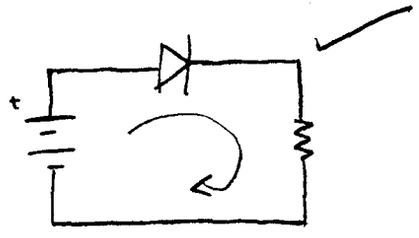
FSK 224 - memo - Toets 1 September 2006

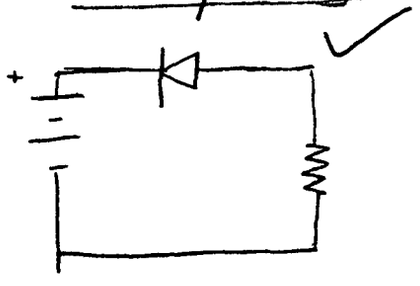
1.1

Voorspanning



- Die elektrone en holtes word na mekaar getrek. ½
- Die verarming gebied verkleen. ½
- Stroom vloei deur die diode. ½
- potensiaal val oor die diode is 0,7V. ½

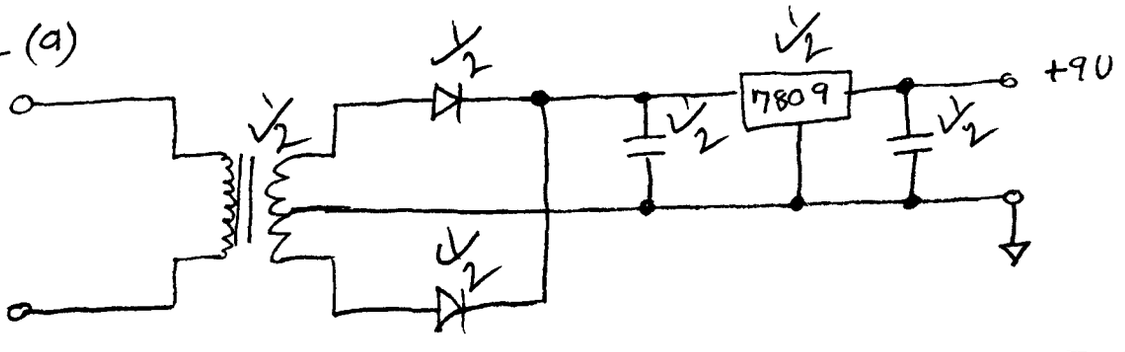
Teenvoorspanning



- Elektron en holtes word weg van mekaar getrek ½
- Die verarming gebied vergroot. ½
- geen stroom vloei ½

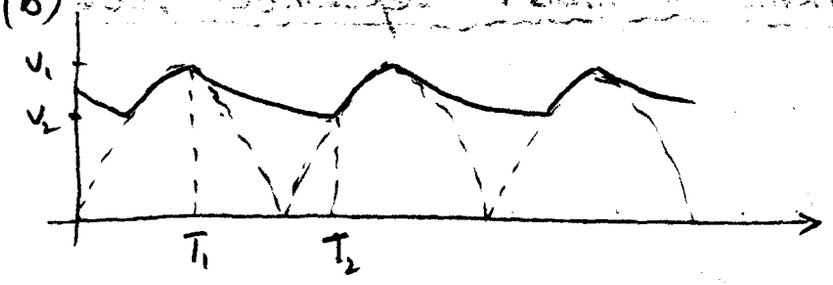
[6]

1.2 (a)



[3]

1.2 (b)



Per def is $C = \frac{Q}{V}$ ✓

Die kapasitor ontlaai van V_1 na V_2 in tyd $\Delta T = T_1 - T_2$

Nou $V_1 = \frac{Q_1}{C}$ en $V_2 = \frac{Q_2}{C}$

Die rimpel spanning is dus

$V_{rip} = \Delta V = V_1 - V_2$

$$\Delta V = \frac{Q_1}{C} - \frac{Q_2}{C} = \frac{Q_1 - Q_2}{C}$$

$$\Delta V = \frac{\Delta Q}{C}$$ ✓

- Deel nou met die ontlaai tyd

$$\frac{\Delta V}{\Delta t} = \frac{\Delta Q}{\Delta t C}$$

Per definisie is $\frac{\Delta Q}{\Delta t} = I$

$$\frac{\Delta V}{\Delta t} = \frac{I}{C}$$ ✓ $\quad \Delta V . f = \frac{I}{C}$

Maar $\frac{1}{\Delta t} = f$ $\Rightarrow \Delta V = \frac{I}{fC}$ ✓

$\Rightarrow C = \frac{I}{f . V_{rimp}}$ ✓ [5]

