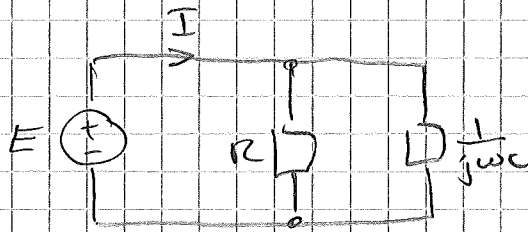


8.10)



$$R = 1,6 \text{ k}\Omega$$

$$C = 6,20 \text{ }\mu\text{F}$$

$$E = 35,6 e^{j(\omega t + 13,8^\circ)}$$

$$\omega = 80 \text{ rad/s}$$

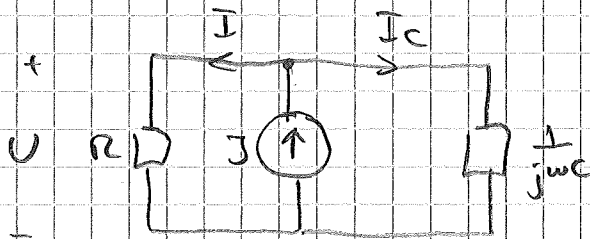
$$Z = R \parallel \frac{1}{j\omega C} = \frac{R \cdot \frac{1}{j\omega C}}{R + \frac{1}{j\omega C}} = \frac{R}{1 + j\omega RC} = \frac{1600}{1 + j0,794} =$$

$$= \frac{1600}{1,277 e^{j38,4^\circ}} = 1253 e^{-j38,4^\circ}$$

$$I = \frac{E}{Z} = \frac{35,6 e^{j(\omega t + 13,8^\circ)}}{1253 e^{-j38,4^\circ}} = 28,4 e^{j(\omega t + 52,2^\circ)} \text{ mA}$$

$$i(t) = 28,4 \sin(\omega t + 52,2^\circ) \text{ mA}$$

8.11)



$$\omega = 2\pi f = 800\pi$$

$$R = 100 \Omega$$

$$C = 2,00 \text{ }\mu\text{F}$$

$$I = 48,5 e^{j(\omega t + 23,0^\circ)} \text{ mA}$$

$$U = R \cdot I = 4,85 e^{j(\omega t + 23,0^\circ)} \text{ V}$$

$$I_C = \frac{U}{\frac{1}{j\omega C}} = j\omega C U = 5,027 \cdot 10^{-3} \cdot e^{j90^\circ} \cdot 4,85 e^{j(\omega t + 23,0^\circ)} =$$

$$= 24,38 e^{j(\omega t + 113,0^\circ)}$$

$$I = I + I_C = (48,5 e^{j23,0^\circ} + 24,38 e^{j113,0^\circ}) e^{j\omega t} =$$

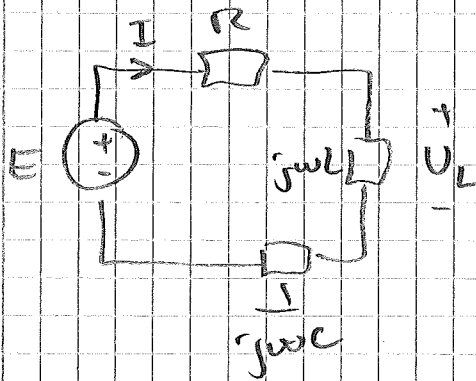
$$= (48,5 \cos 23,0^\circ + 24,38 \cos 113^\circ + j(48,5 \sin 23^\circ + 24,38 \sin 113,0^\circ)) e^{j\omega t}$$

$$= (35,12 + j41,39) e^{j\omega t} \text{ mA} = 54,28 e^{j49,68^\circ} e^{j\omega t} \text{ mA}$$

$$i(t) = 54,28 \sin(\omega t + 49,68^\circ) \text{ mA}$$

8.13

89



$$\omega = 2700 \text{ rad/s}$$

$$R = 120 \Omega$$

$$L = 0,55 \text{ mH}$$

$$C = 280 \text{ nF}$$

$$I = 12,8 e^{j(\omega t + 37,4^\circ)} \text{ mA}$$

$$U_L = j\omega L \cdot I = 1485 e^{j90^\circ} \cdot 12,8 \cdot 10^{-3} e^{j(\omega t + 37,4^\circ)} =$$

$$= 19,0 e^{j(\omega t + 127,4^\circ)} \text{ V}$$

$$\underline{u_L(t) = 19,0 \sin(\omega t + 127,4^\circ) \text{ V}}$$

$$E = I \cdot \left(R + j\omega L + \frac{1}{j\omega C} \right) = I \cdot \left(R + j(\omega L - \frac{1}{\omega C}) \right) =$$

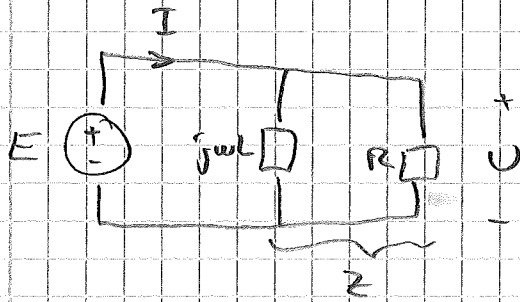
$$= I \cdot (120 + j(1485 - 1323)) = I (120 + j162) =$$

$$= 12,8 \cdot 10^{-3} e^{j(\omega t + 37,4^\circ)} \cdot 202 e^{j53,5^\circ} =$$

$$= 2,6 e^{j(\omega t + 90,9^\circ)} \text{ V}$$

$$e(t) = 2,6 \sin(\omega t + 90,9^\circ) \text{ V}$$

8.14/



$$I = 165 e^{j\omega t} \text{ A}$$

$$\omega = 700 \text{ rad/s}$$

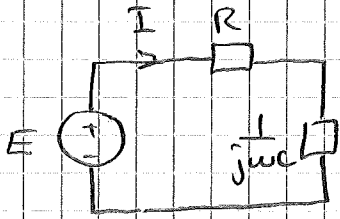
$$R = 180 \, \Omega \quad L = 215 \, \mu\text{H}$$

$$Z = R // j\omega L = \frac{R \cdot j\omega L}{R + j\omega L} = \frac{j27090}{180 + j150,5} = \frac{27090 e^{j90^\circ}}{234,6 e^{j39,90^\circ}} = 115,5 e^{j50,1^\circ} \, \Omega$$

$$U = Z \cdot I = 115,5 e^{j50,1^\circ} \cdot 0,165 e^{j\omega t} = 19,1 e^{j(\omega t + 50,1^\circ)} \text{ V}$$

$$u(t) = 19,1 \sin(\omega t + 50,1^\circ) \text{ V}$$

9.1



$$R = 390 \, \Omega$$

$$C = 4,7 \, \mu F$$

$$E = 325 e^{j\omega t} \, V \quad f = 50 \, Hz$$

$$a) \quad Z_{tot} = R + \frac{1}{j\omega c} = R - j \frac{1}{\omega c} = 390 - j 677,3 = 781,6 e^{-j60,07^\circ} \, \Omega$$

$$I = \frac{E}{Z_{tot}} = \frac{325 e^{j\omega t}}{781,6 e^{-j60,07^\circ}} = 0,416 e^{j(\omega t + 60,1^\circ)} \, A$$

