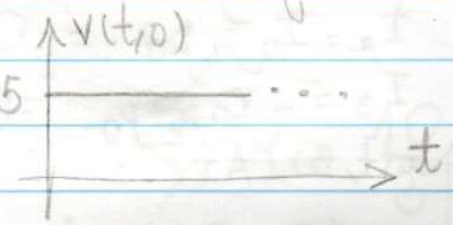
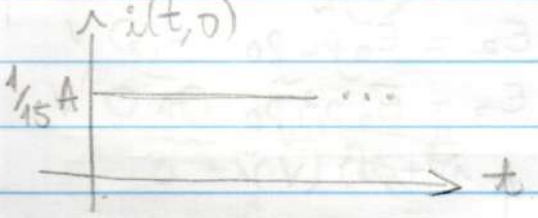
LISTA 1

1 i) a) $\rho_0 = \dfrac{Z_g - Z_0}{Z_g + Z_0} = 0$ $\qquad \rho_e = \dfrac{Z_e - Z_0}{Z_e + Z_0} = 0$

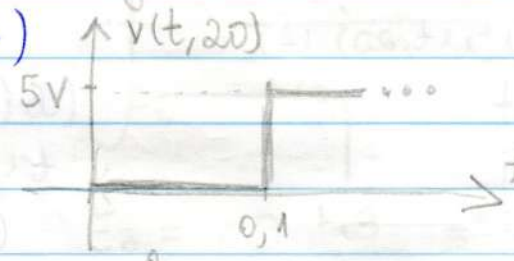
b)

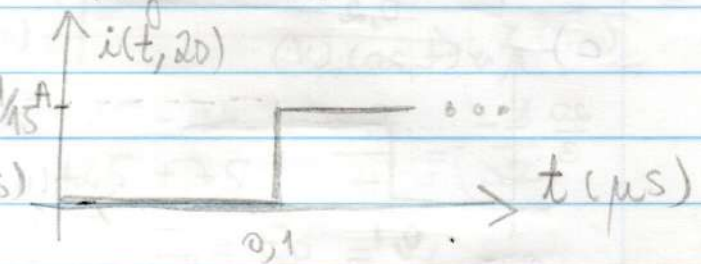




$E = \dfrac{Z_0}{Z_0 + Z_g} 10\,V = 5\,V$ $\qquad I = \dfrac{10 - E}{Z_g} = \dfrac{5}{75} = \dfrac{1}{15}\,A$

c)



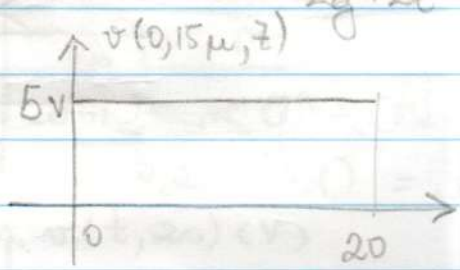


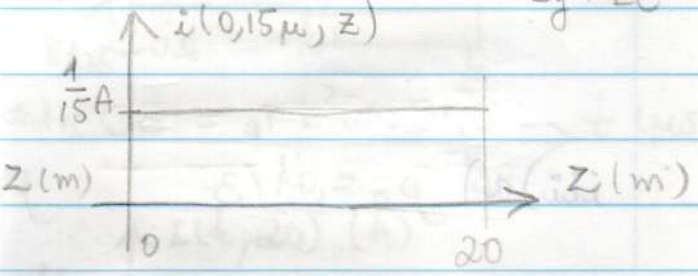
$T = \dfrac{l}{v_p} = \dfrac{20\,m}{2 \cdot 10^8\,m/s} = 0{,}1\,\mu s$ $\qquad E(1+\rho_L) = 5\,V$

$\dfrac{E(1+\rho_L)}{Z_e} = \dfrac{1}{15}\,A$

d) $\lim_{t \to \infty} v_L(t) = \dfrac{Z_e}{Z_g + Z_e} 10 = 5\,V$ $\qquad \lim_{t \to \infty} i_L(t) = \dfrac{10}{Z_g + Z_e} = \dfrac{1}{15}\,A$

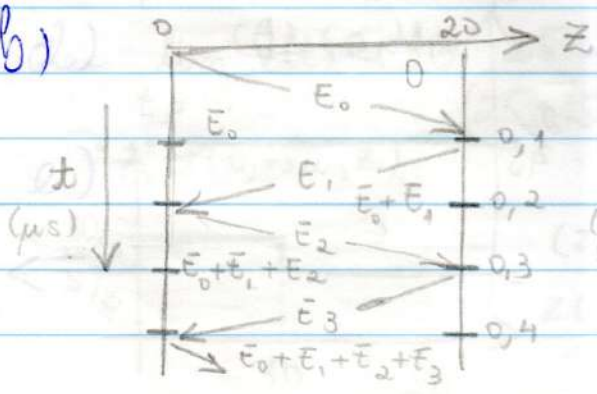
e)

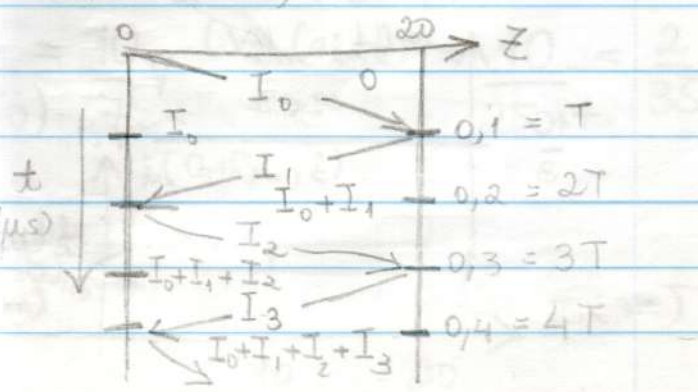




ii) a) $\rho_0 = 0$ $\qquad \rho_L = \dfrac{75(2-1)}{75(2+1)} = \dfrac{1}{3}$

b)





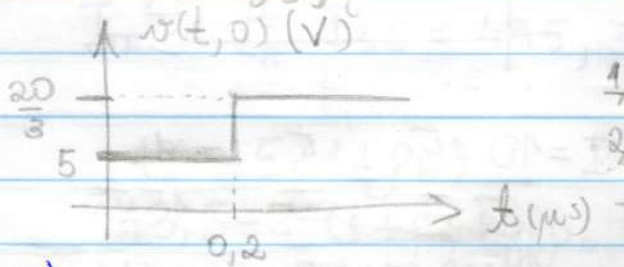
(2)

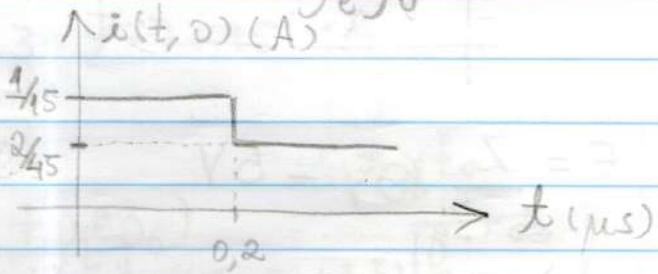
$E_0 = 10 \frac{Z_0}{Z_g + Z_0} = 5\,V$ $\qquad I_0 = \frac{E_0}{Z_0} = \frac{5}{75} = \frac{1}{15}\,A$

$E_1 = E_0 \rho_L = 5/3\,V$ $\qquad I_1 = -I_0 \rho_L = -1/45\,A$

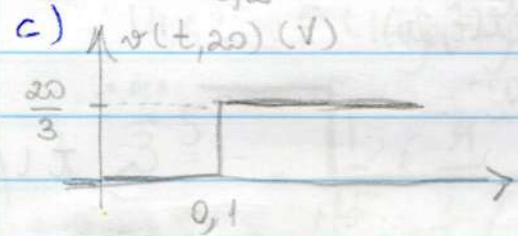
$E_2 = E_0 \rho_L \rho_0 = 0\,V$ $\qquad I_2 = I_0 \rho_L \rho_0 = 0\,A$

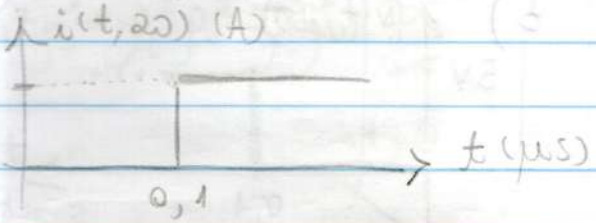
$E_3 = E_0 \rho_L^2 \rho_0 = 0\,V$ $\qquad I_3 = -I_0 \rho_L^2 \rho_0 = 0\,A$





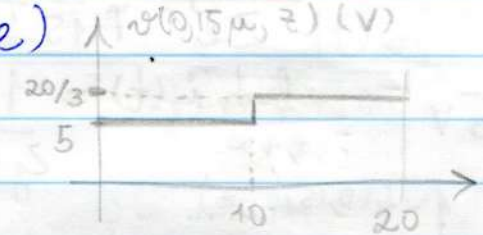
c)

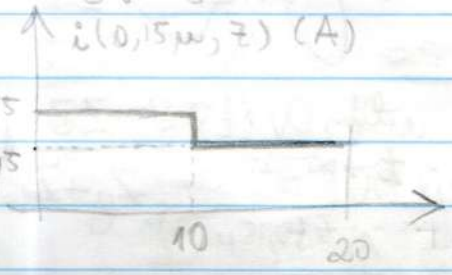




d) $\frac{2}{3} \cdot \frac{75}{75} \cdot 10 = \frac{20}{3}\,V$ $\qquad \frac{10}{3 \cdot 75} = \frac{2}{3} \frac{1}{15} = \frac{2}{45}\,A$

e)



