

Foundations of Audio Signal Processing:

Exercise sheet 2

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Exercise 2.1.

(a).

$$2e^{\frac{\pi}{2}i}(1+i) \quad (1)$$

$$\text{For } a+bi = 1+i \quad (2)$$

$$r = \sqrt{1^2 + 1^2} = \sqrt{2} \quad (3)$$

$$1 = \sqrt{2} \cos \phi \quad (4)$$

$$\cos \phi = \frac{1}{\sqrt{2}} \quad (5)$$

$$\phi = \frac{\pi}{4} \quad (6)$$

$$(7)$$

$$2e^{\frac{\pi}{2}i}(1+i) = 2e^{\frac{\pi}{2}i}\sqrt{2}e^{\frac{\pi}{4}i} = 2\sqrt{2}e^{\frac{3\pi}{4}i} \quad (8)$$

(b).

$$z \cdot \bar{z} = |z|^2 \quad (9)$$

$$z = a + bi = re^{i\phi} \quad (10)$$

$$\bar{z} = a - bi = re^{-i\phi} \quad (11)$$

$$z \cdot \bar{z} = re^{i\phi} \cdot re^{-i\phi} = r^2 = a^2 + b^2 = |z|^2 \quad (12)$$

(c).

$$e^{i\alpha} = \cos \alpha + i \sin \alpha \quad (13)$$

$$i \sin \alpha = e^{i\alpha} - \cos \alpha \quad (14)$$

$$e^{-i\alpha} = \cos (-\alpha) + i \sin (-\alpha) = \cos \alpha - i \sin \alpha \quad (15)$$

$$i \sin \alpha = \cos \alpha - e^{-i\alpha} \quad (16)$$

$$\text{Sum of (14) and (16) gives } 2i \sin \alpha = e^{i\alpha} - e^{-i\alpha} \quad (17)$$

$$\sin \alpha = \frac{1}{2i}(e^{i\alpha} - e^{-i\alpha}) \quad (18)$$