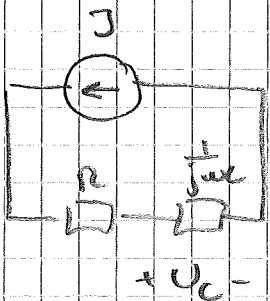
$$i(t) = 0,416 \sin(\omega t + 60,1^\circ) \, A \quad \omega = 100\pi \, rad/s$$

$$b) \quad \varphi = -60,07^\circ$$

$$P_{avg} = \frac{|E||I|}{\sqrt{2}\sqrt{2}} \cos \varphi = \frac{325 \cdot 0,416}{\sqrt{2} \sqrt{2}} \cdot \cos(-60,07^\circ) = 33,7 \, W$$

$$c) \quad P_R = R I_c^2 = R \frac{|I|^2}{2} = 390 \cdot \frac{0,416^2}{2} = 33,7 \, W$$

9.3



$$J = 5,60 \cdot 10^{-3} e^{j(\omega t - 74,6^\circ)} \, A$$

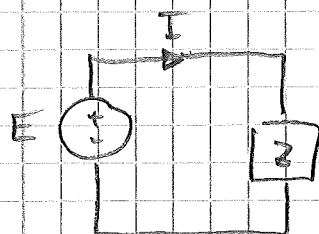
$$\omega = 1000 \, rad/s$$

$$R = 100 \, \Omega \quad C = 4,70 \, \mu F$$

$$U_C = J \cdot \frac{1}{j\omega c} = \frac{J}{j 4,7 \cdot 10^{-3}} = \frac{5,60 \cdot 10^{-3} e^{j(\omega t - 74,6^\circ)}}{4,7 \cdot 10^{-3} e^{j90^\circ}} = 1,19 e^{j(\omega t - 164,6^\circ)} \, V$$

$$u_c(t) = 1,19 \sin(\omega t - 164,6^\circ) \, V$$

9.4



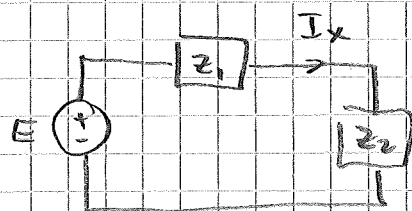
$$E = 5,60 e^{j(\omega t + 34,4^\circ)} \text{ V}$$

$$I = 0,355 e^{j(\omega t - 14,6^\circ)} \text{ A}$$

a) $Z = \frac{E}{I} = \frac{5,60 e^{j(\omega t + 34,4^\circ)}}{0,355 e^{j(\omega t - 14,6^\circ)}} = 15,77 e^{j(49^\circ)} \Omega$

b) $Z = 15,77 e^{j49^\circ} = 15,77 \cos 49^\circ + j 15,77 \sin 49^\circ =$
 $= 10,3 + j 11,9 \Omega = R + jX \quad \begin{cases} R = 10,3 \Omega \\ X = 11,9 \Omega \end{cases}$

9.6



$$E = 120 e^{j\omega t} \text{ V}$$

$$Z_1 = 5,00 \Omega$$

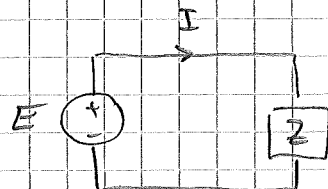
$$Z_2 = 3,86 e^{j72,8^\circ} \Omega$$

$$Z_{\text{tot}} = Z_1 + Z_2 = 5,00 + 3,86 \cos 72,8^\circ + j 3,86 \sin 72,8^\circ =$$

$$= 6,14 + j 3,69 \Omega = 7,163 e^{j31,0^\circ}$$

$$I_x = \frac{E}{Z_{\text{tot}}} = \frac{120 e^{j\omega t}}{7,163 e^{j31,0^\circ}} = 16,8 e^{j(\omega t - 31,0^\circ)} \text{ A}$$

9.8



$$E = 53,0 e^{j(\omega t + 27,5^\circ)} \text{ V}$$

$$I = 21,5 \cdot 10^{-3} e^{j(\omega t - 35,0^\circ)} \text{ A}$$

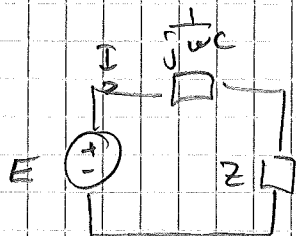
$$\omega = 2000 \text{ rad/s}$$

a) $Z = \frac{E}{I} = \frac{53,0 e^{j(\omega t + 27,5^\circ)}}{21,5 \cdot 10^{-3} e^{j(\omega t - 35,0^\circ)}} = 2465 e^{j62,5^\circ} \Omega$

b) $Z = 2465 \cos 62,5^\circ + j 2465 \sin 62,5^\circ = 1138 + j 2186 = R + j\omega L$
 $R = 1138 \Omega \quad L = \frac{2186}{2000} = 1,09 \text{ mH}$

c) $P = R I_c^2 = R \cdot \frac{I^2}{2} = 1138 \cdot \frac{(21,5 \cdot 10^{-3})^2}{2} = 0,263 \text{ W}$

9.10



$$E = 56,0 e^{j(\omega t + 17,5^\circ)} \text{ V}$$

$$I = 23,7 \cdot 10^{-3} e^{j(\omega t - 26,0^\circ)} \text{ A}$$

$$\omega = 2000 \text{ rad/s}$$

$$C = 500 \text{ nF}$$

93

$$a) \quad Z_{\text{tot}} = \frac{E}{I} = \frac{56,0 e^{j(\omega t + 17,5^\circ)}}{23,7 \cdot 10^{-3} e^{j(\omega t - 26,0^\circ)}} = 2363 e^{j43,5^\circ} \Omega$$

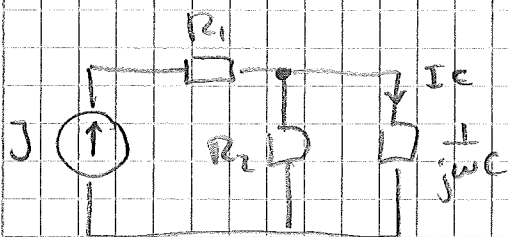
$$b) \quad Z = Z_{\text{tot}} - \frac{1}{j\omega C} = 2363 \cos 43,5^\circ + j 2363 \sin 43,5^\circ + j 1000 =$$

$$= 1714 + j 2627 \Omega$$

$$c) \quad Z = R + j\omega L \Rightarrow R = 1714 \Omega$$

$$L = \frac{2627}{2000} = 1,31 \text{ mH}$$

9.13



$$J = \sqrt{2} \cdot 11,5 e^{j\omega t} \text{ mA}$$

$$R_1 = 3,3 \text{ k}\Omega$$

$$R_2 = 2,3 \text{ k}\Omega$$

$$C = 1,0 \mu\text{F} \quad f = 50 \text{ Hz}$$

$$\omega = 2\pi f = 100 \pi \text{ rad/s}$$

Strömdrehung

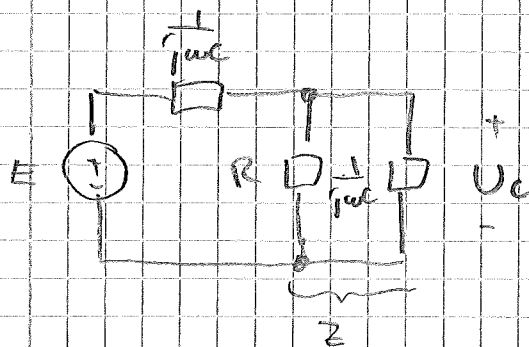
$$I_c = \frac{R_2}{R_2 + \frac{1}{j\omega C}} \cdot J = \frac{j\omega R_2 C}{1 + j\omega R_2 C} \cdot J = \frac{j 0,7226}{1 + j 0,7226} \cdot J =$$

$$= \frac{0,7226 e^{j90^\circ}}{1,234 e^{j35,85^\circ}} \cdot \sqrt{2} \cdot 11,5 \cdot 10^{-3} e^{j\omega t} = 9,52 \cdot 10^{-3} e^{j(\omega t + 54,1^\circ)} \text{ A}$$

$$i_c(t) = 9,52 \sin(\omega t + 54,1^\circ) \text{ mA}$$

9.14

(94)



$$R = 10 \Omega$$

$$C = 20 \mu\text{F}$$

$$E = 600 e^{j(\omega t + 36,0^\circ)} \text{ mV}$$

$$\omega = 5000 \text{ rad/s}$$

$$Z = R \parallel \frac{1}{j\omega C} = \frac{R \cdot \frac{1}{j\omega C}}{R + \frac{1}{j\omega C}} = \frac{R}{1 + j\omega RC}$$

$$U_c = \frac{Z}{Z + \frac{1}{j\omega C}} \cdot E = \frac{\frac{R}{1 + j\omega RC}}{\frac{R}{1 + j\omega RC} + \frac{1}{j\omega C}} \cdot E = \frac{R}{R + \frac{1 + j\omega RC}{j\omega C}} \cdot E =$$

