Name:	**Dr JBO**
Student ID Number:	**Model Answer**
Section: 01/02 A/B	
Lecturer: Dr. Jamaludin Bin Omar	

EEEB273 - Quiz 3
SEMESTER 2, ACADEMIC YEAR 2015/2016
Date: 30 November 2015 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]

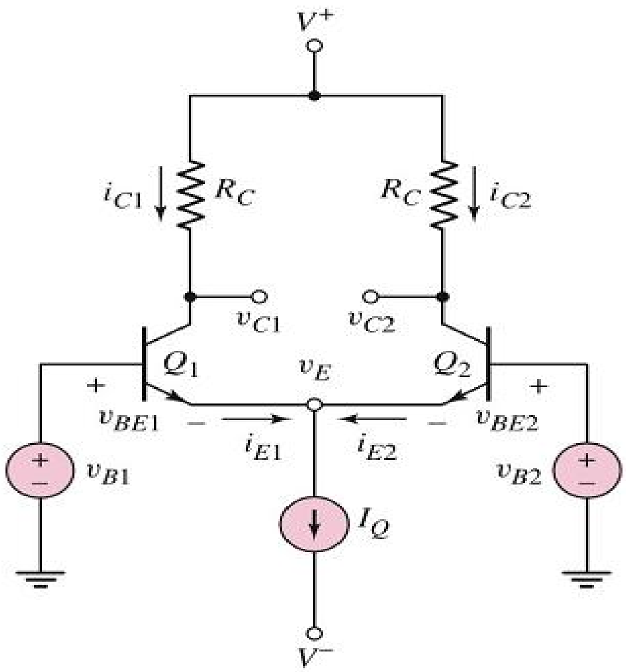

Figure 1

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

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

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

$$i_E = i_B + i_C$$

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

;Small signal

$$\beta = g_m r_\pi$$

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

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

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

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]

EEEB273 - Quiz 3
SEMESTER 2, ACADEMIC YEAR 2015/2016
Date: 30 November 2015 Time: 15 minutes

Name:	**Dr JBO**
Student ID Number:	**Model Answer**
Section: 01/02 A/B	
Lecturer: Dr. Jamaludin Bin Omar	

,

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]

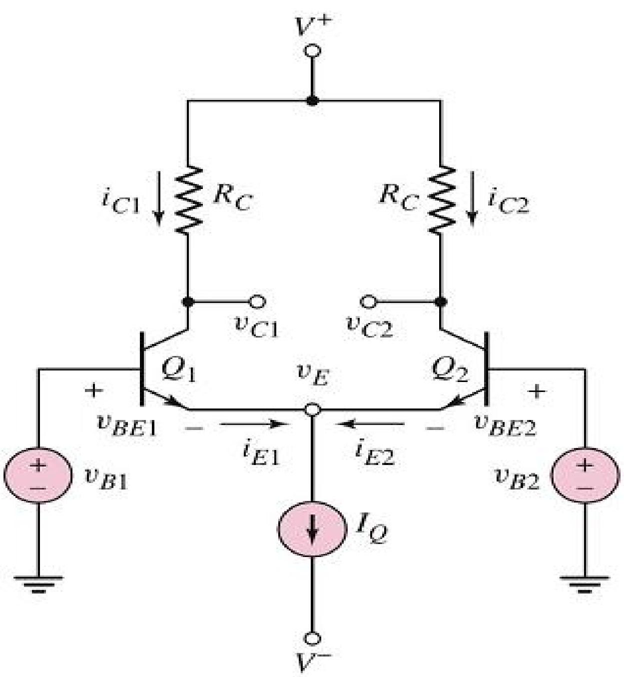

Figure 1

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

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

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

$$i_E = i_B + i_C$$

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

;Small signal

$$\beta = g_m r_\pi$$

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

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

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

Answer:

v_{C2} $= v_{B2} - V_{BE2}(\text{on}) + V_{CE2}$ [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]
$= (5.5 - 2.1) / 2.2\text{k}$ $= 1.545$ **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]

Name:	**Dr JBO**
Student ID Number:	**Model Answer**
Section: 01/02 A/B	
Lecturer: Dr. Jamaludin Bin Omar	

