

Homework 1

1. (40 points) Express the given complex numbers in Cartesian form $(x + jy)$. Demonstrate each step in the process, and do not use a calculator to determine the final answer instantly!

- (a) $j^7 + j + 1$
- (b) $(\sqrt{3} + \sqrt{3}j)^6$
- (c) $j(1 - j\sqrt{3})e^{\frac{j\pi}{6}}$
- (d) $\frac{e^{\frac{j\pi}{3}} - 1}{1 + j\sqrt{3}}$

2. (Bonus question, 10 points) Using Euler's relation show that:

- (a) $\sin \theta \sin \phi = \frac{1}{2} \cos(\theta - \phi) - \frac{1}{2} \cos(\theta + \phi)$
- (b) $\sin(\theta + \phi) = \sin \theta \cos \phi + \cos \theta \sin \phi$

3. (60 points) Using part (b) of the previous question evaluate the followings:

- (a) $\sin(\theta - \phi)$ and $\cos(\theta - \phi)$
- (b) $\sin(2\theta)$ and $\cos(2\theta)$ in terms of $\sin \theta$ and $\cos \theta$
- (c) $\sin(3\theta)$ and $\cos(3\theta)$ in terms of $\sin \theta$ and $\cos \theta$
- (d) $\sin^2 \theta$ and $\cos^2 \theta$ in terms of $\cos(2\theta)$
- (e) $\cos^3 \theta$ in terms of $\cos \theta$ and $\cos(3\theta)$; and similarly for $\sin^3 \theta$