Name:	**Dr JBO**
Student ID Number:	**Model answer**
Section:	
Lecturer:	Dr. Jamaludin Bin Omar

EEEB273 - Quiz 1 [Question Set 1]
SEMESTER 1, ACADEMIC YEAR 2013/2014
Date: 10 June 2013 Time: 15 minutes

Question:

Refer to **Figure 1**. All transistors are matched.
The circuit parameters are: $V^+ = 7.5$ V and $V^- = -7.5$ V.
The transistor parameters are: V_{BE} (on) = 0.6 V, $V_A = 150$ V, and $\beta = 50$.

DESIGN a two-transistor BJT current source similar to the **Figure 1** using all the parameters given above so that **its output resistance** (R_O) is **200 kΩ**. **Show clearly all calculations** as marks are given according to this.

[10 marks]

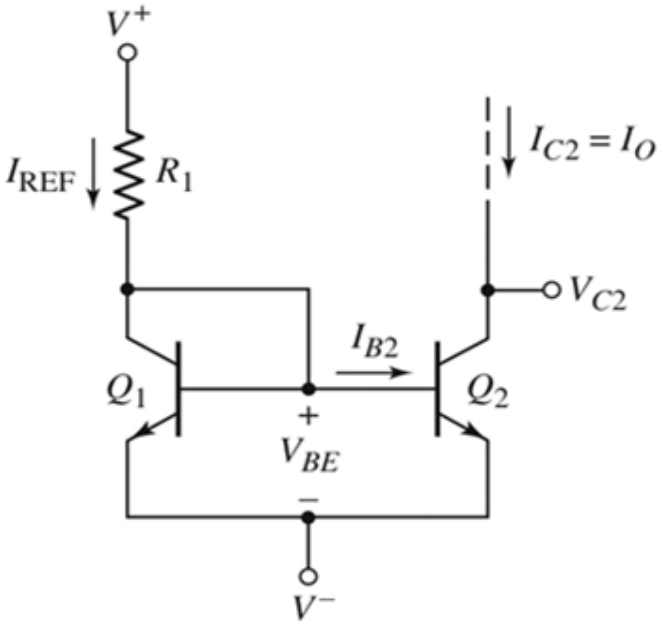

Figure 1

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

;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:

R_O	$= r_{O2}$	$= V_A / I_O$	[2]
I_O		$= V_A / R_O$	[1]
		= (150) / (200k)	[0.5]
		= 0.75 mA	[0.5]
I_{REF}		$= I_O (1 + 2/\beta)$	[2]
		= (0.75m)(1 + 2/50)	[0.5]
		= 0.78 mA	[0.5]
R_1		$= (V^+ - V_{BE} - V^-) / I_{REF}$	[2]
		= (7.5 – 0.6 – (-7.5)) / (0.78m)	[0.5]
		= 18.4615 kΩ	[0.5]

Name:	**Dr JBO**
Student ID Number:	**Model answer**
Section:	
Lecturer:	Dr. Jamaludin Bin Omar

EEEB273 - Quiz 1 [Question Set 2]
SEMESTER 1, ACADEMIC YEAR 2013/2014
Date: 10 June 2013 Time: 15 minutes

Question:

Refer to **Figure 1**. All transistors are matched.
The circuit parameters are: $V^+ = 8$ V and $V^- = -8$ V.
The transistor parameters are: V_{BE} **(on) = 0.6 V**, $V_A = 160$ V, and $\beta = 50$.

DESIGN a two-transistor BJT current source similar to the **Figure 1** using all the parameters given above so that **its output resistance** (R_O) is **200 kΩ**. **Show clearly all calculations** as marks are given according to this.

[10 marks]

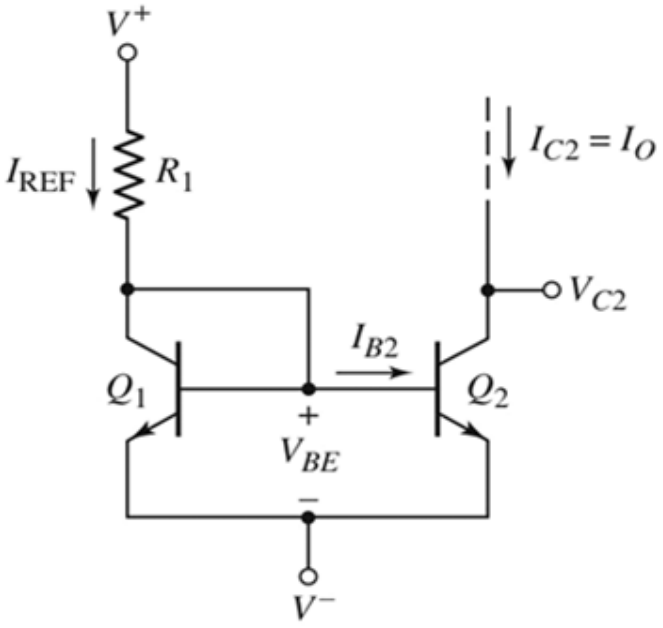

Figure 1

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

;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:

R_O	$= r_{O2}$	$= V_A / I_O$	[2]
I_O		$= V_A / R_O$	[1]
		= (160) / (200k)	[0.5]
		= 0.80 mA	[0.5]
I_{REF}		$= I_O (1 + 2/\beta)$	[2]
		= (0.80m)(1 + 2/50)	[0.5]
		= 0.832 mA	[0.5]
R_1		$= (V^+ - V_{BE} - V^-) / I_{REF}$	[2]
		= (8 – 0.6 – (-8)) / (0.832m)	[0.5]
		= 18.509 kΩ	[0.5]

Name:	**Dr JBO**
Student ID Number:	**Model answer**
Section:	
Lecturer:	Dr. Jamaludin Bin Omar

EEEB273 - Quiz 1 [Question Set 3]
SEMESTER 1, ACADEMIC YEAR 2013/2014
Date: 10 June 2013 Time: 15 minutes

Question:

Refer to **Figure 1**. All transistors are matched.
The circuit parameters are: $V^+ = 7.5$ V and $V^- = -7.5$ V.
The transistor parameters are: V_{BE} (on) = 0.6 V, $V_A = 150$ V, and $\beta = 80$.