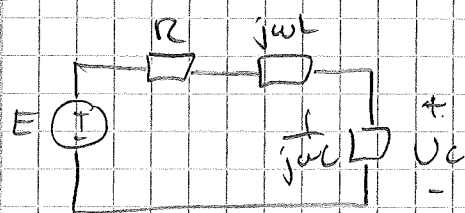
$$= \frac{j\omega RC}{j\omega RC + 1 + j\omega RC} \cdot E = \frac{j\omega RC}{1 + j2\omega RC} \cdot E =$$

$$= \frac{j}{1 + j2} \cdot E = \frac{e^{j90^\circ}}{\sqrt{5} e^{j63,4^\circ}} \cdot 0,600 \cdot e^{j(\omega t + 36,0^\circ)} =$$

$$= 0,268 e^{j(\omega t + 62,6^\circ)} \text{ V}$$

$$u_c(t) = 0,268 \sin(\omega t + 62,6^\circ) \text{ V}$$

9.15



$$E = 600 e^{j(\omega t + 36,0^\circ)} \text{ V}$$

$$\omega = 5000 \text{ rad/s}$$

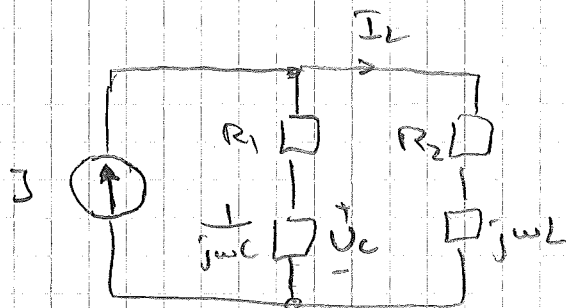
$$R = 10 \Omega \quad L = 10 \text{ mH} \quad C = 5,0 \mu\text{F}$$

$$U_c = \frac{\frac{1}{j\omega C}}{R + j\omega L + \frac{1}{j\omega C}} \cdot E = \frac{-j \frac{1}{\omega C}}{R + j(\omega L - \frac{1}{\omega C})} \cdot E = \frac{-j40}{10 + j10} \cdot E =$$

$$= \frac{40 \cdot e^{-j90^\circ}}{14,14 e^{j45^\circ}} \cdot 0,600 e^{j(\omega t + 36,0^\circ)} = 1,697 e^{j(\omega t - 99,0^\circ)} \text{ V}$$

$$u_c(t) = 1,697 \sin(\omega t - 99,0^\circ) \text{ V}$$

9,16



$$R_1 = 30 \Omega$$

$$R_2 = 10 \Omega$$

$$C = 6,25 \mu F$$

$$L = 17,5 \text{ mH}$$

$$I = 0,8 e^{j\omega t} \text{ A}$$

$$\omega = 4000 \text{ rad/s}$$

95

$$Z_{\text{tot}} = \left(R_1 + \frac{1}{j\omega C} \right) \parallel (R_2 + j\omega L) =$$

$$= (30 - j40) \parallel (10 + j70) = \frac{(30 - j40) \cdot (10 + j70)}{(30 - j40) + (10 + j70)} =$$

$$= \frac{3100 + j1700}{40 + j30} = \frac{3536 e^{j28,74^\circ}}{50 e^{j36,87^\circ}} = 70,72 e^{-j8,13^\circ} \Omega$$

$$U = I \cdot Z_{\text{tot}} = 0,8 \cdot e^{j\omega t} \cdot 70,72 e^{-j8,13^\circ} = 56,62 e^{j(\omega t - 8,13^\circ)} \text{ [V]}$$

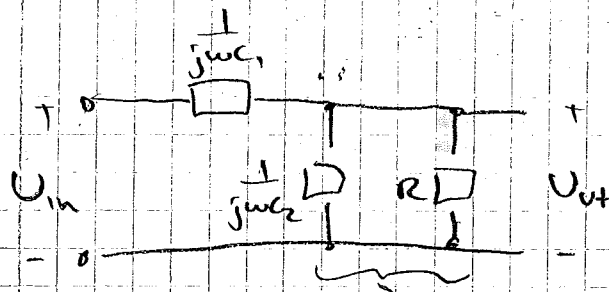
$$\begin{aligned} \text{a) } I_L &= \frac{U}{R_2 + j\omega L} = \frac{U}{10 + j70} = \frac{56,62 \cdot e^{j(\omega t - 8,13^\circ)}}{70,71 e^{j81,87^\circ}} = \\ &= 0,8 e^{j(\omega t - 90^\circ)} \end{aligned}$$

$$i_L(t) = 0,8 \sin(\omega t - 90^\circ) \text{ A}$$

$$\begin{aligned} \text{b) } U_C &= \frac{\frac{1}{j\omega C}}{\frac{1}{j\omega C} + R_1} \cdot U = \frac{1}{1 - j0,75} \cdot U = \frac{56,62 e^{j(\omega t - 8,13^\circ)}}{1,25 e^{j36,87^\circ}} = \\ &= 45,30 e^{j(\omega t - 45^\circ)} \text{ [V]} \end{aligned}$$

$$u_C(t) = 45,30 \sin(\omega t - 45^\circ) \text{ [V]}$$

9.31



$$C_1 = 1 \mu F$$

$$C_2 = 9 \mu F$$

$$R = 1000 \Omega$$

$$Z = \frac{1}{j\omega C_2} \parallel R = \frac{\frac{1}{j\omega C_2} \cdot R}{\frac{1}{j\omega C_2} + R} = \frac{R}{1 + j\omega C_2 R}$$

$$U_{out} = \frac{Z}{Z + \frac{1}{j\omega C_1}} \cdot U_{in}$$

$$\begin{aligned} a) \underline{H(j\omega)} &= \frac{U_{out}}{U_{in}} = \frac{Z}{Z + \frac{1}{j\omega C_1}} = \frac{\frac{R}{1 + j\omega C_2 R}}{\frac{R}{1 + j\omega C_2 R} + \frac{1}{j\omega C_1}} = \\ &= \frac{j\omega C_1 R}{j\omega C_1 R + 1 + j\omega C_2 R} = \frac{j\omega C_1 R}{1 + j\omega (C_1 + C_2) R} = \\ &= 10^{-3} \frac{j\omega}{1 + j\frac{\omega}{100}} = \frac{1}{10} \frac{j\frac{\omega}{100}}{1 + j\frac{\omega}{100}} \end{aligned}$$

