Name:	**Dr JBO**
Student ID Number:	**Model Answer**
Section:	01 A/B
Lecturer:	Dr. Jamaludin Bin Omar

EEEB273 - Quiz 4 .
SEMESTER 1, ACADEMIC YEAR 2017/2018
Date: 7 August 2018 Time: 15 minutes

Question:

A **class-A** emitter follower biased with a constant current source is shown in **Figure 1**. Assume circuit parameters of $V^+ = 12$ V, $V^- = -12$ V, and $R_L = 25\ \Omega$. The transistor parameters are $\beta = 40$ and V_{BE} **(on) = 0.7 V**. The minimum current in Q_1 is to be i_{E1}**(min) = 40 mA** and the minimum collector- emitter voltage is to be v_{CE}**(min) = 0.7 V**.

Determine the value of R that will produce the maximum possible output voltage swing. **What** is the value of I_Q? What is the maximum value of i_{E1}? [10 marks]

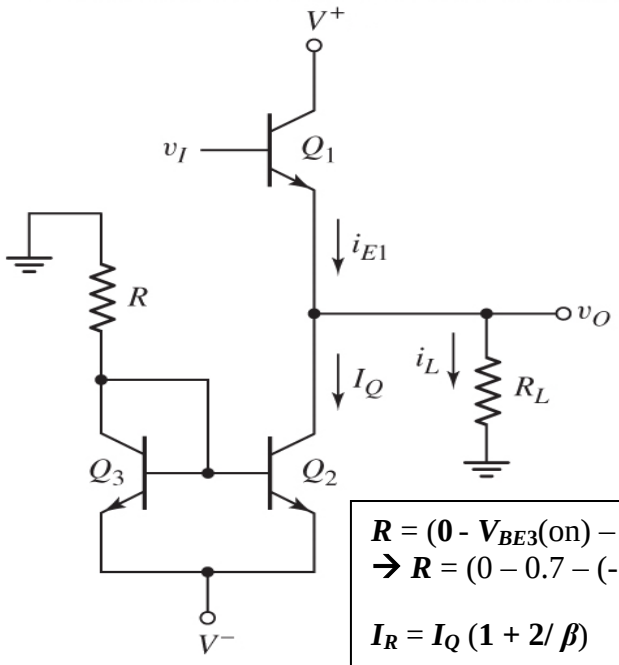

Figure 1

$$i_C = I_S e^{v_{BE}/V_T}\text{; npn}$$
$$i_C = I_S e^{v_{EB}/V_T}\text{; pnp}$$
$$i_C = \alpha i_E = \beta i_B$$
$$i_E = i_B + i_C$$
$$\alpha = \frac{\beta}{\beta + 1}$$

; Small signal

Answer:

$R = (0 - V_{BE3}(\text{on}) - V^-) / I_R$
→ $R = (0 - 0.7 - (-12)) / I_R = 11.3 / I_R$ [1]

$I_R = I_Q\,(1 + 2/\beta)$ [1]

$I_{E1} = I_Q + I_L$ → $I_{E1}(\text{min}) = I_Q + I_L(\text{min})$ [1]

$I_L(\text{min}) = v_O(\text{min}) / R_L = (V^- + V_{CE2}(\text{min})) / R_L$
→ $I_L(\text{min}) = (-12 + 0.7) / 25 = -452$ mA [1]

$I_Q = I_{E1}(\text{min}) - I_L(\text{min})$
→ $I_Q = 40$ mA – (-452 mA) = 492 mA [1]

$I_R = (492\text{ mA})(1 + 2/40) = 516.6$ mA [1]

→ $R = 11.3 / 516.6\text{m} = 21.873\ \Omega$ [1]

$I_{E1}(\text{max}) = I_Q + I_L(\text{max})$ [1]

$I_L(\text{max}) = v_O(\text{max}) / R_L = (V^+ - V_{CE1}(\text{min})) / R_L$
→ $I_L(\text{max}) = (12 - 0.7) / 25 = 452$ mA [1]

