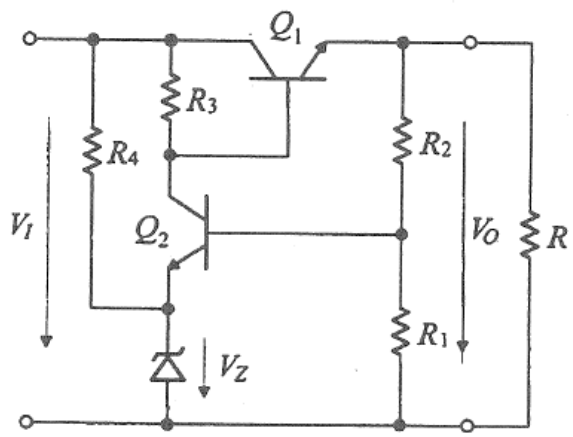
Problema

Conversores Electrónicos de Potência 1 – Regulador série

Considerar o circuito representado na Fig. P11.1, em que os transistores têm $\beta = 100$.

(a) Determinar o valor de V_O.

(b) Calcular o rendimento.

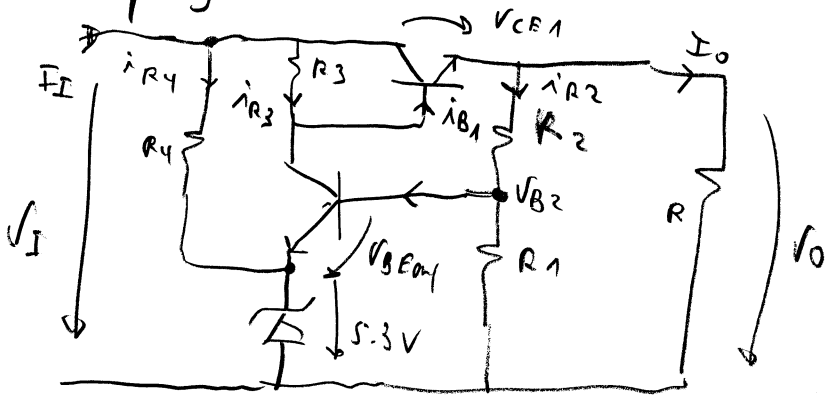


$V_I = 15$ V
$V_Z = 5.3$ V
$R_1 = 2$ kΩ
$R_2 = 1$ kΩ
$R_3 = 500$ Ω
$R_4 = 10$ kΩ
$R = 10$ Ω

Fig. P11.1

CONVERSORES ELECTRÓNICOS DE POTÊNCIA 1

a) Desprezando a corrente de base de Q_2:



$$V_{B2} = V_O \frac{R_1}{R_1+R_2}$$

Considerando que o díodo zener está no joelho de zener $V_Z = 5.3\,V$

$$\Rightarrow \quad V_{B2} = V_{BEON} + V_Z$$

$$\Rightarrow \quad V_O = \left(1 + \frac{R_2}{R_1}\right) \cdot \left(V_{BEON} + V_Z\right) = 1.5 \times 6 = 9\,V$$

$$\boxed{V_O = 9\,V}$$

b)

$$V_I I_I = \left(V_O + V_{CE_1}\right)\left(I_O + I_{X}\right) \qquad I_X = i_{R4} + i_{R3} + i_{R2} - i_{B1}$$

$$= V_O I_O \left(1 + \frac{V_{CE1}}{V_O}\right)\left(1 + \frac{I_X}{I_O}\right) \qquad V_{CE1} = 6\,V \text{ pois } V_O = 9\,V$$

$$\eta = \frac{V_O I_O}{V_I I_I} = \left(1 + \frac{V_{CE1}}{V_O}\right)^{-1}\left(1 + \frac{I_X}{I_O}\right)^{-1} \simeq \left(1 + \frac{V_{CE1}}{V_O}\right)^{-1} \rightarrow \text{desprezando } I_X$$

$$\eta \simeq \frac{1}{1.6667}$$

$$\boxed{\eta \simeq 60\,\%}$$