Name:	**Dr JBO**
Student ID Number:	**Model Answer**
Section:	02 A/B
Lecturer:	Dr. Jamaludin Bin Omar

EEEB2014/EEEB273 - Quiz 4 .
SEMESTER 1, ACADEMIC YEAR 2019/2020
Date: 7 August 2019 Time: 15 minutes

Question:

For the **class-AB** output stage given in **Figure 1**, parameters are V_{CC} **= 10** V, R_L **= 100 Ω**. For the transistors, I_s **= 5 x 10^{-15} A** and $\beta = \infty$.

(a) For the **quiescent condition** when $v_I = 0$, it is given that $V_{BEn} = V_{EBp} = 0.71$ **V. Calculate** the **DC collector currents** of Q_n and Q_p. **[4 marks]**

(b) For an output voltage of $v_O = -3.4$ V, **calculate** load current i_L, and transistor currents i_{Cn} and i_{Cp}. **[6 marks]**

Answer:

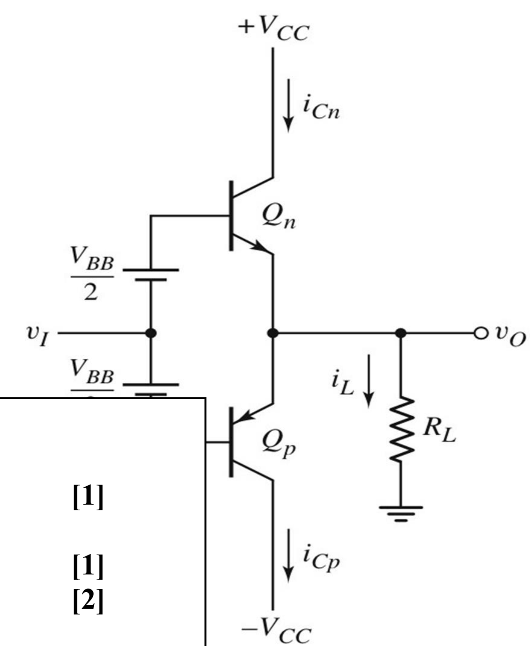

Figure 1

(a) Quiescent condition

$V_{BB} = V_{BEn} + V_{EBp} = 1.42$ V **[1]**

$I_{CQ} = i_{Cn} = i_{Cp} = I_S \exp(V_{BB} / 2V_T)$ **[1]**

$= (5\text{x}10^{-15}) \exp((1.42/2)/26\text{m})) = 3.6187$ mA **[2]**

(b) For $v_O = -3.4$ **V,**

$i_L = v_O / R_L = (-3.4)/(100) = -34$ mA **[1]**

i_L **is negative.** Therefore, Q_p **is conducting** and Q_n is OFF.

Approximate i_{Cp}

$i_{Cp} \approx | i_L | = 34$ mA **[1]**

$v_{EBp} = V_T \ln(i_{Cp} / I_S) = (0.026) \ln(34\text{m} / 5\text{x}10^{-15})$

$= 0.7682$ V **[1]**

$v_{BEn} = V_{BB} - v_{EBp} = 1.42 - 0.7682 = 0.6518$ V **[1]**

$i_{Cn} = I_S \exp(V_{BEn} / V_T) = (5\text{x}10^{-15}) \exp(0.6518 / 0.026)$

$= 0.3851$ mA **[1]**

Recalculate i_{Cp}

$i_{Cp} = i_{Cn} - i_L$

$= (0.3851\text{m}) - (-34\text{m}) = 34.3851$ mA **[1]**

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Question:

For the **class-AB** output stage given in **Figure 1**, parameters are V_{CC} **= 11 V**, R_L **= 110 Ω**. For the transistors, $I_s = 5 \times 10^{-15}$ **A** and $\beta = \infty$.

