

Question:

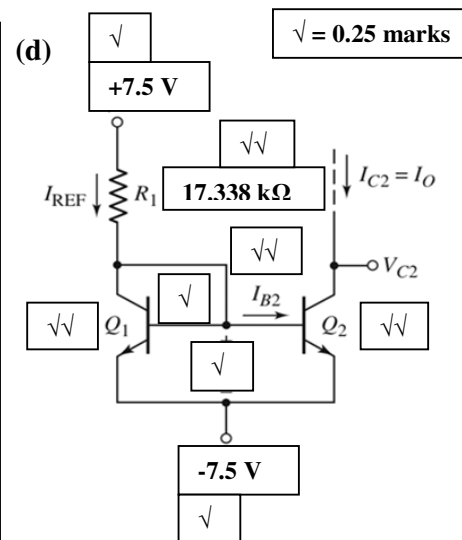
Given that matched **npn transistors** are available with the parameters: $I_S = 5 \times 10^{-16} \text{ A}$, $\beta = 70$, and $V_A = 150 \text{ V}$. Power supplies used to power the circuit are: $V^+ = 7.5 \text{ V}$ and $V^- = -7.5 \text{ V}$.

- (a) Find $V_{BE(\text{on})}$ of the transistor. [1.5 marks]
- (b) Design a two-transistor current source to provide a constant current of $I_O = 0.8 \text{ mA}$ using the available **npn transistors** mentioned above. [3.5 marks]
- (c) Find the output resistance (R_O) of the two-transistor current source. [2 marks]
- (d) Draw the complete **circuit diagram** for the design of the two-transistor current source. [3 marks]

Show clearly all calculations, complete with appropriate Units for all variables used.

Answer:

(a)	$V_{BE} = V_T \ln(I_O / I_S)$	[0.5]
	$= (0.026) \ln(0.8\text{m} / 5 \times 10^{-16})$	[0.5]
	$= 0.7306 \text{ V}$	[0.5]
(b)	$I_{REF} = I_O (1 + 2/\beta)$	[0.5]
	$= (0.8\text{m})(1 + 2/70)$	[0.5]
	$= 0.823 \text{ mA}$	[0.5]
	$R_I = (V^+ - V_{BE} - V^-) / I_{REF}$	[1]
	$= (7.5 - 0.7306 - (-7.5)) / (0.823\text{m})$	[0.5]
	$= 17.338 \text{ k}\Omega$	[0.5]
(c)	$R_O = r_{o2} = V_A / I_O$	[1]
	$= (150) / (0.8\text{m})$	[0.5]
	$= 187.5 \text{ k}\Omega$	[0.5]



EEEE273 - Quiz 2 [Question Set 2]
 SEMESTER 3, ACADEMIC YEAR 2011/2012
 Date: 22 February 2012

Question:

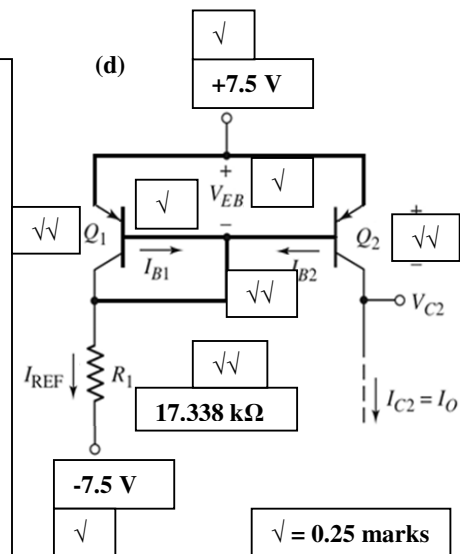
Given that matched **pn_p** transistors are available with the parameters: $I_S = 5 \times 10^{-16}$ A, $\beta = 70$, and $V_A = 150$ V. Power supplies used to power the circuit are: $V^+ = 7.5$ V and $V^- = -7.5$ V.

- (a) Find $V_{EB(on)}$ of the transistor. [1.5 marks]
- (b) Design a two-transistor current source to provide a constant current of $I_O = 0.8$ mA using the available **pn_p** transistors mentioned above. [3.5 marks]
- (c) Find the output resistance (R_O) of the two-transistor current source. [2 marks]
- (d) Draw the complete **circuit diagram** for the design of the two-transistor current source. [3 marks]

Show clearly all calculations, complete with appropriate Units for all variables used.