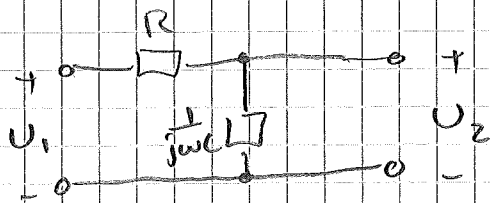
$$b) H(j10) = \frac{j10^{-2}}{1 + j0.1} = \frac{10^{-2} e^{j90^\circ}}{1.005 e^{j5.71^\circ}} = 9.95 \cdot 10^{-3} e^{-j84.3^\circ}$$

$$H(j100) = \frac{j0.1}{1 + j1} = \frac{0.1 e^{j90^\circ}}{\sqrt{2} e^{j45^\circ}} = 0.0707 e^{j45^\circ}$$

$$H(j1000) = \frac{j}{1 + j10} = \frac{e^{j90^\circ}}{10.05 e^{j84.3^\circ}} = 0.0995 \cdot e^{j5.7^\circ}$$

c) Filteringen s\u00e4dan frekvens

11.1) a)



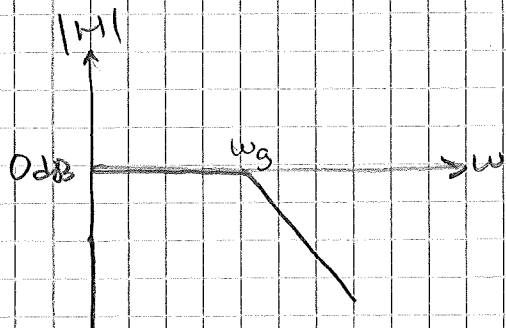
$$R = 1 \text{ k}\Omega$$

$$C = 470 \text{ nF}$$

$$U_2 = \frac{\frac{1}{j\omega C}}{R + \frac{1}{j\omega C}} \cdot U_1 = \frac{1}{1 + j\omega RC} \cdot U_1$$

$$\underline{H(j\omega)} = \frac{U_2}{U_1} = \frac{1}{1 + j\omega RC} = \frac{1}{1 + j \frac{\omega}{2128}} = \frac{1}{1 + j \frac{\omega}{\omega_g}}$$

b) Bode



$$f_g = \frac{\omega_g}{2\pi} = \frac{2128}{2\pi} = 339 \text{ Hz}$$

Övre gränsfrekvens

$$c) \left\{ \begin{aligned} |H|_{dB} &= 20 \log \frac{1}{|1 + j \frac{\omega}{2128}|} = 20 \log \frac{1}{\sqrt{1 + \left(\frac{\omega}{2128}\right)^2}} \\ \arg H &= - \arctan \frac{\omega}{2128} \end{aligned} \right.$$

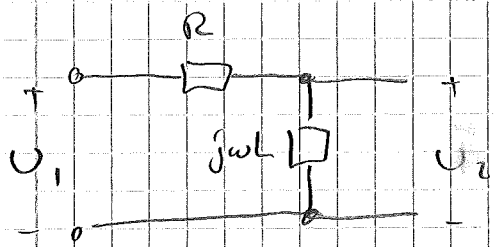
Vid $f = 500 \text{ Hz}$ fås

$$|H|_{dB} = 20 \log \frac{1}{\sqrt{1 + \left(\frac{2\pi \cdot 500}{2128}\right)^2}} = -5,0 \text{ dB} \quad \text{dvs } 5 \text{ dB dämpning}$$

$$\arg H = - \arctan \frac{2\pi \cdot 500}{2128} = -55,9^\circ$$

11.2

98



$$R = 1000 \Omega$$

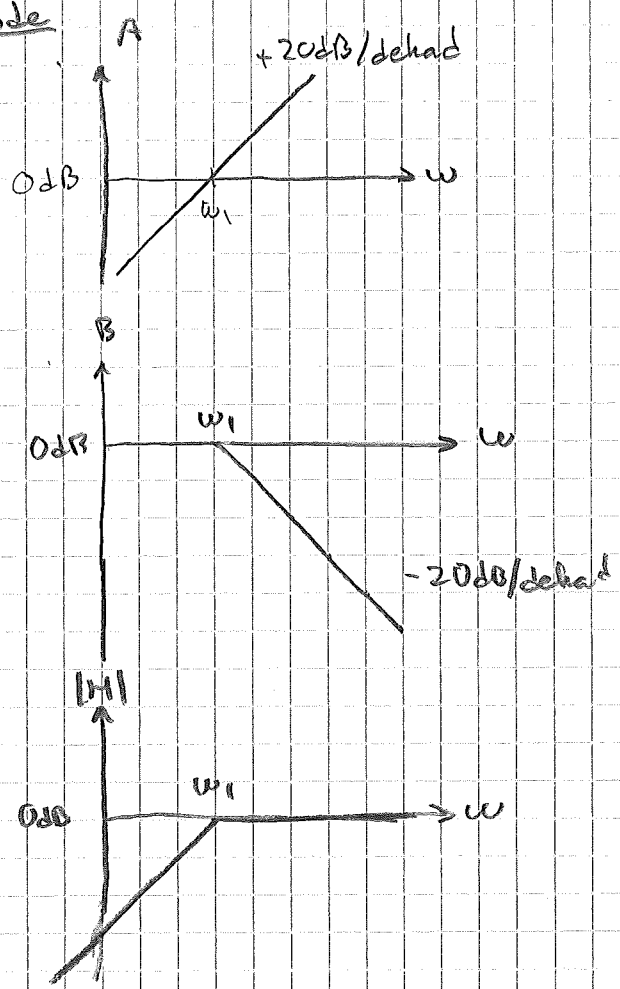
$$L = 150 \text{ mH}$$

$$U_2 = \frac{j\omega L}{R + j\omega L} \cdot U_1 = \frac{j \frac{\omega L}{R}}{1 + j \frac{\omega L}{R}} \cdot U_1$$

$$H(j\omega) = \frac{U_2}{U_1} = \frac{j \frac{\omega L}{R}}{1 + j \frac{\omega L}{R}} = \frac{j 6667}{1 + j \frac{\omega}{6667}} = \frac{j \frac{\omega}{\omega_1}}{1 + j \frac{\omega}{\omega_1}}$$

$$\omega_1 = 6667 \text{ rad/s}$$

Bode



Unter Grenzfrequenz $f_u = \frac{\omega_1}{2\pi} = \frac{6667}{2\pi} = 1061 \text{ Hz}$

11.3

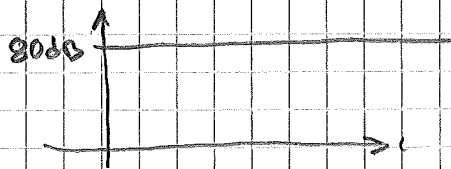
a) $H(j\omega) = \frac{10j\omega}{1+j\frac{\omega}{1000}} = \overset{A}{10^4} \frac{\overset{B}{j\frac{\omega}{1000}}}{\underset{C}{1+j\frac{\omega}{1000}}}$

$\omega_1 = 1000 \text{ rad/s}$

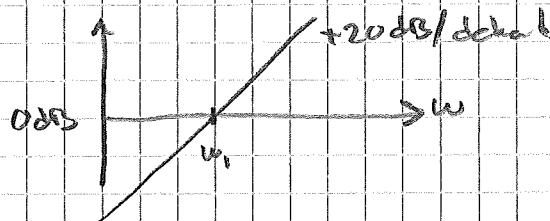
99

(A)

