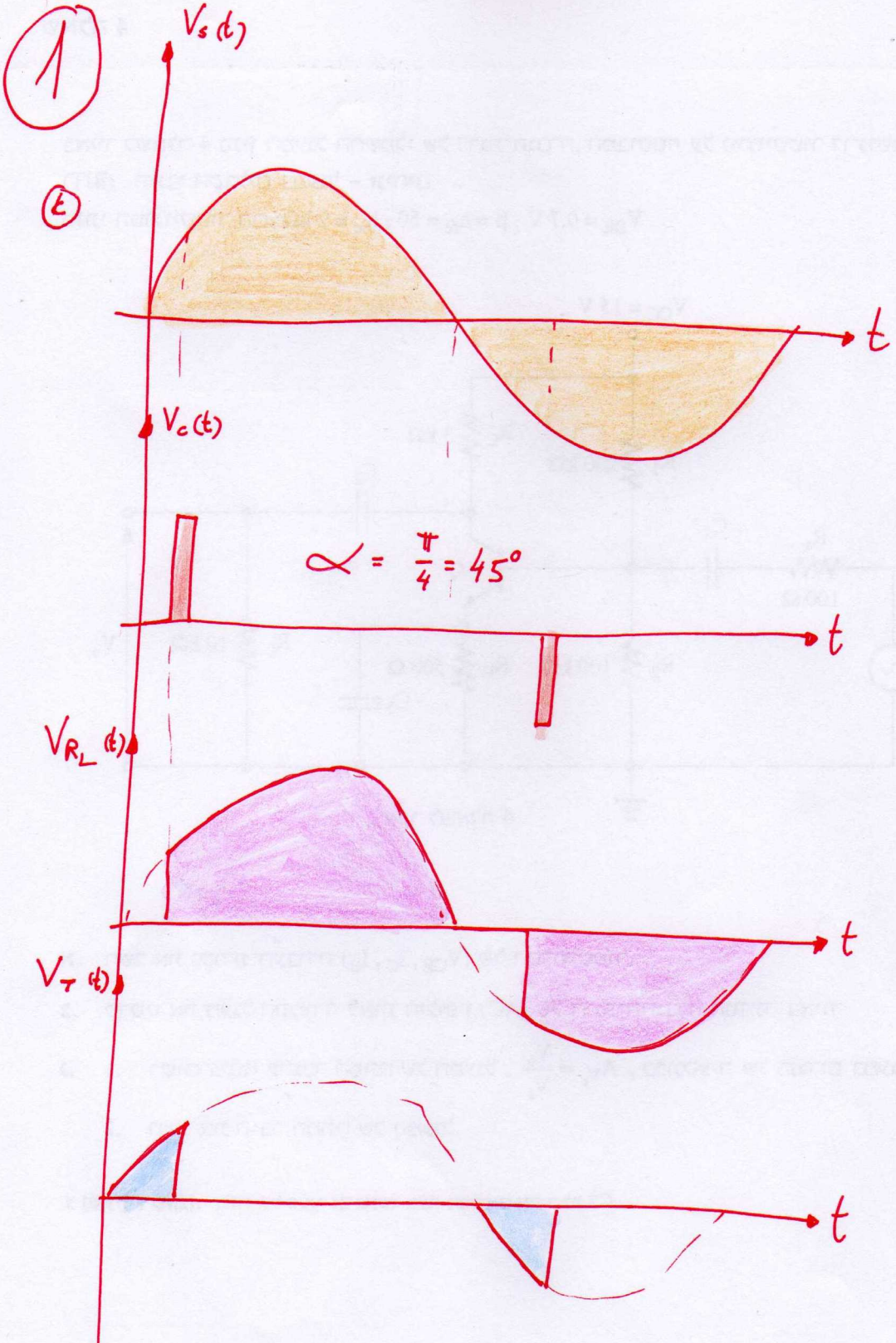

1
$V_s(t)$
t
$V_c(t)$
$\alpha = \frac{\pi}{4} = 45°$
t
$V_{R_L}(t)$
t
$V_T(t)$
t

② $U_{R_L} = \frac{U_{max}}{\sqrt{2}} \cdot \sqrt{\frac{1}{\pi}\left(\pi - \alpha + \frac{\sin 2\alpha}{2}\right)} =$

