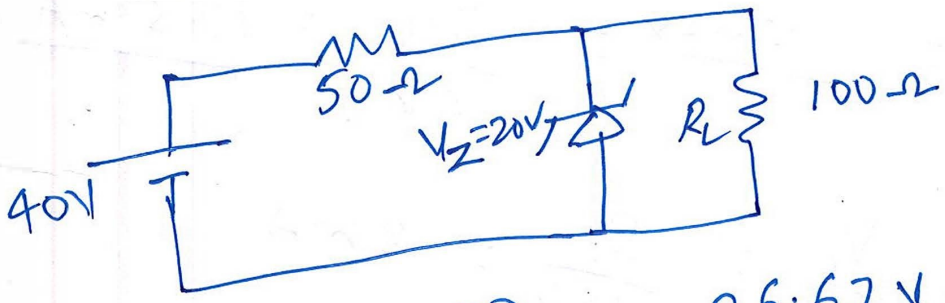
CSET102 Tutorial 9 Solutions

1)



$V_L = \frac{40 \times 100}{50+100} = 26.67\,V > V_Z$.

Then $V_L = 20V$

$I_L = \frac{V_L}{R_L} = \frac{20}{100} = 0.2\,A$

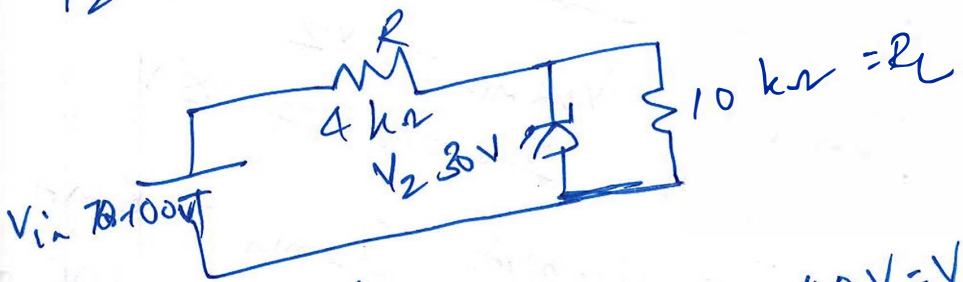
$V_R = V_{in} - V_Z = 40 - 20 = 20V$

$I_R = \frac{V_R}{R} = \frac{20}{50} = 0.4\,A$

$I_Z = I_R - I_L = 0.4 - 0.2 = 0.2\,A$

$P_Z = V_Z I_Z = 20 \times 0.2 = 4W$

2)



i) $V_Z = 30\,V$.

So $V_R = 70 - 30 = 40V = V_{R\,min}$

$V_R = 100 - 30 = 70\,V = V_{R\,max}$

$I_{R\,min} = \frac{40}{4k\Omega} = 10\,mA$

$$I_{R\,max} = \frac{V_{Rmax}}{R} = \frac{70}{4k} = \underline{17.5\ mA}$$

$$I_L = \frac{V_L}{R_L} = \frac{30}{10k} = 3\ mA$$

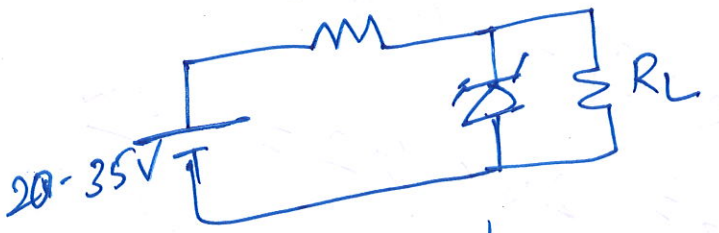
$$I_{Zmin} = I_{Rmin} - I_L = 10 - 3 = \underline{7\ mA}$$

$$I_{Zmax} = I_{Rmax} - I_L = 17.5 - 3 = \underline{14.5\ mA}$$

$$P_{Zmin} = V_Z \cdot I_{Zmin} = 210\ mW$$

$$P_{Zmax} = V_Z \cdot I_{Zmax} = 30 \times 14.5\ mA = \underline{435\ mW}$$

3)



$V_L = 12V$

$$V_Z = V_L = \underline{12V}$$

$$V_{Rmin} = V_{in\,min} - V_Z = 20 - 12 = 8V$$

$I_{Lmin} = 100\ mA$ $I_{Zmin} = 8\ mA$

$I_{Rmin} = I_{Lmin} + I_{Zmin} = 108\ mA$

$$R_L = \frac{V_L}{I_L} = \frac{12}{100\ mA} = 120\Omega$$

$$R = \frac{V_R}{I_R} = \frac{8V}{108\ mA} = 74\Omega$$

4) The minimum input voltage is when $I_Z = 0$.

$$I_L = \frac{30}{2k} = 15\,mA$$

$I = I_L + I_Z \Rightarrow I_{min} = 15\,mA$

$V_{in,min} = V_Z + IR = 30 + 15\times10^{-3}\times200$

$= 30 + 3 = 33\,V$

input is maximum when I_Z is maximum.

$I_{max} = I_L + I_Z = 15 + 25 = 40\,mA$

$V_{in,max} = 30 + I_{max}R$

$= 30 + 40\times10^{-3}\times200$

$= 38\,V$

5) $V_Z = 12\,V$

$R = \frac{V_{in} - V_o}{I}$

I is $I_{L,max} + I_{Z,min} = 200\,mA$

$R = \frac{16-12}{200\times10^{-3}} = 20\,\Omega$

$P_{ZM} = V_Z \cdot I_{ZM} = 2.4\,W$