2. Calcular RTA módulo y fase: considero $z = \Omega . e^{-j\Omega}$.

A. $T(z) = e^{-j0} + e^{-j\Omega} + e^{-j2\Omega} + e^{-j3\Omega} \Rightarrow e^{-j\frac{3}{2}\Omega}\left(e^{j\frac{3}{2}\Omega} + e^{j\frac{1}{2}\Omega} + e^{-j\frac{1}{2}\Omega} + e^{-j\frac{3}{2}\Omega}\right) \Rightarrow$

$T(z) = e^{-j\frac{3}{2}\Omega}\left[2\cos\left(\frac{3}{2}\Omega\right) + 2\cos\left(\frac{\Omega}{2}\right)\right] \Rightarrow |T(z)| = \left|\left[\cos\left(\frac{3}{2}\Omega\right) + \cos\left(\frac{\Omega}{2}\right)\right]2\right|$

$\measuredangle T(z) = -\frac{3}{2}\Omega$

B. $T(z) = e^{-j0} + e^{-j\Omega} + e^{-j2\Omega} + e^{-j3\Omega} + e^{-j4\Omega} \Rightarrow e^{-j2\Omega}\left(e^{j2\Omega} + e^{j\Omega} + 1 + e^{-j\Omega} + e^{-j2\Omega}\right) =$

$e^{-j2\Omega}\left[1 + 2\cos(\Omega) + 2\cos(2\Omega)\right] \Rightarrow |T(z)| = |2\cos(2\Omega) + 2\cos(\Omega) + 1|$

$\measuredangle T(z) = -2\Omega$

C. $T(z) = e^{-j0} - e^{-j\Omega} \Rightarrow e^{-j\frac{\Omega}{2}}\left(e^{j\frac{\Omega}{2}} - e^{-j\frac{\Omega}{2}}\right) = e^{-j\frac{\Omega}{2}}\left[2j\,\mathrm{sen}\left(\frac{\Omega}{2}\right)\right] \Rightarrow |T(z)| = 2\left|\mathrm{sen}\left(\frac{\Omega}{2}\right)\right|$

$\measuredangle T(z) = -\frac{1}{2}\Omega + \frac{\pi}{2}$

D. $T(z) = e^{-j0} - e^{-j2\Omega} \Rightarrow e^{-j\Omega}\left(e^{j\Omega} - e^{-j\Omega}\right) = e^{-j\Omega}\left[2j\,\mathrm{sen}(\Omega)\right] \Rightarrow |T(z)| = 2|\mathrm{sen}(\Omega)|$

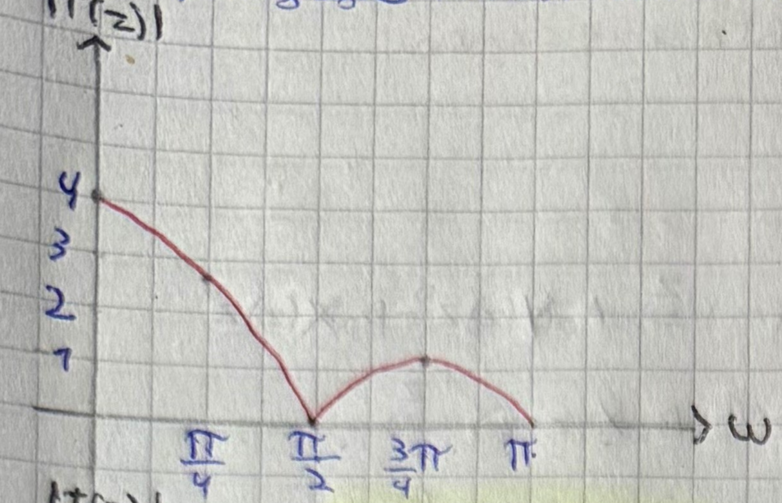
$\measuredangle T(z) = -\Omega + \frac{\pi}{2}$

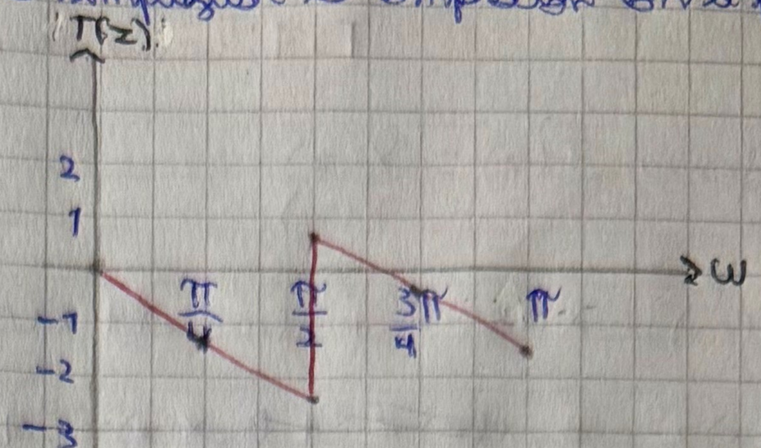
$\triangle$ Se ponderan saltos de $\pm\pi$ en el gráfico de RTA de fase producto del cambio de signo en la parte real de $T(z)$. Además, cuando se anula Re$(T(z))$, la fase es indefinida.