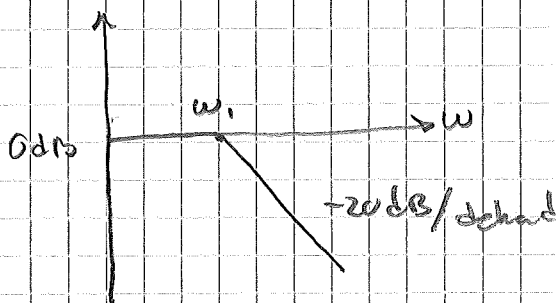
$20 \log 10^4 = 80 \text{ dB}$



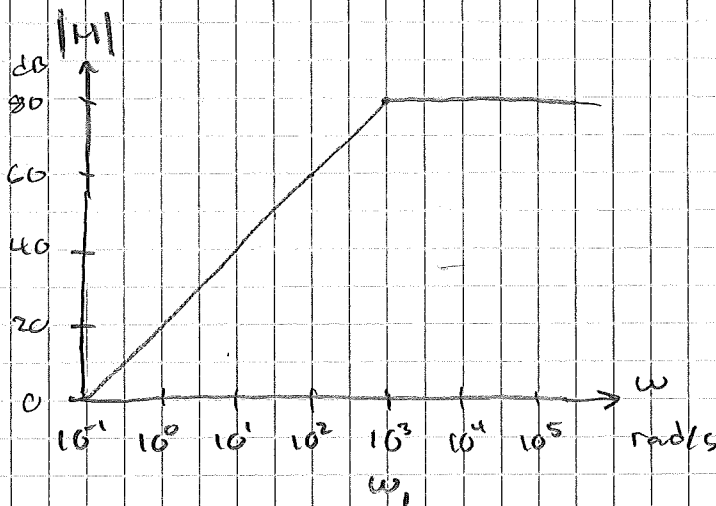
(B)



(C)



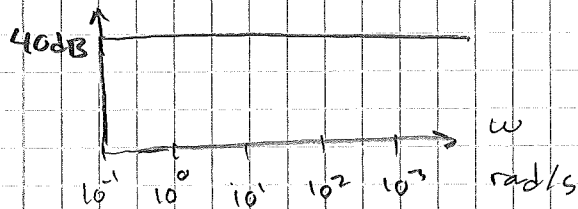
Total



11.3b

$$H(j\omega) = \frac{100 \left(1 + j \frac{\omega}{100}\right)}{\left(1 + j \frac{\omega}{100}\right)} = 100$$

$$|M|_{dB} = 20 \log 100 = 40 \text{ dB}$$



11.3c

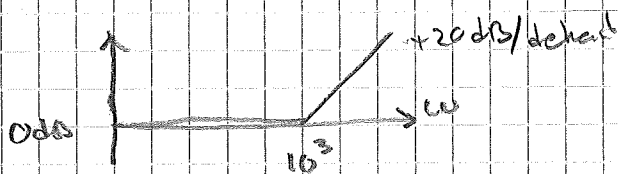
$$H(j\omega) = 100 \frac{1000 + j\omega}{100 + j\omega} = \frac{10^2 \cdot 10^3}{10^2} \frac{\left(1 + j \frac{\omega}{1000}\right)}{\left(1 + j \frac{\omega}{100}\right)} =$$

$$= \textcircled{A} \cdot \frac{\textcircled{B} \left(1 + j \frac{\omega}{1000}\right)}{\textcircled{C} \left(1 + j \frac{\omega}{100}\right)}$$

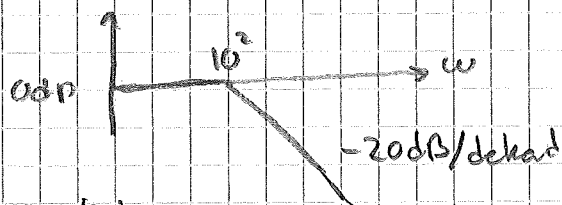
Ⓐ $20 \log 10^3 = 60 \text{ dB}$



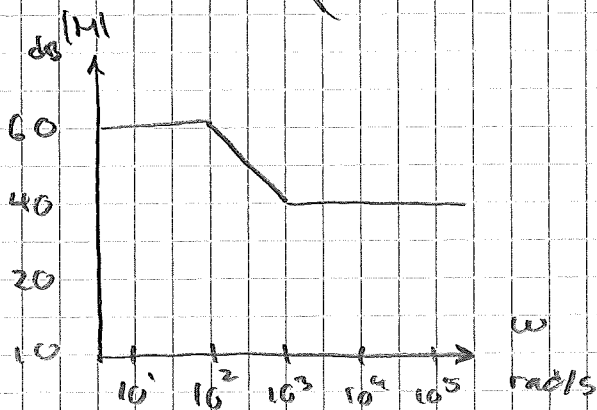
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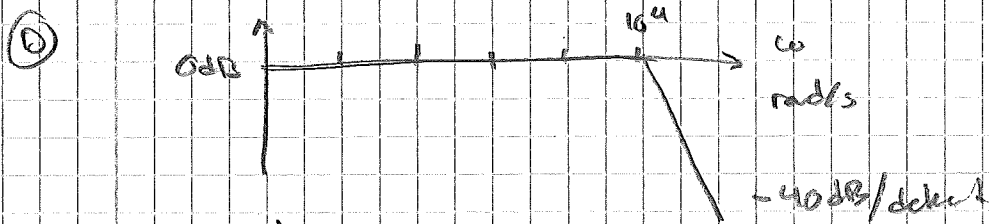
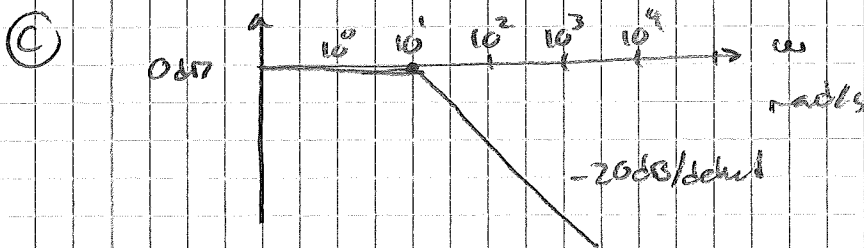
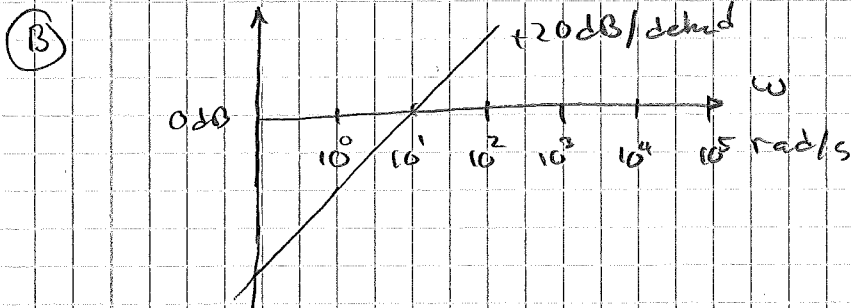
Total



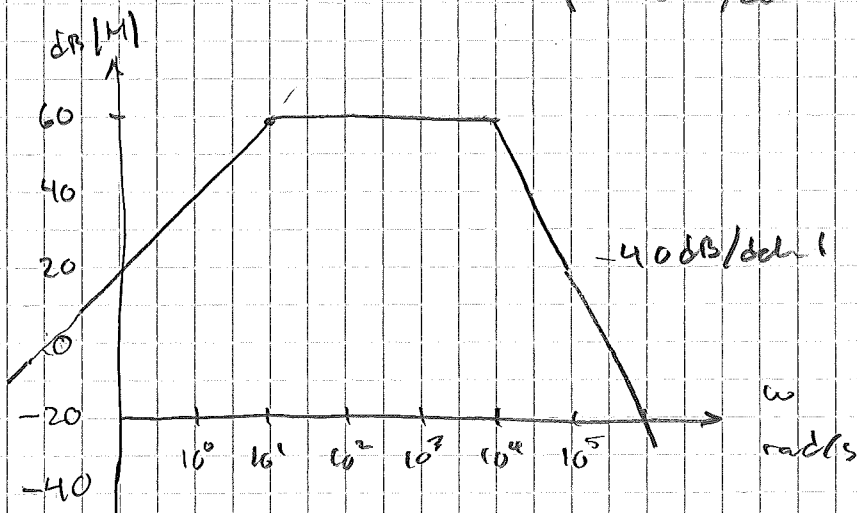
11.3] d $H(j\omega) = \frac{10'' j\omega}{(10 + j\omega)(10^4 + j\omega)^2} = \frac{10'' j\omega}{10 \cdot 10^8 (1 + j\frac{\omega}{10})(1 + j\frac{\omega}{10^4})^2} =$ (100)

$$= \overset{(A)}{1000} \frac{j\frac{\omega}{10}}{\underset{(C)}{(1 + j\frac{\omega}{10})} \underset{(D)}{(1 + j\frac{\omega}{10^4})^2}}$$

