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EX: Express $3e^{j32^\circ} + 4e^{-j40^\circ}$ in rectangular and polar form.

ANS: $5.608 - j0.981$ or $5.693e^{-j9.922^\circ}$ (approx)

SOL'N: Use Euler's formula to write each complex number in rectangular form $a + jb$:

$$Ae^{j\phi} = A\cos\phi + jA\sin\phi$$

$$3e^{j32^\circ} = 3\cos(32^\circ) + j3\sin(32^\circ) = 2.544 + j1.590$$

$$4e^{-j40^\circ} = 4\cos(-40^\circ) + j4\sin(-40^\circ) = 3.064 - j2.571$$

Sum the real and imaginary parts:

$$3e^{j32^\circ} + 4e^{-j40^\circ} = 2.544 + 3.064 + j(1.590 - 2.571)$$

Our answer in rectangular form:

$$3e^{j32^\circ} + 4e^{-j40^\circ} = 5.608 - j0.981$$

Use the Pythagorean theorem to find the magnitude for polar form:

$$\left|3e^{j32^\circ} + 4e^{-j40^\circ}\right| = \sqrt{5.608^2 + 0.981^2} = 5.693$$

Use tangent of phase angle = Im/Re to find angle for polar form:

$$\angle\left(3e^{j32^\circ} + 4e^{-j40^\circ}\right) = \tan^{-1}\left(\frac{-0.981}{5.608}\right) = -9.922^\circ$$

Our answer in polar form:

$$3e^{j32^\circ} + 4e^{-j40^\circ} = 5.693e^{-9.922^\circ}$$