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

EEEB2014/EEEB273 - Quiz 2 .
SEMESTER 1, ACADEMIC YEAR 2019/2020
Date: 3 July 2019 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 $\beta$ = **50** for all transistors in the circuit.

For $R_C$ = **2.2 kΩ** and $v_{CM} = v_{B1} = v_{B2}$ = **0.8 V**, **determine** the value of $I_Q$ such that $V_{CE1}$ = **2.5 V**. Write your answers clearly using PEN with **enough accuracy** and proper **Units** for the parameters.

[10 marks]

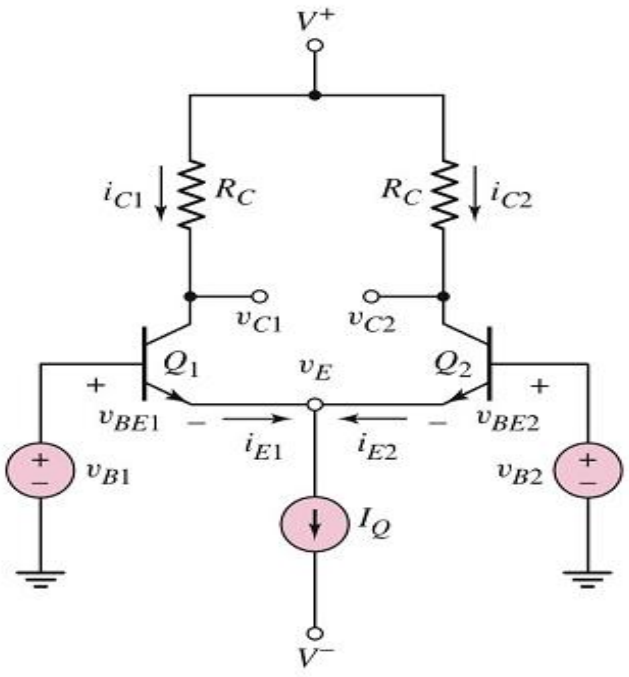


**Figure 1**

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

;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]**
= **0.8 – 0.7 + 2.5** = **2.6 V** **[1]**

$v_{C1}$ = $V^+$ - $i_{C1}$ $R_C$
$i_{C1}$ = ($V^+$ - $v_{C1}$) / $R_C$ **[2]**
= **(5 – 2.6) / 2.2k** = **1.09 mA** **[1]**

**When** $v_{B1} = v_{B2}$ = **0.8 V and** $\beta$ = **50**:
$i_{C1}$ = $i_{C2}$ and $i_{E1} = i_{E2} = ((1+\beta)/\beta)\, i_{C1}$ **[2]**
$i_{E1}$ = $i_{E2}$ = **(51/50)(1.09m) = 1.11 mA** **[1]**
$I_Q$ = $i_{E1} + i_{E2}$ = **2.22 mA** **[1]**

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Date: 3 July 2019 Time: 15 minutes

**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 $\beta$ = **40** for all transistors in the circuit.

For $R_C$ = **2.4 kΩ** and $v_{CM} = v_{B1} = v_{B2}$ = **0.9 V**, **determine** the value of $I_Q$ such that $V_{CE2}$ = **2.6 V**. Write your answers clearly using PEN with **enough accuracy** and proper **Units** for the parameters.

[10 marks]

