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

EEEB273 - Quiz 3 .
SEMESTER 2, ACADEMIC YEAR 2017/2018
Date: 22 November 2017 Time: 15 minutes

Question:

Refer to **Figure 1**. V^+ = **+5 V** and V^- = **-5 V.** Assume V_{BE}**(on) = 0.7 V,** $V_A = \infty$**,** and $\beta = \infty$ for all transistors in the circuit.

For R_C **= 2 kΩ** and $v_{CM} = v_{B1} = v_{B2}$ **= 0.5 V**, **determine** the value of I_Q such that V_{CE1} **= 2.5 V**. Write your answers clearly using PEN with proper Units for the parameters. [10 marks]

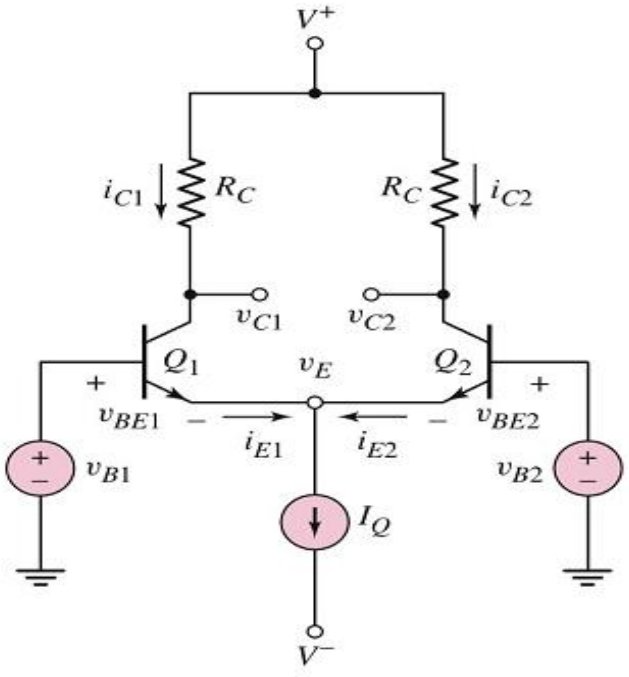

Figure 1

$$i_C = I_S e^{v_{BE}/V_T}\ ;\text{npn}$$

$$i_C = I_S e^{v_{EB}/V_T}\ ;\text{pnp}$$

$$i_C = \alpha i_E = \beta i_B$$

$$i_E = i_B + i_C$$

$$\alpha = \frac{\beta}{\beta + 1}$$

;Small signal

$$\beta = g_m r_\pi$$

$$g_m = \frac{I_{CQ}}{V_T}$$

$$r_\pi = \frac{\beta V_T}{I_{CQ}}$$

$$r_o = \frac{V_A}{I_{CQ}}$$

$$V_T = 26mV$$

Answer:

v_{C1} = v_{B1} - V_{BE1}(on) + V_{CE1} **[2]**
= **0.5 – 0.7 + 2.5** = **2.3 V** **[1]**

v_{C1} = V^+ - i_{C1} R_C
i_{C1} = (V^+ - v_{C1}) / R_C **[2]**
= **(5 – 2.3) / 2k** = **1.35 mA** **[1]**

When $v_{B1} = v_{B2}$ **= 0.5 V and** $\beta = \infty$:
i_{C1} = i_{C2} = i_{E1} = i_{E2} **[1]**
I_Q = i_{E1} + i_{E2} = **2.7 mA** **[3]**

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Question:

Refer to **Figure 1**. V^+ = **+5.5 V** and V^- = **-5.5 V.** Assume V_{BE}**(on) = 0.7 V,** $V_A = \infty$, and $\beta = \infty$ for all transistors in the circuit.