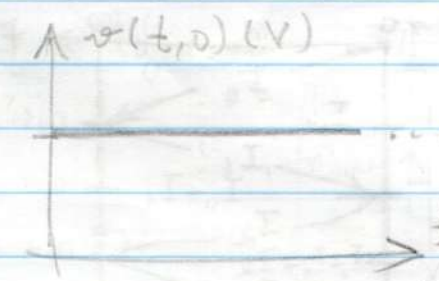


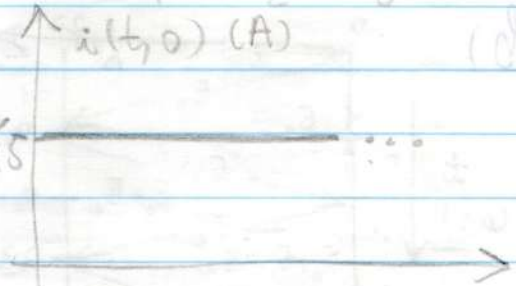
$0{,}15 \cdot 10^{-6} \cdot v_p = 30\,m = 20 + 10\,m$ (ida e 1/2 volta)

iii) a) $\rho_0 = 1/3$ $\qquad \rho_L = 0$

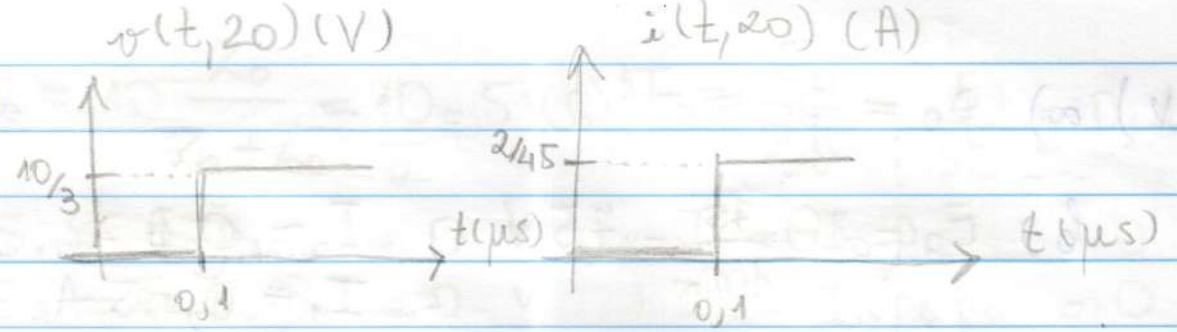
b) $E_0 = 10 \cdot \frac{75}{3 \cdot 75} = \frac{10}{3}\,V$ $\qquad I_0 = \frac{10/3}{75} = \frac{2}{45}\,A$

$E_1 = 0\,V = E_2 = E_3$ $\qquad I_1 = I_2 = I_3 = 0\,A$



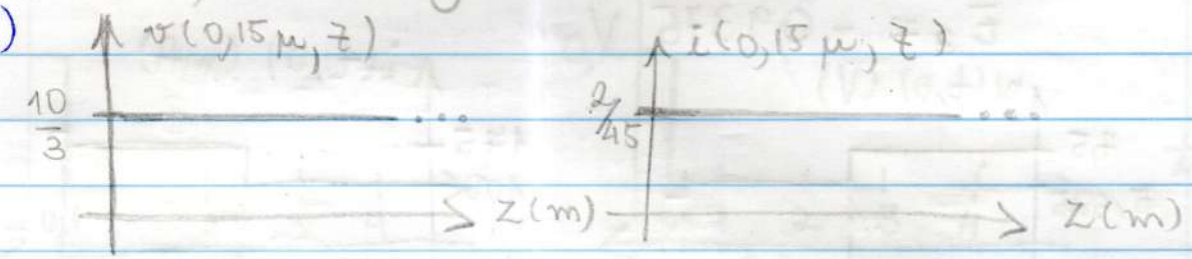


c)



d) $\frac{75}{3.75}10 = \frac{10}{3}$ V $\qquad \frac{10}{3.75} = \frac{2}{45}$ A

e)



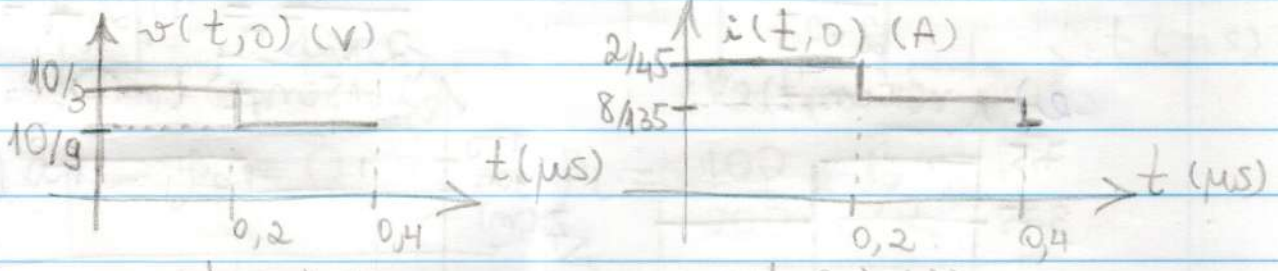
iv) a) $\rho_0 = 1/3$ $\qquad \rho_L = \frac{25-75}{25+75} = \frac{-2}{4} = \frac{-1}{2}$

b) $E_0 = 10\ \frac{3}{(3+6)} = \frac{10}{3}$ V $\qquad I_0 = \frac{E_0}{Z_0} = \frac{2}{45}$ A

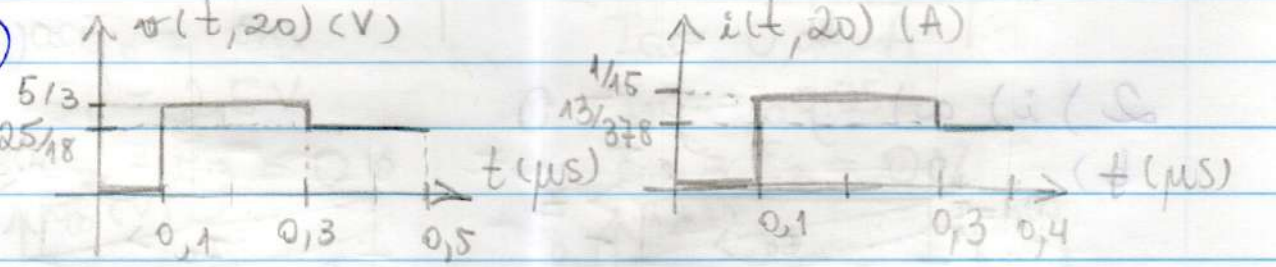
$E_1 = -5/3$ V $\qquad I_1 = 1/45$ A

$E_2 = -5/9$ V $\qquad I_2 = -1/135$ A

$E_3 = 5/18$ V $\qquad I_3 = -1/270$ A

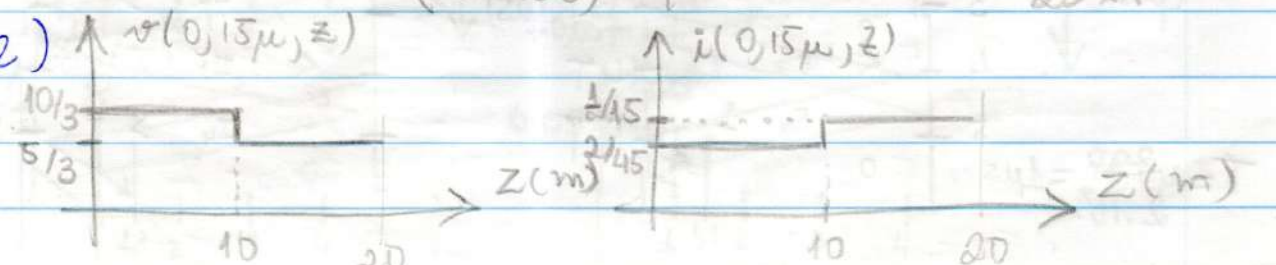


c)



d) $\lim_{t\to\infty} v(t) = 10\ \frac{25}{(25+150)} = \frac{10}{7}$ V $\qquad \lim_{t\to\infty} i(t) = \frac{10}{25\times 7} = \frac{2}{35}$ A

e)



(4)

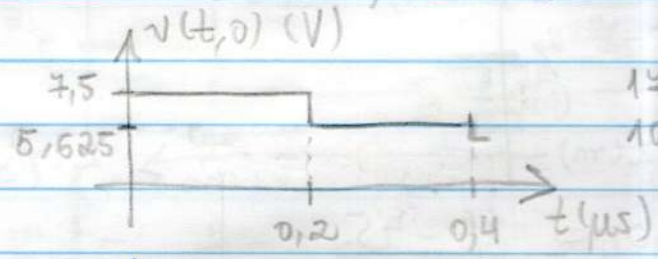
v) a) $\rho_0 = \rho_L = -1/2$

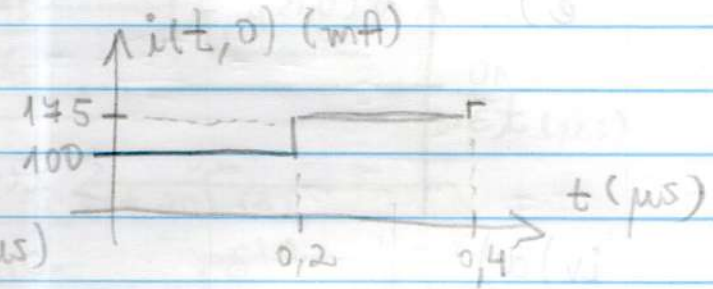
b) $E_0 = 10\,\frac{75}{100} = 7{,}5\ V$ $\quad I_0 = 0{,}1\ A$

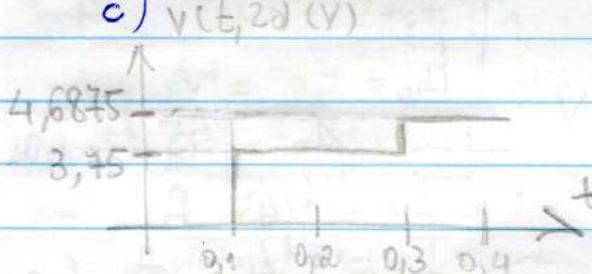
$E_1 = -3{,}75\ V$ $\quad I_1 = 0{,}05\ A$

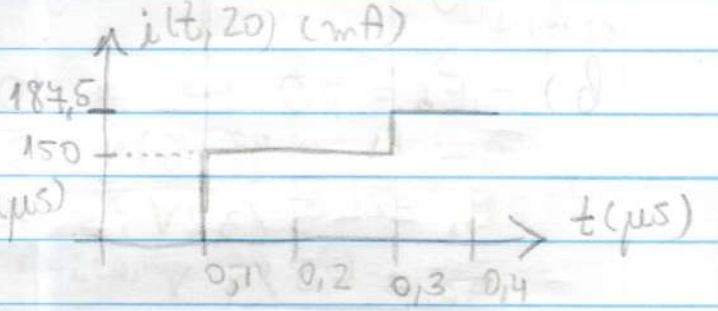
$E_2 = 1{,}875\ V$ $\quad I_2 = 0{,}025\ A$

$E_3 = -0{,}9375\ V$ $\quad I_3 = 0{,}0125\ A$

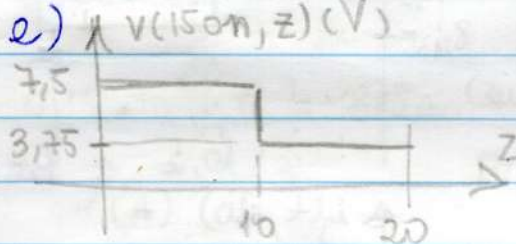


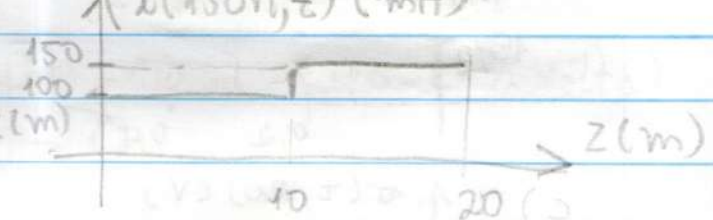


c) 