$= \frac{220\sqrt{2}}{\sqrt{2}} \cdot \sqrt{\frac{1}{\pi}\left(\pi - \frac{\pi}{4} + \frac{\sin\frac{\pi}{2}}{2}\right)} =$

$= 220\sqrt{\frac{1}{\pi}\left(\frac{3\pi}{4} + \frac{1}{2}\right)} = 209.77V$

! RAD p3N

$$P_{R_L} = \frac{U_{R_L}^2}{R_L} = \frac{209.77^2}{100} = 440W_{//}$$

ג)

$$P_{R_L} = 98 = \frac{U_{R_L}^2}{100}$$

$$U_{R_L} = 98.995V$$

$$\Downarrow$$

$$\frac{U_{R_L}}{U_s} = \frac{98.995}{220} = 0.45 = \frac{V_L}{V_{in}}$$

לפי הסתכלות בגרף זווית ההצתה צריכה להיות קצת יותר קטנה מ- 120°. נניח ש- $\alpha = 115^\circ$ ונבדוק האם צדק:

$$\alpha = 115^\circ = 2[rad]$$

$$\Downarrow$$

$$U_{R_L} = \frac{U_{max}}{\sqrt{2}} \sqrt{\frac{1}{\pi}\left(\pi - \alpha + \frac{\sin 2\alpha}{2}\right)} = \frac{220\sqrt{2}}{\sqrt{2}} \sqrt{\frac{1}{\pi}\left(\pi - 2 + \frac{\sin 4}{2}\right)} =$$

$$= 220 \sqrt{\frac{1}{\pi}\left(\pi - 2 + \frac{\sin 4}{2}\right)} = 108.433V$$

U_{R_L} יצא יותר גבוה מהנדרש, ולכן צריך לקחת זווית α יותר קטנה...

(2)

(a)

$R_{BB} = 50k\Omega$

$V_{BB} = 6V$

$\Downarrow$

$V_{BB} = I_B \cdot R_{BB} + V_{BE} + I_B(\beta+1)R_3$

$6 = 50I_B + 0.6 + 101 \cdot 3 I_B$

$I_B = 15.297 \cdot 10^{-3} mA \quad (= 15.297 \mu A)$

$\Downarrow$

$I_C = \beta I_B = 1.529 mA$

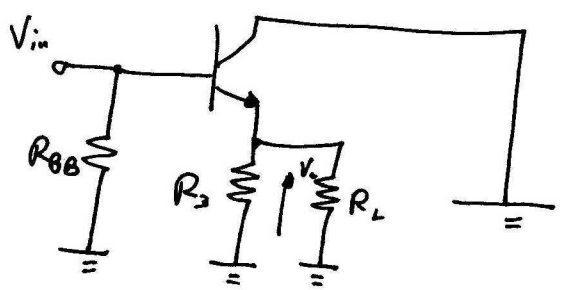
$\Downarrow$

$V_{CC} = V_{CE} + I_E \cdot R_3$

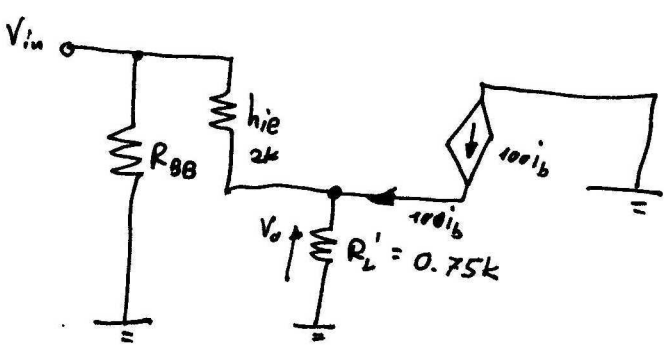
$12 = V_{CE} + 1.545 \cdot 3$

$V_{CE} = 7.364V$

(b)



