EEEB273 - Quiz 1
SEMESTER 2, ACADEMIC YEAR 2013/2014
Date: 22 Oct 2013   Time: 15 minutes

Question:

DESIGN a two-transistor BJT current source using NPN transistors so that **its output current (I_O)** is **0.8 mA**. All transistors are matched. The transistor parameters are V_{BE} **(on) = 0.6 V**, $V_A = \infty$, and $\beta = 50$. The circuit parameters are $V^+ = 7.5$ **V** and $V^- = -7.5$ **V**.

Draw the circuit diagram of your design. **Show clearly all calculations** as marks are given according to this.

[10 marks]

Answer:

I_{REF}	$= I_O (1 + 2/\beta)$	[2]
	$= (0.8m)(1 + 2/50)$	[1]
	$= 0.832$ mA	[0.5]
R_1	$= (V^+ - V_{BE} - V^-) / I_{REF}$	[2]
	$= (7.5 - 0.6 - (-7.5)) / (0.832m)$	[1]
	$= 17.3076$ kΩ	[0.5]

√ V^+ +7.5V   √

I_{REF} ↓ √ R_1 **17.3076 kΩ**   √

$I_{C2} = I_O$ √

√ Q_1 √

I_{B2}

V_{C2}

Q_2 √

V_{BE} √

√ V^- -7.5V   √

√ = 0.25 marks

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

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

$i_C = \alpha i_E = \beta i_B$