DESIGN a two-transistor BJT current source similar to the **Figure 1** using all the parameters given above so that **its output resistance** (R_O) is **200 kΩ**. **Show clearly all calculations** as marks are given according to this.

[10 marks]

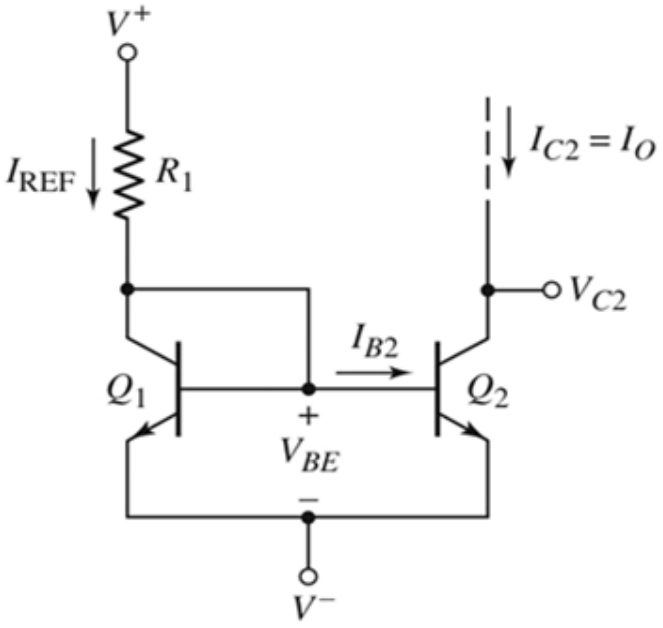

Figure 1

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

;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:

R_O	$= r_{O2}$	$= V_A / I_O$	[2]
I_O		$= V_A / R_O$	[1]
		$= (150) / (200k)$	[0.5]
		$= 0.75$ mA	[0.5]
I_{REF}		$= I_O (1 + 2/\beta)$	[2]
		$= (0.75m)(1 + 2/80)$	[0.5]
		$= 0.76875$ mA	[0.5]
R_1		$= (V^+ - V_{BE} - V^-) / I_{REF}$	[2]
		$= (7.5 - 0.6 - (-7.5)) / (0.76875m)$	[0.5]
		$= 18.7317$ kΩ	[0.5]

Name:	**Dr JBO**
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Section:	
Lecturer:	Dr. Jamaludin Bin Omar

EEEB273 - Quiz 1 [Question Set 4]
SEMESTER 1, ACADEMIC YEAR 2013/2014
Date: 10 June 2013 Time: 15 minutes

Question:

Refer to **Figure 1**. All transistors are matched.
The circuit parameters are: $V^+ = 8$ V and $V^- = -8$ V.
The transistor parameters are: V_{BE} **(on) = 0.6 V**, $V_A = 160$ V, and $\beta = 80$.

DESIGN a two-transistor BJT current source similar to the **Figure 1** using all the parameters given above so that **its output resistance** (R_O) is **200 kΩ**. **Show clearly all calculations** as marks are given according to this.

[10 marks]

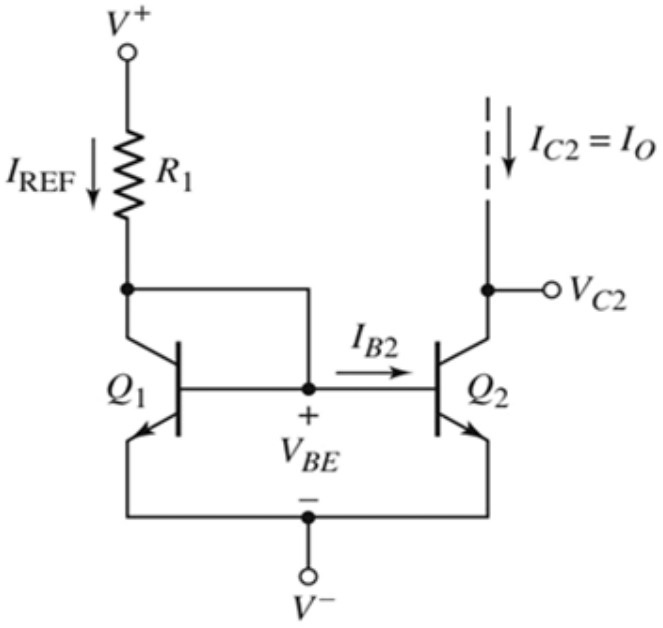

Figure 1

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

;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:

R_O	$= r_{O2}$	$= V_A / I_O$	[2]
I_O		$= V_A / R_O$	[1]
		= (160) / (200k)	[0.5]
		= 0.80 mA	[0.5]
I_{REF}		$= I_O (1 + 2/\beta)$	[2]
		= (0.80m)(1 + 2/80)	[0.5]
		= 0.82 mA	[0.5]
R_1		$= (V^+ - V_{BE} - V^-) / I_{REF}$	[2]
		= (8 – 0.6 – (-8)) / (0.82m)	[0.5]
		= 18.78 kΩ	[0.5]