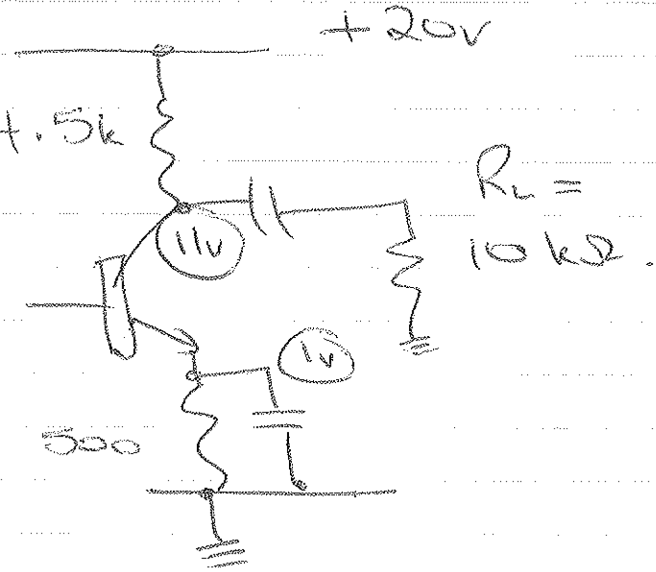
ENEL 434 Electronics II

12 March

Efficiencies of CE amps.



$I_C = 2mA$.

When there is NO signal

Power used $= 20 \times 2\times10^{-3} = 40\,mW$.

How is this comprised?

P in $R_C = I_C^2 R = 18mW$.

P in $R_E = I_C^2 R = 2mW$.

P in BJT $= \langle v(t) \cdot i(t) \rangle$

$= 10 \times 2\times10^{-3} = 20mW$.

Now with a signal present

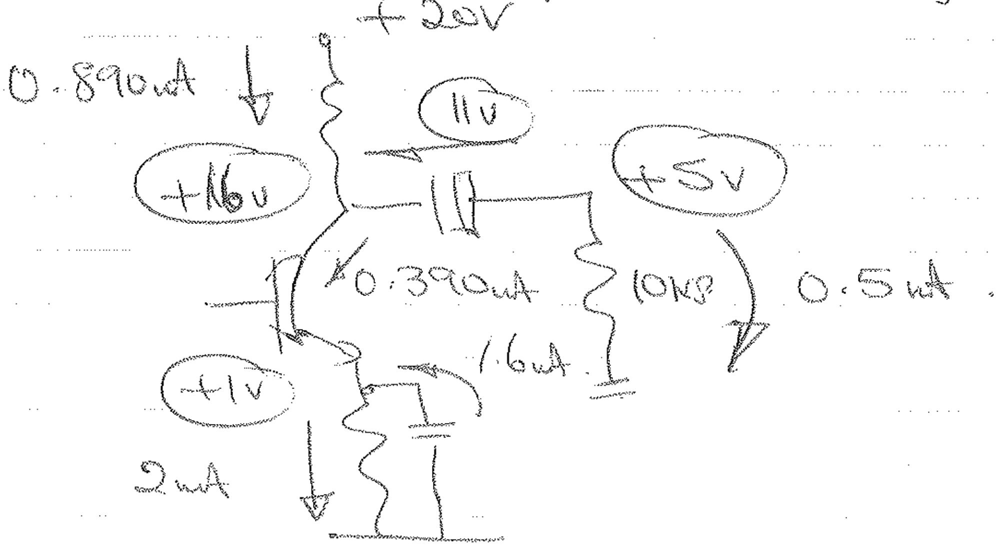
let $v_o(t) = 5 \cos 2\pi f t$.

$\therefore v_c(t) = 11 + 5 \cos 2\pi f t$.

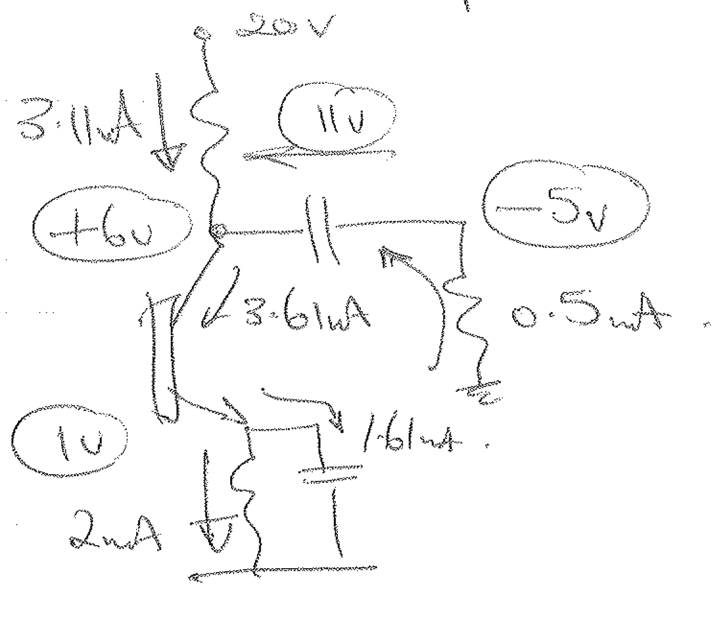
$V_e(t) = V_E = 1\,V$ (ie constant)

$V_{CE} = 10 + 5 \cos 2\pi f t$.

