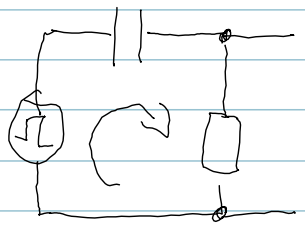
1) CR ili RC

$U_{12} = 0$

$\tau \ll T$



2)

3) a) $n - p = N_D - N_A$

$n + N_A^- = p + N_D^+$!

$n - p = N_D^+ - N_A^-$

$n \cdot p = n_i^2$

4) $j = S \cdot \underbrace{q(n^{n_i} \mu_n + p^{n_i} \mu_p)}_{\sigma} \cdot E =$

$= q \cdot S \, n_i \, (\mu_n + \mu_p) \, E$

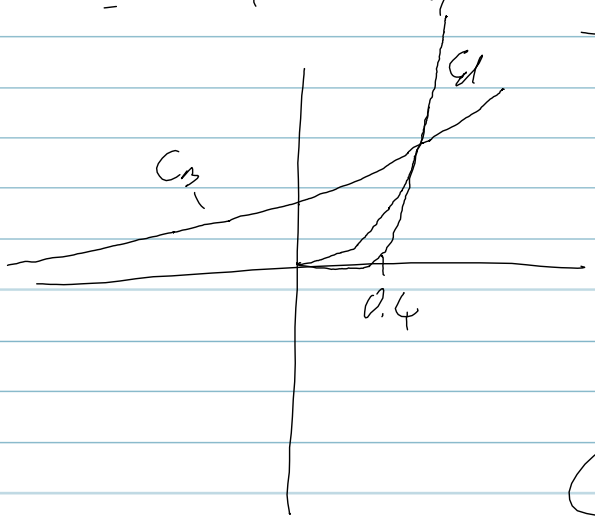
$n_i \uparrow \quad \mu \downarrow$ spero

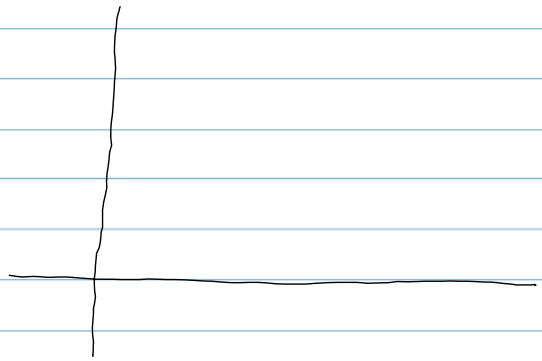
C

5) $U_V = 0.7\ V$

$\Delta V = 100\ mV$

$C_- = 54.6 \cdot C_1$





$C_B = \varepsilon_0 \varepsilon' \frac{S}{d_B} \sim \frac{1}{\sqrt{U_K - V}}$

$d_B = \sqrt{\quad} \cdot \sqrt{U_K - V}$

C

6) $I_s = q \cdot S \cdot \left(\frac{n_{0p} \cdot D_n}{L_n} + \frac{p_{0n} \cdot D_p}{L_p} \right)$

$W_p \qquad W_n$

$$\frac{I_{sn}}{I_{sp}} = \frac{\frac{n_{0p} D_n}{W_p}}{\frac{p_{0n} \cdot D_p}{W_n}} \simeq \frac{n_{0p} D_n W_n}{p_{0n} D_p W_p} = \frac{n_i^2 W_D}{N_A n_i^2} \frac{U_T \mu_n W_n}{U_T \mu_p 2 W_p} \quad (3 W_p)$$

$$\simeq \frac{3}{20}$$

D

7) FOTONIZ = ZA PORNA POL

LED = PROPUSNA POL.