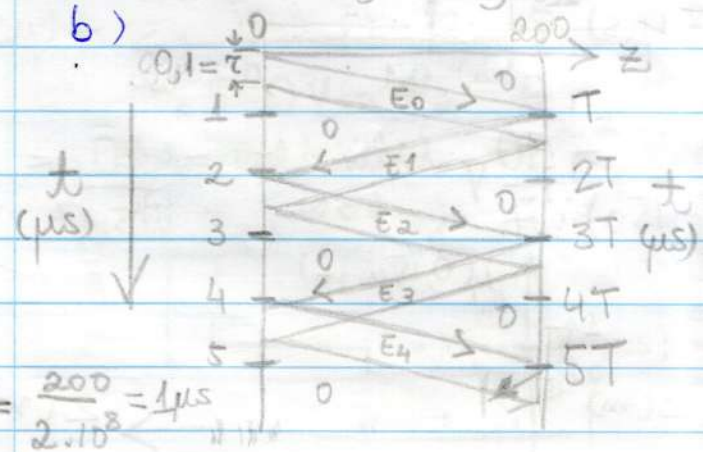


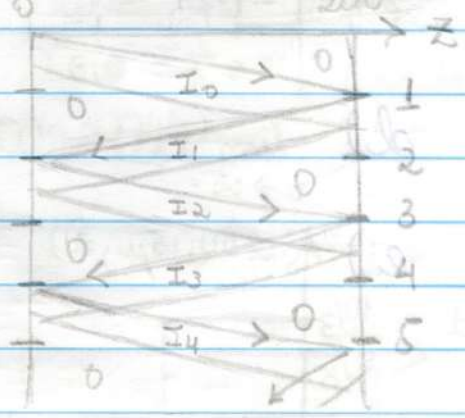
d) $\frac{10}{2\times 25} = 5\ V$ $\qquad \frac{10\ V}{2\times 25\ \Omega} = 0{,}2\ A = 200\ mA$

e) 



2) i) a) $\rho_0 = \rho_L = 0$

b) 



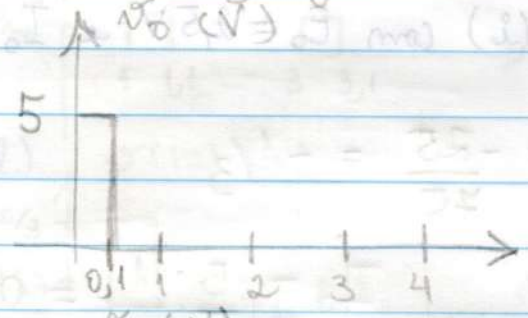
$T = \frac{200}{2\cdot 10^8} = 1\,\mu s$

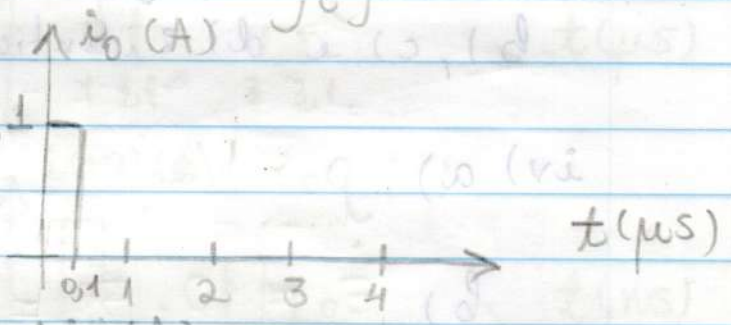
$E_0 = 10 \frac{Z_0}{Z_g + Z_0} = \frac{10}{2} = 5\,V$ $\quad I_0 = \frac{E_0}{Z_0} = \frac{5}{50} = 0,1\,A$

$E_1 = E_0 \rho_L = 0\,V$ $\quad I_1 = -I_0 \rho_L = 0\,A$

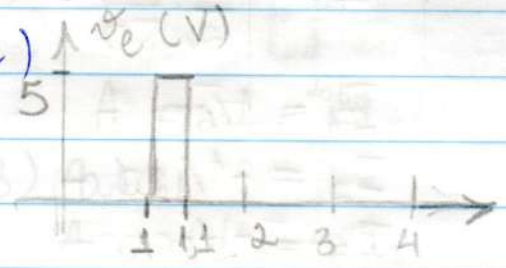
$E_2 = E_0 \rho_L \rho_0 = 0\,V$ $\quad I_2 = I_0 \rho_L \rho_0 = 0\,A$

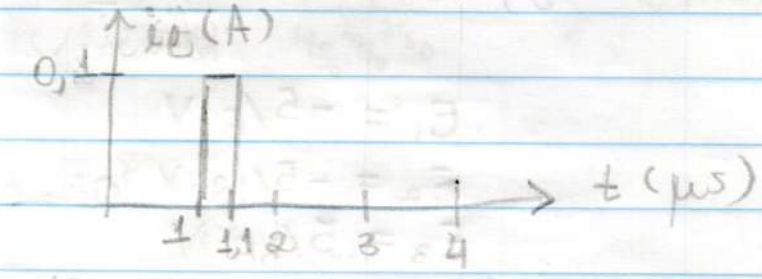
$E_3 = E_0 \rho_L^2 \rho_0 = 0\,V$ $\quad I_3 = -I_0 \rho_L^2 \rho_0 = 0\,A$



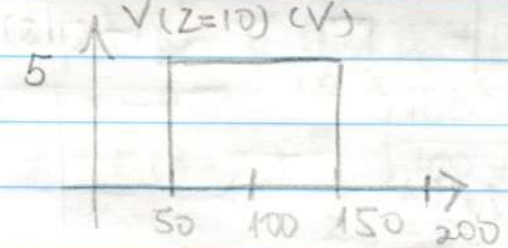


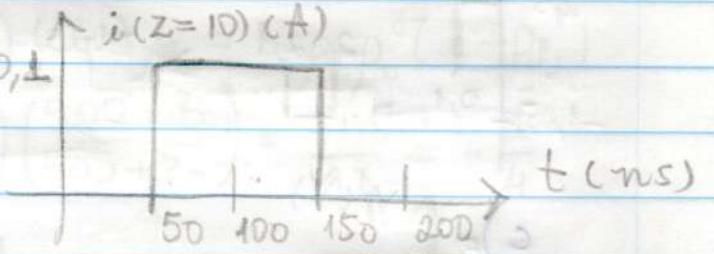
c)





d) $Z = 10\,m$ $\quad t_1 = 10/2 \cdot 10^8 = 50\,ns$



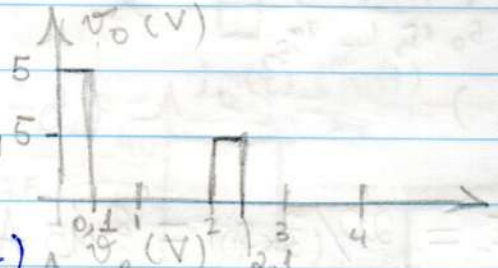


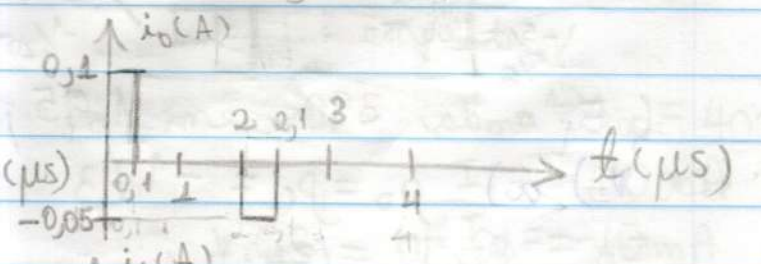
ii) a) $\rho_0 = 0$ $\quad \rho_L = \frac{100}{200} = 1/2$

b) $E_0 = 5\,V$ $\quad I_0 = 0,1\,A$

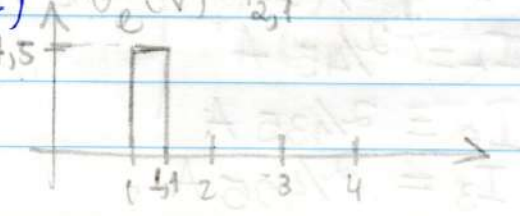
$E_1 = 2,5\,V$ $\quad I_1 = -0,05\,A$

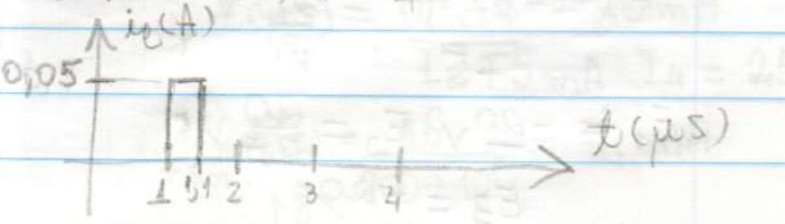
$E_2 = E_3 = 0\,V$ $\quad I_2 = I_3 = 0\,V$





c)





⑥

d) $v(10m)$ (V) — 5, 2,5; 50 150 2050 2150; t(ns)

$i(10m)$ (A) — 0,1; -0,05; 50 150 2050 2150; t(ns)

iii) a) $\rho_0 = 1/2$ $\rho_e = 0$

b), c) e d): idêntico a (i) com $E_0 = 2,5\,V$ e $I_0 = \frac{0,1}{2} = 0,05\,A$

iv) a) $\rho_0 = 1/2$ $\rho_e = -\frac{25}{75} = -1/3$

b) $E_0 = 10 \cdot \frac{50}{200} = 2,5\,V$ $I_0 = \frac{5}{2} \cdot \frac{1}{50} = 0,05\,A$

$E_1 = -5/6\,V$ $I_1 = 1/60\,A$

$E_2 = -5/12\,V$ $I_2 = -1/120\,A$

$E_3 = 5/36\,V$ $I_3 = -1/360\,A$

v_0 (V) — 2,5; -1,25; 0,1; 2 2,1; t(μs)

i_0 (A) — 0,05; 1/120; 0,1; 2 2,1; t(μs)

c) v_e(V) — 5/3; -5/18; 3 3,1; 1 1,1

i_e (A) — 1/15; -1/60; 3 3,1; 1 1,1; t(μs)

d) $v(10m)$ (A) — 2,5; -5/12; -5/6; 50 150; 1950 2050 2150

$i(10m)$ (A) — 1/20; 1/60; -1/120; 50 150; 1950 2050 2150; t(ns)

