5. The regulator in Figure 5 employs a zener diode D_z that is specified to have a 8V drop at a test current of 25mA with $r_z = 10\Omega$ and $I_{ZK} = 0.2$mA.

$V_s = 10\ V \pm 15\%$

$11.5\ V$

$8.5\ V$

$V_s = 10\ V \pm 15\%$

R

V_{out}

$V_{Z0} = \underset{7.75\ V}{\pm}$

$r_z = 10$

$$V_{Z0} = V_{00} - (r_z)(I_z)$$
$$= 8 - (10)(0.025)$$
$$= 8 - 0.25$$
$$= 7.75\ V$$

$$I_s = I_{ZK} + I_L$$

$$\frac{V_s - V_{out}}{R} = \frac{V_{out} - V_{Z0}}{r_z} + \frac{V_{out}}{R_L}$$
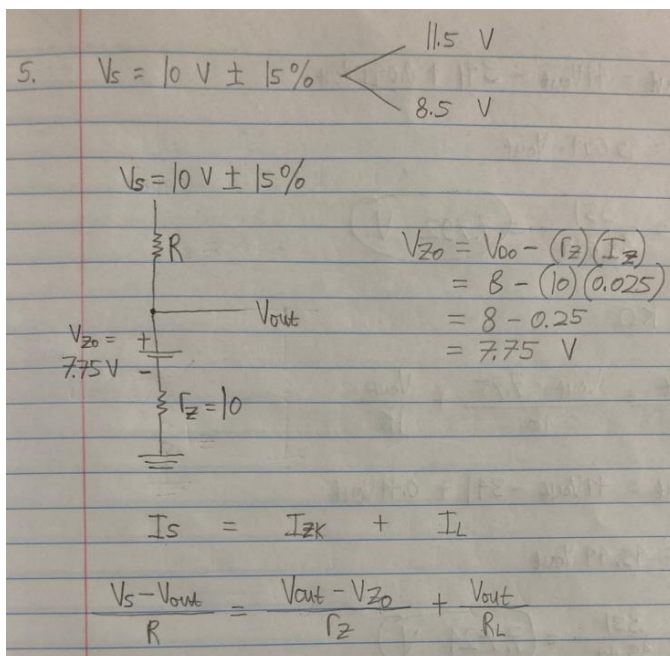
(a) Find **the value of R** needed to obtain an output voltage $V_{out} = 7.8$V at nominal supply voltage Vs and no load.

a. $\dfrac{10 - 7.8}{R} = \dfrac{7.8 - 7.75}{10} + 0$

$22 = 0.05\,R$

$R = 22 \cdot 20$
$= 440\ \Omega$

(b) With the value of R as obtained in (a) and nominal Vs find the **value of Vout** with a load resistance of

(i) $R_L = 10k\Omega$

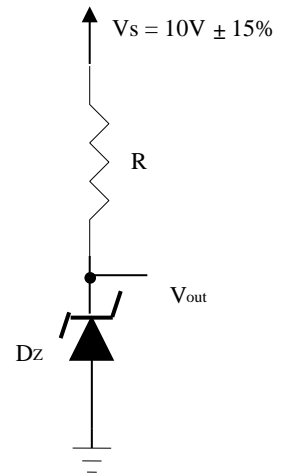b.i. $R_L = 10\,K\Omega$

$$\frac{10 - V_{out}}{440} = \frac{V_{out} - 7.75}{10} + \frac{V_{out}}{10K}$$

$$10 - V_{out} = 44 V_{out} - 341 + 0.044 V_{out}$$

$$351 = 45.044 \; V_{out}$$

$$V_{out} = \frac{351}{45.044} = \boxed{7.792 \; V}$$

(ii) $R_L = 1k\Omega$

ii. $R_L = 1\,K\Omega$

$$\frac{10 - V_{out}}{440} = \frac{V_{out} - 7.75}{10} + \frac{V_{out}}{1K}$$

$$10 - V_{out} = 44 V_{out} - 341 + 0.44 V_{out}$$

$$351 = 45.44 \; V_{out}$$

$$V_{out} = \frac{351}{45.44} = \boxed{7.724 \; V}$$

$V_S = 10V \pm 15\%$

R

V_{out}

Dz