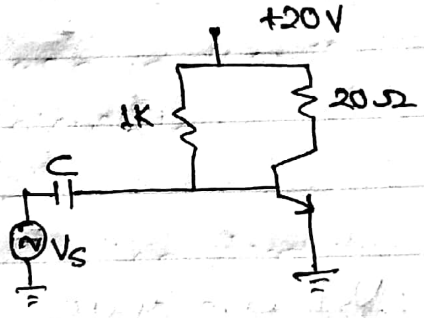
Calculate Power loss in transistor, collector efficiency, overall efficiency of given ckt. Assume $\beta = 25$ & base current at peak is 10 mA.



Soln: Given,

$V_{cc} = 20V$, $R_c = 20\Omega$, $R_B = 1K$, $\beta = 25$

$I_{BP} = 10\,mA$

Applying KVL at I/p,

$V_{cc} = I_{BQ} R_B + V_{BE}$

$\Rightarrow I_{BQ} = \dfrac{V_{cc} - V_{BE}}{R_B} = \dfrac{(20 - 0.7)V}{1K} = 19.3\,mA$

And we know, $I_c = \beta I_B$

so, $I_{CQ} = \beta I_{BQ} = 25 \times 19.3 = 0.48\,A$

I/p power $(P_{in(dc)}) = V_{cc} I_{CQ} = 20V \times 0.48A$

$= 9.6W$

O/p Power, $P_{o(ac)} = V_{CE,rms} \times I_{c,rms}$

$= \dfrac{V_{CE,P} \times I_{cp}}{2}$

$= \dfrac{I_{cp} R_c \times I_{cp}}{2} = \dfrac{I_{cp}^2 R_c}{2}$

$= \dfrac{(0.25)^2 \times 20}{2} = 0.625W$

where, $I_{cp} = \beta I_{BP} = 25 \times 10mA = 0.25A$

i) Power Loss in transistor $= V_{cc} I_{CQ} - I_{CQ}^2 R_c$

$= 20 \times 0.48 - (0.48)^2 \times 20$

$= 4.99W$

= avg DC power dissipated at collector.

ii) Collector Efficiency $(\eta_c) = \dfrac{\text{avg ac power delivered to load}}{\text{avg dc power dissipated at collector}} \times 100\%$

$= \dfrac{0.625}{4.99} \times 100\%$

$= 12.52\%$

iii) Overall Efficiency $(\eta) = \dfrac{P_{o(ac)}}{P_{in(dc)}} \times 100\%$

$= \dfrac{0.625}{9.6} \times 100\%$

$= 6.51\%$

For a class B amp providing a 20V peak signal to the 16Ω load and a power supply of $V_{cc} = 30V$. Find I/p and O/p power and efficiency also.

Sol^n:

Given, $V_{LP} = 20V$

$R_L = 16\Omega$

$V_{cc} = 30V$

i) I/p power, $P_{in(dc)} = V_{cc} \times I_{dc}$

$= V_{cc} \times \dfrac{I_{cp}}{\pi} = V_{cc} \dfrac{V_{LP}}{R_L \pi}$

$= 30 \times \dfrac{20}{16 \times \pi} = 11.94W$

ii) O/p Power, $P_{o(ac)} = \dfrac{1}{4} I_{cp} V_{cc}$

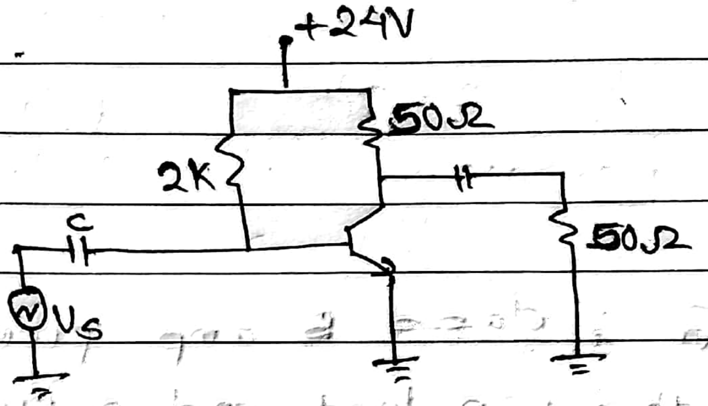
$= 1/4 \times \dfrac{V_{LP}}{R_L} \times V_{cc}$

