

Foundations of Audio Signal Processing:

Exercise sheet 1

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Exercise 1.1.

(a).

$$(4 - i) \cdot (2 + i) = 6 + 4i - 2i - i^2 = 5 + 2i \quad (1)$$

(b).

$$(1 + 2i)^{-1} = a + bi \quad | \cdot (1 + 2i) \quad (2)$$

$$\Leftrightarrow 1 = (a + bi) \cdot (1 + 2i) = a + 2ai + bi + 2bi^2 \quad (3)$$

$$\Leftrightarrow 1 + 0i = a - 2b + (2a + b)i \quad (4)$$

Only fulfilled by

$$(I) \quad a - 2b = 1 \quad (5)$$

$$(II) \quad 2a + b = 0 \quad \Leftrightarrow \quad b = -2a \quad (6)$$

$$\text{insert in (I)} \quad a - 2(-2a) = 5a = 1 \quad \Leftrightarrow \quad a = \frac{1}{5} \quad (7)$$

$$\text{insert in (II)} \quad b = -2\frac{1}{5} = \frac{-2}{5} \quad (8)$$

So it can be concluded that

$$(1 + 2i)^{-1} = \frac{1}{5} - \frac{2}{5}i \quad (9)$$

(c).

$$2e^{2\pi i} + e^{i\pi 3/2} = 2(\cos(2\pi) + i\sin(2\pi)) + \cos\left(\frac{3}{2}\pi\right) + i\sin\left(\frac{3}{2}\pi\right) \quad (10)$$

$$= 2(1 + 0i) + 0 - 1i = 2 - 1i \quad (11)$$

(d).

$$4 \left(\frac{1-i}{1+i} \right)^2 = 4 \frac{(1-i)^2}{(1-i)^2} = 4 \frac{1-2i-1}{1+2i-1} = -4 \frac{2i}{2i} = -4 + 0i \quad (12)$$