(a) For the **quiescent condition** when $v_I = 0$, it is given that $V_{BEn} = V_{EBp} = 0.72$ **V. Calculate** the **DC collector currents** of Q_n and Q_p. **[4 marks]**

(b) For an output voltage of $v_O = -3.3$ V, **calculate** load current i_L, and transistor currents i_{Cn} and i_{Cp}. **[6 marks]**

Answer:

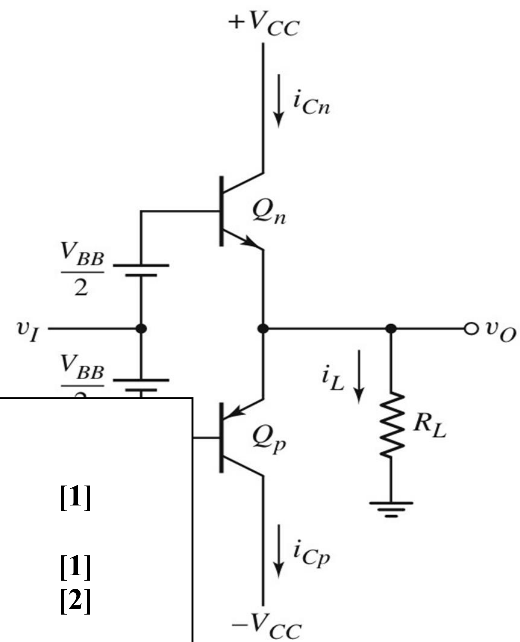

Figure 1

(a) Quiescent condition

$V_{BB} = V_{BEn} + V_{EBp} = 1.44$ V **[1]**

$I_{CQ} = i_{Cn} = i_{Cp} = I_S \exp(V_{BB} / 2V_T)$ **[1]**
$= (5\text{x}10^{-15}) \exp((1.44/2)/26\text{m})) = 5.3160$ mA **[2]**

(b) For $v_O = -3.3$ **V,**

$i_L = v_O / R_L = (-3.3)/(110) = -30$ **mA** **[1]**
i_L **is negative.** Therefore, Q_p **is conducting** and Q_n is OFF.
Approximate i_{Cp}
$i_{Cp} \approx |\, i_L \,| = 30$ **mA** **[1]**

$v_{EBp} = V_T \ln(i_{Cp} / I_S) = (0.026) \ln(30\text{m} / 5\text{x}10^{-15})$
$= 0.765$ **V** **[1]**
$v_{BEn} = V_{BB} - v_{EBp} = 1.44 - 0.765 = 0.675$ **V** **[1]**
$i_{Cn} = I_S \exp(V_{BEn} / V_T) = (5\text{x}10^{-15}) \exp(0.675 / 0.026)$
$= 0.942$ **mA** **[1]**
Recalculate i_{Cp}
$i_{Cp} = i_{Cn} - i_L$
$= (0.942\text{m}) - (-30\text{m}) = 30.942$ **mA** **[1]**

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Question:

For the **class-AB** output stage given in **Figure 1**, parameters are V_{CC} **= 12 V**, R_L **= 120 Ω**. For the transistors, $I_s = 5 \times 10^{-15}$ **A** and $\beta = \infty$.

(a) For the **quiescent condition** when $v_I = 0$, it is given that $V_{BEn} = V_{EBp} = 0.73$ **V. Calculate** the **DC collector currents** of Q_n and Q_p. **[4 marks]**

(b) For an output voltage of $v_O = -3.2$ V, **calculate** load current i_L, and transistor currents i_{Cn} and i_{Cp}. **[6 marks]**

Answer:

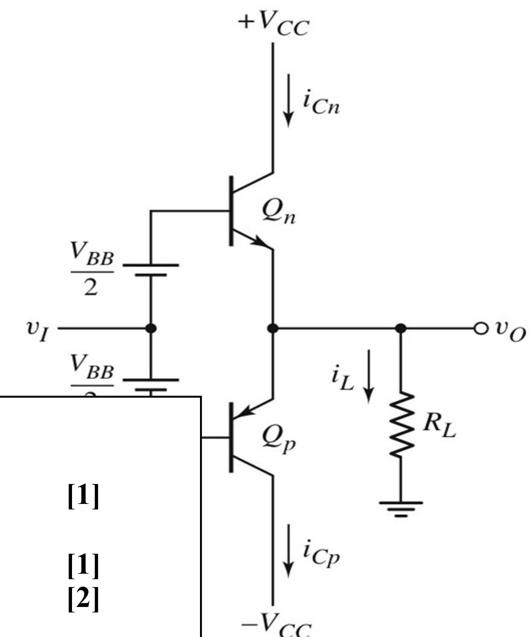

Figure 1

(a) Quiescent condition

$V_{BB} = V_{BEn} + V_{EBp} = 1.46$ V **[1]**

$I_{CQ} = i_{Cn} = i_{Cp} = I_S \exp(V_{BB} / 2V_T)$ **[1]**
$= (5\times10^{-15}) \exp((1.46/2)/26m)) = 7.8095$ mA **[2]**

