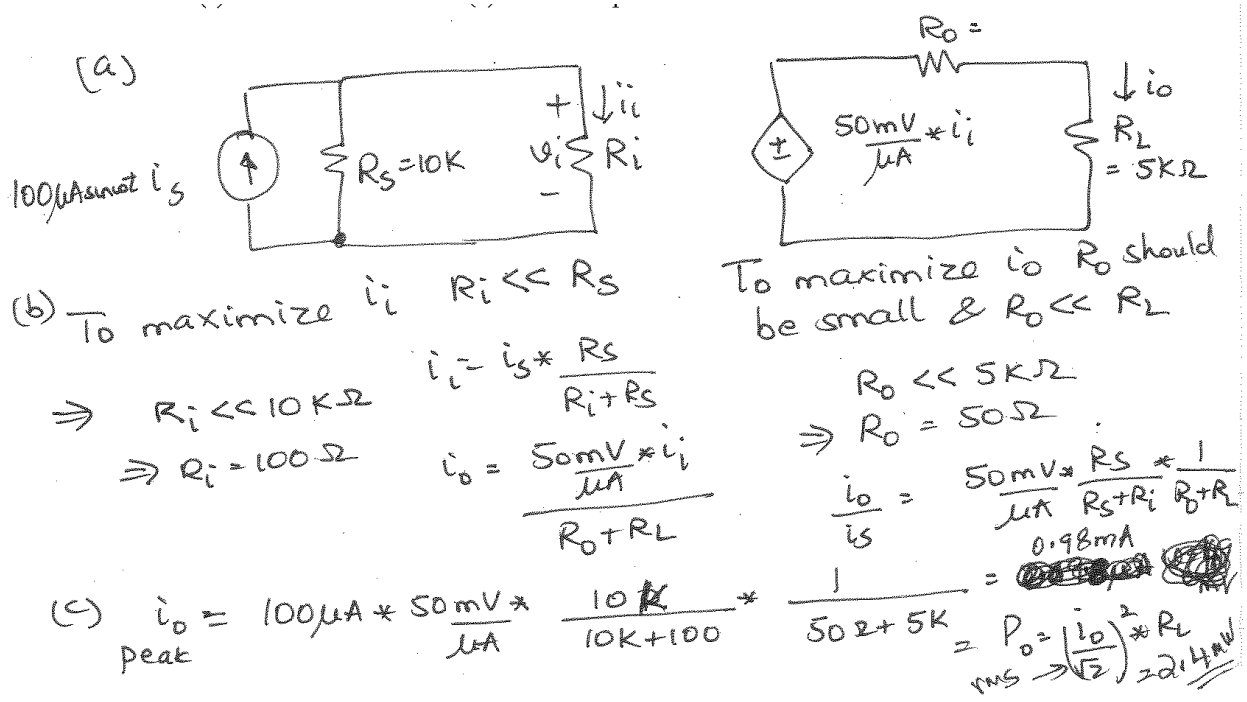
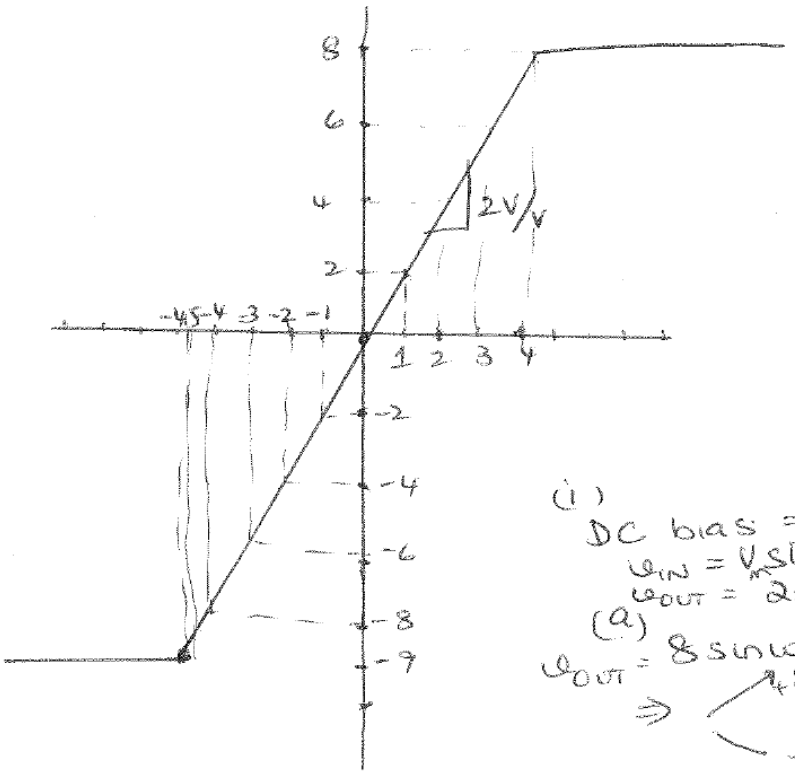
SANTA CLARA UNIVERSITY	ELEN 115 – Spring 2023	S. Krishnan
Homework #4 Solutions		

1.