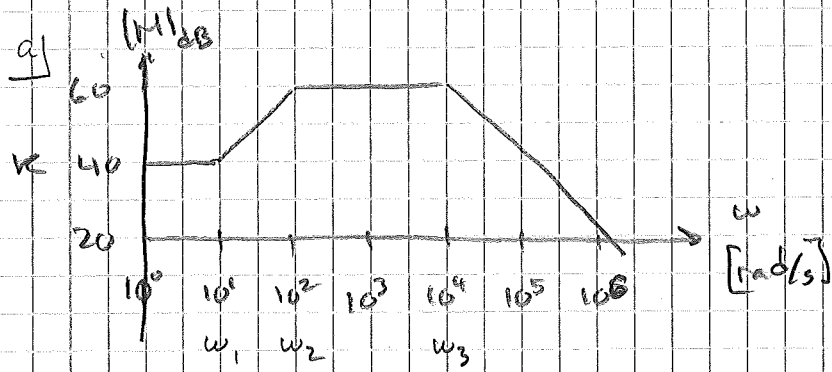
(A) $20 \log 1000 = 60 \text{ dB}$



Totalt



11.4)

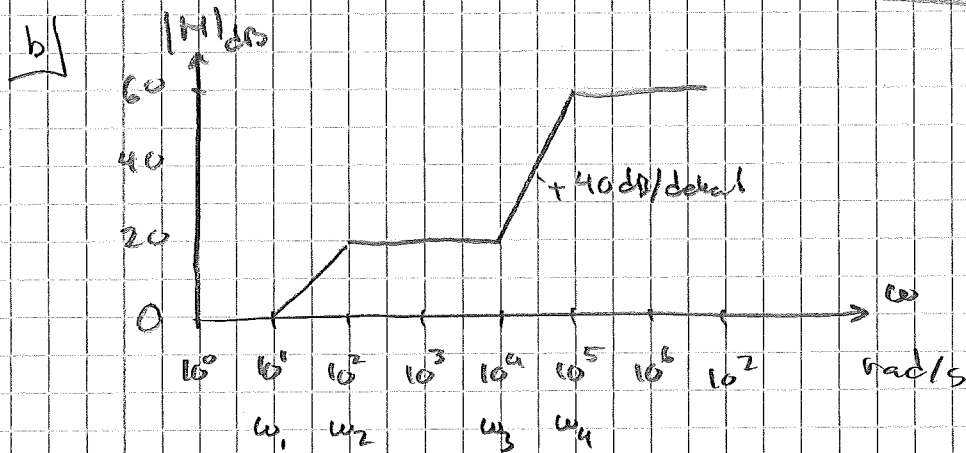


Vr Bode

$$H(j\omega) = K \cdot \frac{(1 + j\frac{\omega}{\omega_1})}{(1 + j\frac{\omega}{\omega_2})(1 + j\frac{\omega}{\omega_3})} =$$

$$20 \log K = 40 \text{ dB} \Rightarrow K = 10^{\frac{40}{20}} = 100$$

$$\therefore H(j\omega) = \frac{100 (1 + j\frac{\omega}{10})}{(1 + j\frac{\omega}{100})(1 + j\frac{\omega}{10^4})}$$



Vr Bode

$$H(j\omega) = K \frac{(1 + j\frac{\omega}{\omega_1})(1 + j\frac{\omega}{\omega_3})^2}{(1 + j\frac{\omega}{\omega_2})(1 + j\frac{\omega}{\omega_4})^2}$$

$$20 \log K = 0 \text{ dB} \Rightarrow K = 10^0 = 1$$

$$H(j\omega) = \frac{(1 + j\frac{\omega}{10})(1 + j\frac{\omega}{10^4})^2}{(1 + j\frac{\omega}{100})(1 + j\frac{\omega}{10^5})^2}$$

11.5

$$H(j\omega) = \frac{120 (1 + j\omega RC)}{(2 + j\frac{\omega}{10^3})(5 + j\frac{\omega}{10^4})}$$

$$R = 125\Omega$$

$$C = 1\mu F$$

(103)

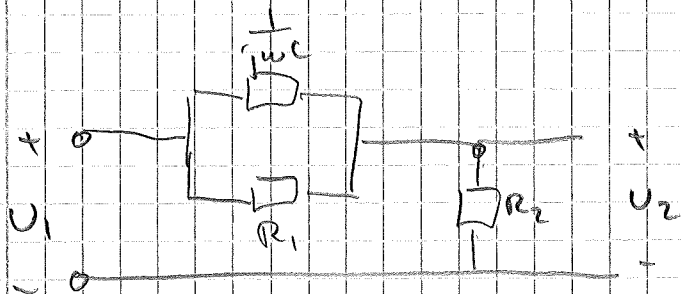
$$\arg H = \arctan \omega RC - \arctan \frac{\omega}{2 \cdot 10^3} - \arctan \frac{\omega}{5 \cdot 10^4} =$$

$$f = 1000 \text{ Hz} \rightarrow \omega = 2\pi 1000 = 2000\pi \text{ rad/s} \Rightarrow$$

$$\arg H = \arctan 2000\pi \cdot 10^3 \cdot 10^{-6} - \arctan \frac{2000\pi}{2 \cdot 10^3} - \arctan \frac{2000\pi}{5 \cdot 10^4} =$$

$$= 1,45^\circ$$

11.7



$$C = 10 \text{ nF}$$

$$R_1 = 100 \text{ k}\Omega$$

$$R_2 = 10 \text{ k}\Omega$$

$$Z_1 = R_1 \parallel \frac{1}{j\omega C} = \frac{R_1 \cdot \frac{1}{j\omega C}}{R_1 + \frac{1}{j\omega C}} = \frac{R_1}{1 + j\omega RC}$$

$$U_2 = \frac{R_2}{R_2 + Z_1} \cdot U_1$$

$$H(j\omega) = \frac{U_2}{U_1} = \frac{R_2}{R_2 + Z_1} = \frac{R_2}{R_2 + \frac{R_1}{1 + j\omega RC}} = R_2 \frac{(1 + j\omega RC)}{R_2 + j\omega R_1 R_2 C + R_1} =$$