(E₁ anda 390m em 1,95 μs)

v) a) $\rho_0 = \rho_e = -1/3$

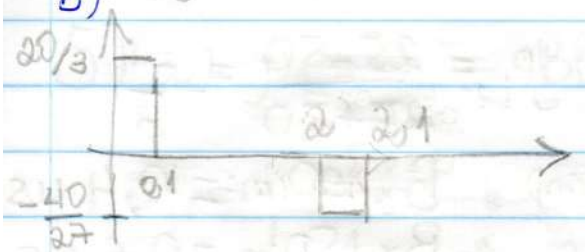
$E_0 = \frac{10 \cdot 50}{75} = \frac{20}{3}\,V$ $I_0 = 20/(3 \times 50) = 2/15\,A$

$E_1 = -\frac{20}{9}\,V$ $E_2 = \frac{20}{27}\,V$ $I_1 = 2/45\,A$

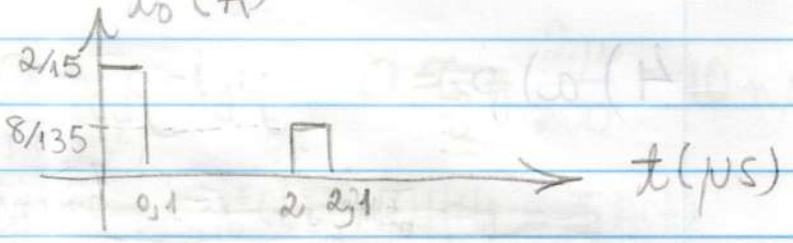
$E_3 = -20/81\,V$ $I_2 = 2/135\,A$

$I_3 = 2/405\,A$

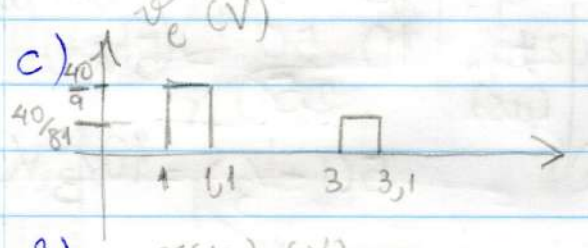
b) $v_0(V)$



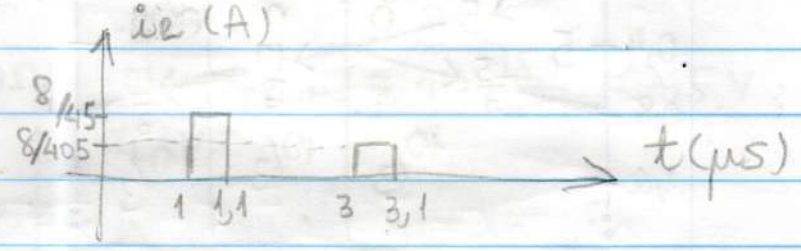
$i_0(A)$



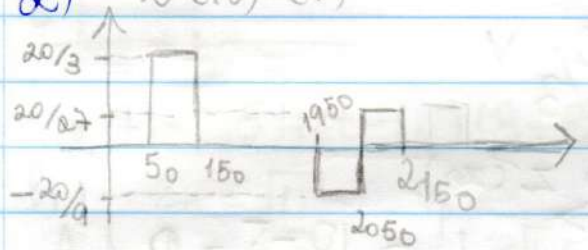
c) $v_e(V)$



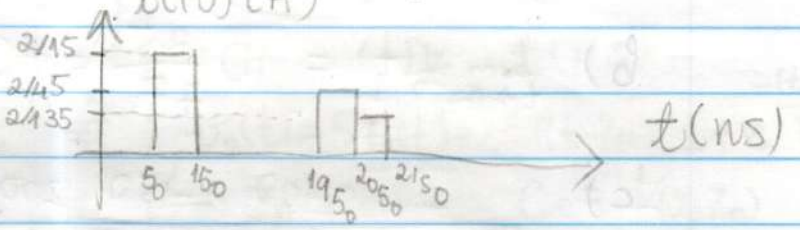
$i_2(A)$



d) $v(10)(V)$



$i(10)(A)$



3) a) $\frac{30\ m}{0{,}12\times10^{-6}\ s} = 2{,}5\cdot10^{8}\ m/s$

b) $18 = E(1+\rho_L)$

$13{,}5-18 = E(\rho_L\rho_0+\rho_L^2\rho_0) = -4{,}5 = E\rho_L\rho_0(1+\rho_L)$

$$\frac{-4{,}5}{E(1+\rho_L)} = \left(\frac{100-z_0}{100+z_0}\right)\left(\frac{900-z_0}{900+z_0}\right) = \frac{-4{,}5}{18} = -\frac{1}{4}$$

$z_0 = 300\ \Omega$

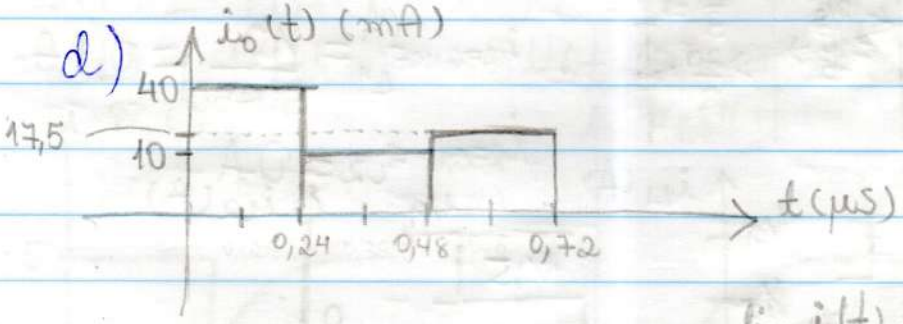
$$\rho_0 = \frac{100-300}{100+300} = \frac{-1}{2} \qquad \rho_L = \frac{900-300}{900+300} = \frac{1}{2}$$

c) $Z_0 = 300\ \Omega$

$18 = E(1+0{,}5)$ $E = 12\ V$ $V = E\ \frac{(100+300)}{300}$

$V = 16\ V$

d) $i_0(t)\ (mA)$



$I_0 = 12/300 = 40\ mA$

$I_1 = -20\ mA$

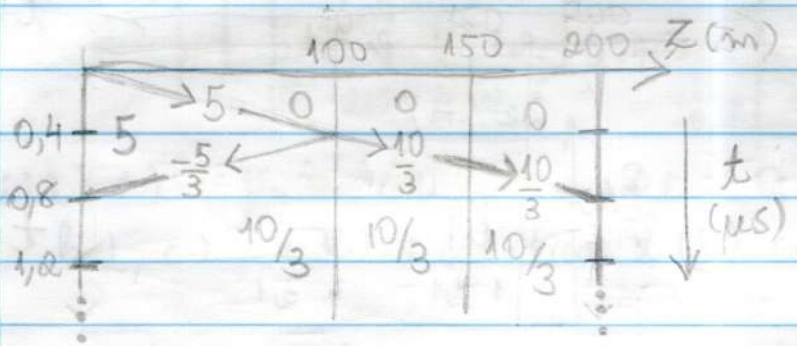
$I_2 = -10\ mA$

$I_3 = 5\ mA$ $I_4 = 25\ mA$

$\lim_{t\to\infty} i_0(t) = \frac{16}{900+100} = 16\ mA$

(8)

4) a) $\rho_g = 0$ $\rho_{L1} = \rho_{L2} = 0$ $\rho_L = \frac{25-50}{25+50} = -\frac{1}{3}$



$B \times 100m = 0,4\ \mu s$

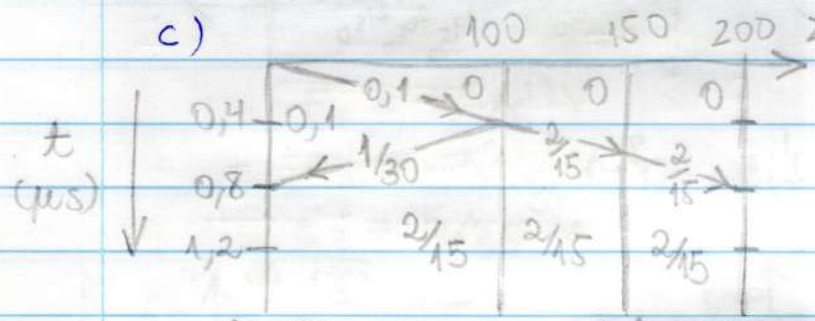
$B \times 150m = 0,6\ \mu s$

$10\ \frac{50}{2.50} = 5V$

$5(1-\frac{1}{3}) = 10/3\ V$

b) $\lim_{t\to\infty} v_1(t) = 10\ \frac{25}{75} = 10/3\ V$

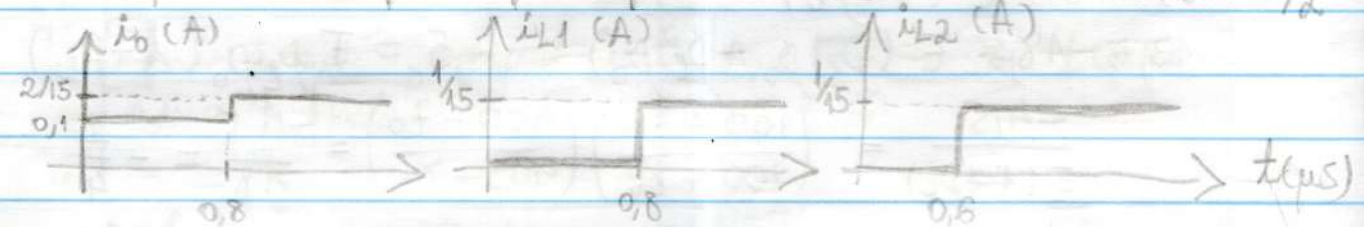
c)



$i_0 = \frac{10-5}{50} = 0,1\ A$

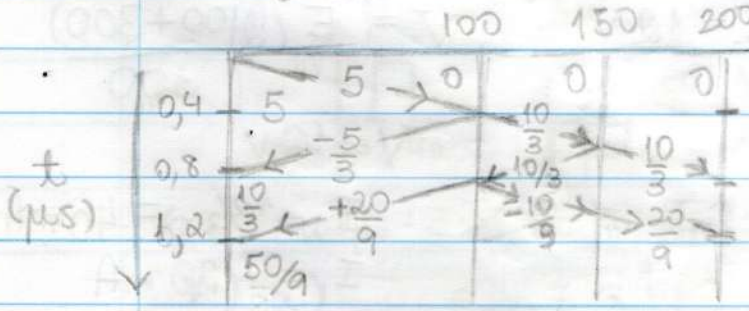
$i_L = (1+\frac{1}{3})0,1 = 2/15\ A$

$i_{L1} = i_{L2} = i_L/2$



d) $i_{L1}(t\to\infty) = i_{L2}(t\to\infty) = \frac{v(t\to\infty)}{50} = \frac{10/3}{50} = \frac{1}{15}\ A$

