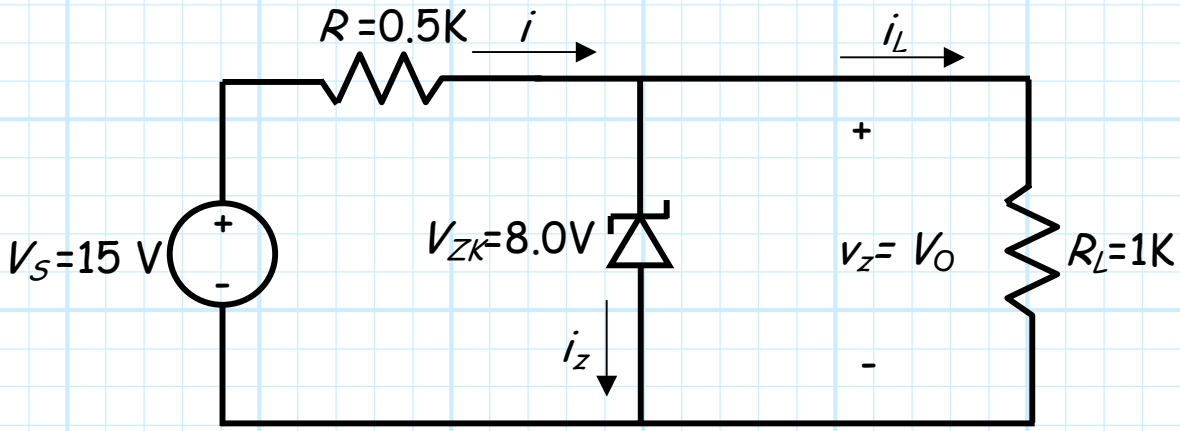
Example: Zener Diode Circuit Analysis

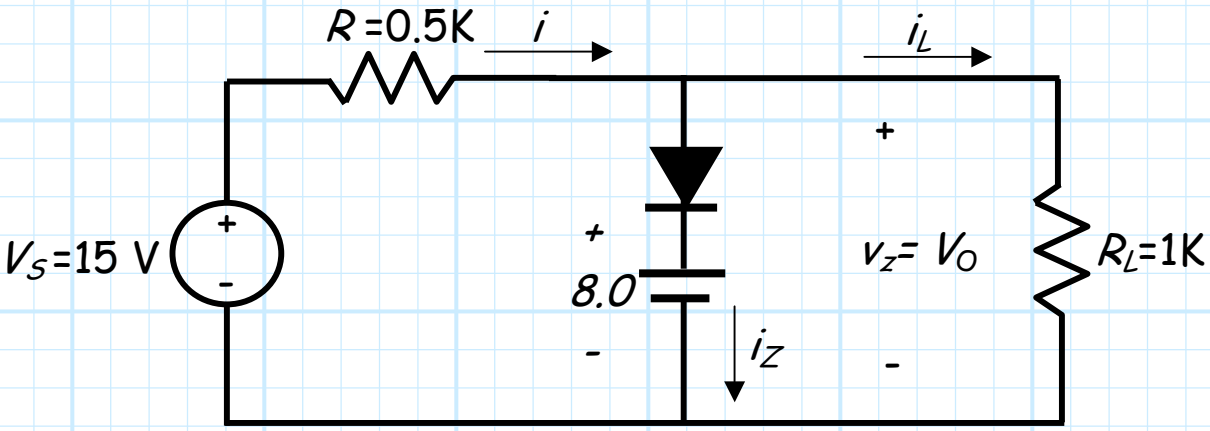
Consider the circuit below:



Note that the load resistor R_L is in **parallel** with the Zener diode, so that the voltage V_O across this load resistor is **equal** to the Zener diode voltage v_Z.

Q: *So just what is the value of voltage V_O?*

A: Let's **replace** the Zener diode with a **Zener CVD model** and find out!



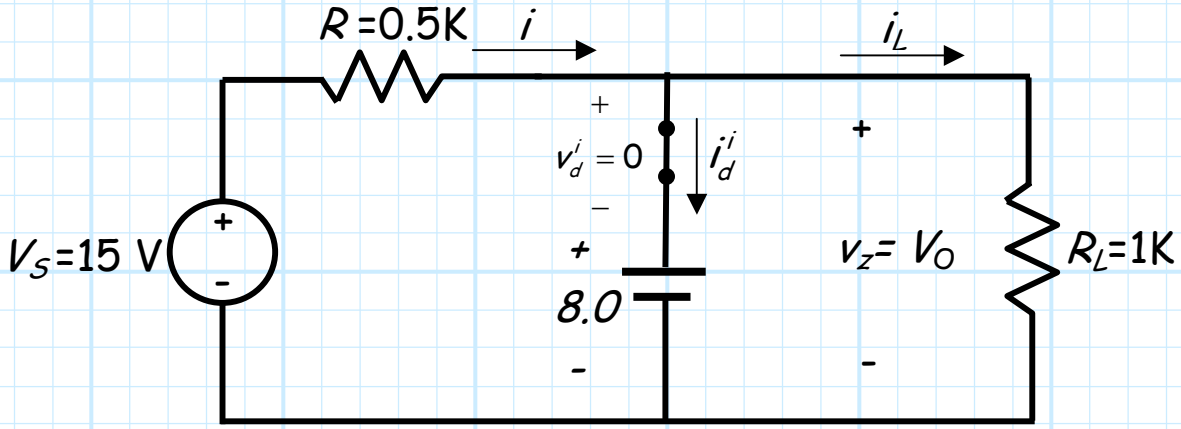
Q: *Yikes! We have an **IDEAL** diode circuit!*

A: Yes! We analyze it **precisely** like we did in section 3.1—remember, there are **no** Zener diodes in the circuit above!

ASSUME: IDEAL diode is **forward biased**.

ENFORCE: $v_d^i = 0$

ANALYZE:



From KVL:

$$v_Z = V_O =$$

From KCL:

$$i =$$

where from Ohm's Law:

$$i =$$

and:

$$i_L =$$

Therefore:

$$i_D = \\ = \\ =$$

CHECK:

$$i_D =$$ ✓

Look at what this means!

→ The voltage across load resistor R_L is equal to the Zener breakdown voltage V_{ZK}—**regardless** of the value of load resistor R_L or source voltage V_S (provided, of course, that the Zener diode is in breakdown)!

This is an example of a primary **application** of Zener diodes—**voltage regulation**.

We call this particular regulator circuit the **shunt regulator**.