(b) For $v_O = -3.2$ **V,**

$i_L = v_O / R_L = (-3.2)/(120) = -26.667$ **mA** **[1]**
i_L **is negative.** Therefore, Q_p **is conducting** and Q_n is OFF.
Approximate i_{Cp}
$i_{Cp} \approx | i_L | = 26.667$ **mA** **[1]**

$v_{EBp} = V_T \ln(i_{Cp} / I_S) = (0.026) \ln(26.667m / 5\times10^{-15})$
$= 0.7619$ V **[1]**
$v_{BEn} = V_{BB} - v_{EBp} = 1.46 - 0.7619 = 0.6981$ V **[1]**
$i_{Cn} = I_S \exp(V_{BEn} / V_T) = (5\times10^{-15}) \exp(0.6981 / 0.026)$
$= 2.2871$ **mA** **[1]**
Recalculate i_{Cp}
$i_{Cp} = i_{Cn} - i_L$
$= (2.2871m) - (-26.667 m) = 28.9537$ **mA** **[1]**

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Question:

For the **class-AB** output stage given in **Figure 1**, parameters are V_{CC} **= 13 V**, R_L **= 130 Ω**. For the transistors, $I_s = 5 \times 10^{-15}$ **A** and $\beta = \infty$.

(a) For the **quiescent condition** when $v_I = 0$, it is given that $V_{BEn} = V_{EBp} = 0.74$ **V. Calculate** the **DC collector currents** of Q_n and Q_p. **[4 marks]**

(b) For an output voltage of $v_O = -3.1$ V, **calculate** load current i_L, and transistor currents i_{Cn} and i_{Cp}. **[6 marks]**

Answer:

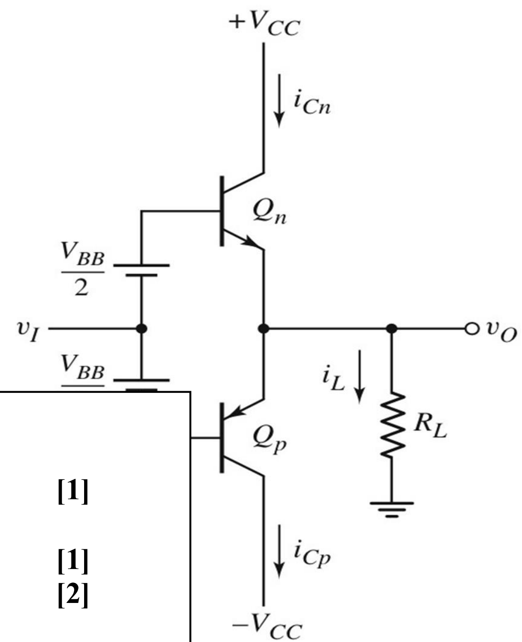

Figure 1

(a) Quiescent condition

$V_{BB} = V_{BEn} + V_{EBp} = 1.48$ V **[1]**

$I_{CQ} = i_{Cn} = i_{Cp} = I_S \exp(V_{BB} / 2V_T)$ **[1]**
$= (5\text{x}10^{-15}) \exp((1.48/2)/26\text{m})) = 11.4725$ mA **[2]**

(b) For $v_O = -3.1$ V,

$i_L = v_O / R_L = (-3.1)/(130) = -23.8462$ **mA** **[1]**
i_L **is negative.** Therefore, Q_p **is conducting** and Q_n is OFF.
Approximate i_{Cp}
$i_{Cp} \approx | i_L | = 23.8462$ **mA** **[1]**

$v_{EBp} = V_T \ln(i_{Cp} / I_S) = (0.026) \ln(23.8462\text{m} / 5\text{x}10^{-15})$
$= 0.759$ **V** **[1]**
$v_{BEn} = V_{BB} - v_{EBp} = 1.48 - 0.759 = 0.721$ **V** **[1]**
$i_{Cn} = I_S \exp(V_{BEn} / V_T) = (5\text{x}10^{-15}) \exp(0.721 / 0.026)$
$= 5.5195$ **mA** **[1]**
Recalculate i_{Cp}
$i_{Cp} = i_{Cn} - i_L$
$= (5.5195\text{m}) - (-23.8462\text{m}) = 29.3657$ **mA** **[1]**