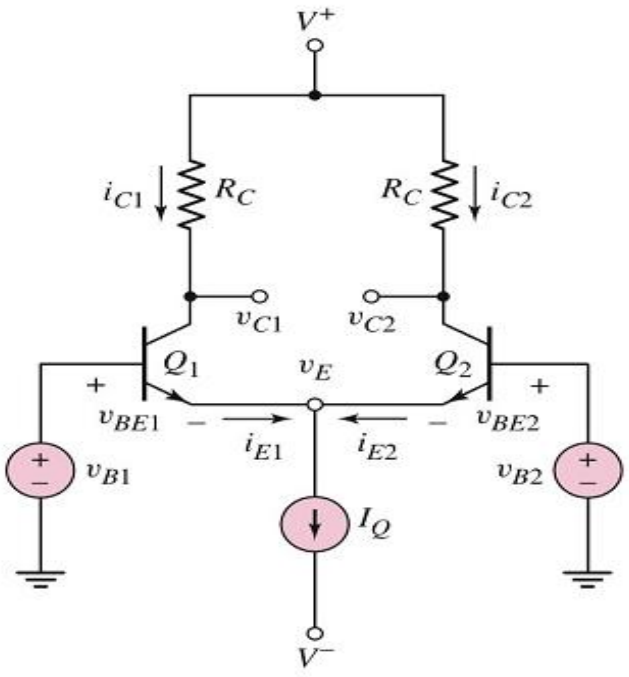


**Figure 1**

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

;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:**

$v_{C2}$ = $v_{B2}$ - $V_{BE2}$(on) + $V_{CE2}$ **[2]**
= **0.9 – 0.7 + 2.6** = **2.8 V** **[1]**

$v_{C2}$ = $V^+$ - $i_{C2}$ $R_C$
$i_{C2}$ = ($V^+$ - $v_{C2}$ ) / $R_C$ **[2]**
= **(5.5 – 2.8) / 2.4k** = **1.125 mA** **[1]**

**When** $v_{B1} = v_{B2}$ = **0.9 V and** $\beta$ = **40**:
$i_{C2}$ = $i_{C1}$ and $i_{E1} = i_{E2} = ((1+\beta)/\beta)\, i_{C1}$ **[2]**
$i_{E1}$ = $i_{E2}$ = **(41/40)(1.125m) = 1.153 mA** **[1]**
$I_Q$ = $i_{E1} + i_{E2}$ = **2.306 mA** **[1]**

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SEMESTER 1, ACADEMIC YEAR 2019/2020
Date: 3 July 2019 Time: 15 minutes

**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 $\beta$ = **40** for all transistors in the circuit.

For $R_C$ = **2.6 kΩ** and $v_{CM} = v_{B1} = v_{B2}$ = **0.4 V**, **determine** the value of $I_Q$ such that $V_{CE1}$ = **2.2 V**. Write your answers clearly using PEN with **enough accuracy** and proper **Units** for the parameters.

[10 marks]

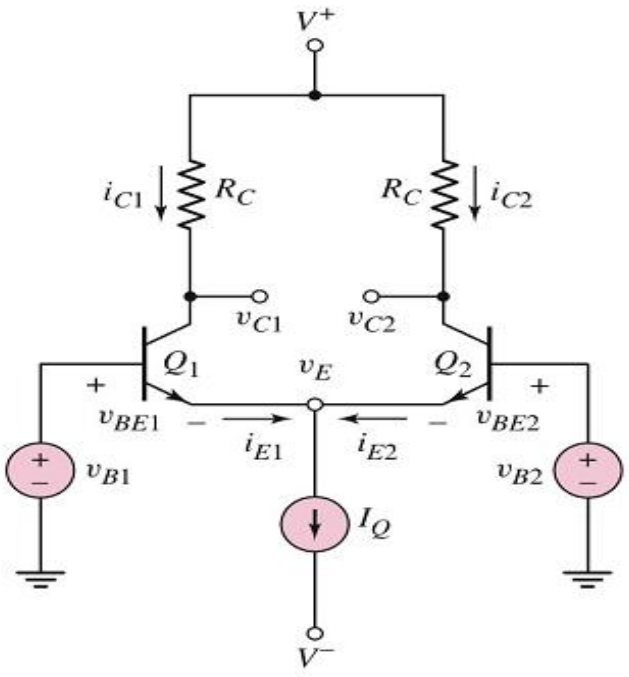


**Figure 1**

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

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

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

$$i_E = i_B + i_C$$

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

;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]**
= **0.4 – 0.7 + 2.2** = **1.9 V** **[1]**

