1. Express each of the following complex numbers in polar exponential form: \( re^{i\theta} \)

   a. \(-2i\);   b. \( \frac{1}{\sqrt{2}} - \frac{i}{\sqrt{2}} \);   c. \( \sqrt{3} - i \);

2. Express the following complex numbers in real: form \( x + iy \), where \( x \) and \( y \) are real:

   a. \( \frac{1}{1-2i} \);   b. \( (1 - i)^2(1 + 2i) \);   c. \( |1 - 3i| \)

3. Solve for all the roots of the following equation: \( z^3 - 2z^2 + 2z = 0 \)

4. Establish the following inequalities:

   a. \( |4z_1 - z_2| \leq 4(|z_1| + |z_2|) \);   b. \( |2z_1 \bar{z}_2 + 3\bar{z}_1 z_2| \leq 5|z_1||z_2| \)

5. Sketch the region associated with the following inequality and determine if the region is open, closed, bounded, compact, connected: \( 6 \leq |3z + 7| \leq 9 \); Explain.

6. Show that \( \text{Im}(\frac{1}{z}) \) and \( \text{Im}(-z) \) have the same sign for all \( z \neq 0 \).

7. Find the series expansion around \( z = 0 \) of: \( \frac{\sin x - x}{x^3} \)
8. Evaluate the following limits, explain reasoning:

a. \( \lim_{z \to 0} \frac{\cos \beta z - 1}{z^2}, \beta \neq 0 \text{ const.} \)

b. \( \lim_{z \to 0} \frac{\sin \alpha z}{\sin \beta z}, \alpha, \beta \neq 0 \text{ const.} \)

c. \( \lim_{z \to \infty} \frac{Mz^4 + z}{(Nz^2 + 3)^2}, M, N \neq 0 \text{ const.} \)

d. \( \lim_{z \to \infty} \frac{\sinh 2az}{\cosh 2az}, a > 0 \text{ const.} \)

9. a) Solve 1.3: 3

b) Where are the following functions differentiable: i) \( \tanh z \) ii) \( e^{1/(z-i)} \)

10. Find the general solution of the following differential equation: \( \frac{d^3w}{dz^3} - 8w = 0 \); write the solution in real form.

XC (Extra Credit) Use '\( \epsilon, \delta \)' formulation to prove that \( \lim_{z \to i} z^2 = -1 \)