HW Set 2

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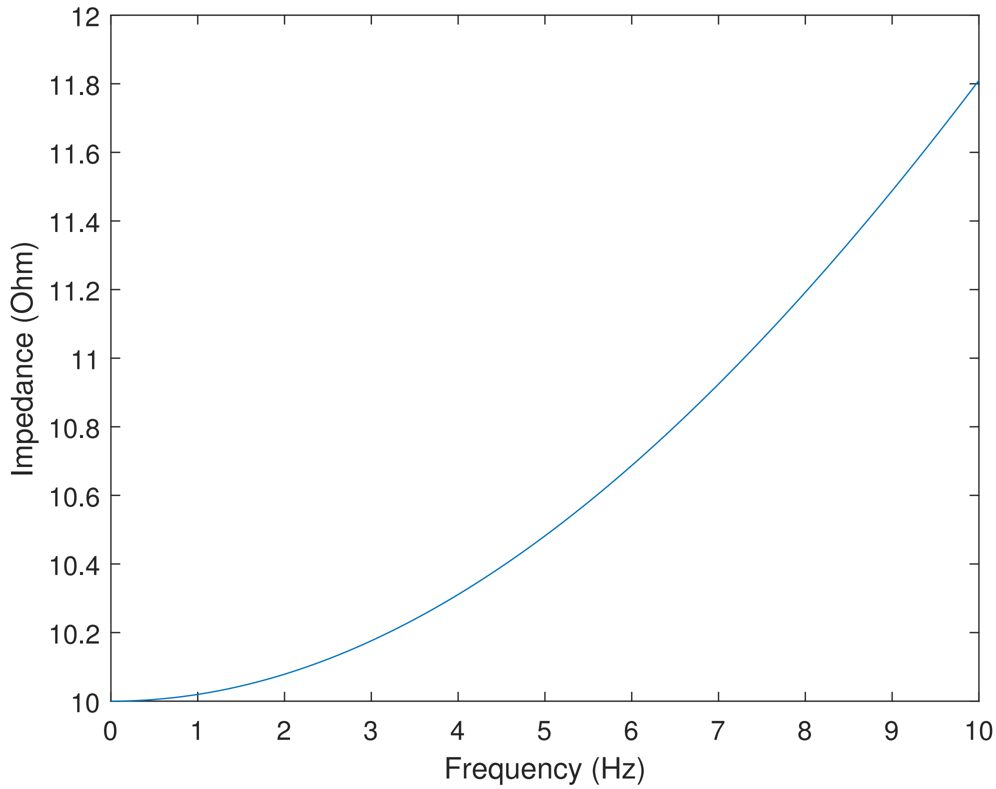
1.a $Z = R + j\omega L$
1.b f = linspace(0, 10, 1001);
1.c Z = 10 + 1i*2*pi*10*10$^{(}-3).*f;$

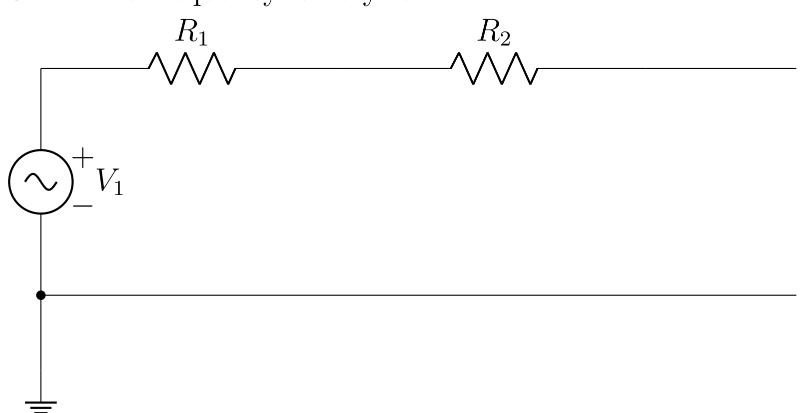


1.d

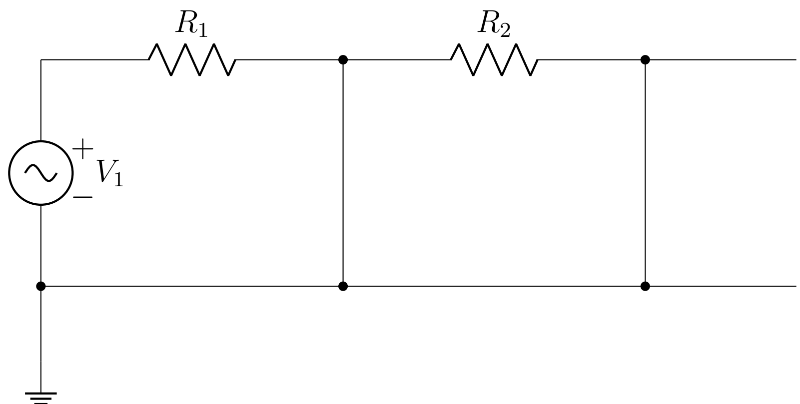
1.e At the low frequency the R^2 term dominates, and thus the line starts of horizontal, however at high frequencies the $\omega^2 L^2$ term dominates, and since the whole thing is under a square root it approaches a straight line function.

2.a $Z = \left(\frac{1}{Z_R} + \frac{1}{Z_C} + \frac{1}{Z_L}\right)$
$Z_R = R, \quad Z_C = \frac{1}{j\omega C}, \quad Z_L = j\omega L$
$Z_{tot} = \left(\frac{1}{R} + j\omega C + \frac{1}{j\omega L}\right)$
2.b $|Z| = \sqrt{\left(\frac{1}{R} + j\omega C + \frac{1}{j\omega L}\right)\left(\frac{1}{R} - j\omega C - \frac{1}{j\omega L}\right)} = \sqrt{\frac{1}{R^2} + \frac{(\omega^2 CL-1)^2}{\omega^2 L^2}}$
2.c $V_0 e^{j\frac{\pi}{2}}$ The magnitude is V_0 and the phase is $\frac{\pi}{2}$.
2.d $\tilde{I}_s = \frac{\tilde{V}_s}{\tilde{Z}_s} = \frac{V_0 e^{j\frac{\pi}{2}}}{\left(\frac{1}{R}+j\omega C+\frac{1}{j\omega L}\right)}$
$|\tilde{I}_s| = \left(\frac{V_0 e^{j\frac{\pi}{2}}}{\left(\frac{1}{R}+j\omega C+\frac{1}{j\omega L}\right)}\right)\left(\frac{V_0 e^{-j\frac{\pi}{2}}}{\left(\frac{1}{R}-j\omega C+\frac{1}{-j\omega L}\right)}\right) = \frac{LRV_0\omega}{\sqrt{R^2(CL\omega^2-1)^2+L^2\omega^2}}$
2.e $\tilde{I}_R = \frac{V_0 e^{j\frac{\pi}{2}}}{R}$
$\tilde{I}_C = V_0 e^{j\frac{\pi}{2}} j\omega C$
$\tilde{I}_L = \frac{V_0 e^{j\frac{\pi}{2}}}{j\omega L}$

3.a If the frequency is very low:



If the frequency is very high:



3.b $Z = R_1 + \left(j\omega C_1 + \frac{1}{R_2 + \frac{1}{j\omega C_2}}\right)^{-1}$

3.c $\tilde{I}_{tot} = \frac{\tilde{V}_1 e^{j\phi}}{R_1 + \left(j\omega C_1 + \frac{1}{R_2 + \frac{1}{j\omega C_2}}\right)^{-1}}$