

EEEB273 - Quiz 1 [Question Set 1]
 SEMESTER 1, ACADEMIC YEAR 2012/2013
 Date: 15 October 2012

Question:

Refer to **Figure 1**. All transistors are matched.

The circuit parameters are: $V^+ = 7.5 \text{ V}$ and $V^- = -7.5 \text{ V}$.

The transistor parameters are: $\beta = 100$, $V_{BE(on)} = 0.6 \text{ V}$, and $V_A = 150 \text{ V}$.

- (a) Design a two-transistor current source using all the parameters given above so that $I_{B2} = 6 \mu\text{A}$. [8 marks]
 (b) Find the **output resistance (R_O)** of the two-transistor current source. [2 marks]

Show clearly all calculations as marks are given according to this.

Answer:

$I_O = I_{C2}$	$= \beta I_{B2}$	[1]
	$= (100)(6\mu)$	[1]
	$= 0.6 \text{ mA}$	[0.5]
I_{REF}	$= I_O (1 + 2/\beta)$	[1]
	$= (0.6\text{m})(1 + 2/100)$	[1]
	$= 0.612 \text{ mA}$	[0.5]
R_1	$= (V^+ - V_{BE} - V^-) / I_{REF}$	[1.5]
	$= (7.5 - 0.6 - (-7.5)) / (0.612\text{m})$	[1]
	$= 23.529 \text{ k}\Omega$	[0.5]
R_O	$= V_A / I_O$	[1]
	$= (150) / (0.6\text{m})$	[0.5]
	$= 250 \text{ k}\Omega$	[0.5]

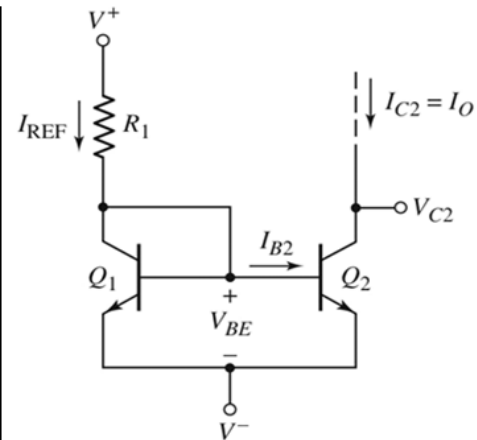


Figure 1

EEEE273 - Quiz 1 [Question Set 2]
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Question:

Refer to **Figure 1**. All transistors are matched.

The circuit parameters are: $V^+ = 7.0 \text{ V}$ and $V^- = -7.0 \text{ V}$.

The transistor parameters are: $\beta = 100$, $V_{BE(\text{on})} = 0.6 \text{ V}$, and $V_A = 150 \text{ V}$.

- (a) Design a two-transistor current source using all the parameters given above so that $I_{B2} = 7 \mu\text{A}$. [8 marks]
 (b) Find the **output resistance (R_O)** of the two-transistor current source. [2 marks]

Show clearly all calculations as marks are given according to this.

Answer:

$I_O = I_{C2}$	$= \beta I_{B2}$	[1]
	$= (100)(7\mu)$	[1]
	$= 0.7 \text{ mA}$	[0.5]
I_{REF}	$= I_O (1 + 2/\beta)$	[1]
	$= (0.7\text{m})(1 + 2/100)$	[1]
	$= 0.714 \text{ mA}$	[0.5]
R_1	$= (V^+ - V_{BE} - V^-) / I_{REF}$	[1.5]
	$= (7.0 - 0.6 - (-7.0)) / (0.714\text{m})$	[1]
	$= 18.767 \text{ k}\Omega$	[0.5]
R_O	$= V_A / I_O$	[1]
	$= (150) / (0.7\text{m})$	[0.5]
	$= 214.28 \text{ k}\Omega$	[0.5]

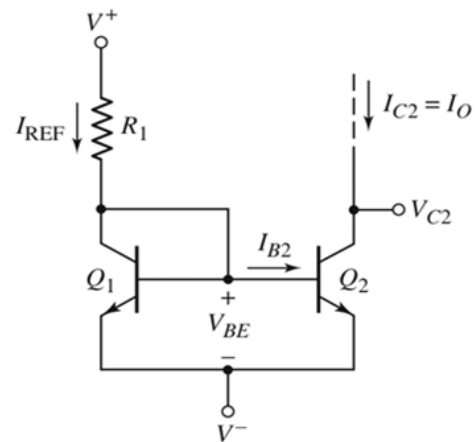


Figure 1

EEEB273 - Quiz 1 [Question Set 3]
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Question:

Refer to **Figure 1**. All transistors are matched.

