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

EEEB273 - Quiz 1 [Question Set 1]
SEMESTER 1, ACADEMIC YEAR 2012/2013
Date: 12 June 2012

Question:

Given that matched **npn transistors** are available with the parameters: β **= 50,** V_{BE} **(on) = 0.6 V,** and V_A **= 150 V**. These transistors are used in the designs of a two-transistor current source (as shown in **Figure 1**) and a three-transistor current source (as shown in **Figure 2**). Power supplies used to power the current sources are: V^+ **= 7.5 V** and V^- **= -7.5 V**.

(a) Design a two-transistor current source and a three-transistor current source with I_{REF} **= 0.90 mA using the npn transistors** mentioned above. [4 marks]

(b) Find the **output resistance** (R_O) of the two-transistor current source and the three-transistor current source. [6 marks]

Show clearly all calculations.

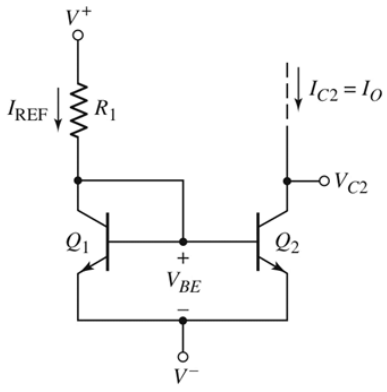

Figure 1

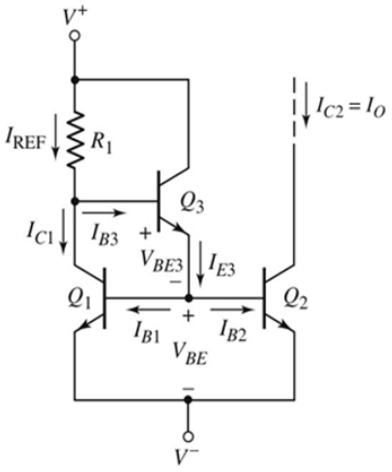

Figure 2

Answer:

2T:	R_1	$= (V^+ - V_{EB} - V^-) / I_{REF}$		**[1]**
		$= (7.5 - 0.6 - (-7.5)) / (0.90m)$	**= 16.000 kΩ**	**[0.5, 0.5]**
3T:	R_1	$= (V^+ - 2V_{EB} - V^-) / I_{REF}$		**[1]**
		$= (7.5 - 2(0.6) - (-7.5)) / (0.90m)$	**= 15.333 kΩ**	**[0.5, 0.5]**
2T:	I_O	$= I_{REF} / (1 + 2/\beta)$		**[1]**
		$= (0.90m) / (1 + 2/50)$	**= 0.8654 mA**	**[0.5]**
	R_O	$= V_A / I_O$		**[1]**
		$= (150) / (0.8654m)$	**= 173.333 kΩ**	**[0.5]**
3T:	I_O	$= I_{REF} / [1 + 2/\beta(\beta+1)]$		**[1]**
		$= (0.90m) / [1 + 2/50(50+1)]$	**= 0.8993 mA**	**[0.5]**
	R_O	$= V_A / I_O$		**[1]**
		$= (150) / (0.8993m)$	**= 166.797 kΩ**	**[0.5]**

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EEEB273 - Quiz 1 [Question Set 2]
SEMESTER 1, ACADEMIC YEAR 2012/2013
Date: 12 June 2012

Question:

Given that matched **npn transistors** are available with the parameters: β **= 50,** V_{BE} **(on) = 0.6 V,** and V_A **= 150 V**. These transistors are used in the designs of a two-transistor current source (as shown in **Figure 1**) and a three-transistor current source (as shown in **Figure 2**). Power supplies used to power the current sources are: V^+ **= 8.5 V** and V^- **= -8.5 V**.

(a) Design a two-transistor current source and a three-transistor current source with I_{REF} **= 0.95 mA using the npn transistors** mentioned above. [4 marks]

(b) Find the **output resistance** (R_O) of the two-transistor current source and the three-transistor current source. [6 marks]

Show clearly all calculations.