For R_C **= 2.2 kΩ** and $v_{CM} = v_{B1} = v_{B2}$ **= 0.5 V**, **determine** the value of I_Q such that V_{CE2} **= 2.3 V**. Write your answers clearly using PEN with proper Units for the parameters. [10 marks]

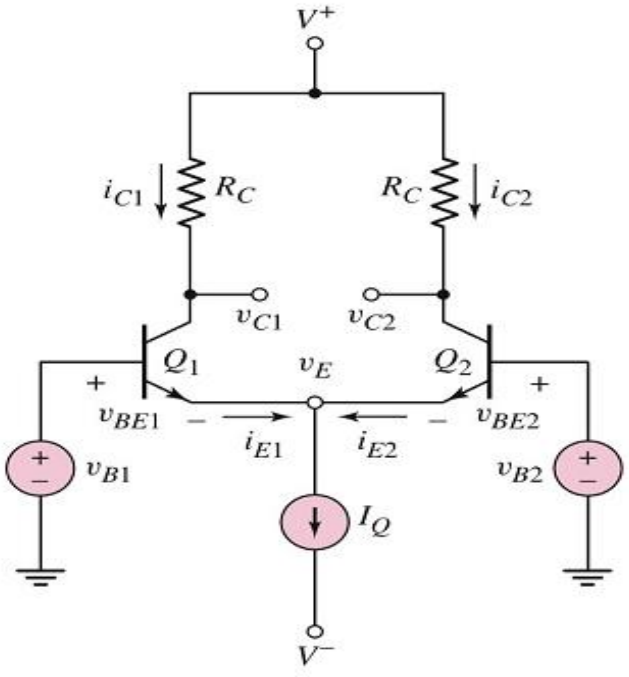

Figure 1

$$i_C = I_S e^{v_{BE}/V_T}\ ;\text{npn}$$

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$$i_C = \alpha i_E = \beta i_B$$

$$i_E = i_B + i_C$$

$$\alpha = \frac{\beta}{\beta + 1}$$

;Small signal

$$\beta = g_m r_\pi$$

$$g_m = \frac{I_{CQ}}{V_T}$$

$$r_\pi = \frac{\beta V_T}{I_{CQ}}$$

$$r_o = \frac{V_A}{I_{CQ}}$$

$$V_T = 26mV$$

Answer:

v_{C2} = v_{B2} - V_{BE2}(on) + V_{CE2} **[2]**
= **0.5 – 0.7 + 2.3** = **2.1 V** **[1]**

v_{C2} = V^+ - i_{C2} R_C
i_{C2} = (V^+ - v_{C2}) / R_C **[2]**
= **(5.5 – 2.1) / 2.2k** = **1.545 mA** **[1]**

When $v_{B1} = v_{B2}$ **= 0.5 V and** $\beta = \infty$:
i_{C2} = $i_{C1} = i_{E1} = i_{E2}$ **[1]**
I_Q = $i_{E1} + i_{E2}$ = **3.09 mA** **[3]**

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Question:

Refer to **Figure 1**. V^+ = **+5.5 V** and V^- = **-5.5 V.** Assume V_{BE}**(on) = 0.7 V,** $V_A = \infty$, and $\beta = \infty$ for all transistors in the circuit.

For R_C **= 2.4 kΩ** and $v_{CM} = v_{B1} = v_{B2}$ **= 0.3 V**, **determine** the value of I_Q such that V_{CE1} **= 2.3 V**. Write your answers clearly using PEN with proper Units for the parameters. [10 marks]

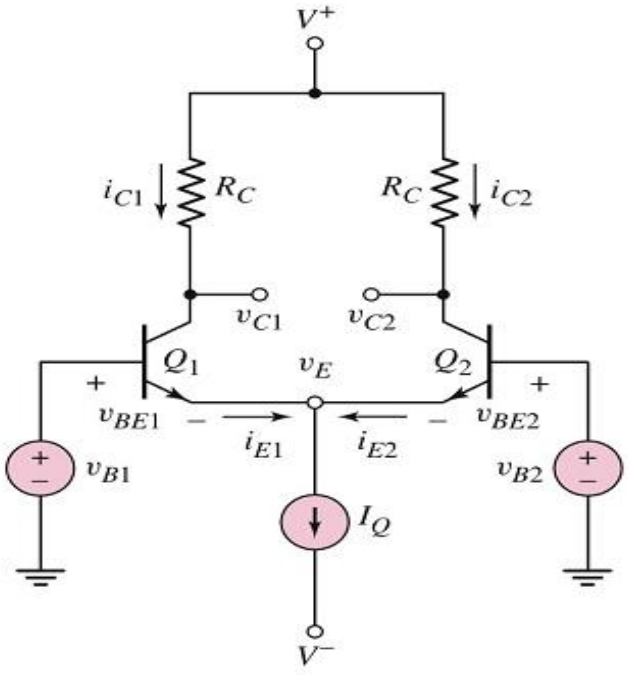

Figure 1

$$i_C = I_S e^{v_{BE}/V_T}\ ;\text{npn}$$

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$$i_C = \alpha i_E = \beta i_B$$