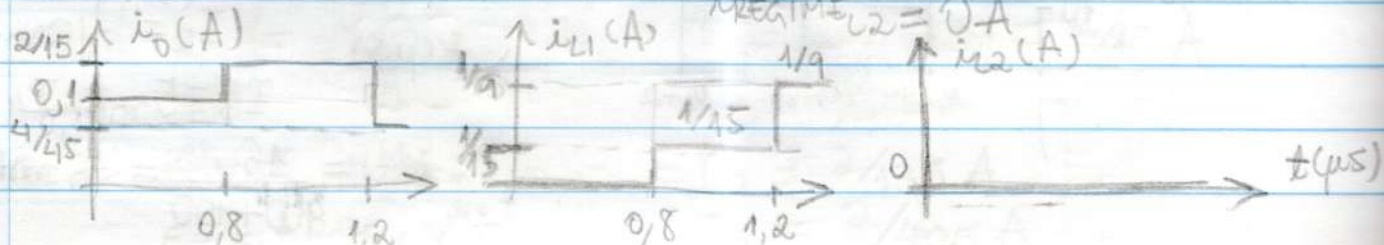
e) $\rho_{L1} = 1$



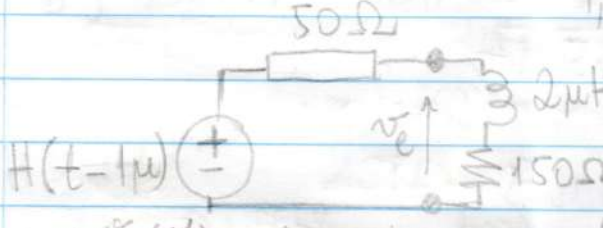
$U_{REGIME} = \frac{10 \times 50}{100} = 5V$

$i_{REGIME\ L1} = \frac{10}{50+50} = 0,1A$

$i_{REGIME\ L2} = 0A$

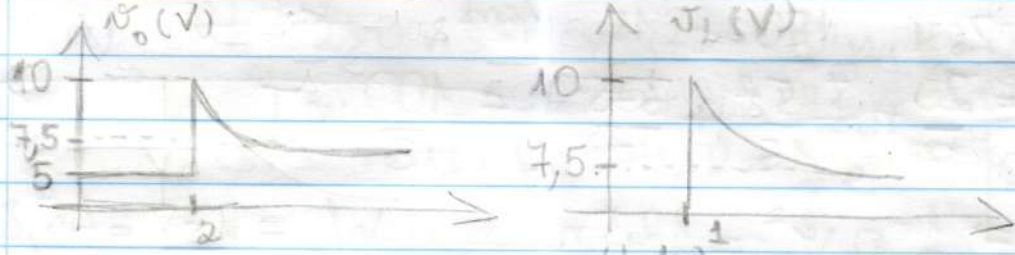


5) a) $\rho_0 = 0$ $\quad Bl = \frac{150}{1,5\cdot10^8} = 1\mu s$ $\quad \tau = \frac{2\mu}{200} = 10\,ns$



$v_0^+(t) = \frac{10H(t)}{2} = 5H(t)$

$V_{REGIME} = 10\,\frac{150}{200} = 7,5\,V$



$V_e(t) = 2,5\,H(t-1\mu)\,(3+e^{-\frac{(t-1\mu)}{\tau}})$, $v_0(t) = 5H(t) + 2,5H(t-2\mu)\,[1+e^{-\frac{(t-2,\mu)}{\tau}}]$

b) $Z_0 = \sqrt{\frac{L}{C}}$ $\quad v_p = \frac{1}{\sqrt{LC}}$ $\quad L = Z_0^2 C$ $\quad C_0 = 1/(v_p Z_0)$

$C = 1/(v_p^2 L)$ $\quad L = Z_0/v_p$

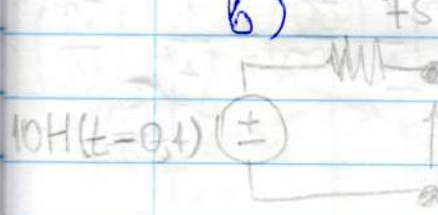
$L = 50/(1,5\cdot10^8) = \frac{1}{3}\cdot10^{-6}\,H/m$ $\quad C = 10^{-8}/75\,F/m$

c) $W = \frac{1}{2}Cl\,v_R^2 + \frac{1}{2}Ll\,i_R^2 = 5,625\cdot10^{-7} + 6,25\cdot10^{-8} =$

$6,25\cdot10^{-7}\,J$

6) a) $\rho_L(s) = \frac{R//(\frac{1}{sC}) - Z_0}{R//(\frac{1}{sC}) + Z_0} = \frac{R - Z_0 RsC - Z_0}{R + Z_0 RsC + Z_0} = \frac{75\cdot10^{-9}s}{75\cdot10^{-9}s + 2}$

b)



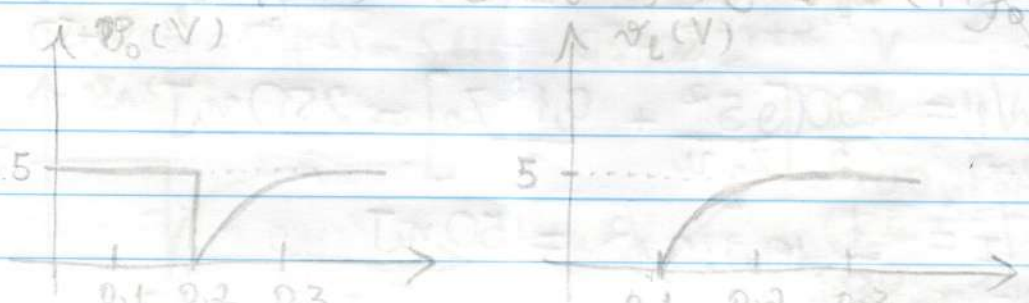
$v_e^+ = \frac{10}{2} = 5\,V$ $\quad Bl = 0,1\,\mu s$

$V_L(s) = \frac{10}{s}e^{-0,1s}\,\frac{75//\frac{1}{1n\,s}}{75//\frac{1}{1n\,s} + 75}$

$V_L(s) = 10e^{-0,1s}\left[\frac{1}{s}\left(\frac{1}{2}\right) + \frac{1}{s+\frac{2}{75n}}\left(\frac{-1}{2}\right)\right]$

$v_e(t) = 5H(t-0,1)\,[1-e^{-\frac{(t-0,1)}{\tau}}]$, $\quad \tau = \frac{1}{2/75n} = 37,5\,ns$

$v_0(t) = 5H(t) - 5H(t-0,2)\,e^{-\frac{(t-0,2)}{\tau}}\,(1+\rho_0)$ $\quad \rho_0 \to 0$



(10)

c) $v_R = 10\,\frac{75}{75+75} = 5\,V$ $\qquad i_R = \frac{10}{75+75} = \frac{1}{15}\,A$

d) $L = \frac{Z_0}{u} = \frac{75}{2\cdot10^8} = 375\,nH/m$

$C = \frac{1}{Z_0 u} = \frac{10^8}{150} = \frac{1}{15}\,nF/m$

e) $W_l = \frac{20}{2}\,n\left(\frac{5^2}{15} + \frac{375}{15^2}\right) = \frac{100}{3}\,nJ$

$W_C = \frac{1}{2} C V_R^2 = 12{,}5\,n$ $\qquad W_L = \frac{275}{6} = 45{,}83\,nJ$

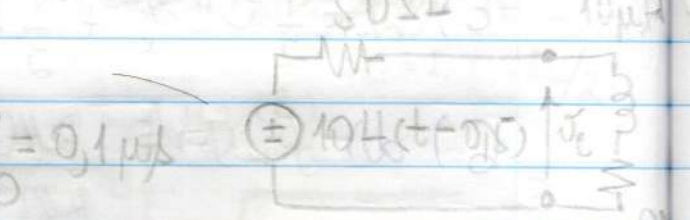
7) a) $\sqrt{\epsilon\mu} = \frac{1}{u} = \frac{3}{2}\frac{1}{c} = \frac{3}{2}\sqrt{\epsilon_0\mu_0}$

$\epsilon = \frac{9}{4}\epsilon_0 = 1{,}9922\cdot10^{-11}\,F/m$

b) $v_0^+ = \frac{10}{2} = 5\,V$

$\tau = \frac{10\mu}{50+50} = 0{,}1\,\mu s$

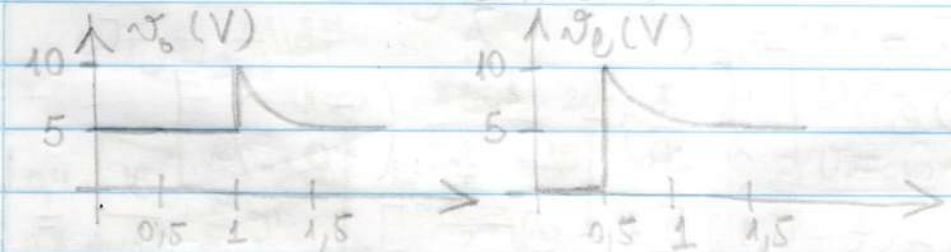
$Bl = 0{,}5\,\mu s$



$V_L(p) = \frac{10}{s} e^{-0{,}5s}\,\frac{10\mu s + 50}{10\mu s + 100} = 10\,e^{-0{,}5s}\left[\frac{1}{s}\left(\frac{50}{100}\right) + \frac{1}{s+\frac{1}{\tau}}\left(\frac{50}{100}\right)\right]$

$v_L(t) = 5\,H(t-0{,}5)\left[1 + e^{-\frac{(t-0{,}5)}{0{,}1}}\right]$

$v_0(t) = 5\,H(t) + 5\,H(t-1)\,e^{-10t+10}$



c) $v_{0_R} = v_{L_R} = \frac{10\cdot50}{50+50} = 5\,V$ $\qquad i_{0_R} = i_{L_R} = \frac{10}{50+50} = 0{,}1\,A$

d) $W_l = \frac{100}{2}\left[\frac{5^2}{Z_0 u} + \frac{0{,}1^2 Z_0}{u}\right] = 250\,nJ$

$W_L = \frac{1}{2}\cdot10\mu\cdot0{,}1^2 = 50\,nJ$

8) a) $Z_1(s) = Z_0 = 75\ \Omega$

b) $Z_2(s) = 75 \,//\, \frac{1}{s4n} = \frac{75/4ns}{75 + \frac{1}{4ns}} = \frac{75}{0,3\mu s + 1}\ \Omega$

