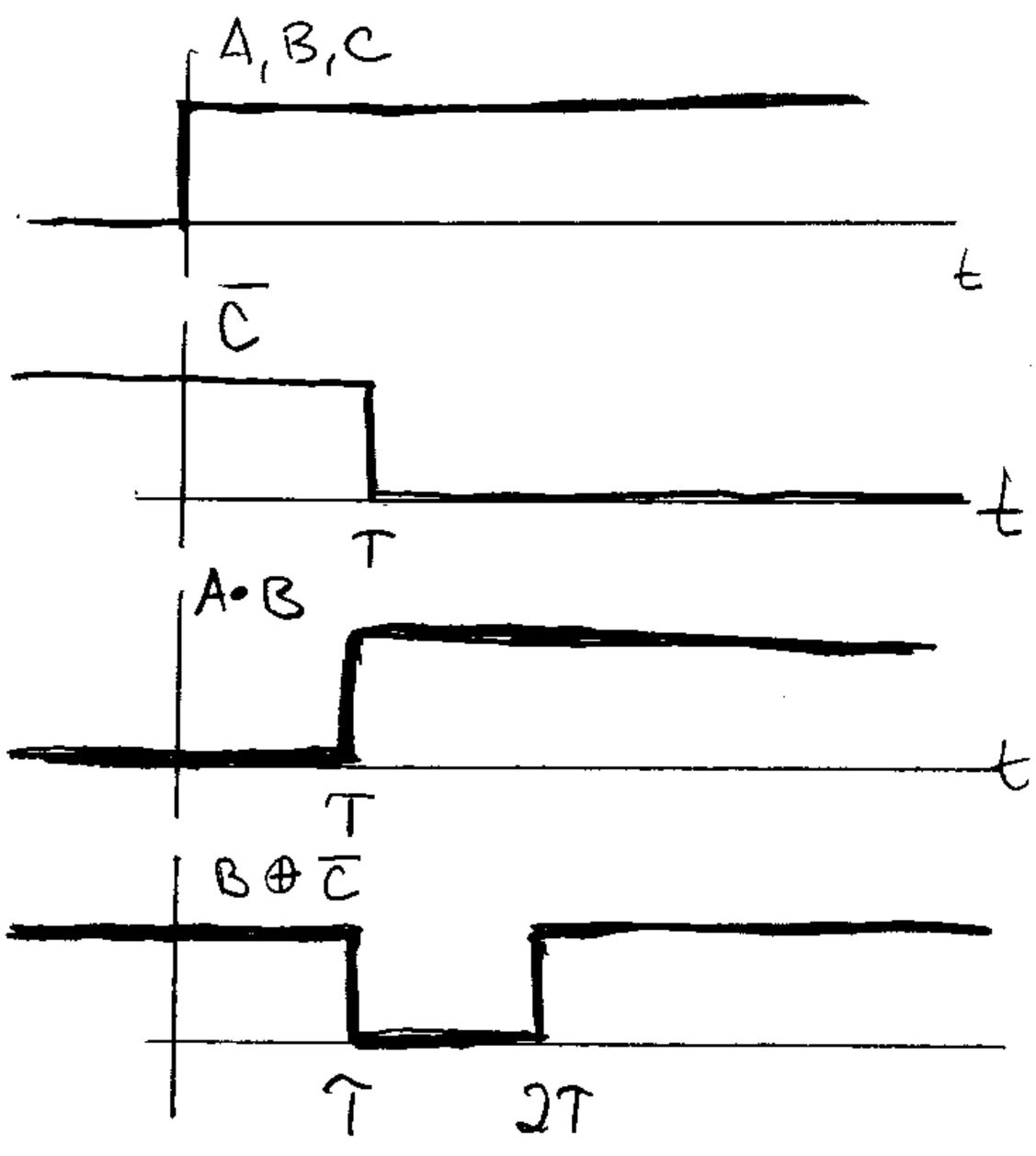
$S_1 = AB + BC + AC$

I can't think of a simpler expression.



or NAND-NAND version of the same

Problem 6:



$F = \overline{(A \cdot B) \cdot (B \oplus \bar{C})}$