Quantum Physics I (PHYS313)

Complex number practice*(optional, not graded)*

Since complex numbers are used in quantum calculations all the time, it will help to review the basic concepts. For many calculations we will use complex numbers in *polar form*: $z = r\ e^{i\phi} = r\cos(\phi) + ir\sin(\phi)$.

Practice 1 Change to polar form:
(i) $-i$, (ii) $\frac{1}{2} - \frac{\sqrt{3}i}{2}$, (iii) $1+i$, (iv) $1-i$, (v) $(1+i)/(1-i)$.

Practice 2 Find real and imaginary parts of: (i) i^5, (ii) $(2+3i)/(1+6i)$, (iii) $e^{i\pi/6} - e^{-i\pi/6}$.

Practice 3 For $z_1 = 2e^{i\pi/4}$ and $z_2 = e^{-3i\pi/4}$, find:
(i) z_1^2, (ii) $|z_1|^2*$, (iv) $z_1 + z_2$, (v) $z_1 \cdot z_2$, (vi) z_1/z_2.

Practice 4 This one is a little trickier. Use polar form and complex exponents to prove that
$\cos 4\theta = 8\cos^4\theta - 8\cos^2\theta + 1$.
Find the expression for $\sin 4\theta$ in therms of $\sin\theta$ and $\cos\theta$?

Practice 5 Calculate:
(i) $(1+i)^{10}$, (i) $(1+i)^9/(1-i)^9$.
If you use polar form, the calculations should be one-liners.