1. True or False?

There exists some $\lambda \in \mathbf{C}$ such that

$$\lambda(1+i, 1-i, i) = (2i, 2, -1+i)$$

2. True or False?

Any vector space over $\mathbf{C}$ is also a vector space over $\mathbf{R}$.

3. True or False?

Suppose V is a vector space over $\mathbf{F}$ and we have $\lambda, \lambda' \in \mathbf{F}$ and $v \in V$ such that $\lambda v = \lambda' v$. Then $\lambda = \lambda'$.

4. True or False?

Let $V = \{(a, b) : a, b \in \mathbf{R}\}$. Define addition on V coordinate-wise, and define a scalar multiplication operation @ by the formula

$$\lambda @ (a, b) = (a, b)$$

for all $(a, b) \in V$ and $\lambda \in \mathbf{R}$. Then V, equipped with these operations, is a vector space over $\mathbf{R}$.