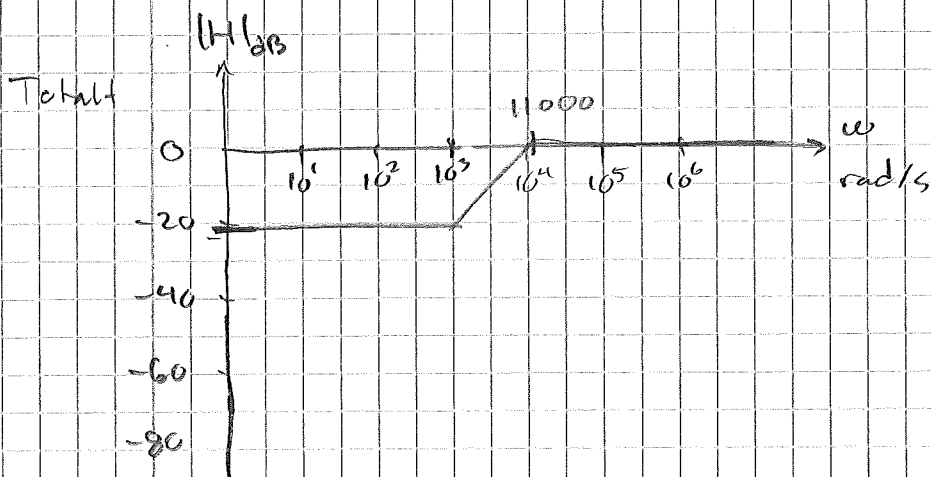
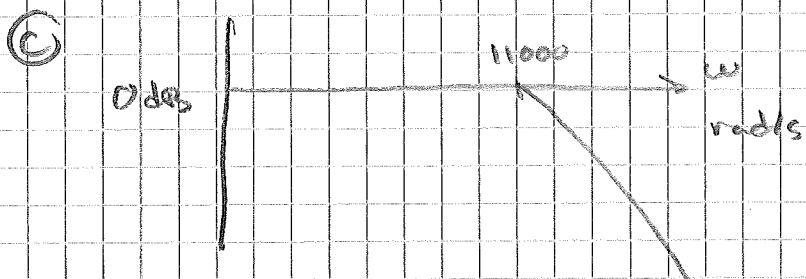
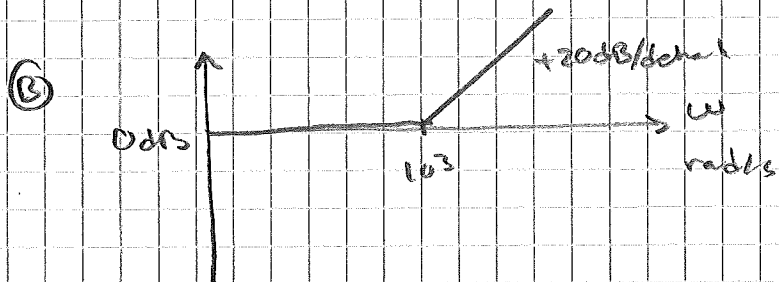
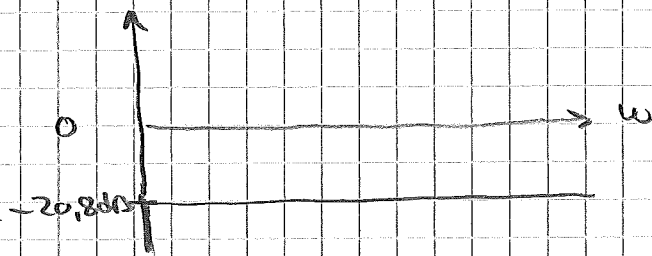
$$= \frac{R_2}{R_1 + R_2} \frac{(1 + j\omega RC)}{(1 + j\omega \frac{R_1 R_2}{R_1 + R_2} C)} = \underbrace{\left(\frac{10}{110} \right)}_A \cdot \frac{1 + j \underbrace{\omega}_{(B)} \frac{10}{1000}}{1 + j \frac{\omega}{11000}} \underbrace{(C)}$$

^

11.7 fests

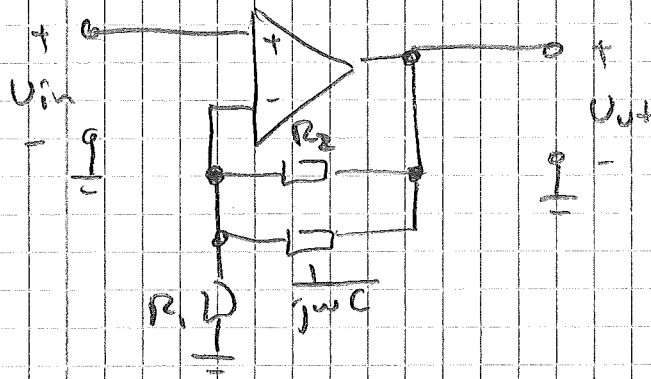
104

(A) $20 \log \frac{10}{110} = -20,8 \text{ dB}$



11.8

105



$$R_1 = 1 \text{ k}\Omega$$

$$R_2 = 47 \text{ k}\Omega$$

$$C = 2 \text{ nF}$$

$$Z_2 = R_2 \parallel \frac{1}{j\omega C} = \frac{R_2 \cdot \frac{1}{j\omega C}}{R_2 + \frac{1}{j\omega C}} = \frac{R_2}{1 + j\omega R_2 C}$$

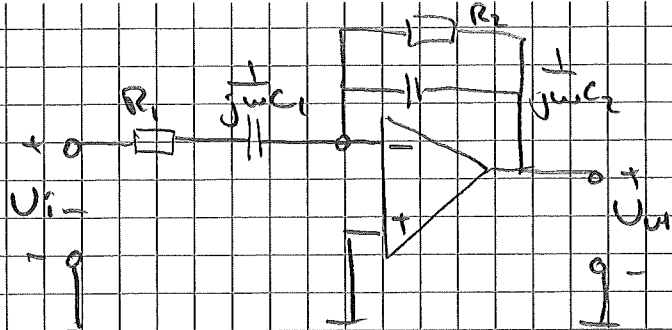
$$H(j\omega) = \frac{V_{out}}{V_{in}} = \frac{R_1 + Z_2}{R_1} = \frac{R_1 + \frac{R_2}{1 + j\omega R_2 C}}{R_1} = 1 + \frac{R_2}{R_1(1 + j\omega R_2 C)}$$

$$= \frac{R_1 + R_2 + j\omega R_1 R_2 C}{R_1(1 + j\omega R_2 C)}$$

$$= \frac{R_1 + R_2}{R_1} \cdot \frac{1 + j\omega \frac{R_1 R_2 C}{R_1 + R_2}}{1 + j\omega R_2 C} =$$

$$= 4.8 \cdot \frac{1 + j \frac{\omega}{510638}}{1 + j \frac{\omega}{10638}}$$

11.9



$$R_1 = 1 \text{ k}\Omega$$

$$R_2 = 100 \text{ k}\Omega$$

$$C_1 = 2 \mu\text{F}$$

$$C_2 = 150 \text{ pF}$$

(100)