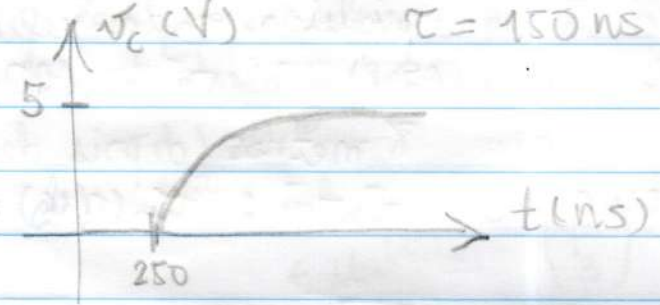
$$\rho_2(s) = \frac{Z_2(s) - Z_0}{Z_2(s) + Z_0} = \frac{75 - 22,5\mu s - 75}{75 + 22,5\mu s + 75} = -\frac{0,3\mu s}{2 + 0,3\mu s}$$

d) $B_{l_c} = 250\ ns \qquad v_c^+(t) = \frac{10}{2} H(t-250)\ V$

$$V_c(s) = V_c^+(s)(1+\rho_2(s)) = \frac{5}{s} e^{-250t}\left[1 - \frac{s}{2/3\cdot 10^2 + s}\right]$$

$$v_c(t) = 5\,H(t-250)\left[1 - e^{-\frac{(t-250)}{300/2}}\right] V$$

→ em nano segundos

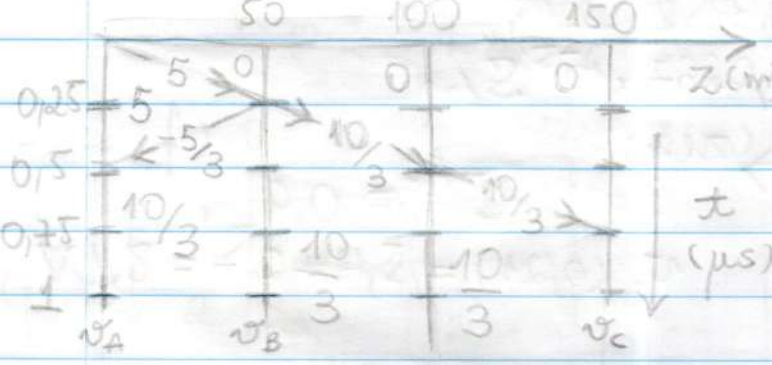


$\tau = 150\ ns$

e) $v_2 = 10\,\frac{75}{75+75} = 5\ V$

9) a) $\rho_{d1} = \frac{25-50}{25+50} = -\frac{1}{3} \qquad B_{d1} = B_{d2} = 0,25\mu s$

$B_{d3} = 0,5\ \mu s \qquad v_0^+ = \frac{10}{2} = 5V$



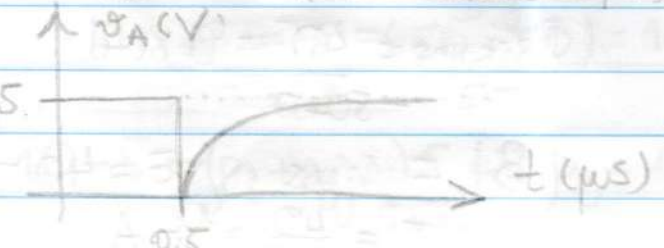
b) $L = \frac{Z_0}{v} = 250\ \frac{nH}{m}$

$$C = \frac{1}{Z_0 v} = 0,1\ \frac{nF}{m}$$

d) $V_B(s) = \frac{5}{s} e^{-0,25s}(1+\rho_B(s)) = \frac{5}{s} e^{-0,25s}\left[1 - \frac{s}{s+4}\right]$

$v_B(t) = 5\,H(t-0,25)\left[1 - e^{-4t+1}\right] V, \quad \tau = 0,25$ → μ em segundos

$v_A(t) = 5\,H(t) - 5\,H(t-0,5)\,e^{-4t+2}\ V$



e) $W_T = W_e + W_e$

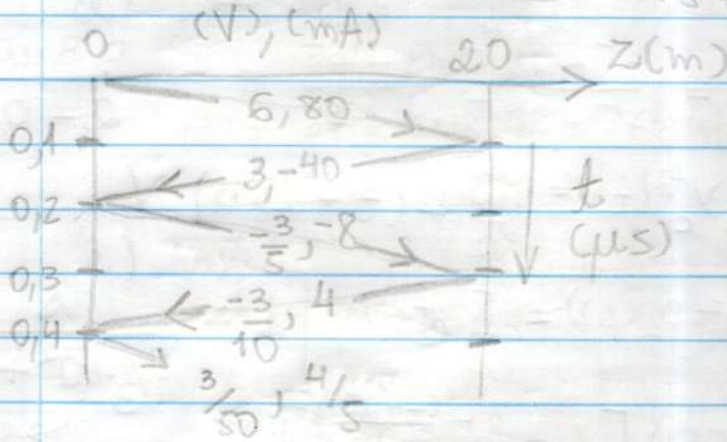
$$= \frac{100}{2} n\left[250\left(\frac{10}{150}\right)^2 + 0,1,5^2\right]$$

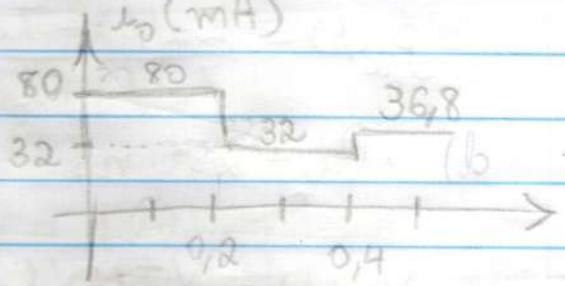
$$+ \frac{10}{2} n5^2 = 0,375\ \mu J$$

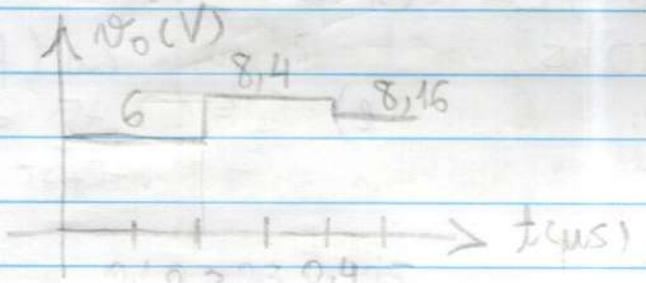
(12)

10) a) $\rho_g = \frac{50-75}{50+75} = -\frac{1}{5}$ $\rho_b = \frac{225-75}{225+75} = \frac{1}{2}$

b) $BL = 0,1\,\mu s$ $E = \frac{10 \cdot 75}{75+50} = 6V$ $I = \frac{10-6}{50} = 80mA$







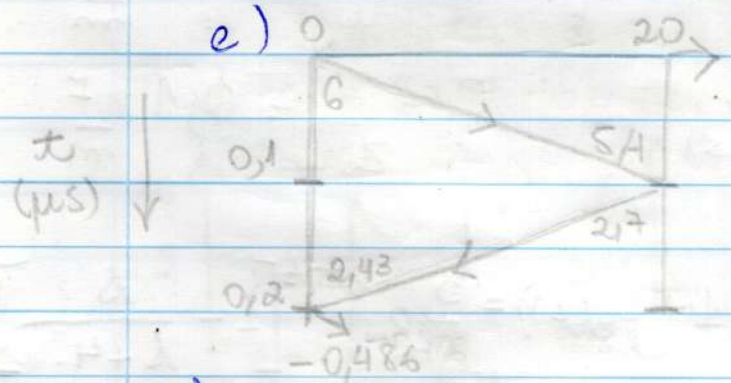
c) Em 0,16 μs, a primeira onda refletida (3V) já está em 20-6.2 = 8 metros (depois de 10m). Então: $v_{10}(0,16) = 6+3 = 9V$

d) $Z_0(s) = \sqrt{\frac{L}{C}}$ $\gamma(s) = \frac{R}{Z_0} + s\sqrt{LC} = GZ_0 + s\sqrt{LC}$ $= A + sB$

$R = 0,00527 \times 75 = 0,39525\,\Omega/m$

$G = 0,00527 \div 75 = 7,0267 \times 10^{-5}\,S/m$

e)

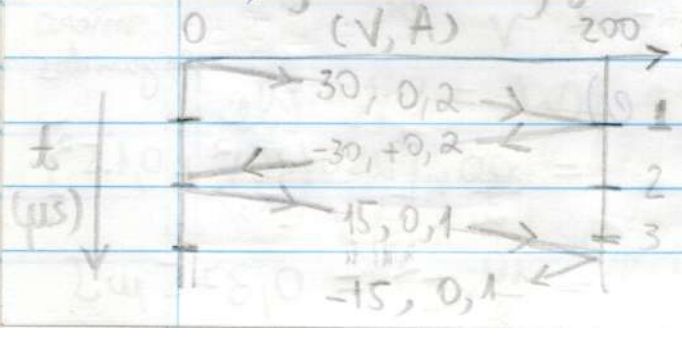


$e^{-A\Delta} = 0,9$

$v_{20}(0,21) = 5,4 + 2,7 = 8,1V$

$v_0(0,21) = 6 + 2,43 - 0,486 = 7,944V$

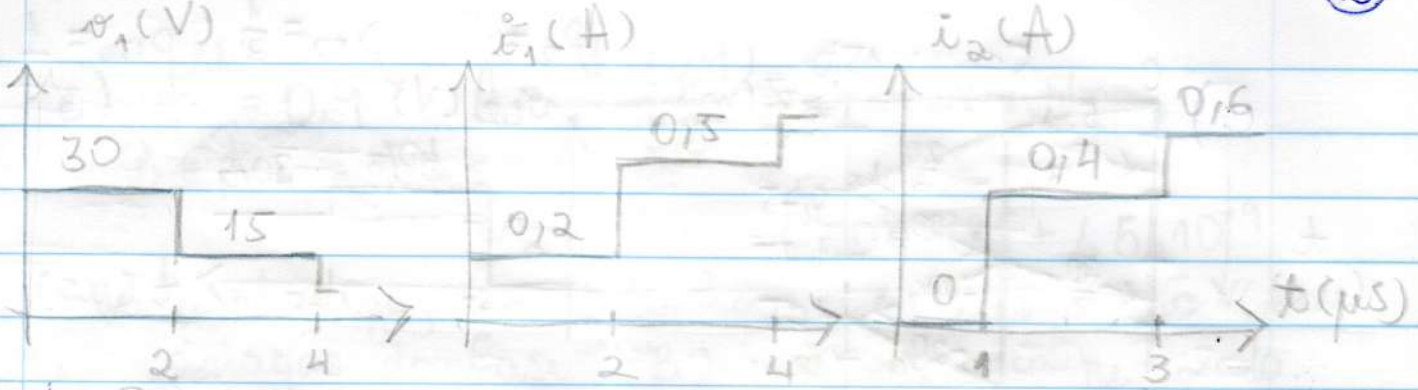
11) $\rho_0 = -1/2$ $\rho_b = -1$ $V_{REGIME} = \frac{40 \times 0}{50+0} = 0V$