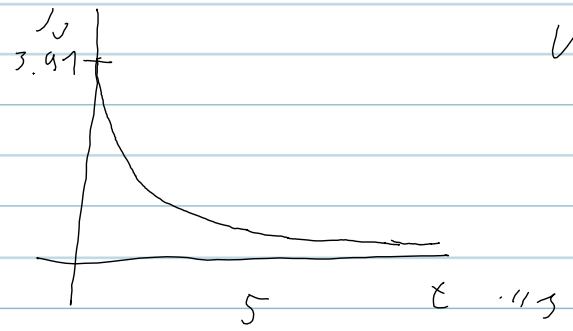
$E = \frac{1.24}{\lambda}$ $\qquad$ E [eV]

λ [μm]

$\lambda = \frac{1.24}{2} = 0.62 \mu m$ $\qquad$ D

8) NIEMA

ZAD 1.



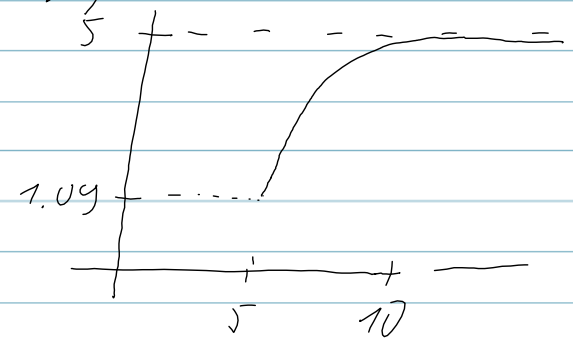
$$V_{12} = V_0 \cdot e^{-t/\tau}$$

$$V_5 = V_{12}(5\,ms) = 3.91 \cdot e^{-\frac{5}{\tau}}$$

$$\tau = 3.9 \; ms$$

1.1) C 1.2) D

1.3)

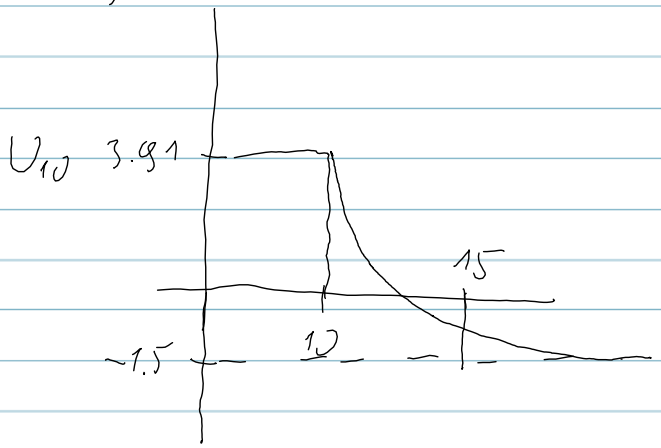


$$V_{12} = V_5 + (5 - V_5) \cdot (1 - e^{-}$$

$$= V.$$

(C)

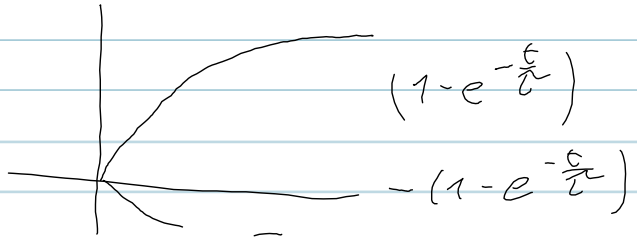
1.4)



$$V_{12} = V_{10} - (\underbrace{1.5 + V_{10}}_{5.41}) \cdot (1 - e^{-\frac{t-10}{\tau}}$$

$$V_{12} = V_{10} + (-1.5 - V_{10})(1 - e^{-\frac{t-}{\tau}}$$

(A)



1.5) D

ZAD 2.

1.1) $T = 250\,^{\circ}C = 273 + 250 = 523\ K$

$n_i = 6.37 \cdot 10^{14}\ cm^{-3}$ c)

1.2) $N_A = 1.5 \cdot 10^{15}\ cm^{-3}$

p - šup. => VIĚC. NOS.

n_i

$$p = \frac{N_A + \sqrt{N_A^2 + 4n_i^2}}{2} = 1.735 \cdot 10^{15}$$

$$p = n_i \exp\left(\frac{E_{Fi} - E_i}{E_T}\right)$$

$$E_{Fi} - E_i = E_T \ln\frac{p}{n_i} = \frac{523}{1160} \cdot \ln\frac{p}{n_i}$$