→ $I_{E1}(\text{max}) = 492\text{ mA} + 452\text{ mA} = 944$ mA [1]

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Question:

A **class-A** emitter follower biased with a constant current source is shown in **Figure 1**. Assume circuit parameters of $V^+ = 11$ V, $V^- = -11$ V, and $R_L = 15\ \Omega$. The transistor parameters are $\beta = 40$ and V_{BE} **(on) = 0.7 V**. The minimum current in Q_1 is to be i_{E1}**(min) = 45 mA** and the minimum collector- emitter voltage is to be v_{CE}**(min) = 0.7 V**.

Determine the value of R that will produce the maximum possible output voltage swing. **What** is the value of I_Q? What is the maximum value of i_{E1}? [10 marks]

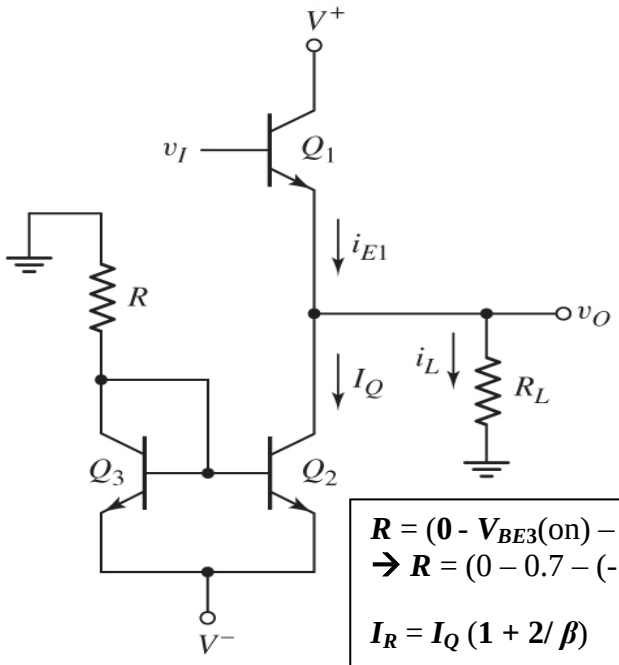

Figure 1

$$i_C = I_S e^{v_{BE}/V_T}\ ;\text{npn}$$
$$i_C = I_S e^{v_{EB}/V_T}\ ;\text{pnp}$$
$$i_C = \alpha i_E = \beta i_B$$
$$i_E = i_B + i_C$$
$$\alpha = \frac{\beta}{\beta + 1}$$

;Small signal

Answer:

$R = (0 - V_{BE3}(\text{on}) - V^-) / I_R$
→ $R = (0 - 0.7 - (-11)) / I_R = 10.3 / I_R$ [1]

$I_R = I_Q\,(1 + 2/\beta)$ [1]

$I_{E1} = I_Q + I_L$ → $I_{E1}(\text{min}) = I_Q + I_L(\text{min})$ [1]

$I_L(\text{min}) = v_O(\text{min}) / R_L = (V^- + V_{CE2}(\text{min})) / R_L$
→ $I_L(\text{min}) = (-11 + 0.7) / 15 = -686.7$ mA [1]

$I_Q = I_{E1}(\text{min}) - I_L(\text{min})$
→ $I_Q = 45\text{ mA} - (-686.7\text{ mA}) = 731.7$ mA [1]

$I_R = (731.7\text{ mA})(1 + 2/40) = 768.285$ mA [1]

→ $R = 10.3 / 768.285\text{m} = 13.406\ \Omega$ [1]

$I_{E1}(\text{max}) = I_Q + I_L(\text{max})$ [1]

$I_L(\text{max}) = v_O(\text{max}) / R_L = (V^+ - V_{CE1}(\text{min})) / R_L$
→ $I_L(\text{max}) = (11 - 0.7) / 15 = 686.7$ mA [1]