Find currents at peak +ve output voltage



Find currents at peak -ve output voltage



$\therefore\ i_C(t) = \left(2 - 1.61 \cos 2\pi ft\right) \times 10^{-3}$ amps.

$i_{R_C} = \left(2 - 1.11 \cos 2\pi ft\right) \times 10^{-3}$ amps.

Power in $R_L = \left\langle \left(5 \cos 2\pi ft\right)^2 \right\rangle / R_L$

$= 1.25\,\text{mW}$.

Power in $R_C = \left\langle \left(2 - 1.11 \cos 2\pi ft\right)^2 \times 10^{-6} \right\rangle \times 4.5 \times 10^{+3}$

$= 20.77\,\text{mW}$.

Power in BJT $= \left\langle v_{CE}(t) \cdot i(t) \right\rangle$

$= \left\langle \left(10 + 5\cos 2\pi ft\right)\left(2 - 1.61 \cos 2\pi ft\right) \right\rangle$

$= \left(20 - \dfrac{8.05}{2}\right) \times 10^{-3}$

$= 15.98\,\text{mW}$

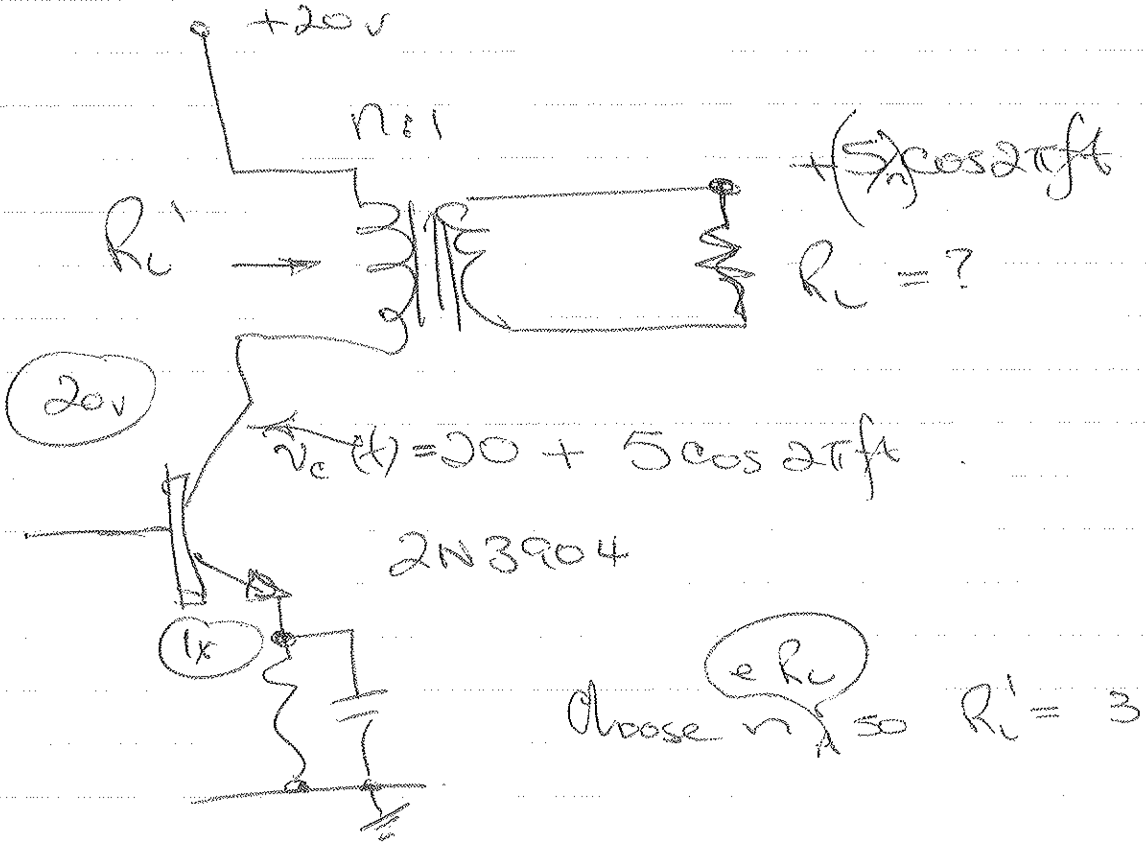
Total Power used

$$\begin{array}{ccccccccc} & R_C & & R_E & & BJT & & R_L & \\ = & 20.77 & + & 2 & + & 15.98 & + & 1.25 & \text{mW} \end{array}$$

$= 41.25\,\text{mW}$.

$\therefore\ \eta = \dfrac{1.25}{41.25} \times 100 = 3.02\%$!!

Transformer Coupled load



Choose n so $R_L' = 3.1k\Omega$ @ R_L

$v_{ce}(t) = 19 + 5\cos 2\pi ft$

$i_c(t) = ?$

Power in R_E = $1 \times 2mA$ = 2mW.

Power in R_L = ?

Power in BJT = $\langle v_{ce}(t) \cdot i_c(t) \rangle$

Total Power = $P_{RE} + P_{RL} + P_{BJT}$

$\eta = P_{RL}/\text{Total }P \times 100\% = ?$