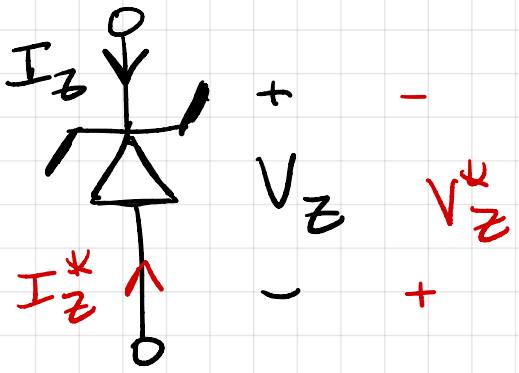
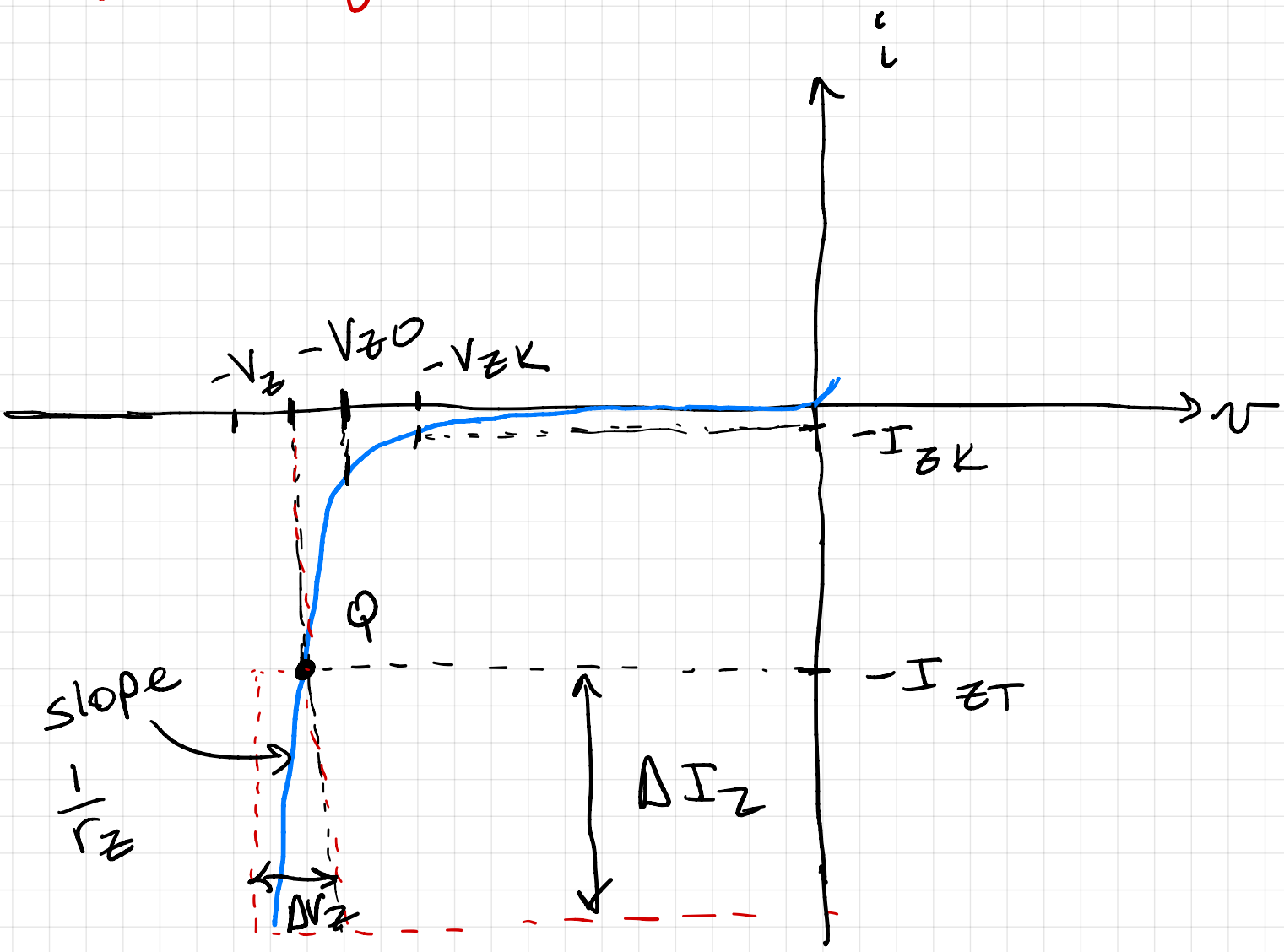
Zener Diodes

operate in breakdown or reverse-biased.