1.3

(a) Berechnung von V_L:

$$V_Z = V_{BE} + V_L \checkmark$$

$$\Rightarrow V_L = V_Z - V_{BE}$$

$$= 6{,}1\,V - 0{,}7\,V$$

$$\underline{V_L = 4{,}4\,V} \checkmark$$

Berechnung von I_B:

$$I_E = I_L = \frac{V_L}{R_L}$$

$$= \frac{4{,}4\,V}{20\,\Omega} \checkmark$$

$$= 220\,mA$$

Nun $I_E = I_B + I_C$

Mit $I_C = \beta I_B$

$$\Rightarrow I_E = I_B + \beta I_B \checkmark$$

$$= I_B(1+\beta)$$

$$\Rightarrow I_B = \frac{I_E}{(1+\beta)}$$

$$= \frac{220\,mA}{(1+20)}$$

$$\underline{I_B = 10{,}48\,mA} \checkmark$$

Berekening van R_S:

$$V_{cc} = I_S R_S + V_Z$$

$$\Rightarrow R_S = \frac{V_{cc} - V_Z}{I_S}$$

Maar $I_S = I_Z + I_B$

$$= 50\,mA + 10{,}48\,mA$$

$$I_S = 60{,}48\,mA$$

$$\Rightarrow R_S = \frac{12V - 5{,}1V}{60{,}48\,mA}$$

$$R_S = 114\,\Omega$$

[7]

(b) Die maksimum stroom waarby die spanning (U_L) nog gereguleerd is, is wanneer daar geen meer deur die Zener diode vloei nie

$$\Rightarrow I_S = I_B + I_Z$$

Maar $I_Z = 0$

$$\Rightarrow I_B = I_S$$

$$= 50\,mA + 10{,}48\,mA$$

$$= 60{,}48\,mA$$

Maar $I_E = I_B(1+\beta) = 60{,}48\,mA(21)$

$$= 1{,}27\,A$$

[3]

2.1

(a) Berekening van I_B:

$$V_{cc} = I_B R_B + V_{BE} + I_E R_E \checkmark$$

Nou $I_E = I_B(\beta + 1)$

$$\Rightarrow V_{cc} = I_B R_B + V_{BE} + I_B(\beta+1) R_E$$

$$\Rightarrow I_B = \frac{V_{cc} - V_{BE}}{(R_B + (\beta+1)R_E)}$$

$$= \frac{20V - 0,7V}{(232\,000\,\Omega + 161 \cdot 157,3\,\Omega)}$$

$$\underline{I_B = 75\,\mu A} \checkmark$$

Berekening van I_C:

$$I_C = \beta I_B \checkmark$$

$$= 161 \times 75\,\mu A$$

$$\underline{I_C = 12\,mA} \checkmark$$

Berekening van I_E:

$$I_E = I_C + I_B \checkmark$$

$$= 12mA + 0,075mA$$

$$\underline{I_E = 12,075\,mA} \checkmark$$

Berekening van V_{CE}:

$$V_{cc} = I_c R_c + V_{CE} + I_E R_E \checkmark$$

$$\Rightarrow V_{CE} = V_{cc} - I_c R_c - I_E R_E$$

$$= 20V - (12mA \cdot 750\Omega) - (12{,}075mA \cdot 157{,}3\Omega)$$

$$\underline{V_{CE} = 9{,}144\,V \checkmark}$$

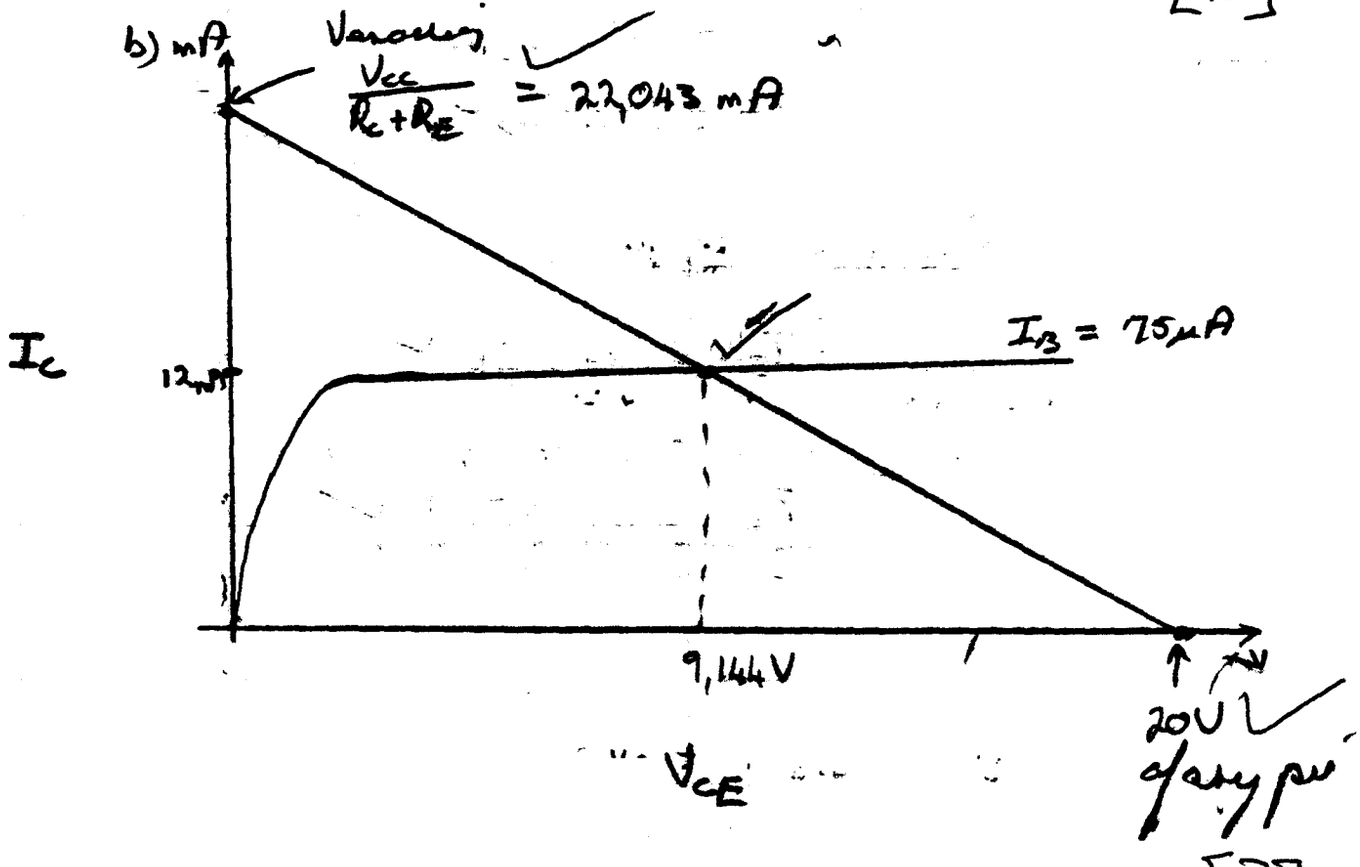
Berekening van V_o:

$$V_o = I_E R_E + V_{CE} \checkmark$$

$$= (12{,}075mA \times 157{,}3\Omega) + 9{,}144V$$

$$\underline{V_o = 11{,}043\,V \checkmark}$$

[10]



[3]

3.1

Die stroom kan in fig 3 is 'n treg-voer stroombaan daar is:

$V_+ \approx V_-$

Maar $V_+ = 0$ gegrond gelede

$\Rightarrow V_- = 0$. "virtuele grond".

Nou per def is $C = \frac{Q}{V}$ vir 'n kapasitor.

$\Rightarrow q_{in} = C \cdot V_{in}$ vir die stroombaan.

(Differensieer met t.

$$\frac{dq_{in}}{dt} = C \frac{dV_{in}}{dt}.$$

Maar per def is $i_{in} = \frac{dq_{in}}{dt}$.

$$\Rightarrow \quad i_{in} = C\frac{dV_{in}}{dt}$$

Maar in die stroombaan is

$i_{in} = i_R$ (geen stroom vloei in die op amp in nie)