→ $I_{E1}(\text{max}) = 731.7\text{m} + 686.7\text{m} = 1418.4$ mA [1]

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Date: 7 August 2018 Time: 15 minutes

Question:

A **class-A** emitter follower biased with a constant current source is shown in **Figure 1**. Assume circuit parameters of $V^+ = 11$ V, $V^- = -11$ V, and $R_L = 25\ \Omega$. The transistor parameters are $\beta = 40$ and V_{BE} **(on) = 0.7 V**. The minimum current in Q_1 is to be i_{E1}**(min) = 45 mA** and the minimum collector- emitter voltage is to be v_{CE}**(min) = 0.7 V**.

Determine the value of R that will produce the maximum possible output voltage swing. **What** is the value of I_Q? What is the maximum value of i_{E1}? [10 marks]

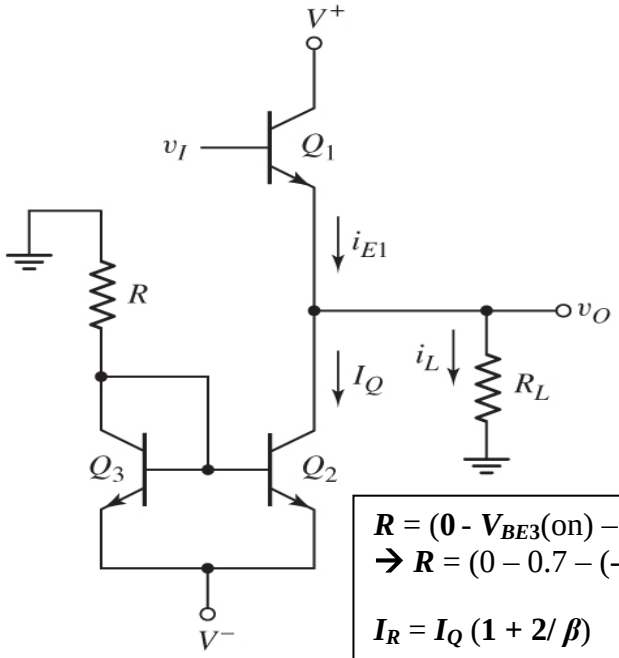

Figure 1

$$i_C = I_S e^{v_{BE}/V_T}\ ;\text{npn}$$
$$i_C = I_S e^{v_{EB}/V_T}\ ;\text{pnp}$$
$$i_C = \alpha i_E = \beta i_B$$
$$i_E = i_B + i_C$$
$$\alpha = \frac{\beta}{\beta + 1}$$

Answer:

$R = (0 - V_{BE3}(\text{on}) - V^-) / I_R$
→ $R = (0 - 0.7 - (-11)) / I_R = 10.3 / I_R$ [1]

$I_R = I_Q\ (1 + 2/\beta)$ [1]

$I_{E1} = I_Q + I_L$ → $I_{E1}(\text{min}) = I_Q + I_L(\text{min})$ [1]

$I_L(\text{min}) = v_O(\text{min}) / R_L = (V^- + V_{CE2}(\text{min})) / R_L$
→ $I_L(\text{min}) = (-11 + 0.7) / 25 = -412$ mA [1]

$I_Q = I_{E1}(\text{min}) - I_L(\text{min})$
→ $I_Q = 45\text{ mA} - (-412\text{ mA}) = 457$ mA [1]

$I_R = (457\text{ mA})(1 + 2/40) = 479.85$ mA [1]

→ $R = 10.3 / 479.85\text{m} = 21.465\ \Omega$ [1]

$I_{E1}(\text{max}) = I_Q + I_L(\text{max})$ [1]

$I_L(\text{max}) = v_O(\text{max}) / R_L = (V^+ - V_{CE1}(\text{min})) / R_L$
→ $I_L(\text{max}) = (11 - 0.7) / 25 = 412$ mA [1]

→ $I_{E1}(\text{max}) = 457\text{ m} + 412\text{ m} = 869$ mA [1]

