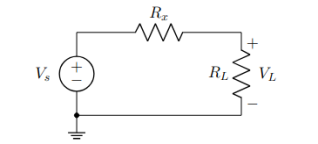
Quiz 3



1 a)

$$V_s = V_x + V_L$$

$$V_L = V_s - V_x = V_s - \frac{R_x}{R_x + R_L} V_s$$

$$V_L = V_s\left(1 - \frac{R_x}{R_x + R_L}\right)$$

1 b)

$$V_s = V_x + V_L$$

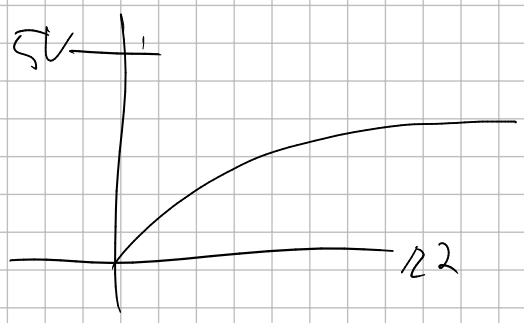
$$V_x = V_s - V_L$$

$$V_x = V_s - \frac{R_L}{R_x + R_L} V_s = V_s\left(1 - \frac{R_L}{R_x + R_L}\right)$$

$$V_x + V_L = V_s\left(1 - \frac{R_x}{R_L + R_x}\right) + V_s\left(1 - \frac{R_L}{R_L + R_x}\right) = V_s\left(1 - \frac{R_x}{R_x + R_L} + 1 - \frac{R_L}{R_x + R_L}\right)$$

$$= V_s\left(2 - \frac{R_x + R_L}{R_x + R_L}\right) = V_s(2 - 1) = V_s$$

2 a)



2 b) $R_2 = [4{,}00 \,;\, 2{,}0]\,k\Omega \qquad U_q = 5\,V$

$$U_B = \frac{R_2}{R_1 + R_2} U_q$$

$U_B \in [1{,}43 \,;\, 2{,}73]\,V$

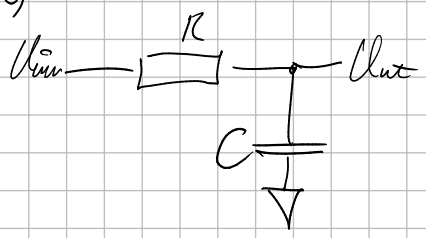
$$a = \frac{2{,}73\,V - 1{,}43\,V}{1{,}20\,k\Omega - 4{,}00\,k\Omega} = 0{,}000160\,\frac{V}{\Omega} = 0{,}160\,V/k\Omega$$

$$U(R_2) = 1{,}43\,V + 0{,}160\,V/k\Omega \cdot (R_2 - 4\,k\Omega)$$

$$= 1{,}43\,V - 0{,}65\,V + 0{,}160\,V/k\Omega \cdot R_2$$

$$= \underline{\underline{0{,}79\,V + 0{,}160\,V/k\Omega \cdot R_2}}$$

3)



$\left|\frac{U_{вых}}{U_{вх}}\right| = \frac{1}{\sqrt{1+\left(\frac{f}{f_c}\right)^2}}$ $\quad f_c = \frac{1}{2\pi RC}$ $\quad f = 0{,}5\ МГц$, $0{,}03$ – какое ослабление

$\left|\frac{U_{вых}}{U_{вх}}\right| = 0{,}03$

$\frac{1}{\sqrt{1+\left(\frac{0{,}5\ МГц}{f_c}\right)^2}} = 0{,}03$

$\left(\frac{0{,}5\ МГц}{f_c}\right)^2 = \left(\frac{1}{0{,}03}\right)^2 - 1$

$\frac{f}{f_c} = \sqrt{\left(\frac{1}{0{,}03}\right)^2 - 1}$

$f_c = \frac{f}{\sqrt{\frac{1}{0{,}03^2} - 1}} = \frac{1}{2\pi RC}$

$RC = \frac{\sqrt{\frac{1}{0{,}03^2} - 1}}{2\pi f}$

$RC = 1{,}06 \cdot 10^{-5}$

$f = 400\ Гц$ $\quad f_c = \frac{1}{2\pi RC} = 15000\ Гц$

$\frac{1}{\sqrt{1+\left(\frac{f}{f_c}\right)^2}} = \frac{1}{\sqrt{1+\left(\frac{400\ Гц}{15000\ Гц}\right)^2}} = 0{,}9996$

Ослаб мал 0,04%

4 a)

$m = 0{,}000\ kg \Rightarrow R_w = 119\ \Omega$ $\quad$ $m = 135{,}62\ kg \Rightarrow R_w = 127\ \Omega$

$R_z = (0,\ 200)\ \Omega$

$a = b$ $\quad$ $R_w = 119\ \Omega$ $\quad$ $R_1 R_3 = R_2 R_4$

$$(100\ \Omega + \frac{(24\ \Omega)(70\ \Omega + R_z)}{94\ \Omega + R_z})\ R_w = (120\ \Omega)^2$$

$$\frac{(24\ \Omega)(70\ \Omega + R_z)}{94\ \Omega + R_z} = \frac{(120\ \Omega)^2}{R_w} - 100\ \Omega$$

$$(24\ \Omega)(70\ \Omega + R_z) = \left(\frac{(120\ \Omega)^2}{R_w} - 100\ \Omega\right)(94\ \Omega + R_z)$$

$$24 \cdot 70\ \Omega^2 + R_z \cdot 24\ \Omega = 21{,}008 \cdot 94\ \Omega^2 + 21{,}008 \cdot R_z$$

$$R_z(24\ \Omega - 21{,}008\ \Omega) = 21{,}008 \cdot 94\ \Omega^2 - 70 \cdot 24\ \Omega^2$$

$$R_z = 98{,}5391\ \Omega$$

4 b) $(100\ \Omega + \frac{(24\ \Omega)(70\ \Omega + R_z)}{94\ \Omega + R_z})\ R_w = (120\ \Omega)^2$

$$R_w = \frac{(120\ \Omega)^2}{100\ \Omega + \frac{(24\ \Omega)(70\ \Omega + R_z)}{94\ \Omega + R_z}}$$

$R_w = [117,\ 122]$

4 c) $R_z = 98{,}5391\ \Omega$ $\quad$ $R_w = 127\ \Omega$

$$a - b = \left(\frac{120\ \Omega}{220\ \Omega + \frac{(24\ \Omega)(70\ \Omega + 98\ \Omega)}{94\ \Omega + 98\ \Omega}} - \frac{127\ \Omega}{120\ \Omega + 127\ \Omega}\right) =$$