$i_E = i_B + i_C$

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

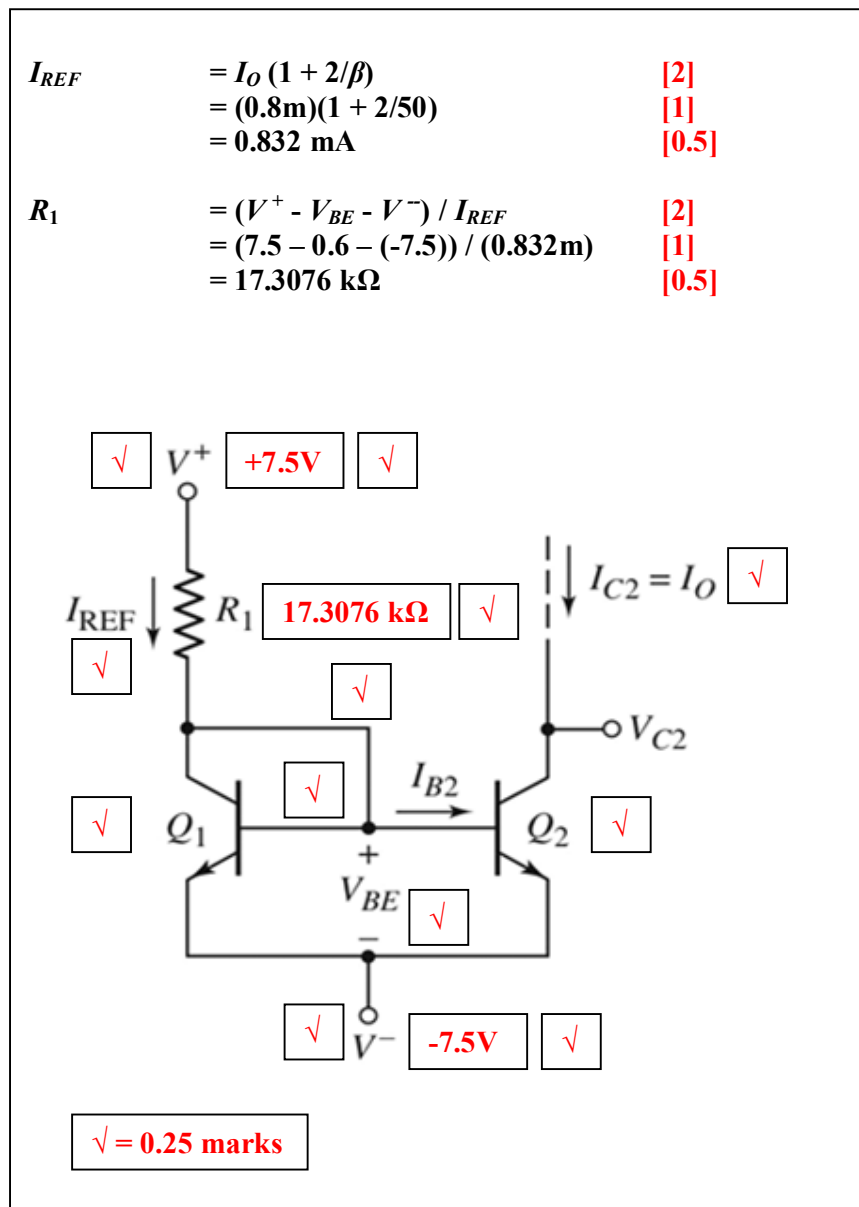; Small signal

$\beta = g_m r_\pi$

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

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

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

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Question:

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Draw the circuit diagram of your design. **Show clearly all calculations** as marks are given according to this.

[10 marks]

Answer:

I_{REF}	$= I_O (1 + 2/\beta)$		[2]
	$= (0.8m)(1 + 2/50)$		[1]
	$= 0.832$ mA		[0.5]
R_1	$= (V^+ - V_{BE} - V^-) / I_{REF}$		[2]
	$= (8.5 - 0.6 - (-8.5)) / (0.832m)$		[1]
	$= 19.7115$ kΩ		[0.5]

√ = 0.25 marks

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

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

$i_C = \alpha i_E = \beta i_B$

$i_E = i_B + i_C$

$\alpha = \dfrac{\beta}{\beta + 1}$
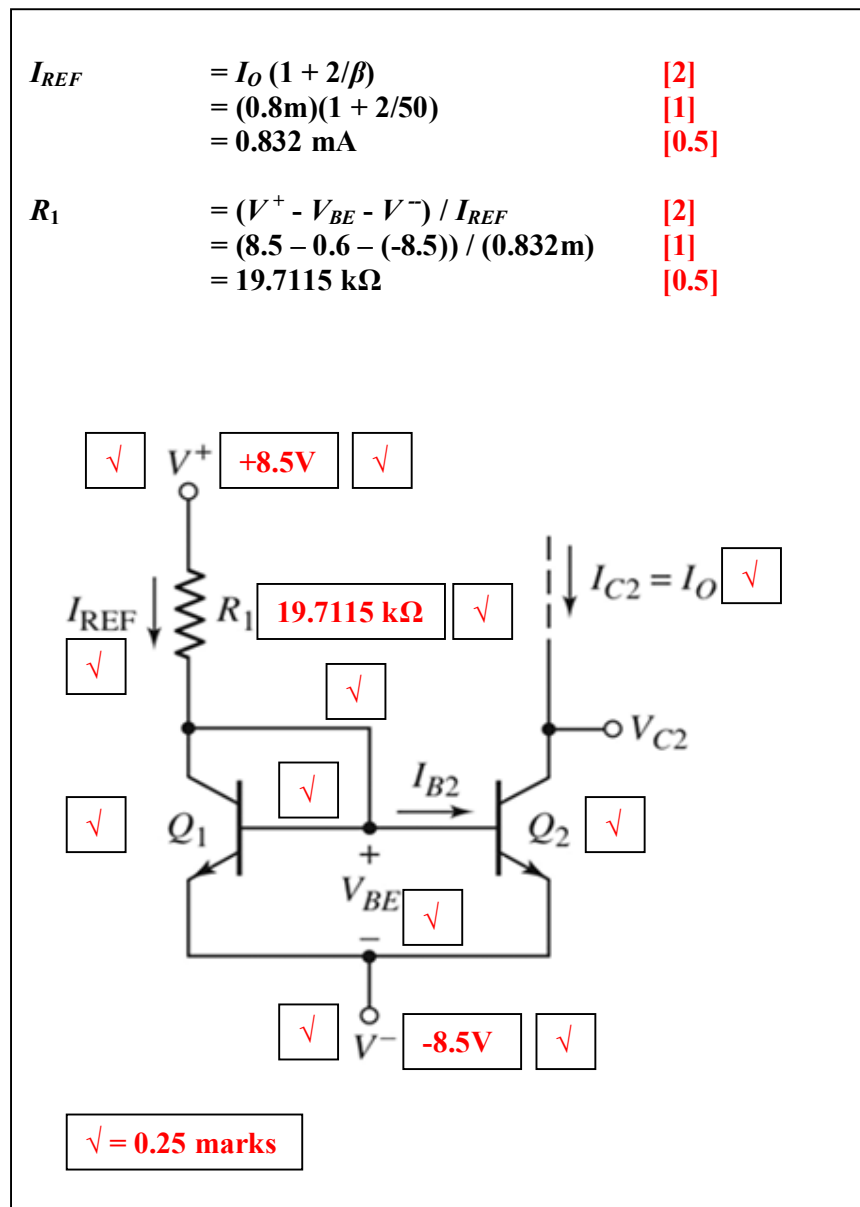
;Small signal