$= 1/4 \times 20/16 \times 30 = 9.375W$

iii) Efficiency, $\eta = \dfrac{P_{o(ac)}}{P_{in(dc)}} \times 100\% = \dfrac{9.375}{11.94} \times 100\% = 78.5\%$

A class A amp biased at $V_{CE} = 12V$ is as shown in fig below. The o/p voltage is maxm possible without distortion. Calculate,

i) average dc power from source
ii) average ac power delivered to the load.
iii) collector efficiency.
iv) overall efficiency.



Sol^n: Given,

$V_{CC} = 24V$, $V_{CEQ} = 12V$, $R_B = 2K$, $R_C = R_L = 50\Omega$

we have,

$$V_{CC} = I_{CQ}R_C - V_{CEQ}$$

$$\Rightarrow I_{CQ} = \frac{V_{CC} - V_{CEQ}}{R_C} = \frac{24-12}{50} = 0.24\,A$$

i) Avg dc I/p power from Source,

$$P_{in(dc)} = V_{CC} \times I_{CQ}$$

$$= 24 \times 0.24$$

$$= 5.76\,W$$

ii) Avg ac power delivered to load

$$P_{o(ac)} = V_{CE,rms} \times I_{C,rms}$$

$$= \frac{V_{CEP}\, I_{CP}}{2}$$

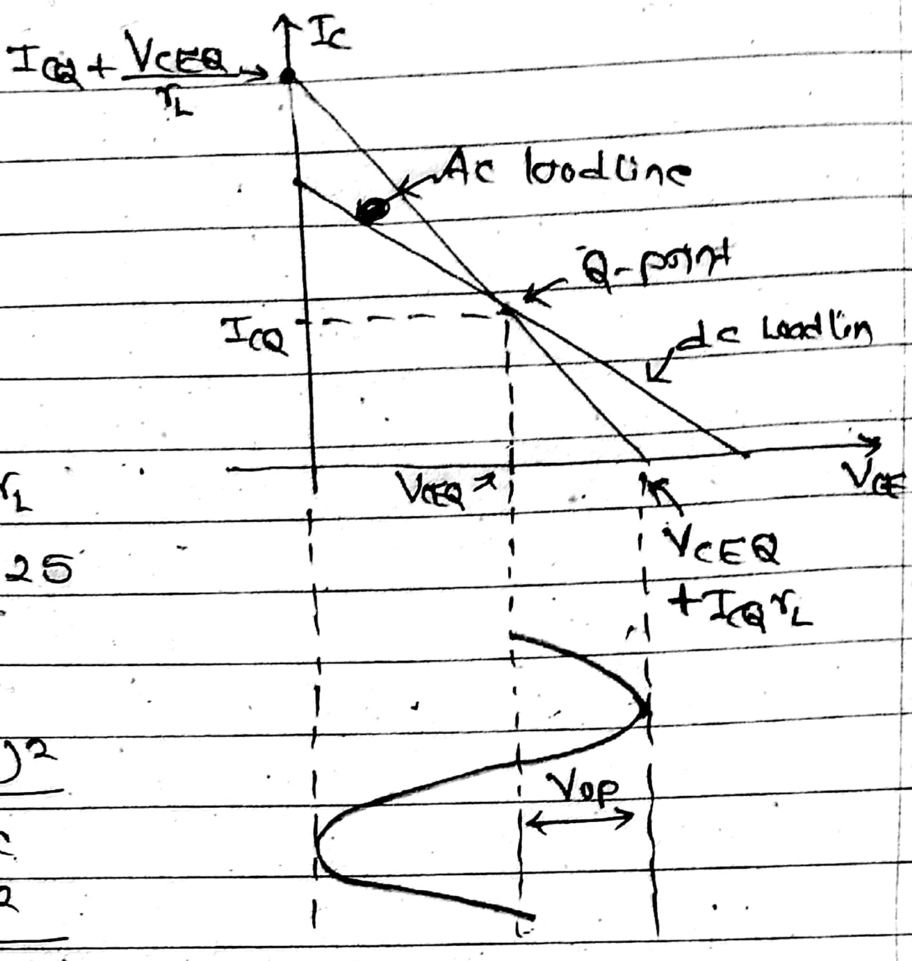
$$= \frac{(V_{CEP})^2}{2R_C} = \frac{(V_{OP})^2}{2R_C}$$