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EEEB273 - Quiz 4 :
SEMESTER 1, ACADEMIC YEAR 2017/2018
Date: 7 August 2018 Time: 15 minutes

Question:

A **class-A** emitter follower biased with a constant current source is shown in **Figure 1**. Assume circuit parameters of $V^+ = 9$ V, $V^- = -9$ V, and $R_L = 15\ \Omega$. The transistor parameters are $\beta = 40$ and V_{BE} **(on) = 0.7 V**. The minimum current in Q_1 is to be i_{E1}**(min) = 55 mA** and the minimum collector- emitter voltage is to be v_{CE}**(min) = 0.7 V**.

Determine the value of R that will produce the maximum possible output voltage swing. **What** is the value of I_Q? What is the maximum value of i_{E1}? [10 marks]

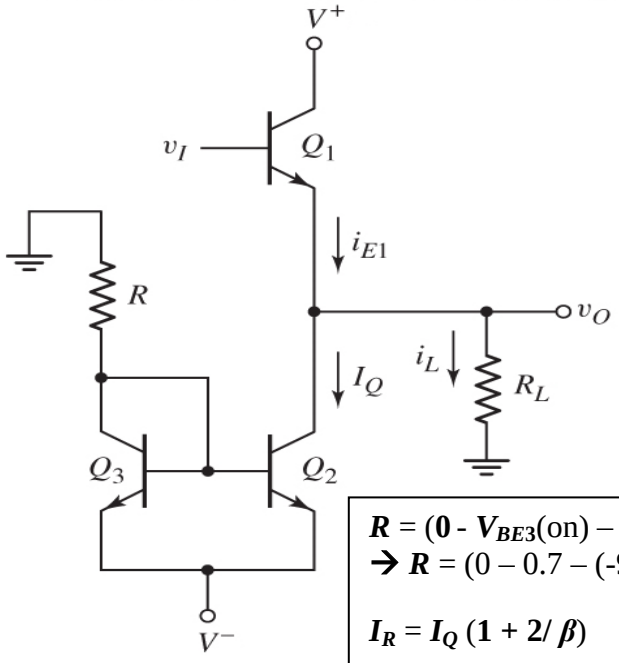

Figure 1

$$i_C = I_S e^{v_{BE}/V_T}\ ;\text{npn}$$
$$i_C = I_S e^{v_{EB}/V_T}\ ;\text{pnp}$$
$$i_C = \alpha i_E = \beta i_B$$
$$i_E = i_B + i_C$$
$$\alpha = \frac{\beta}{\beta + 1}$$

;Small signal

Answer:

$R = (0 - V_{BE3}(\text{on}) - V^-) / I_R$
→ $R = (0 - 0.7 - (-9)) / I_R = 8.3 / I_R$ [1]

$I_R = I_Q\ (1 + 2/\beta)$ [1]

$I_{E1} = I_Q + I_L$ → $I_{E1}(\text{min}) = I_Q + I_L(\text{min})$ [1]

$I_L(\text{min}) = v_O(\text{min}) / R_L = (V^- + V_{CE2}(\text{min})) / R_L$
→ $I_L(\text{min}) = (-9 + 0.7) / 15 = -553.3$ mA [1]

$I_Q = I_{E1}(\text{min}) - I_L(\text{min})$
→ $I_Q = 55$ mA – (-553.3 mA) = 608.3 mA [1]

$I_R = (608.3\text{ mA})(1 + 2/40) = 638.715$ mA [1]

→ $R = 8.3 / 638.715\text{m} = 12.995\ \Omega$ [1]

$I_{E1}(\text{max}) = I_Q + I_L(\text{max})$ [1]

$I_L(\text{max}) = v_O(\text{max}) / R_L = (V^+ - V_{CE1}(\text{min})) / R_L$
→ $I_L(\text{max}) = (9 - 0.7) / 15 = 553.3$ mA [1]

→ $I_{E1}(\text{max}) = 608.3$ m + 553.3 m = 1161.6 mA [1]