$\beta = g_m r_\pi$

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

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

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

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

Question:

DESIGN a two-transistor BJT current source using NPN transistors so that **its output current (I_O)** is **0.7 mA**. All transistors are matched. The transistor parameters are V_{BE} **(on) = 0.6 V**, $V_A = \infty$, and $\beta = 50$. The circuit parameters are V^+ **= 8.5 V** and V^- **= -8.5 V**.
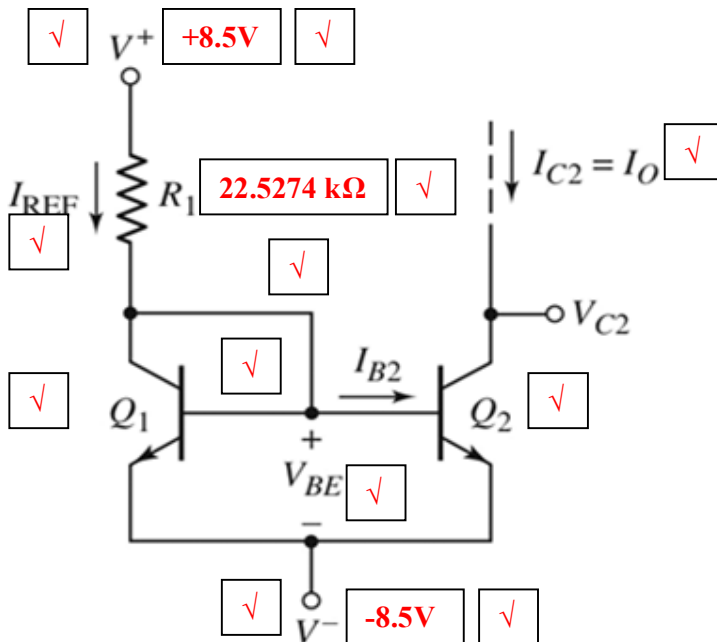
Draw the circuit diagram of your design. **Show clearly all calculations** as marks are given according to this.

[10 marks]

Answer:

$$I_{REF} \quad = I_O (1 + 2/\beta) \qquad\qquad \text{[2]}$$
$$= (0.7m)(1 + 2/50) \qquad \text{[1]}$$
$$= 0.728 \text{ mA} \qquad\qquad \text{[0.5]}$$

$$R_1 \quad = (V^+ - V_{BE} - V^-) / I_{REF} \qquad \text{[2]}$$
$$= (8.5 – 0.6 – (-8.5)) / (0.728m) \qquad \text{[1]}$$
$$= 22.5274 \text{ k}\Omega \qquad\qquad \text{[0.5]}$$

