Name Surname:

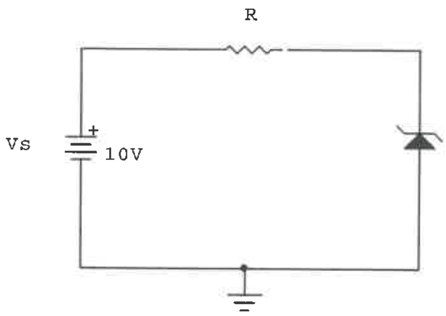
Student No:

INFE242, 2022-23, Spring, Quiz#1

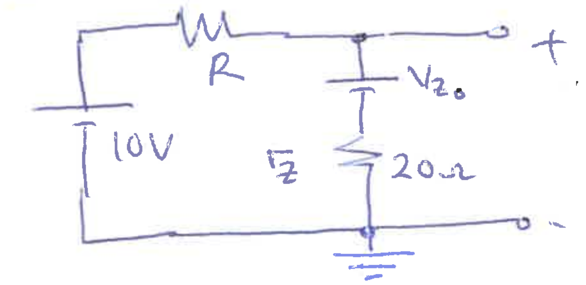
-B-

Q.1)

A zener diode has equivalent resistance of 20 Ω. The zener diode is 5.1 V at 1mA. Determine the value of resistance R required **to limit the power dissipated** in the zener diode to 20mW.



Solution:



(i) $5.1V = V_{Z_0} + (1mA \times 0.02k\Omega)$

$V_{Z_0} = 5.08V$

(ii) $P_Z = V_Z I_Z$

$I_Z = 20mW / 5.1V$

$I_Z = 3.92mA$

(iii) $10V = (3.92mA \times R) + V_{Z_0} + (3.92mA \times 0.02k\Omega)$

Put $V_{Z_0} = 5.08V$ then $\dfrac{10V - 5.08V - 0.0784V}{3.92mA} = R$

$R = \dfrac{4.8416V}{3.92mA}$

* $R = 1235.1\ \Omega$

Q.2)

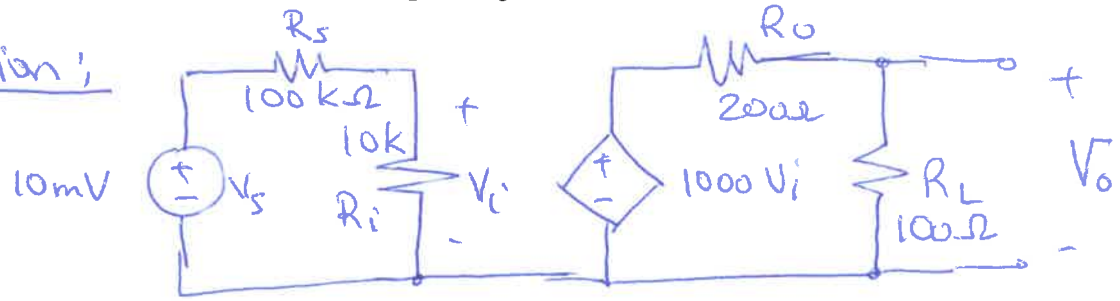
A voltage amplifier with an input resistance of 10 kΩ, an output resistance of 200 Ω, and a gain of 1000 V /V is connected between a 100 kΩ source with an open-circuit voltage of 10 mV and a 100 Ω load. For this situation:

(a)What output voltage results?

(b) What is the overall voltage gain from source to load?

(c) What is the overall current gain and power gain in terms of dB?

Solution ;



(a) $V_i = \frac{10k\Omega}{100k + 10k} \times 10mV = 0.9mV$

$V_o = \frac{100\Omega}{100\Omega + 200\Omega} \times 1000 \times 0.9mV = 300mV$, $V_o = 300mV$

(b) * $\frac{V_o}{V_s} = \frac{300mV}{10mV} = 30\ V/V$

(c) * $A_i = \frac{i_o}{i_s} = \frac{300mV / 100\Omega}{0.9mV / 10k\Omega} = \frac{300}{0.9} \times \frac{10,000}{100} = 33,333\ A/A$

* $A_p = A_i \cdot A_v = 30 \times 33,333 = 999,990$

* $G_i(dB) = 20 \log 33,333 = 90.45\ dB$

* $G_p(dB) = 10 \log 999,990 \simeq 60\ dB$

Name-Surname :