The circuit parameters are: $V^+ = 7.0 \text{ V}$ and $V^- = -7.0 \text{ V}$.

The transistor parameters are: $\beta = 120$, $V_{BE(\text{on})} = 0.6 \text{ V}$, and $V_A = 150 \text{ V}$.

- (a) Design a two-transistor current source using all the parameters given above so that $I_{B2} = 7 \mu\text{A}$. [8 marks]
 (b) Find the **output resistance (R_O)** of the two-transistor current source. [2 marks]

Show clearly all calculations as marks are given according to this.

Answer:

$I_O = I_{C2}$	$= \beta I_{B2}$	[1]
	$= (120)(7\mu)$	[1]
	$= 0.84 \text{ mA}$	[0.5]
I_{REF}	$= I_O (1 + 2/\beta)$	[1]
	$= (0.84\text{m})(1 + 2/120)$	[1]
	$= 0.854 \text{ mA}$	[0.5]
R_1	$= (V^+ - V_{BE} - V^-) / I_{REF}$	[1.5]
	$= (7.0 - 0.6 - (-7.0)) / (0.854\text{m})$	[1]
	$= 15.691 \text{ k}\Omega$	[0.5]
R_O	$= V_A / I_O$	[1]
	$= (150) / (0.84\text{m})$	[0.5]
	$= 178.57 \text{ k}\Omega$	[0.5]

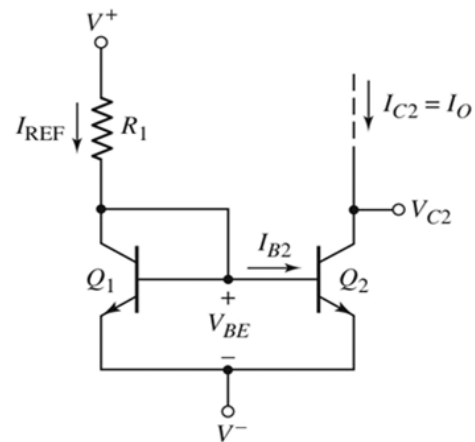


Figure 1

EEEE273 - Quiz 1 [Question Set 4]
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 Date: 15 October 2012

Question:

Refer to **Figure 1**. All transistors are matched.

The circuit parameters are: $V^+ = 7.5 \text{ V}$ and $V^- = -7.5 \text{ V}$.

The transistor parameters are: $\beta = 120$, $V_{BE(\text{on})} = 0.6 \text{ V}$, and $V_A = 150 \text{ V}$.

- (a) Design a two-transistor current source using all the parameters given above so that $I_{B2} = 6 \mu\text{A}$. [8 marks]
 (b) Find the **output resistance (R_O)** of the two-transistor current source. [2 marks]

Show clearly all calculations as marks are given according to this.

Answer:

$I_O = I_{C2}$	$= \beta I_{B2}$	[1]
	$= (120)(6\mu)$	[1]
	$= 0.72 \text{ mA}$	[0.5]
I_{REF}	$= I_O (1 + 2/\beta)$	[1]
	$= (0.72\text{m})(1 + 2/120)$	[1]
	$= 0.732 \text{ mA}$	[0.5]
R_1	$= (V^+ - V_{BE} - V^-) / I_{REF}$	[1.5]
	$= (7.5 - 0.6 - (-7.5)) / (0.732\text{m})$	[1]
	$= 19.672 \text{ k}\Omega$	[0.5]
R_O	$= V_A / I_O$	[1]
	$= (150) / (0.72\text{m})$	[0.5]
	$= 208.33 \text{ k}\Omega$	[0.5]

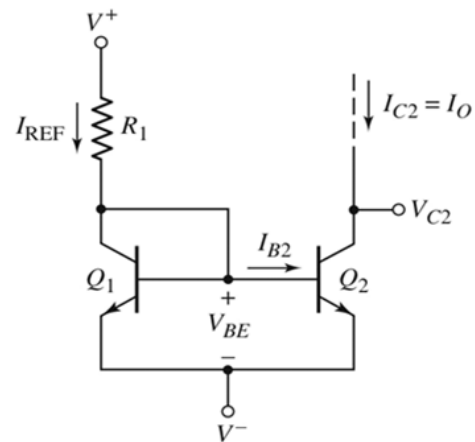


Figure 1