$\Downarrow$



② $V_o = 101 i_b \cdot R_L' = 75.75 i_b$

$V_{in} = hie\, i_b + 101 i_b \cdot R_L' = 2 i_b + 75.75 i_b = 77.75 i_b$

$$\Downarrow$$

$$A_V = \frac{V_o}{V_{in}} = \frac{75.75 i_b}{77.75 i_b} = 0.974 //$$

③ $R_{in} = R_{BB} \,//\, \left[hie + (h_{fe}+1) R_L' \right] =$

$= 50 \,//\, 77.75 = 30.43 k\Omega //$

③ $V_{in\,max} = 0.5V$

$V_{o\,max} = 6V$

$\Rightarrow |A_v| = \frac{V_{o\,max}}{V_{in\,max}} = 12$

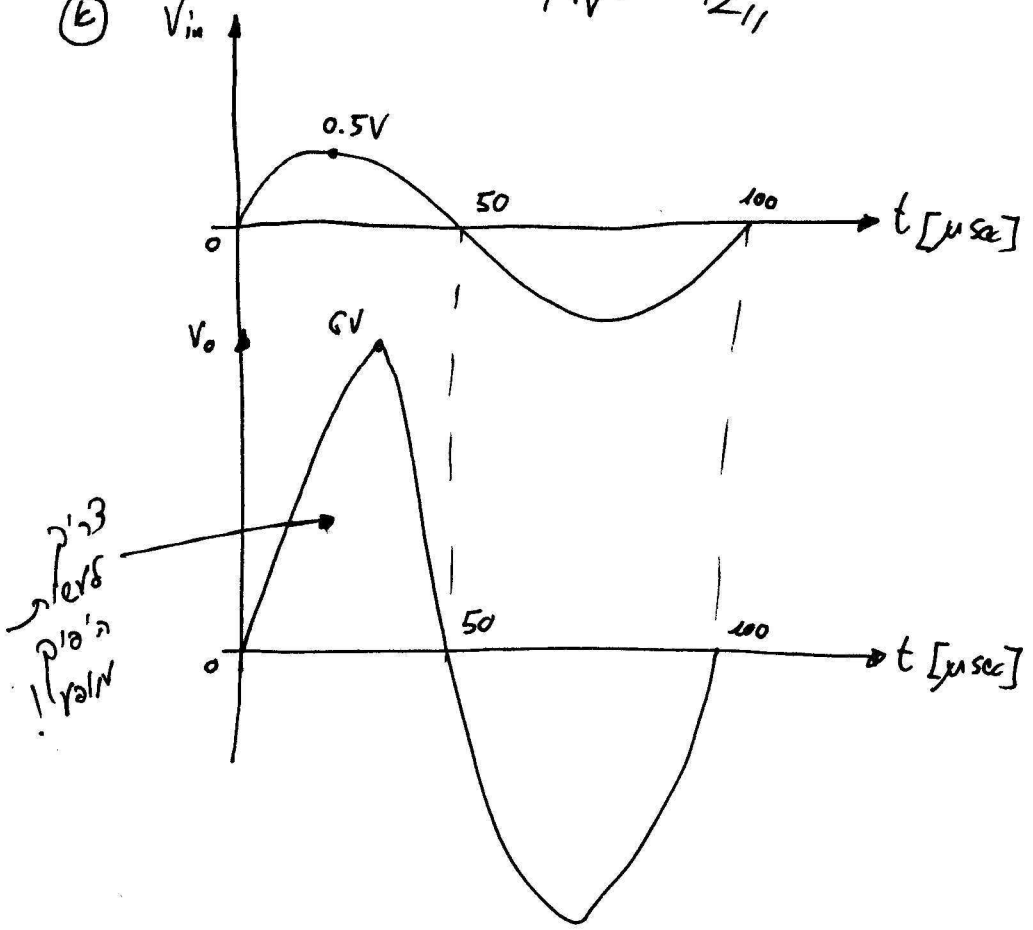
$A_v = -12$

$f = 10kHz$

$\Downarrow$

$T = 100\mu sec$

ⓔ



ⓑ A_1 - מגבר הפוך פאזה, A_2 - מגבר הופך מוצא.

