

### 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?