Special Problem 3.4-3

Use your general knowledge of shunt regulators to answer the following questions (i.e., you are not required to do detailed circuit analysis).

A shunt regulator has a series resistor \( R = 1\, \text{K} \), load resistor \( R_L = 10\, \text{K} \), and Zener breakdown voltage \( V_{Zk} = 10\, \text{V} \).

1) If the Zener diode is in breakdown, approximately what is the voltage across \( R_L \)?

2) The Zener will be in breakdown only if the source voltage \( V_s \) is greater than what value?

3) Say \( V_s \) is sufficiently large, such that the Zener is in breakdown, and the dynamic resistance of the Zener is \( r_z = 10\, \Omega \).

If \( V_s \) increases by 1.0 V, the voltage across \( R_L \) will change by a small amount.

Determine the value of this voltage change.
4) If we make $V_s$ negative, the Zener will become **forward biased**!

Approximately what would the **output voltage** $V_o$ of the regulator be for this case?