I_Z^* is negative

V_Z^* is negative



V_{ZK} : Knee voltage

I_{ZK} : Knee current

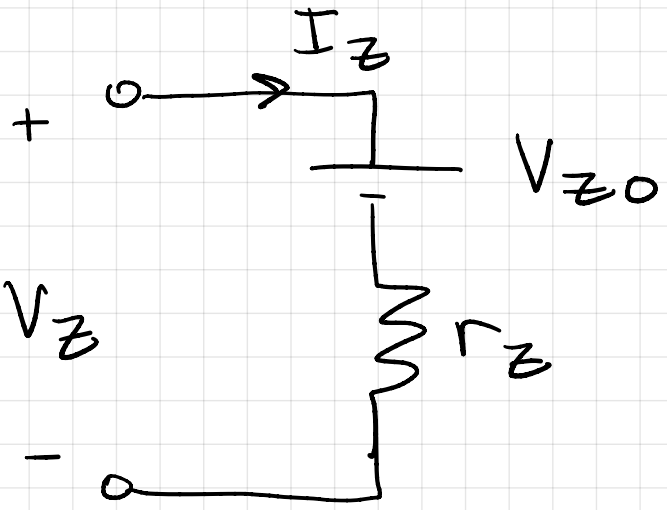
I_{ZT} : Zener current for a zener voltage, V_Z

(V_Z, I_{ZT})

r_z : incremental zener resistance.

1 - 50 Ω

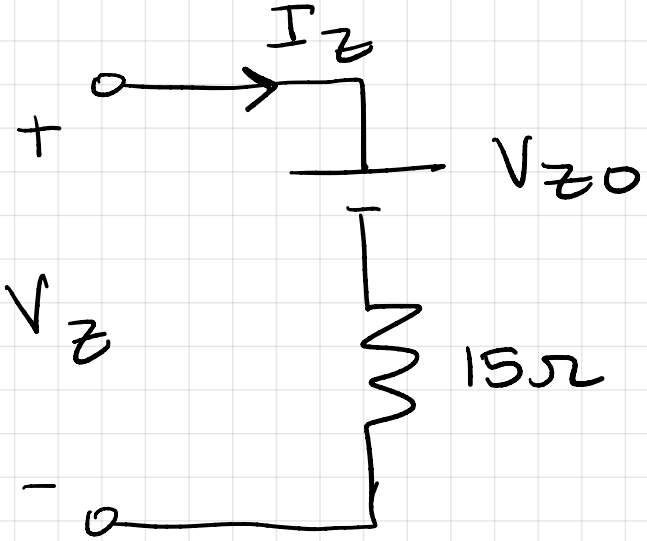
2.4 V zeners
3.3 V
5.6 V
6.8 V
9.1 V



$V_z \cong V_{z0}$ as r_z decreases

Ex $r_z = 15\Omega$

$(V_z, I_{zt}) = (6.8V, 10mA)$



$V_z = V_{z0} + I_z r_z$

$\rightarrow V_{z0} = V_z - I_z r_z$

$V_{z0} = 6.8 - (10\times10^{-3})(20)$

$V_{z0} = 6.65V$

what is V_z for $I_z = 5mA$

$V_z = V_{z0} + I_z r_z$

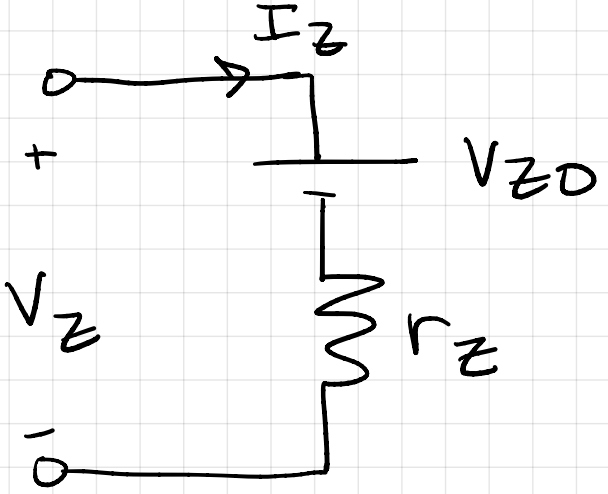
$= 6.65 + (5\times10^{-3})(15)$

$V_z = 6.725\,V$

EX $(V_z, I_z) \Rightarrow$ 10V, 10mA

$r_z = 50\Omega$

what is V_z if I_z is doubled?