$$Z_1 = R_1 + \frac{1}{j\omega C_1} = \frac{1 + j\omega R_1 C_1}{j\omega C_1}$$

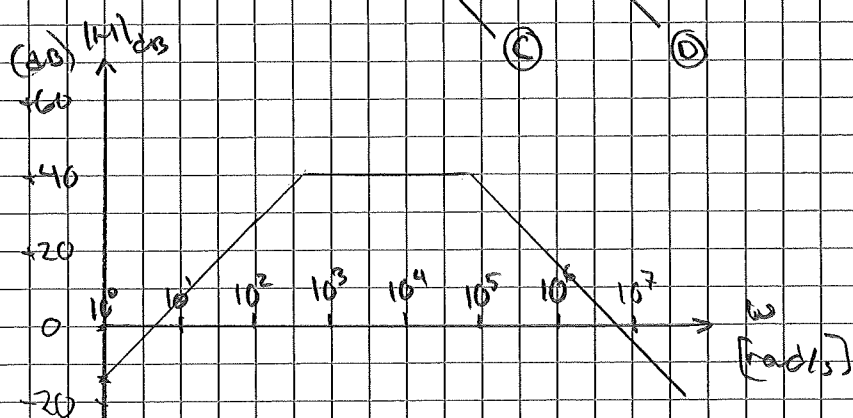
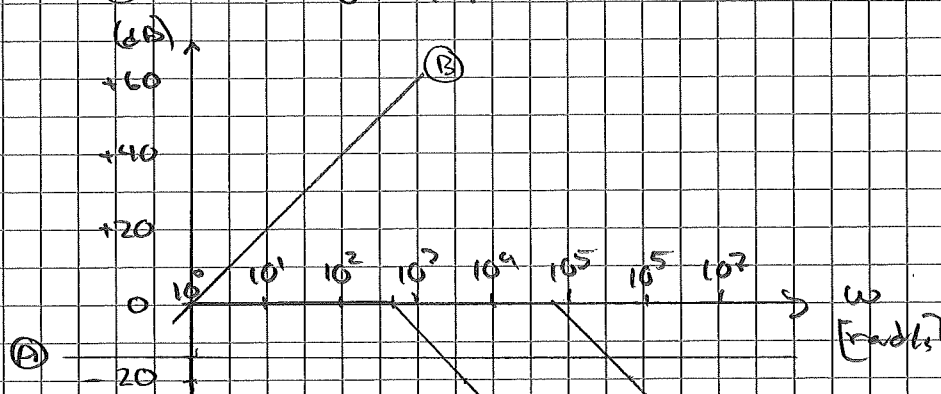
$$Z_2 = R_2 \parallel \frac{1}{j\omega C_2} = \frac{R_2 \cdot \frac{1}{j\omega C_2}}{R_2 + \frac{1}{j\omega C_2}} = \frac{R_2}{1 + j\omega R_2 C_2}$$

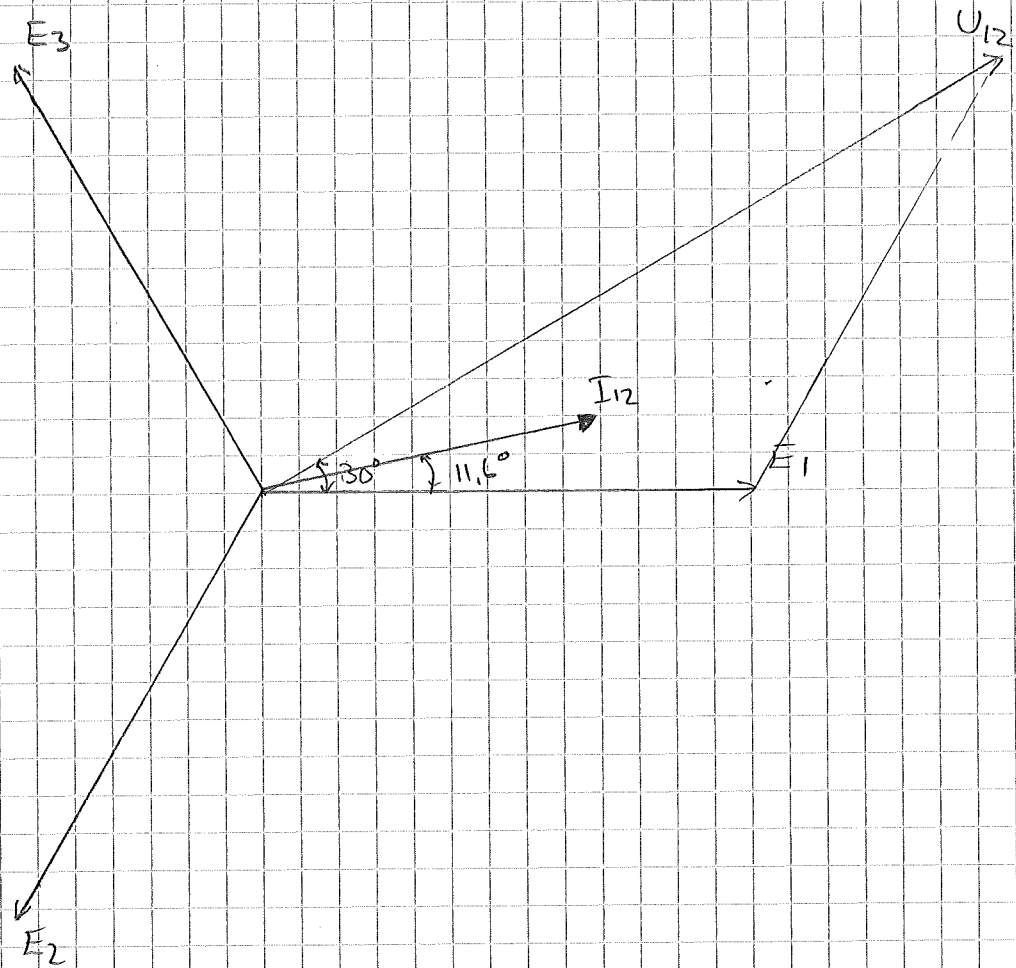
$$H(j\omega) = \frac{U_u}{U_i} = - \frac{Z_2}{Z_1} = - \frac{\frac{R_2}{1 + j\omega R_2 C_2}}{\frac{1 + j\omega R_1 C_1}{j\omega C_1}} = - \frac{j\omega R_2 C_1}{(1 + j\omega R_1 C_1)(1 + j\omega R_2 C_2)}$$

$$= \textcircled{A} \quad \textcircled{B} \quad \textcircled{C} \quad \textcircled{D}$$

$$= -0,2 \frac{j\omega}{(1 + j\frac{\omega}{500})(1 + j\frac{\omega}{66667})}$$

$$\textcircled{A} \quad 20 \log |-0,2| = -14 \text{ dB}$$





$$U_{12} = E_1 - E_2 = \sqrt{3} |E| \cdot e^{j30^\circ} = 562,9 e^{j30^\circ} \text{ [V]}$$

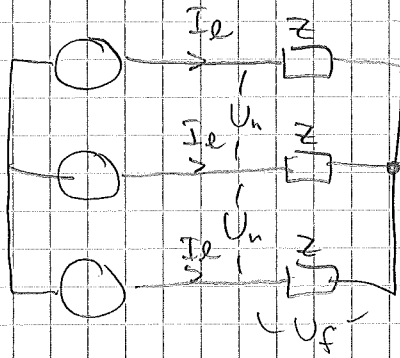
$$Z = 120 + j40 \Omega = 126,5 \cdot e^{j18,43^\circ} \Omega$$

$$I_{12} = \frac{U_{12}}{Z} = \frac{562,9 e^{j30^\circ}}{126,5 e^{j18,43^\circ}} = 4,45 e^{j11,6^\circ} \text{ [A]}$$

c) $|U_{12}| = 562,9 \text{ V}$

$|I_{12}| = 4,45 \text{ A}$

10.11



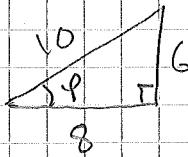
$$Z = 8 + j6 = 10 e^{j36,9^\circ} \Omega$$

Huvudspänning $U_{ne} = 400 \text{ V}$

Fassspänning $U_{fe} = \frac{U_{ne}}{\sqrt{3}} = 231 \text{ V}$

a) Linjestrom $I_{Le} = \frac{U_{fe}}{|Z|} = \frac{231}{10} = 23,1 \text{ A}$

b) Impedanstriangel för Z



$$\cos \phi = \frac{8}{10} = 0,8$$

$$\sin \phi = \frac{6}{10} = 0,6$$

c) $P = \sqrt{3} U_{ne} I_{Le} \cos \phi = \sqrt{3} \cdot 400 \cdot 23,1 \cdot 0,8 = 12,8 \text{ kW}$

$$Q = \sqrt{3} U_{ne} I_{Le} \sin \phi = \sqrt{3} \cdot 400 \cdot 23,1 \cdot 0,6 = 9,6 \text{ kvar}$$