EEEB273 - Quiz 3
SEMESTER 2, ACADEMIC YEAR 2015/2016
Date: 30 November 2015 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 $\beta = \infty$ 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]

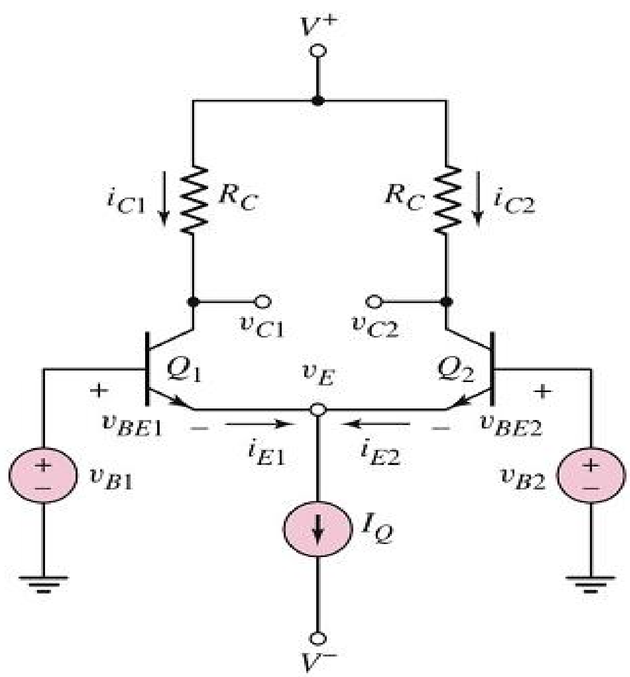

Figure 1

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

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

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

$$i_E = i_B + i_C$$

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

;Small signal

$$\beta = g_m r_\pi$$

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

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

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

Answer:

v_{C1}	$= v_{B1} - V_{BE1}\text{(on)} + V_{CE1}$		[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]
	$= (5.5 - 1.9) / 2.4\text{k}$	$= 1.5$ 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]

Name:	Dr JBO
Student ID Number:	Model Answer
Section: 01/02 A/B	
Lecturer: Dr. Jamaludin Bin Omar	

EEEB273 - Quiz 3
SEMESTER 2, ACADEMIC YEAR 2015/2016
Date: 30 November 2015 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 **= 2.2 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]

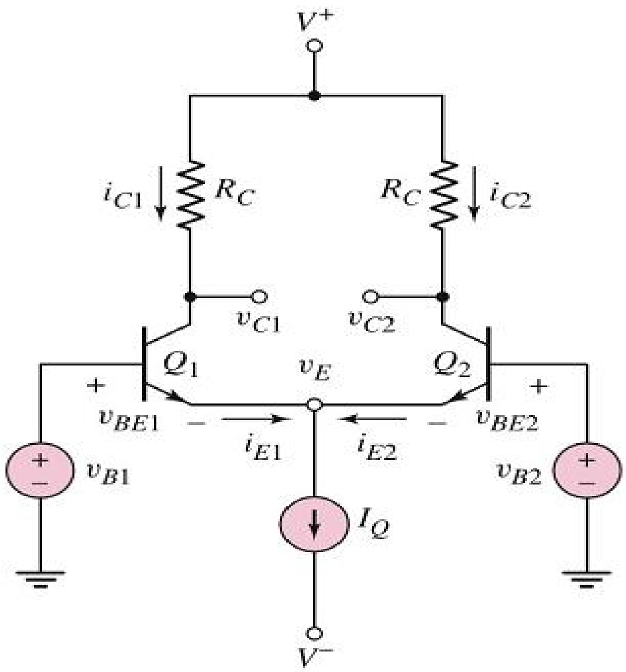

Figure 1

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

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

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

$$i_E = i_B + i_C$$

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

;Small signal

$$\beta = g_m r_\pi$$

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

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

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

Answer:

v_{C2} $= v_{B2} - V_{BE2}(\text{on}) + V_{CE2}$ [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]
$= (5 - 2.2) / 2.2\text{k}$ $= 1.273$ **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]