$$i_E = i_B + i_C$$

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;Small signal

$$\beta = g_m r_\pi$$

$$g_m = \frac{I_{CQ}}{V_T}$$

$$r_\pi = \frac{\beta V_T}{I_{CQ}}$$

$$r_o = \frac{V_A}{I_{CQ}}$$

$$V_T = 26mV$$

Answer:

v_{C1} = v_{B1} - V_{BE1}(on) + V_{CE1} **[2]**
= **0.3 – 0.7 + 2.3** = **1.9 V** **[1]**

v_{C1} = V^+ - i_{C1} R_C
i_{C1} = (V^+ - v_{C1}) / R_C **[2]**
= **(5.5 – 1.9) / 2.4k** = **1.5 mA** **[1]**

When $v_{B1} = v_{B2}$ **= 0.3 V and** $\beta = \infty$:
i_{C1} = i_{C2} = i_{E1} = i_{E2} **[1]**
I_Q = i_{E1} + i_{E2} = **3.0 mA** **[3]**

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Refer to **Figure 1**. V^+ = **+5 V** and V^- = **-5 V.** Assume V_{BE}**(on) = 0.7 V,** $V_A = \infty$**,** and $\beta = \infty$ for all transistors in the circuit.

For R_C **= 2.2 kΩ** and $v_{CM} = v_{B1} = v_{B2}$ **= 0.3 V**, **determine** the value of I_Q such that V_{CE2} **= 2.6 V**. Write your answers clearly using PEN with proper Units for the parameters. [10 marks]

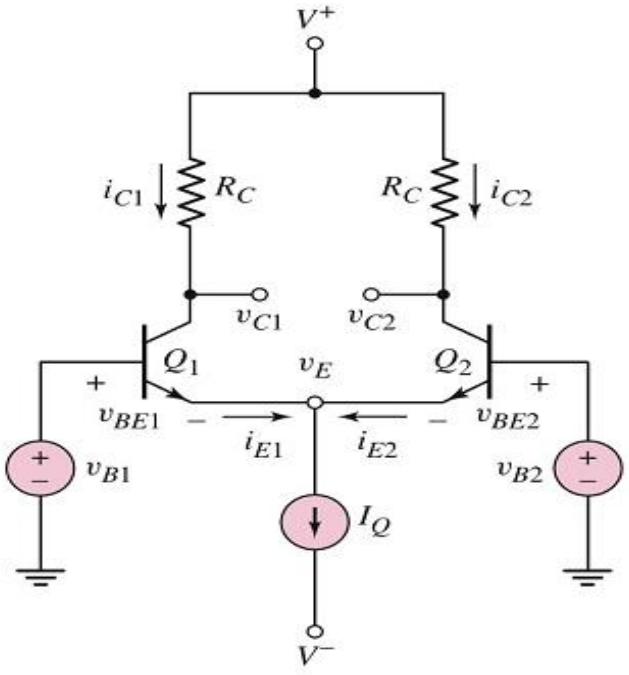

Figure 1

$$i_C = I_S e^{v_{BE}/V_T}\text{; npn}$$

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$$i_C = \alpha i_E = \beta i_B$$

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$$\beta = g_m r_\pi$$

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$$r_\pi = \frac{\beta V_T}{I_{CQ}}$$

$$r_o = \frac{V_A}{I_{CQ}}$$

$$V_T = 26mV$$

Answer:

v_{C2} = v_{B2} - V_{BE2}(on) + V_{CE2} **[2]**
= **0.3 – 0.7 + 2.6** = **2.2 V** **[1]**

v_{C2} = V^+ - i_{C2} R_C
i_{C2} = (V^+ - v_{C2}) / R_C **[2]**
= **(5 – 2.2) / 2.2k** = **1.273 mA** **[1]**

When $v_{B1} = v_{B2}$ **= 0.3 V and** $\beta = \infty$:
i_{C2} = i_{C1} = i_{E1} = i_{E2} **[1]**
I_Q = i_{E1} + i_{E2} = **2.545 mA** **[3]**