$i_{REGIME} = \frac{40}{50+0} = 0,8A$

$BL = 1\,\mu s$ $E = 40\frac{150}{200} = 30V$

$I = \frac{40}{200} = 1/5\,A$



b) Para defeitos tipo curto ou aberto, a reflexão é total ($|\rho|=1$), com valores finais de (com $\rho_0=-1/2$):
curto: $E_{1^a\ MUDANÇA} = E/2$, aberto: $E_{1^a\ MUDANÇA} = E \times 2,5$
Com tal mudança ocorrendo na posição $\frac{t}{2}u$, onde u é a velocidade de propagação e t é o tempo de leitura para ocorrer tal variação.

c) $L = \frac{Z_0}{u} = 750\ nH/m$ $\quad C = \frac{1}{Z_0 u} = 100\ pF/m$

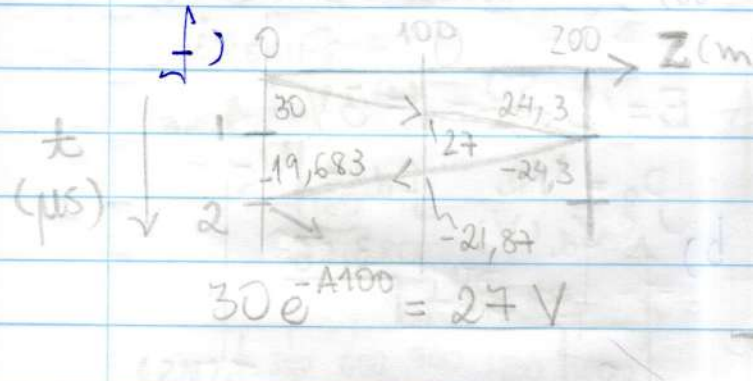
d) $u^2 = \frac{1}{\epsilon\mu} = c^2\left(\frac{2}{3}\right)^2 = \frac{1}{\epsilon_0\mu_0}\left(\frac{2}{3}\right)^2 \Rightarrow \frac{1}{\epsilon} = \frac{1}{\epsilon_0}\frac{4}{9}$

$\epsilon = \epsilon_0 \times 2,25 = 19,92\ pF/m$

e) tensão de regime = 0V $\Rightarrow$ apenas energia magnética

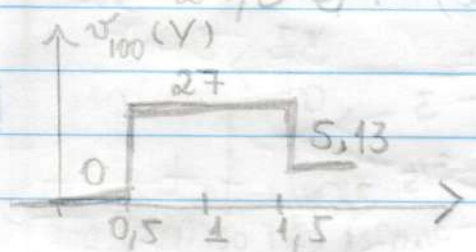
$W_m = \frac{1}{2} L i_R^2 = 48\ \mu J$

f)



$e^{-A100} = \sqrt{e^{-A200}} = 0,9$

$-24,3\ e^{-A100} = -21,87\ V$



12) a) $2Bd = 500\ n = \frac{2d}{2\cdot10^8} \Rightarrow d = 50\ m$

$10\ V = V_{REGIME} \Rightarrow \rho_g = 0 \quad \rho_g = 0 = \frac{R_g - 50}{50+50} \Leftrightarrow R_g = 50\Omega$

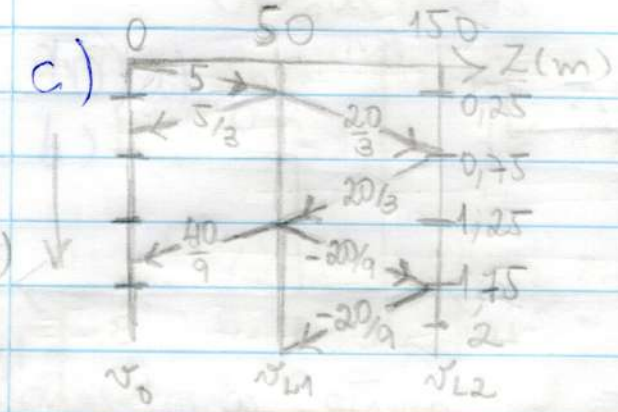
b) $V_0 = 5 \cdot \frac{(50+50)}{50} = 10V$

$10 + \bar{5} = (\rho_L + \rho_0\rho_g)5 \Rightarrow \rho_L = 1 = \frac{Z_L - 50}{Z_L + 50} \Rightarrow Z_L \to \infty$

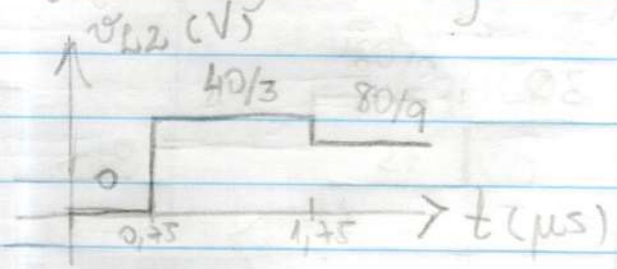
$\rho_g \to 0$

(14)

c)

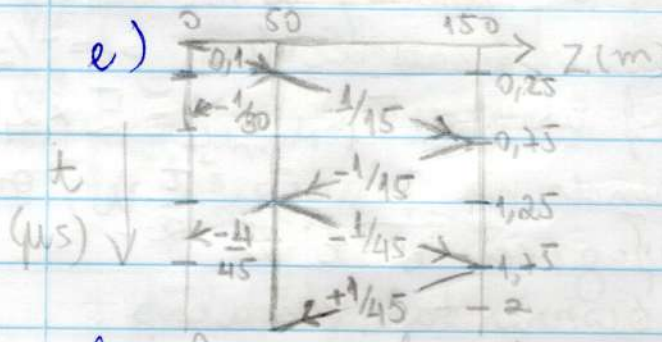


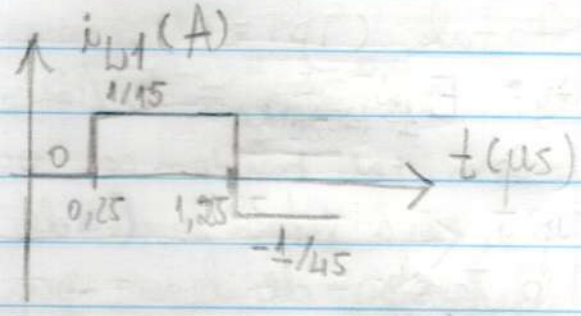
$\rho_0 = 0 \quad \rho_{50} = \frac{1}{3} \quad \rho_{150} = 1$



d) $v_{REGIME} = 10\ V$ (v_{L2} aberto)

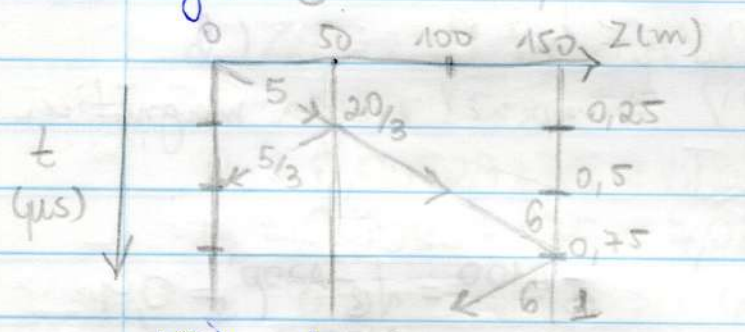
e)

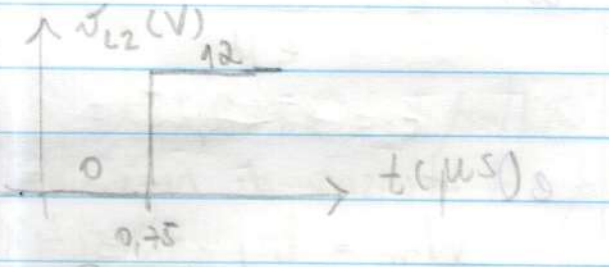




f) São aquelas de Z_0 real, que transportam determinada informação atenuando-a, mas sem mudar sua forma.

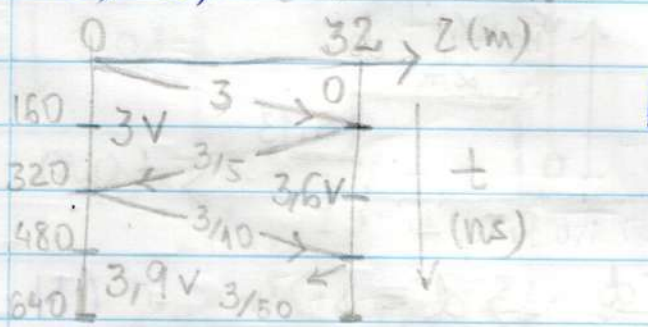
g) $e^{-100A} = 0,9$





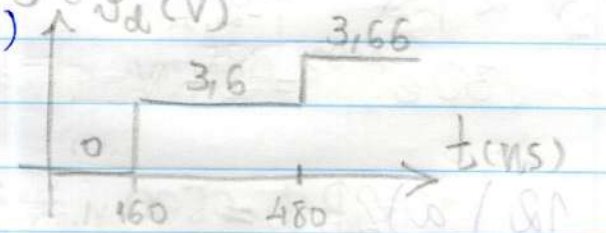
h) $R = A Z_0 = 0,1\ \Omega/m$

13) a) $Bd = 160\ ns \quad E = 12 \frac{50}{50+150} = 3V$

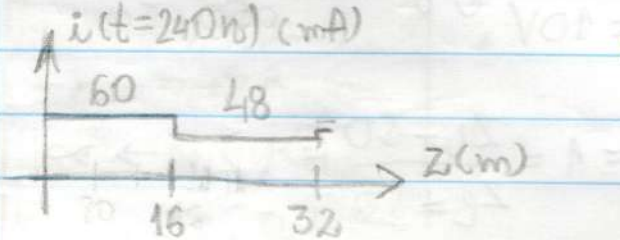


$\rho_g = 1/2 \quad \rho_d = 1/5$

b)



c) $I_0 = 12/200 = 60mA \quad I_1 = -12mA \quad d_1 = (240-160)ns \times u = 16m$



d) $v_{REGIME} = 12 \cdot \frac{75}{150+75} = 4V$

$i_{REGIME} = \frac{12}{150+75} = \frac{4}{75}\ A$

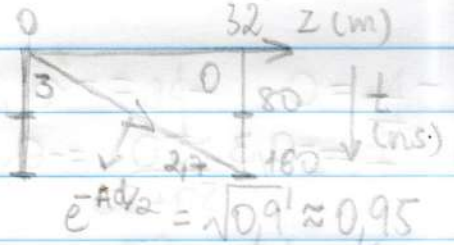
e) $e^{-Al} = 0,9 \quad A = \frac{\ln(0,9)}{-32} = 3,2925\ m\frac{Np}{m}$

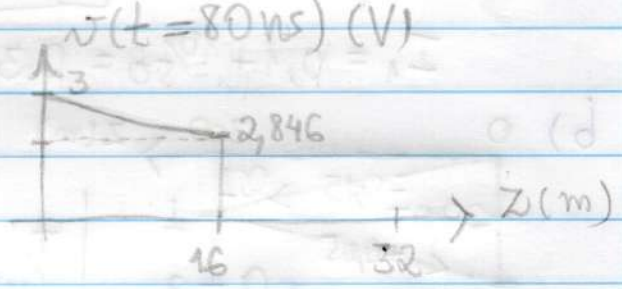
$B = 1/v = 5\ \frac{ns}{m} \qquad \gamma(s) = 0,0032925 + s\,5\cdot10^{-9}$

Qual rege, numa linha, sua atenuação (A) e variação de fase (B) no percurso realizado.

