9) This is simply taking the inverse DFT.

$$\boxed{\alpha_n = \frac{1}{\sqrt{N}} \cdot \sum_{k=0}^{N-1} \tilde{\alpha}_k \, e^{i\frac{2\pi n k}{N}}}$$

$$\alpha_n = \frac{1}{\sqrt{N}} \cdot \left(\tilde{\alpha}_1 \cdot e^{i\frac{2\pi n}{N}} + \tilde{\alpha}_{N-1} e^{\frac{2\pi n (N-1)}{N}} \right)$$

$\alpha_1 = e^{i\theta}$, $\alpha_{N-1} = e^{-i\theta}$

$$= \frac{1}{\sqrt{N}} \cdot \left(e^{i\theta} \cdot e^{i\frac{2\pi n}{N}} + e^{-i\theta} e^{\frac{2\pi n (N-1)}{N}} \right)$$

} do some maths

$$\alpha_n = \frac{2}{\sqrt{N}} \cos\left(\frac{2\pi}{N} n + \theta \right)$$