$v_{C1}$ = $V^+$ - $i_{C1}$ $R_C$
$i_{C1}$ = ($V^+$ - $v_{C1}$ ) / $R_C$ **[2]**
= **(5.5 – 1.9) / 2.6k** = **1.385 mA** **[1]**

**When** $v_{B1} = v_{B2}$ = **0.4 V and** $\beta$ = **40**:
$i_{C1}$ = $i_{C2}$ and $i_{E1} = i_{E2} = ((1+\beta)/\beta)\, i_{C1}$ **[2]**
$i_{E1}$ = $i_{E2}$ = **(41/40)(1.385m) = 1.419 mA** **[1]**
$I_Q$ = $i_{E1} + i_{E2}$ = **2.838 mA** **[1]**

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EEEB2014/EEEB273 - Quiz 2 :
SEMESTER 1, ACADEMIC YEAR 2019/2020
Date: 3 July 2019 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 $\beta$ = **45** for all transistors in the circuit.

For $R_C$ = **2.5 kΩ** and $v_{CM} = v_{B1} = v_{B2}$ = **0.6 V**, **determine** the value of $I_Q$ such that $V_{CE2}$ = **2.4 V**. Write your answers clearly using PEN with **enough accuracy** and proper **Units** for the parameters.

[10 marks]

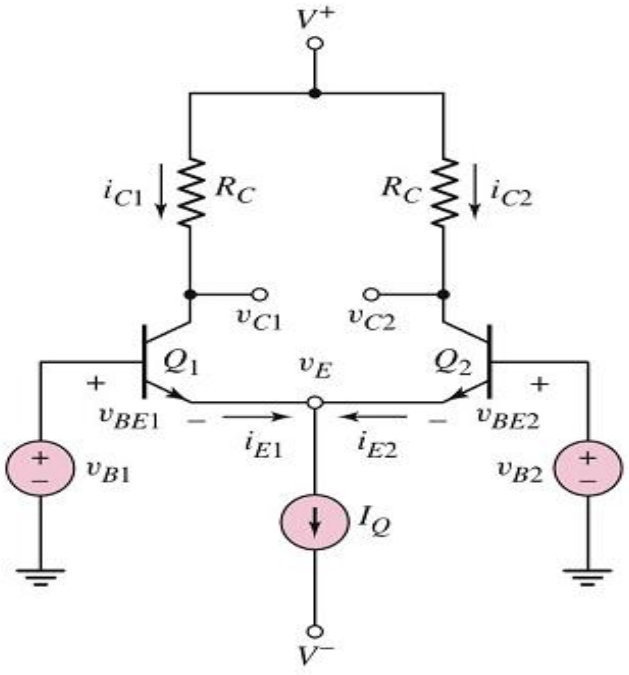


**Figure 1**

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

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

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

$$i_E = i_B + i_C$$

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

;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:**

$v_{C2}$ = $v_{B2}$ - $V_{BE2}$(on) + $V_{CE2}$ **[2]**
= **0.6 – 0.7 + 2.4** = **2.3 V** **[1]**

$v_{C2}$ = $V^+$ - $i_{C2}$ $R_C$
$i_{C2}$ = ($V^+$ - $v_{C2}$ ) / $R_C$ **[2]**
= **(5 – 2.3) / 2.5k** = **1.08 mA** **[1]**

**When** $v_{B1} = v_{B2}$ = **0.6 V and** $\beta$ = **45**:
$i_{C2}$ = $i_{C1}$ and $i_{E1} = i_{E2} = ((1+\beta)/\beta)\, i_{C1}$ **[2]**
$i_{E1}$ = $i_{E2}$ = **(46/45)(1.08m) = 1.104 mA** **[1]**
$I_Q$ = $i_{E1}$ + $i_{E2}$ = **2.208 mA** **[1]**