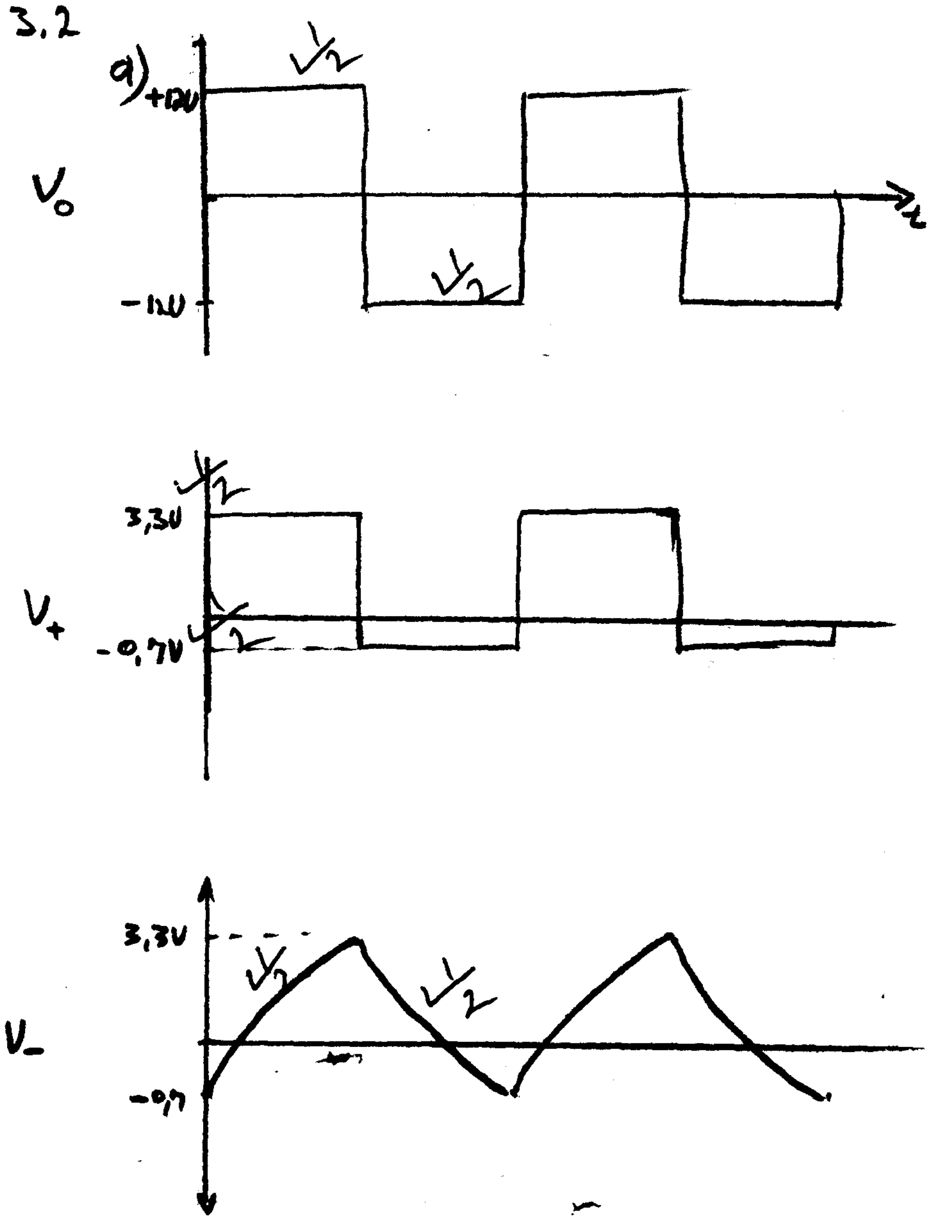
Nou $V_o = -i_R R$. ← uit die stroombaan.

Dus $\Rightarrow V_o = -RC\frac{dV_{in}}{dt}$

$= -(\frac{1}{4} \times \frac{1}{4}) RC\frac{dV_{in}}{dt} = -0{,}0625\, RC\frac{dV_{in}}{dt}$ [5]

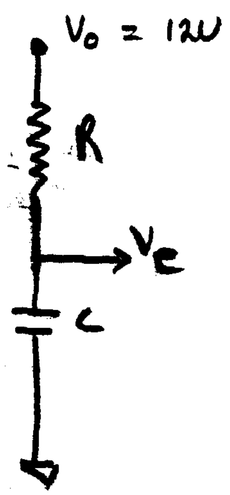
3.2

a)



[3]

(b) Bereken die verly gedeelte van die stroombaan



Vir die stroombaan is

$V_o = Ri + V_c$ ✓

Nou per def is $i = \frac{dq}{dt}$.

$\Rightarrow V_o = R\frac{dq}{dt} + V_c$ ✓

Nou per def is $Q = C.V_c$ net 'n kopf.

$$\Rightarrow \quad \frac{dq}{dt} = C\frac{dV_c}{dt}.$$

Stel is verg nef.

$$\Rightarrow \quad V_0 = RC\frac{dV_c}{dt} + V_c$$ ✓

los nou op deur skei der ver ve.

$$\Rightarrow \int_{t_1}^{t}\frac{dt}{RC} = \int_{V_1}^{V_1}\frac{dV_c}{V_0 - V_c}$$

$$= \left[t\right]_{t_1}^{t_2} = RC\left[-\ln(V_0 - V_c)\right]_{V_1}^{V_2}.$$

$$\Delta t = RC\ln\left[\frac{V_0 - (-0,7)}{V_0 - 3,3}\right]$$ ✓

$$= RC\ln\left(\frac{12+0,7}{12-3,3}\right)$$

$$= 0,378 . RC.$$ ✓

[5]