This is a non-inverting amplifier with a gain of \( G = 1 + \frac{426}{1.69} = 253.1 \).
With such a large gain, it will saturate when \( V_i = \pm 10 V/G = \pm 0.040 V \).

Times when \( |V_i| < 0.040 \), are
\[
T_1 = \frac{0.1 - 0.040}{5/100 \text{ms}} = \pm 1.200 \text{ ms}.
\]
\[
T_2 = \frac{0.1 + 0.040}{5/100 \text{ms}} = \pm 2.800 \text{ ms}.
\]

- Sketch \( V_o \).
- At what times does \( V_o \) reach \( \pm 10 V \)?
- Does this circuit suffer from multiple transitions?

(Notes: voltage axis not to scale. The slope of the voltage may be approximated as 5 V/100 ms. Op amps are ideal)
• Sketch $V_o$.

• At what times does $V_o$ reach $\pm 10 \, \text{V}$?

• Does this circuit suffer from multiple transitions?

(Notes: voltage axis not to scale. The slope of the voltage may be approximated as $5 \, \text{V}/100 \, \text{ms}$. Op amps are ideal)

\[
\text{Thresholds at } \frac{1.42 \, \text{k}\Omega}{380+1.42 \, \text{k}\Omega} \times 10 \, \text{V} = \pm 0.037 \, \text{V}.
\]

\text{Conditions:}
1) If $V_i < V_+ \implies V_o = +10 \, \text{V}$ and $V_+ = +0.037 \, \text{V}$.
2) If $V_i > V_+ \implies V_o = -10 \, \text{V}$ and $V_+ = -0.037 \, \text{V}$.

• Sketch $V_o$.
  1) Initially, $V_o = +10$ and $V_+ = +0.037 \, \text{V}$
  2) when $V_i$ crosses $+0.037 \, \text{V}$, then $V_o = -10$ and $V_+ = -0.037 \, \text{V}$
  3) when $V_i$ crosses $-0.037 \, \text{V}$, then $V_o = +10$ and $V_+ = +0.037 \, \text{V}$
  4) when $V_i$ crosses $+0.037 \, \text{V}$, then $V_o = -10$ and $V_+ = -0.037 \, \text{V}$

• At what times does $V_o$ reach $\pm 10 \, \text{V}$?
  Transitions at $\pm \frac{0.1-0.037}{5 \, \text{V}/100 \, \text{ms}} = \pm 1.26 \, \text{ms}$.
  1) Beginning until $-1.26 \, \text{ms} \implies V_o = +10 \, \text{V}$.
  2) $-1.26 \, \text{ms}$ until $0 \, \text{ms} \implies V_o = -10 \, \text{V}$.
  3) $0 \, \text{ms}$ until $+2.74 \, \text{ms} \implies V_o = +10 \, \text{V}$.
  4) $+2.74 \, \text{ms}$ until end $\implies V_o = -10 \, \text{V}$.

• Does this circuit suffer from multiple transitions?
  Yes
• Sketch $V_o$ (this is difficult because of the exponential – indicate the main features of the curve)

• At what times does $V_o$ reach $\pm 10\ V$?

• Does this circuit suffer from multiple transitions?

(Notes: voltage axis not to scale. The slope of the voltage may be approximated as $5\ V/100\ ms$. Op amps are ideal)

This is a low pass filter with a gain of $G = -\frac{516\ k\Omega}{19.6\ k\Omega} = -26.33$.
With such a large gain, it will saturate when $V_i = \pm 10\ V/G = \pm 0.380\ V$.
The time constant is $\tau = 516\ k\Omega \times 508\ nF = 262.1\ ms$.

• At what times does $V_o$ reach $\pm 10\ V$?
  Transitions at $\pm \frac{0.1+0.380}{5\ V/100\ ms} = \pm 9.6\ ms$.
  Thus: 1) Beginning until $−9.6\ ms \implies V_o = +10\ V$.
   2) $+9.6\ ms$ until end $\implies V_o = −10\ V$.

• Sketch $V_o$ (this is difficult because of the exponential – indicate the main features of the curve)
  Beginning until $−9.6\ ms \implies V_o = +10\ V$. Then, from $+9.6\ ms$ until $−9.6\ ms$ the will go from $+10$ to $−10\ V$, following the flipped blue line (with gain) but with a slight delay. However, it will only deviate slightly at the zigzag. The time constant $\tau$ is longer than the gap in the zigzag. Finally, from $+9.6\ ms$ until end $\implies V_o = −10\ V$.

• Does this circuit suffer from multiple transitions?
  [No]

Explanation: In the above case, the response is linear throughout the +/-0.1V transition of the input signal. The addition of the capacitor turns the circuit into a “lossy integrator”. Its step response would be an exponential with time constant $RC = 262.1\ ms$. We don’t have exactly a step at the input; however, if the input transitions are short compared to the time constant we can approximate the output as an exponential (perhaps with a “bump” $V_i$ briefly changes sign). Assuming the input transitions are short compared to $RC$, then $V_o$ will NOT suffer from multiple transitions.