√ = 0.25 marks

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

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

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

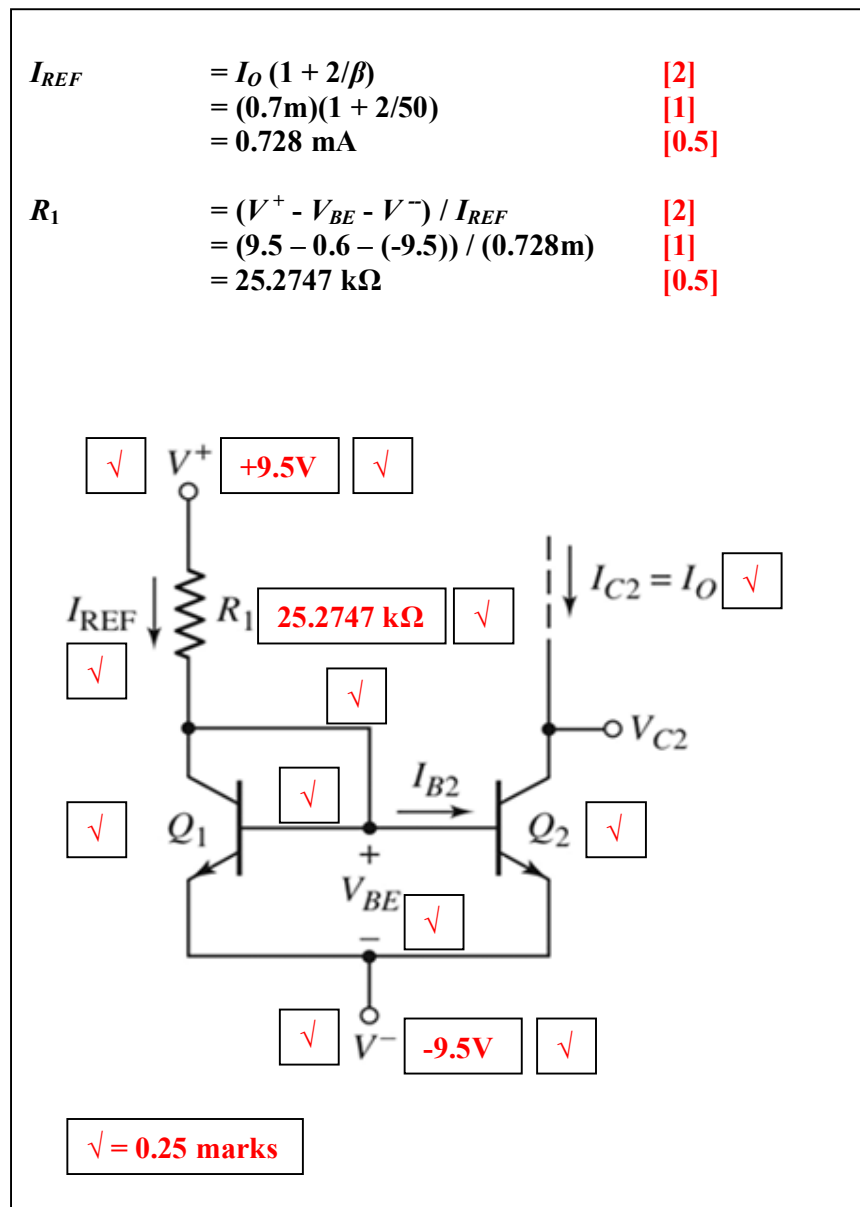$$i_E = i_B + i_C$$

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

;Small signal

$$\beta = g_m r_\pi$$

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

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

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

Name:	**Dr JBO**
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Question:

DESIGN a two-transistor BJT current source using NPN transistors so that **its output current (I_O)** is **0.7 mA**. All transistors are matched. The transistor parameters are V_{BE} **(on) = 0.6 V**, $V_A = \infty$, and β **= 50**. The circuit parameters are V^+ **= 9.5 V** and V^- **= -9.5 V**.

Draw the circuit diagram of your design. **Show clearly all calculations** as marks are given according to this.

[10 marks]

Answer:

I_{REF}	$= I_O (1 + 2/\beta)$	**[2]**	
	$= (0.7m)(1 + 2/50)$	**[1]**	
	$= 0.728$ mA	**[0.5]**	
R_1	$= (V^+ - V_{BE} - V^-) / I_{REF}$	**[2]**	
	$= (9.5 – 0.6 – (-9.5)) / (0.728m)$	**[1]**	
	$= 25.2747$ kΩ	**[0.5]**	

√ = 0.25 marks

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

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

$i_C = \alpha i_E = \beta i_B$

$i_E = i_B + i_C$

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

;Small signal

$\beta = g_m r_\pi$

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

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

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