Um B dependente de s significaria que, nas perdas, R/L e G/C não seriam comparáveis, e que a linha teria distorção das informações e $Im\{Z_0\} \neq 0$.

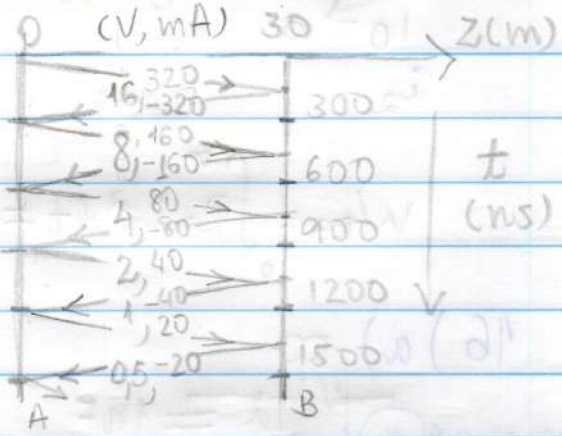
f)





14) a) $E = \frac{64}{4} = 16V$

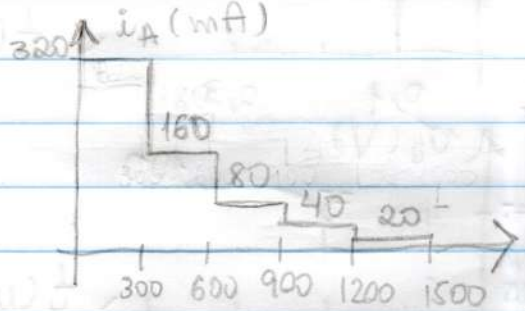
$I = \frac{64}{200} = 320mA$

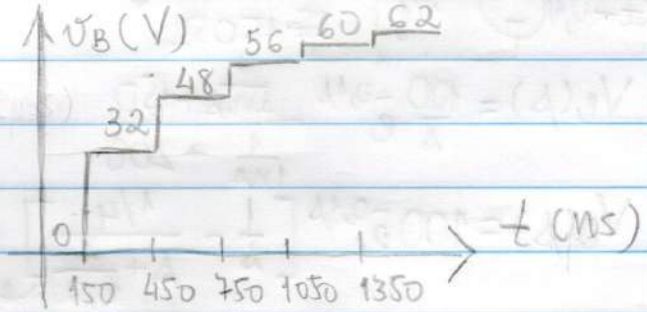


$B_L = 150\ ns \quad \rho_0 = 1/2 \quad \rho_L = 1$

$v_{REGIME} = 64\ V$

$i_{REGIME} = 0$





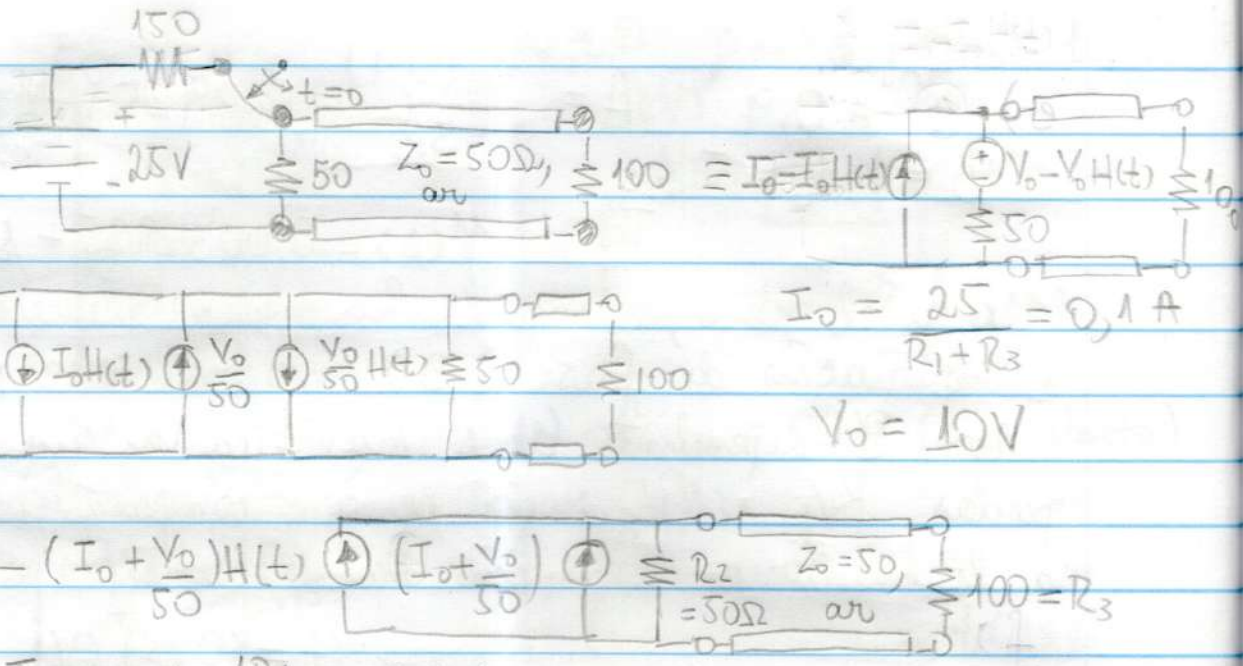
b) $L = \frac{50}{2\cdot10^8} = 250\ \frac{nH}{m} \qquad C = \frac{1}{50\cdot2\cdot10^8} = 0,1\ \frac{nF}{m} \qquad \epsilon = 2,25\epsilon_0 = 19,92\ \frac{pF}{m}$

c) $\frac{64}{100+J50} = 0,4267 + A$

d) $W = \frac{l}{2} C v_R^2 = \frac{30}{2}(0,1n)64^2 = 6,144\ \mu J$

(16)

15) a)

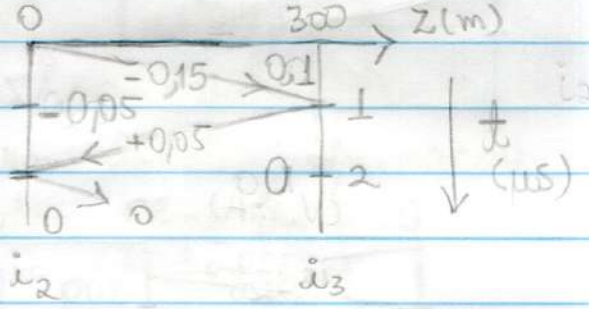


$I_0 = \frac{25}{R_1 + R_3} = 0,1\ A$

$V_0 = 10V$

$I_1 = 0,1 + 10/50 = 0,3\ A$

b)



$-I_0 = 0$ $-I_2 = -1/3$

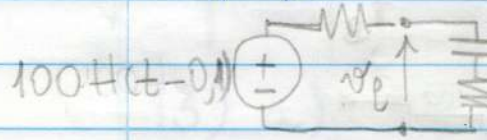
$I_2 = -0,3 \cdot \frac{50}{50+50} = -0,15\ A$

c) $W_{R2} = \int_0^\infty R_2 i_2^2 dt = 50(-0,05)^2 \times 2 \times 10^{-6} =$

$W_{R2} = 0,25\ \mu J$

$W_{R3} = \int_0^\infty R_3 i_3^2 dt = 100 \cdot 0,1^2 \cdot 10^{-6} = 1\ \mu J$

16) a) 50

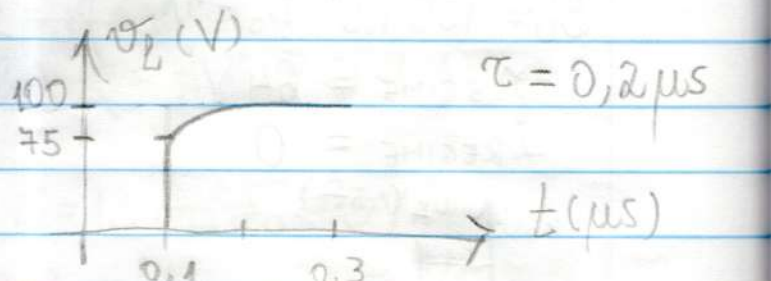


$V_e(s) = \frac{100}{s} e^{-0,1s} \frac{\frac{1}{1ns} + 150}{\frac{1}{1ns} + 200}$

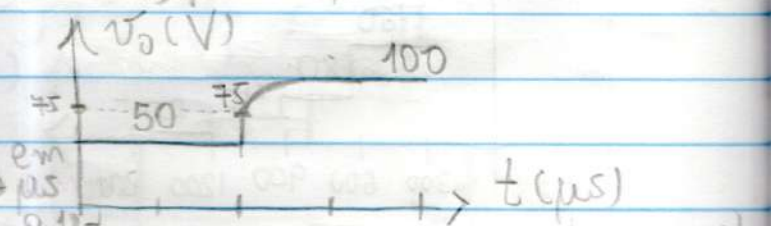
$V_e(s) = 100 e^{-0,1s} \left[\frac{1}{s} - \frac{1/4}{s + \frac{1}{0,2}} \right]$

$v_e(t) = 25 H(t-0,1)[1 - e^{-\frac{(t-0,1)}{0,2}}]$

$v_0(t) = 50H(t) + 25H(t-0,2)[2 - e^{-\frac{(t-0,2)}{0,2}}]$



$\tau = 0,2\ \mu s$



$v_{REGIME} = 100V$ (capacitor aberto)

b) $W = W_e + W_c = 15\ \mu J$

c) $v_0(t) = 50H(t) + 375H(t-0,2)[2 - \exp(-\frac{(t-0,2)}{0,2})]$

d) $I = \frac{(\frac{100}{50}) \cdot 50}{50+50} = 1A$