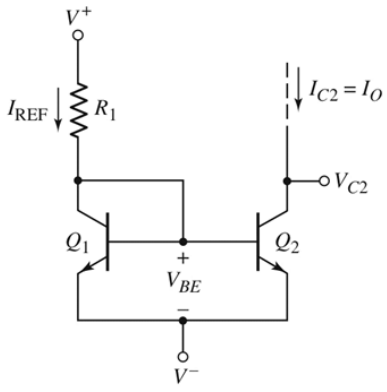

Figure 1

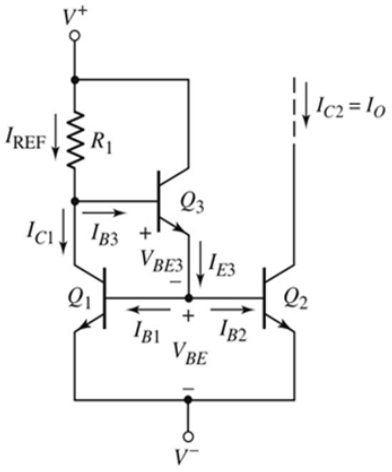

Figure 2

Answer:

2T:	R_1	$= (V^+ - V_{EB} - V^-) / I_{REF}$		**[1]**
		= (8.5 – 0.6 – (-8.5)) / (0.95m)	**= 17.263 kΩ**	**[0.5, 0.5]**
3T:	R_1	$= (V^+ - 2V_{EB} - V^-) / I_{REF}$		**[1]**
		= (8.5 – 2(0.6) – (-8.5)) / (0.95m)	**= 16.632 kΩ**	**[0.5, 0.5]**
2T:	I_O	$= I_{REF} / (1 + 2/\beta)$		**[1]**
		= (0.95m) / (1 + 2/50)	**= 0.9135 mA**	**[0.5]**
	R_O	$= V_A / I_O$		**[1]**
		= (150) / (0.9135m)	**= 164.211 kΩ**	**[0.5]**
3T:	I_O	$= I_{REF} / [1 + 2/\beta(\beta+1)]$		**[1]**
		= (0.95m) / [1 + 2/50(50+1)]	**= 0.9493 mA**	**[0.5]**
	R_O	$= V_A / I_O$		**[1]**
		= (150) / (0.9493m)	**= 158.019 kΩ**	**[0.5]**

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EEEB273 - Quiz 1 [Question Set 3]
SEMESTER 1, ACADEMIC YEAR 2012/2013
Date: 12 June 2012

Question:

Given that matched **npn transistors** are available with the parameters: β **= 60,** V_{BE} **(on) = 0.6 V,** and V_A **= 150 V**. These transistors are used in the designs of a two-transistor current source (as shown in **Figure 1**) and a three-transistor current source (as shown in **Figure 2**). Power supplies used to power the current sources are: V^+ **= 8.5 V** and V^- **= -8.5 V**.

(a) Design a two-transistor current source and a three-transistor current source with I_{REF} **= 0.90 mA using the npn transistors** mentioned above. [4 marks]

(b) Find the **output resistance** (R_O) of the two-transistor current source and the three-transistor current source. [6 marks]

Show clearly all calculations.

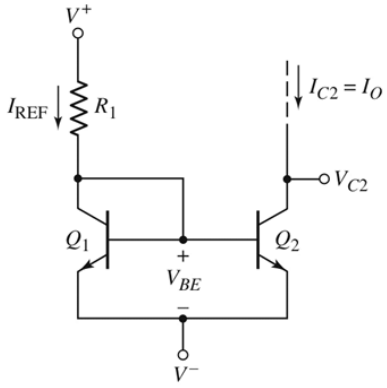

Figure 1

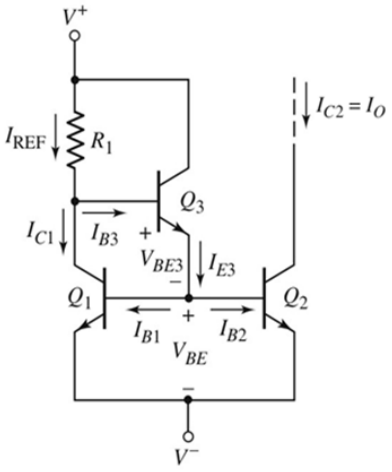

Figure 2

Answer:

2T:	R_1	$= (V^+ - V_{EB} - V^-) / I_{REF}$		**[1]**
		$= (8.5 - 0.6 - (-8.5)) / (0.90m)$	$= 18.222\ k\Omega$	**[0.5, 0.5]**
3T:	R_1	$= (V^+ - 2V_{EB} - V^-) / I_{REF}$		**[1]**
		$= (8.5 - 2(0.6) - (-8.5)) / (0.90m)$	$= 17.556\ k\Omega$	**[0.5, 0.5]**
2T:	I_O	$= I_{REF} / (1 + 2/\beta)$		**[1]**
		$= (0.90m) / (1 + 2/60)$	$= 0.8710\ mA$	**[0.5]**
	R_O	$= V_A / I_O$		**[1]**
		$= (150) / (0.8710m)$	$= 172.222\ k\Omega$	**[0.5]**
3T:	I_O	$= I_{REF} / [1 + 2/\beta(\beta+1)]$		**[1]**
		$= (0.90m) / [1 + 2/60(60+1)]$	$= 0.8995\ mA$	**[0.5]**
	R_O	$= V_A / I_O$		**[1]**
		$= (150) / (0.8995m)$	$= 166.758\ k\Omega$	**[0.5]**

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EEEB273 - Quiz 1 [Question Set 4]
SEMESTER 1, ACADEMIC YEAR 2012/2013
Date: 12 June 2012

Question:

Given that matched **npn transistors** are available with the parameters: β **= 60,** V_{BE} **(on) = 0.6 V,** and V_A **= 150 V**. These transistors are used in the designs of a two-transistor current source (as shown in **Figure 1**) and a three-transistor current source (as shown in **Figure 2**). Power supplies used to power the current sources are: V^+ **= 7.5 V** and V^- **= -7.5 V**.

(a) Design a two-transistor current source and a three-transistor current source with I_{REF} **= 0.95 mA using the npn transistors** mentioned above. [4 marks]

(b) Find the **output resistance** (R_O) of the two-transistor current source and the three-transistor current source. [6 marks]

Show clearly all calculations.

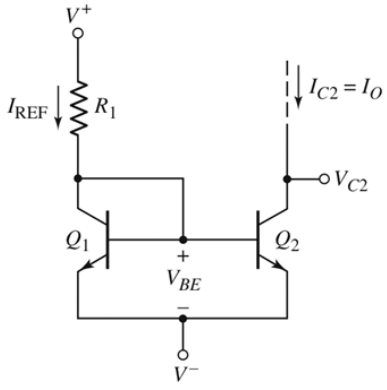

Figure 1

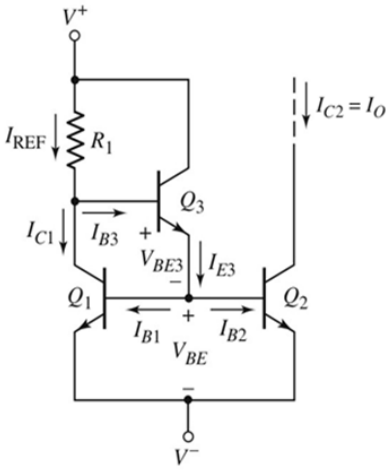

Figure 2

Answer:

2T:	R_1	$= (V^+ - V_{EB} - V^-) / I_{REF}$		**[1]**
		$= (7.5 - 0.6 - (-7.5)) / (0.95m)$	$= 15.158\ k\Omega$	**[0.5, 0.5]**
3T:	R_1	$= (V^+ - 2V_{EB} - V^-) / I_{REF}$		**[1]**
		$= (7.5 - 2(0.6) - (-7.5)) / (0.95m)$	$= 14.526\ k\Omega$	**[0.5, 0.5]**
2T:	I_O	$= I_{REF} / (1 + 2/\beta)$		**[1]**
		$= (0.95m) / (1 + 2/60)$	$= 0.9194\ mA$	**[0.5]**
	R_O	$= V_A / I_O$		**[1]**
		$= (150) / (0.9194m)$	$= 163.158\ k\Omega$	**[0.5]**
3T:	I_O	$= I_{REF} / [1 + 2/\beta(\beta+1)]$		**[1]**
		$= (0.95m) / [1 + 2/60(60+1)]$	$= 0.9495\ mA$	**[0.5]**
	R_O	$= V_A / I_O$		**[1]**
		$= (150) / (0.9495m)$	$= 157.981\ k\Omega$	**[0.5]**