Problem 1.
Invert $V_a$ first, then use inverting–summing.

Or, do it all with one fancy amplifier.

Here, $R_1 \times R_2$ can be any positive value.
Problem 2°

Since $7.5\,k\Omega + 1.5\,k\Omega$ resistors have same current by voltage division,

$$V_p = -18 \cdot \frac{1.5k}{7.5k + 1.5k} = -3\,V$$

$$V_n = V_p = -3\,V$$

$$I_F = -\frac{V_n}{1k\Omega} = 3\,mA$$

$$-V_o - I_F R_F + V_n = 0$$

$$V_o = V_n - I_F R_F = -3\,V - 3\,mA R_F$$

So $V_o$ is negative, cannot hit 18 V rail

$$-9 < V_o \Rightarrow -9 < -3 - 3 \cdot 10^{-3} R_F \Rightarrow R_F < 2k\Omega$$
Problem 3.8

Ideal model:

large-signal model:
Small-Signal model

Section is $V_o = \frac{10\sin \theta - 4.7}{2} + 4.7$

Problem 4:

Problem 5:

$F = \overline{A\overline{B}C} + \overline{A}BC + A\overline{B}C + ABC$

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The circle corresponds to $F = C$
Problem 6°

\[ V_0 = A(V_p - V_n) \] as long as \( V_0 \) within rails

\[ V_0 = 10^5(V_{in} - 2) \quad \text{if } 0 \leq V_0 \leq 5 \text{ V} \]

\[ 0 \leq 10^5(V_{in} - 2) \leq 5 \quad \iff \]

\[ 0 \leq V_{in} - 2 \leq 5 \times 10^{-5} \quad \iff \]

\[ 2 \leq V_{in} \leq 2 + 5 \times 10^{-5} \]