$V_{z0} = V_z - I_z r_z$

$= 9.5V$

$I_z = 20mA$

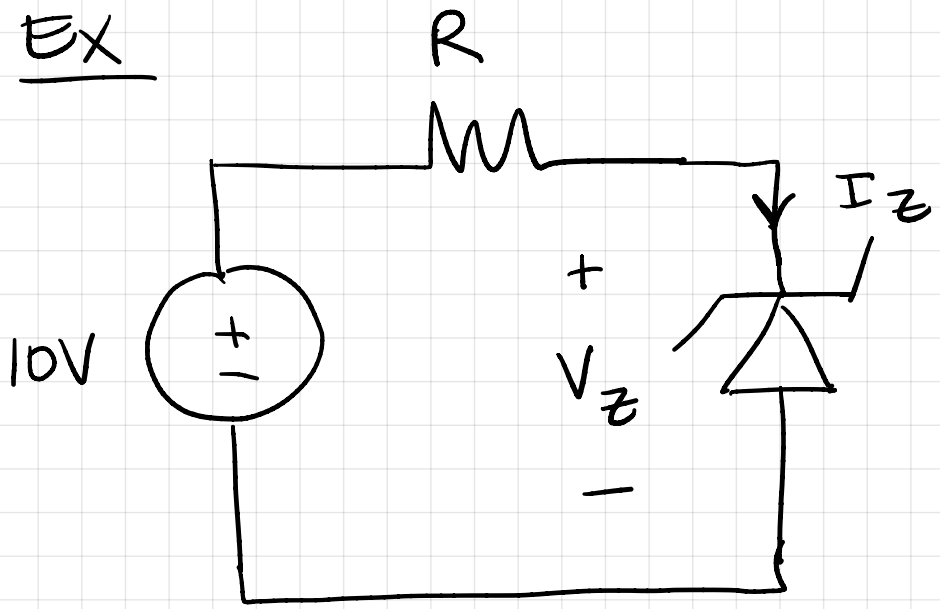
V_z ?

$V_z = V_{z0} + I_z r_z$

$= 9.5 + (20 \times 10^{-3})(50)$

$V_z = 10.5V$

Ex

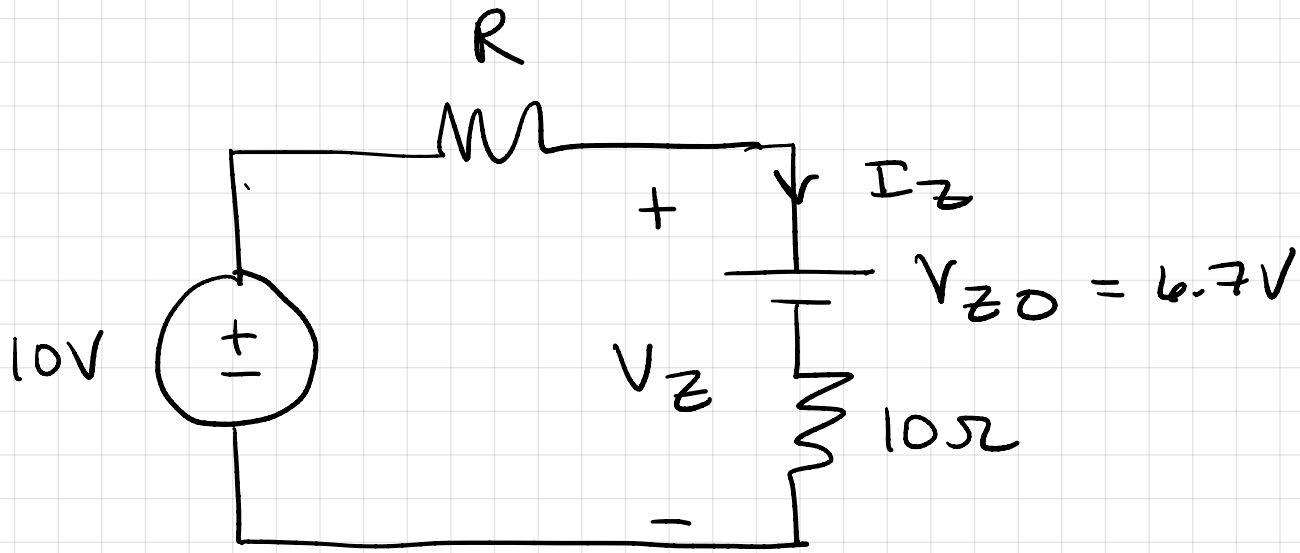


$V_z = 6.8V$

$I_z = 10mA$

$r_z = 10\Omega$

Find R such that $I_z = 8mA$



$$V_{z0} = V_z - I_z r_z$$

$$= 6.8 - (10 \times 10^{-3})(10)$$

$$V_{z0} = 6.7\,V$$

$$V_Z = V_{Z0} + I_Z r_Z$$

$$= 6.7 + (8 \times 10^{-3})(10)$$

$$V_Z = 6.78\ V$$

$$R = \frac{10 - V_Z}{I_Z}$$

$$R = \frac{10 - 6.78}{8 \times 10^{-3}}$$

$$R = 0.4025\ k\Omega$$

$$\boxed{R = 402.5\ \Omega}$$