2.



(i)
DC bias = 0V
$v_{IN} = V_m \sin\omega t$
$v_{OUT} = 2 \times V_{in} \sin\omega t$

(a)
$v_{OUT} = 8 \sin\omega t$
$\Rightarrow$ +8V max
-8V min

(b) $v_{IN} = \frac{v_{OUT}}{gain}$

$v_{IN} = 4 \sin\omega t$

(ii) Vout swing peak to peak -9 to $+8$ $\Rightarrow$ 17V
$\Rightarrow V_{out\ peak} = \frac{17}{2} = 8.5V$

$V_{out\ peak\ max} = 8V = V_{DC\ out} + V_{out\ peak} = V_{out\ max}$

$? + 8.5 = 8V \Rightarrow V_{OUT\ DC} = -0.5V$

Also V_{in} swing peak to peak to stay in this range of Vout
$= -4.5$ to $1 = 8.5V$

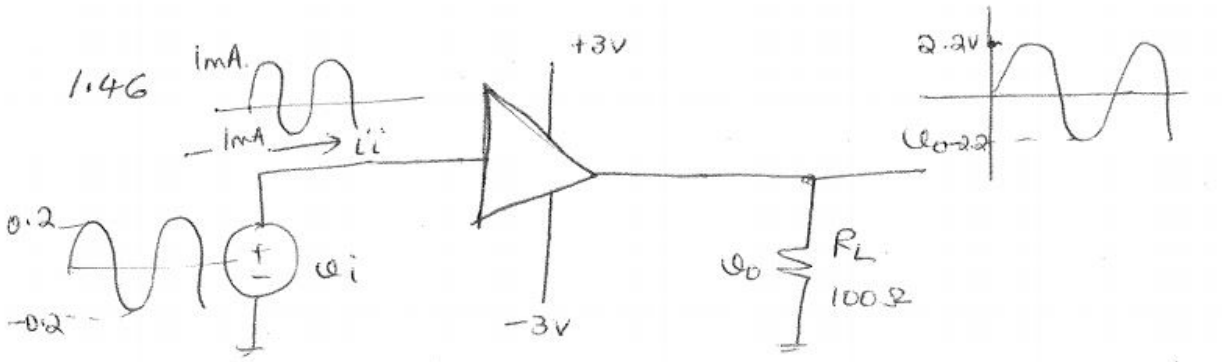
$V_{in\ peak} = \frac{8.5}{2} = 4.25V$

$v_{IN} = -0.25 + 4.25 \sin\omega t$

$V_{IN} = V_{DC\ in} + V_{in\ peak} = V_{in\ max}$

$? + 4.25 = 4 \Rightarrow V_{IN\ DC} = -0.25V$

3. 1.46



Voltage gain = $\frac{v_o}{v_i} = \frac{2.2}{0.2} = 11\ V/V$ $20\log 11 = 20.8dB$

Current gain = $\frac{i_o}{i_L} = \frac{2.2/100}{1mA} = 22\ A/A$ $20\log 22 = 26.8dB$

Power gain = $\frac{\frac{v_o}{\sqrt{2}}\frac{i_o}{\sqrt{2}}}{\frac{v_i}{\sqrt{2}}\frac{i_i}{\sqrt{2}}} = \frac{v_o i_o}{v_i i_i} = 11 \times 22 = 242\ W/W$

$10\log 242 = 23.8dB$

$P_o = \frac{(V_o/\sqrt{2})^2}{R_L} = \frac{\left(\frac{2.2}{\sqrt{2}}\right)^2}{100} = 24.2mW$ $P_o/P_{DC} = \eta$

$P_i = \frac{0.2}{\sqrt{2}}\frac{1mA}{\sqrt{2}} = 100\mu W$ (very small can be ignored)

$\Rightarrow P_{DC} = \frac{P_o}{\eta} = \frac{24.2}{\frac{10}{100}}$

$P_{DC} = 242mW$

$P_{DC} + P_i = P_o + P_{AMP}$ $I_{supply} = \frac{242}{3-(-3)} = 40.3mA$

$P_{AMP} = P_{DC} - P_o = 242 - 24.2 = 217.8mW$