Here, $r_L = R_C // R_L$

$= 50 // 50$

$= \frac{50 \times 50}{50+50}$

$= 25\Omega$



Thus, $V_{op} = I_{CQ} \times r_L$

$= 0.24 \times 25$

$= 6V$

So,

$P_o(ac) = \frac{(V_{op})^2}{2R_C}$

$= \frac{6^2}{2 \times 50}$

$= 0.36W$

ii) Overall Efficiency, $\eta = \frac{P_o(ac)}{P_{in}(dc)} \times 100\%$

$= \frac{0.36}{5.76} \times 100\%$

$= 6.25\%$

iii) collector efficiency,

$\eta_c = \frac{\text{avg ac power delivered to load}}{\text{avg dc power dissipated at collector}} \times 100\%$

where,

avg dc power dissipated at collector $= V_{CEQ} \times I_{CQ}$

$= 12V \times 0.24A$

$= 2.88W$

$\therefore \eta_c = \frac{0.36}{2.88} = 12.5\%$

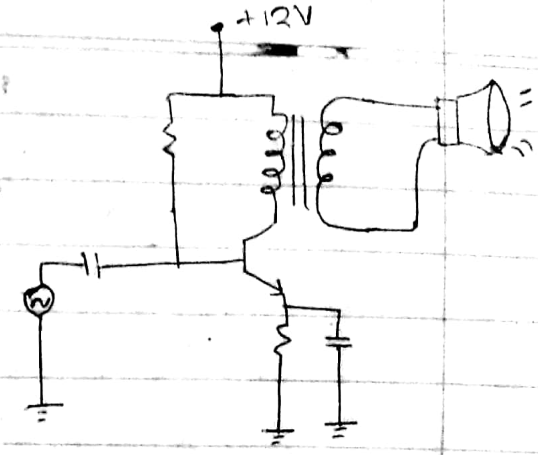
Scanned by CamScanner

2018 Fall

$V_{cc} = 12V$

or, $\Delta I_C = 100mA$, $\Delta V_{CE(max)} = 12V$

$R_L = 5\Omega$



Resistance of transistor $= \frac{\Delta V_{CE}}{\Delta I_C} = \frac{12V}{100mA}$

$= 120\Omega$

Let $n:1$ be the turn ratio of transformer & let R_L' be primary load resistance,

$I_1^2 R_L' = I_2^2 R_L$

$\Rightarrow R_L' = \left(\frac{I_2}{I_1}\right)^2 R_L = \left(\frac{N_1}{N_2}\right)^2 R_L \qquad \left(\because \frac{N_1}{N_2} = \frac{I_2}{I_1} = \frac{V_1}{V_2}\right)$

or, $R_L' = n^2 R_L$

or, $120 = n^2 \times 5 \Rightarrow n^2 = 120/5$

$\Rightarrow n = 4.9$

So, turn ratio $= 4.9:1$

Also, $\frac{N_1}{N_2} = \frac{V_1}{V_2}$ where, V_1 = primary (i/p) voltage,
V_2 = secondary voltage

$\Rightarrow V_2 = \left(\frac{N_2}{N_1}\right) \times V_1 = \left(\frac{V_1}{N_1/N_2}\right) = \frac{V_1}{n}$

$= \frac{12}{4.9} = 2.47V$

& Load current, $I_L = \frac{V_2}{R_L} = \frac{2.47V}{5\Omega} = 0.49A$

$\therefore$ Power transferred to load $= I_L^2 R_L$

$= (0.49)^2 \times 5$

$= 1.2 W$