1. Show that $f'(z)$ doesn't exist at any point if $f(z) = z + \bar{z}$.
2. Determine when $f'(z)$ exists if $f(z) = zRe(z)$, where $Re(z)$ denotes the real part of z.
3. Prove that $f(z) = (3x + y) + i(3y - x)$ is entire.
4. (i). $z = x + yi \in \mathbb{C}$, prove $x = \frac{z+\bar{z}}{2}$ and $y = \frac{z-\bar{z}}{2i}$

   (ii). We define $\frac{\partial}{\partial \bar{z}} = \frac{1}{2}(\frac{\partial}{\partial x} + i\frac{\partial}{\partial y})$. Prove if $f'(z)$ exists, then $\frac{\partial f}{\partial \bar{z}} = 0$.
5. Derive the polar form of Cauchy-Riemann Equations. (Recall that $x = r\cos\theta$ and $y = r\sin\theta$).
6. Derive the polar form of Laplace's equation $u_{xx} + u_{yy} = 0$.
7. If $u(x, y)$ is a harmonic function on a domain D, we say $v(x, y)$ is a harmonic conjugate of $u(x, y)$ if the complex function $f(z) = u(x, y) + v(x, y)i$ has derivative. Prove that if $v(x, y)$ and $w(x, y)$ are both harmonic conjugates of $u(x, y)$ on D, then $v(x, y)$ and $w(x, y)$ are differed by a constant.