NOTA

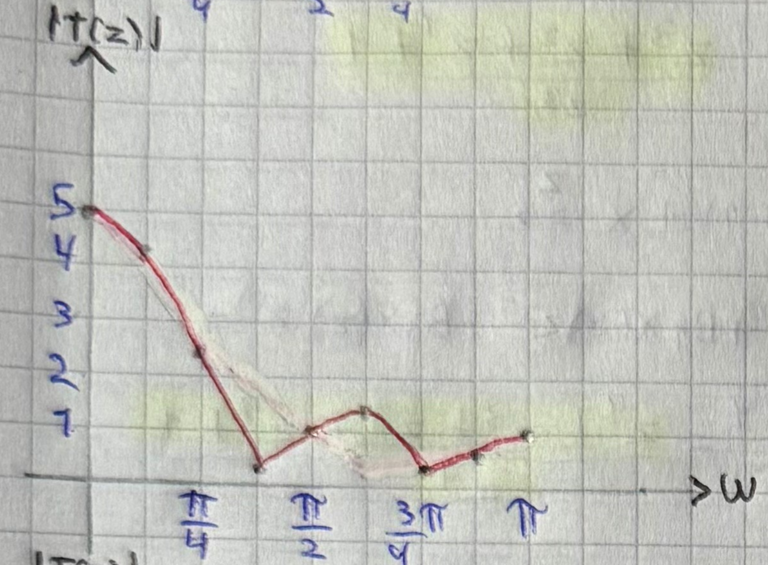
También, se grafica $|T(z)|$ sin escala dB para simplificar la comparación con el punto 3.

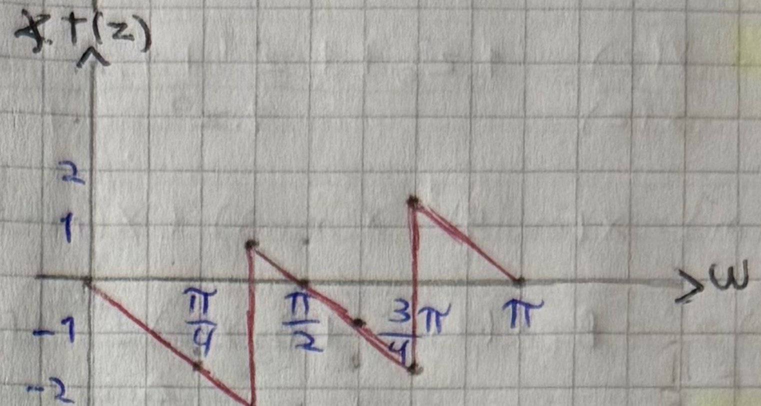
A.



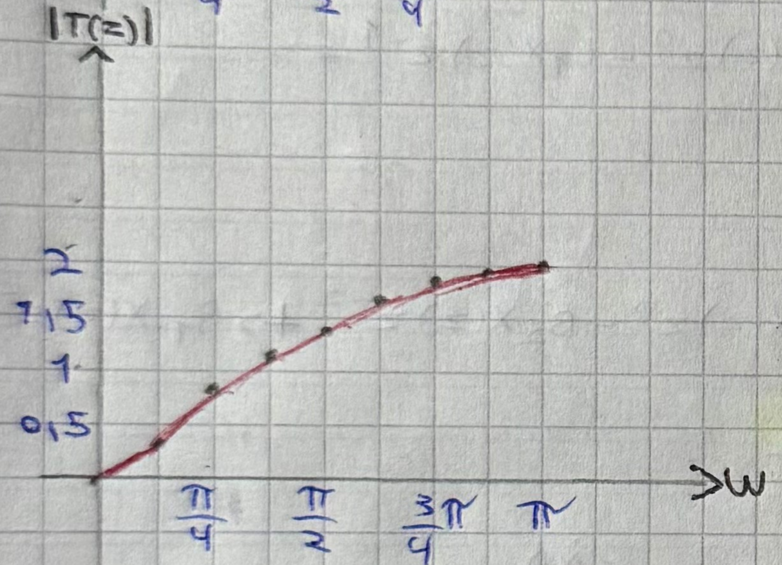


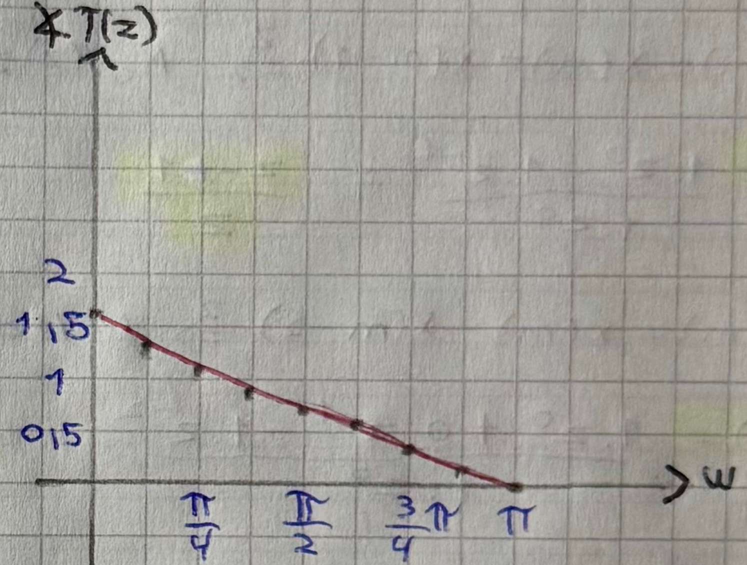
B.





C.





D.