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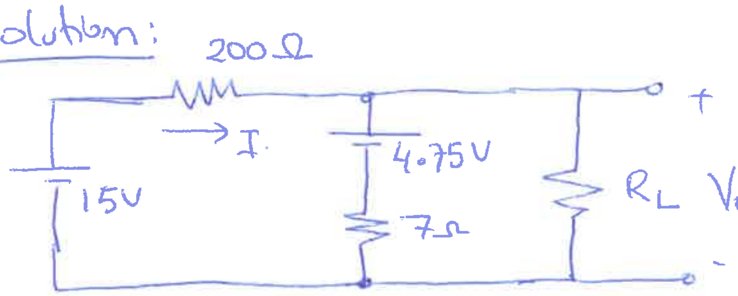
- A -

Q.1)

A shunt regulator utilizes a zener diode whose voltage is 5.1 V at a current of 50 mA whose incremental resistance is 7 Ω and I_{ZK} = 0.2 mA. The diode is fed from a supply of 15 V nominal voltage through a 200 Ω resistor.

a) What is **the output voltage** at no load?
b) What is the **minimum value** of RL for which the diode still operates in the breakdown region?

Solution:



$5.1V = V_{Z0} + (50mA \times 7\Omega)$

$V_{Z0} = 4.75V$

(a) At no-load $I = I_Z = \frac{15V - 4.75V}{~~15\Omega~~ + 7\Omega} = 49.5mA$

200Ω

Then $V_O = 4.75V + (49.5mA \times 7\Omega)$

$V_O = 5.09V$

(b) At I_{ZK}, $V_O = 4.75V + (0.2mA \times 7\Omega) \cong 4.75V$

$I = \frac{15V - 4.75V}{200\Omega} = 51.25mA$

$I_{L(max)} = I - I_{ZK} = 51.25mA - 0.2mA = 51.05mA$

$R_{L(min)} = \frac{V_O}{I_{L(maks)}}$

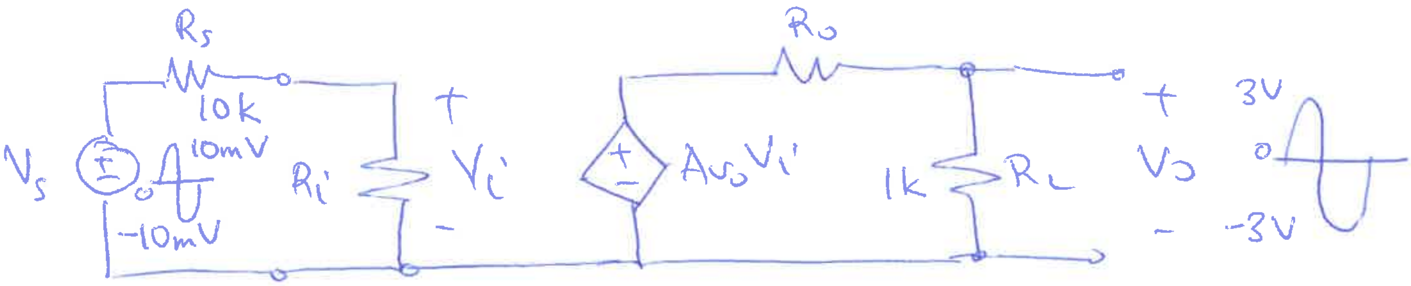
$R_{L(min)} = \frac{4.75V}{51.05mA} = 93\Omega$

Q.2)

It is required to design a voltage amplifier to be driven from a signal source having a 10 mV peak amplitude and a source resistance of 10 kΩ to supply a peak output of 3 V across a 1 kΩ load.

a) What is the required **voltage gain** from the source to the load? (R_i)

b) If the peak current available from the source is 0.1uA, what is the **smallest input resistance** allowed? For the design with this value of R_i find the **overall current gain and power gain**.



(a) $A_v = \frac{V_o}{V_s} = \frac{3000\,mV}{10\,mV} = 300\ V/V$

(b) $\frac{10\,mV}{10k\Omega + R_i} = 0.1\,\mu A \Rightarrow 10\,mV = 0.1\,\mu A\,(10k + R_i)$

$100K = 10k + R_i$

$\ast\ R_i = 90\,k\Omega$

$A_i = \frac{i_L}{i_s} = \frac{3V/1k\Omega}{0.1\,\mu A} = 30{,}000\ A/A$

$A_p = A_v A_i = 300 \times 30{,}000$

$\ast\ A_p = 9{,}000{,}000$