Answer:

(a)	$V_{EB} = V_T \ln(I_O / I_S)$	[0.5]
	$= (0.026) \ln(0.8\text{m} / 5 \times 10^{-16})$	[0.5]
	$= 0.7306$ V	[0.5]
(b)	$I_{REF} = I_O (1 + 2/\beta)$	[0.5]
	$= (0.8\text{m})(1 + 2/70)$	[0.5]
	$= 0.823$ mA	[0.5]
	$R_1 = (V^+ - V_{EB} - V^-) / I_{REF}$	[1]
	$= (7.5 - 0.7306 - (-7.5)) / (0.823\text{m})$	[0.5]
	$= 17.338$ k Ω	[0.5]
(c)	$R_O = r_{o2} = V_A / I_O$	[1]
	$= (150) / (0.8\text{m})$	[0.5]
	$= 187.5$ k Ω	[0.5]



Question:

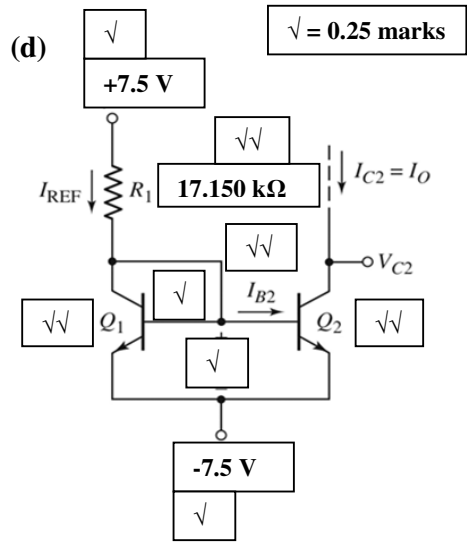
Given that matched **npn transistors** are available with the parameters: $I_S = 5 \times 10^{-16}$ A, $\beta = 50$, and $V_A = 100$ V. Power supplies used to power the circuit are: $V^+ = 7.5$ V and $V^- = -7.5$ V.

- (a) Find $V_{BE(\text{on})}$ of the transistor. [1.5 marks]
- (b) Design a two-transistor current source to provide a constant current of $I_O = 0.8$ mA using the available npn transistors mentioned above. [3.5 marks]
- (c) Find the output resistance (R_O) of the two-transistor current source. [2 marks]
- (d) Draw the complete circuit diagram for the design of the two-transistor current source. [3 marks]

Show clearly all calculations, complete with appropriate Units for all variables used.

Answer:

(a)	$V_{BE} = V_T \ln (I_O / I_S)$	[0.5]
	$= (0.026) \ln (0.8\text{m}/5 \times 10^{-16})$	[0.5]
	$= 0.7306$ V	[0.5]
(b)	$I_{REF} = I_O (1 + 2/\beta)$	[0.5]
	$= (0.8\text{m})(1 + 2/50)$	[0.5]
	$= 0.832$ mA	[0.5]
	$R_1 = (V^+ - V_{BE} - V^-) / I_{REF}$	[1]
	$= (7.5 - 0.7306 - (-7.5)) / (0.832\text{m})$	[0.5]
	$= 17.150$ k Ω	[0.5]
(c)	$R_O = r_{o2} = V_A / I_O$	[1]
	$= (100) / (0.8\text{m})$	[0.5]
	$= 125$ k Ω	[0.5]



EEEE273 - Quiz 2 [Question Set 4]
 SEMESTER 3, ACADEMIC YEAR 2011/2012
 Date: 22 February 2012

Question:

Given that matched **pn_p** transistors are available with the parameters: $I_S = 5 \times 10^{-16}$ A, $\beta = 50$, and $V_A = 100$ V. Power supplies used to power the circuit are: $V^+ = 7.5$ V and $V^- = -7.5$ V.

- (a) Find $V_{EB(on)}$ of the transistor. [1.5 marks]
- (b) Design a two-transistor current source to provide a constant current of $I_O = 0.8$ mA using the available **pn_p** transistors mentioned above. [3.5 marks]
- (c) Find the output resistance (R_O) of the two-transistor current source. [2 marks]
- (d) Draw the complete **circuit diagram** for the design of the two-transistor current source. [3 marks]

Show clearly all calculations, complete with appropriate Units for all variables used.

Answer:

(a)	$V_{EB} = V_T \ln(I_O / I_S)$	[0.5]
	$= (0.026) \ln(0.8m / 5 \times 10^{-16})$	[0.5]
	$= 0.7306$ V	[0.5]
(b)	$I_{REF} = I_O (1 + 2/\beta)$	[0.5]
	$= (0.8m)(1 + 2/50)$	[0.5]
	$= 0.832$ mA	[0.5]
	$R_1 = (V^+ - V_{EB} - V^-) / I_{REF}$	[1]
	$= (7.5 - 0.7306 - (-7.5)) / (0.832m)$	[0.5]
	$= 17.150$ k Ω	[0.5]
(c)	$R_O = r_{o2} = V_A / I_O$	[1]
	$= (100) / (0.8m)$	[0.5]
	$= 125$ k Ω	[0.5]