ⓒ

$|A_v| = 12$

$A_{v[dB]} = 20\log 12 = 21.583dB$

ⓓ $A_v = -\frac{R_2}{R_1}$

$-12 = -\frac{R_2}{R_1}$

$R_2 = 24k\Omega$

4

(א)

$V_x = \frac{30}{2} = 15V$

$V_y = V_x = 15V$

$V_z = V_y = 15V$

$V_o = 0V$

[DC]

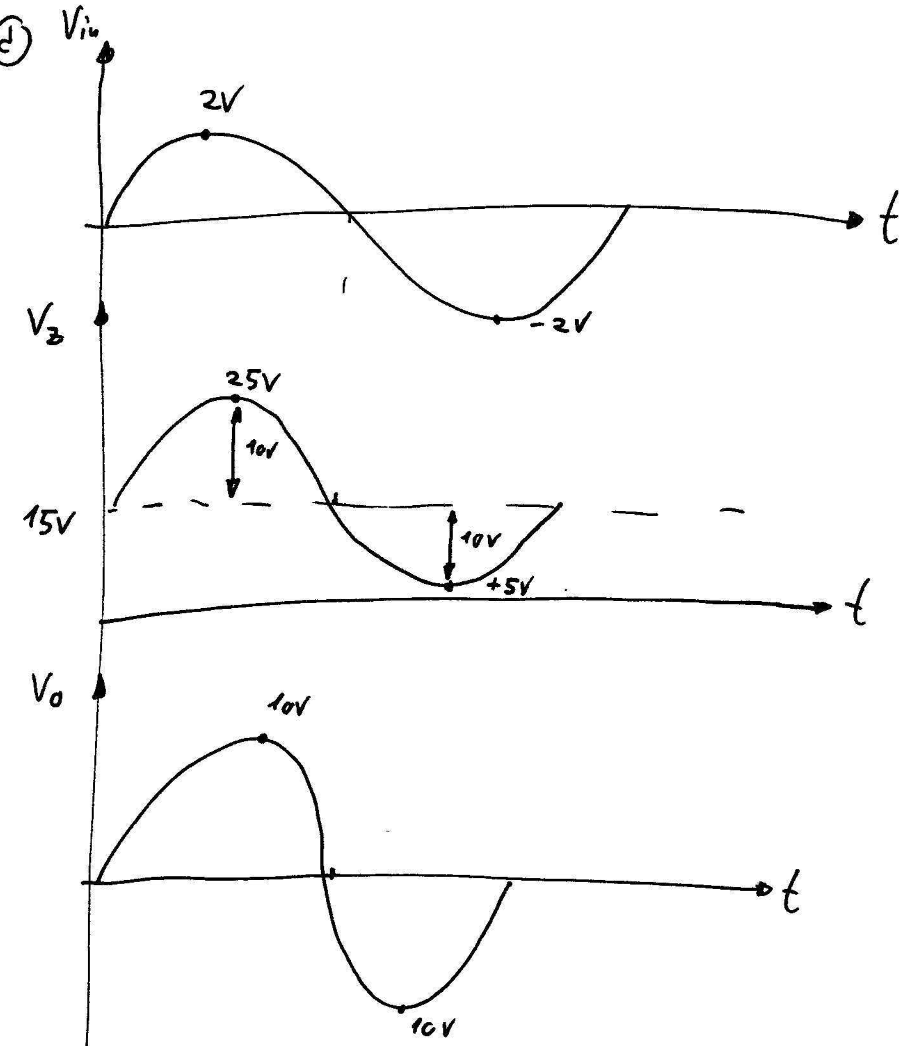
(ב)

$$V_z = V_o = \left(1 + \frac{R_2}{R_1}\right)V_s = \left(1 + \frac{20}{5}\right)V_s = 5V_s$$

$$\Downarrow$$

$$A_v = 5$$

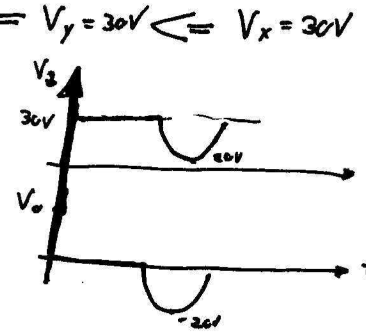
(ג)



(ד) אם R_3 מקוצר, אזי: $V_z = 30V \Leftarrow V_y = 30V \Leftarrow V_x = 30V$

$\Downarrow$

$V_o = 0V$ ללא שינוי



5

א) $j5\Omega \le X_L \le j15\Omega \Rightarrow 5-j5 \le Z_T \le 5+j5$

$7.07\angle{-45^\circ}\,\Omega \le Z_T \le 7.07\angle{45^\circ}\,\Omega$

$\Downarrow$

$5mH \le L \le 15mH$

ב) I_{max} מתקבל עבור תדר תהודה $\Leftarrow$ להי מעגל טורי

$\Downarrow$

אם המעגל בתהודה, אזי הפרש המופע בין המתח לזרם שווה ל-אפס!