$E_{Fi} - E_i = 0.045\ eV$ (D)

2.3) n - typ

$N_{D\,netto} = N_D - N_A = 5 \cdot 10^{14}\ cm^{-3}$

$$n = \frac{N_{D\,netto} + \sqrt{N_{D\,netto}^2 + 4n_i^2}}{2} = 4.35 \cdot 10^{14}\ cm^{-3}$$

$$p = \frac{n_i^2}{n} = 4.35 \cdot 10^{14}\ cm^{-3}$$ (E)

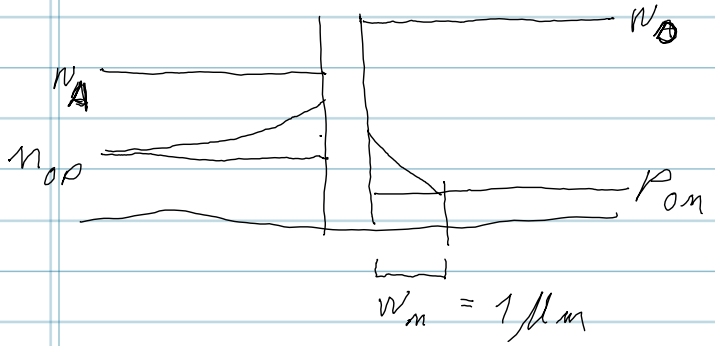
2.4) $E_{Fi} - E_i = E_T \ln\frac{p}{n_i} = -0.017\ eV$ (D)

2.5) $R = \rho\frac{L}{S} = \frac{1}{\sigma} \cdot \frac{L}{S} = \frac{1}{0.2} \cdot \frac{10 \cdot 10^{-4}}{0.1 \cdot 10^{-2}} = 5\ \Omega$

(E)

ZAD 3

3.1) $N_A = 10^{15}\ cm^{-3}$ $N_D = 10^{17}\ cm^{-3}$



$W_p >> L_s$

$$I_S = q \cdot S \left(\frac{n_{0p} \cdot D_n}{L_n} + \frac{p_{0n} \cdot D_p}{W_n} \right)$$

$$I_{Sn} = q S \frac{n_{0p} \cdot D_n}{L_n} = q S \frac{n_i^2 \mu_n \cdot U_T}{N_A \sqrt{\tau_n \cdot \mu_n \cdot U_T}} = 2.23 \cdot 10^{-14}\ A$$

(5)

3.2)

3.3) $I = I_S \left(e^{\frac{U}{U_T}} - 1 \right)$

$$U = U_T \ln \left(\frac{I}{I_S} + 1 \right) =$$

3.4) $p_{n0} = p_{0n} \exp\left(\frac{U}{U_T} \right) = \frac{n_i^2}{N_D} \cdot \exp\left(\frac{U}{U_T} \right)$

3.5) $I = 5\ mA$

$$r_d = \frac{U_T}{I} = \frac{25 \cdot 10^{-3}}{5 \cdot 10^{-3}} = 5\ \Omega \qquad A$$

2) 3) $\sigma_1 = \sigma_n = q\left(n\mu_n + \cancel{p\mu_p}\right)$

$= q\mu_n N_D$

$\sigma_2 = q\left(\cancel{n\mu_n} + p\mu_p\right) = q\left(N_A - N_D\right)\mu_p$

4) $\sigma = q\left(\underset{n_i}{n}\mu_n + \underset{n_i}{p}\mu_p\right)$

$= q n_i \left(\mu_n + \mu_p\right)$

5) $\frac{I_{sn}}{I_{sp}} = \frac{\frac{n_{0p} \cdot D_n}{L_n}}{\frac{p_{0n} \cdot D_p}{L_p}} = \frac{n_{0p} D_n L_p}{p_{0n} D_p L_n}$

$= \frac{\sqrt{D_n}\ \sqrt{\cancel{\tau_p}\,\tau_p}}{\sqrt{\tau_n \cancel{\tau_n}}\ \sqrt{D_p}}$

6)

7)

8)