$\Downarrow$

$X_L = X_c = 10\Omega$

$\omega L = 10$

$1000L = 10$

$L = 10mH$

ג) $U_{max} = 10V \Rightarrow U = \frac{U_{max}}{\sqrt{2}} = \frac{10}{2} = 7.07V$

$P = \frac{U^2}{R} = \frac{7.07^2}{5} = 10W$

(6)

ⓑ $\underline{I}_{R_2} = \frac{\underline{U}_{MN}}{R_2 + \underline{X}_{L_2}} = \frac{20\angle 0}{2+j6} = 3.162\angle -71.56^\circ A$ //

ⓒ $\underline{Z}_T = \left[(R_2 + \underline{X}_{L_2}) \parallel \underline{X}_C\right] + R_1 + \underline{X}_{L_1} =$

$= \left[(2+j6) \parallel (-j4)\right] + 2 + j6 =$

$= [4-j8] + 2 + j6 =$

$= (6-j2)\,\Omega = 6.324\angle -18.43^\circ\,\Omega$ //

ⓓ $\varphi = -18.43^\circ < 0$

קיבולי!

ⓐ $\underline{I}_T = \frac{\underline{U}_{MN}}{(R_2 + \underline{X}_{L_2}) \parallel \underline{X}_C} = \frac{20\angle 0}{4-j8} = 2.236\angle 63.43^\circ A$

$\underline{U}_S = \underline{I}_T \cdot \underline{Z}_T = 14.14\angle 45^\circ V$ //

(8)

$$
\begin{cases}
+R_{11} I_1' - R_{12} I_2' - R_{13} I_3' = E_1' \\
-R_{21} I_1' + R_{22} I_2' - R_{23} I_3' = E_2' \\
-R_{31} I_1' - R_{32} I_2' + R_{33} I_3' = E_3'
\end{cases}
$$

$$
\begin{aligned}
&+40 I_1' - 40 I_2' - 0 I_3' = 120 \\
&-40 I_1' + 120 I_2' - 20 I_3' = 0 \\
&-0 I_1' - 20 I_2' + 50 I_3' = 0
\end{aligned}
\Longrightarrow
\begin{aligned}
I_1' &= 4.666\,mA \\
I_2' &= 1.666\,mA \\
I_3' &= 0.666\,mA
\end{aligned}
$$

$\Downarrow$

(e) $I_T = I_1' = 4.666\,mA$,

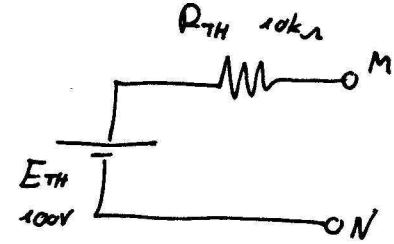
$I_3 = I_2' = 1.666\,mA$,

$I = I_1' - I_2' = 3\,mA$,

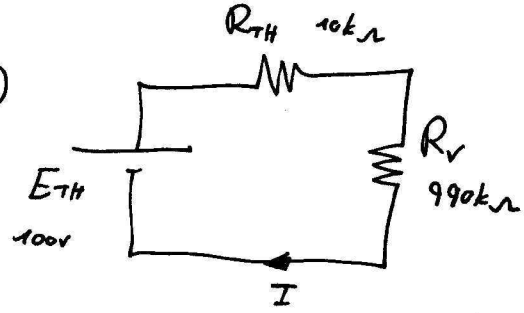
(f) $E_{TH} = U_{MN_0} = U_{R_3} = I_3 \cdot R_3 = 100V$

$R_{TH} = R_1 \| R_2 \| R_3 = 30 \| 20 \| 60 = 10\,k\Omega$

$\Longrightarrow$



(g)



$$I = \frac{E_{TH}}{R_{TH} + R_V} = 0.1\,mA$$

$\Downarrow$

$U_V = I \cdot R_V = 99V$,