1. [1pt each] Describe (and draw) the images of the following sets under the map \( f(z) = e^z = \exp(z) \).

   (a) \( S = \{ z \mid \frac{\pi}{4} \leq \Im(z) \leq \frac{2\pi}{3} \} \)
   
   (b) \( S = \{ z \mid 1 \leq \Re(z) \leq 2 \} \).

2. [1pt each] Describe (and draw) the images of the following sets under the map \( f(z) = \Log(z) \).

   (a) \( S = \{ z \mid \Re(z) > 0, \Im(z) > 0 \} \)
   
   (b) \( S = \{ z \mid |z| \geq e \} \).

   **Note:** In class we introduced the notation \( \Log \) to denote the principal complex logarithm \( \log \), where we take the principal argument \( \Arg \in (-\pi, \pi] \), so that \( \Log \) is single-valued function, and the inverse of the complex exponential \( e^z \).

3. [1pt each] Find all values of

   (a) \((1 - i)^i\), 
   
   (b) \(i^{\frac{3}{4}}\), 
   
   (c) \((\sqrt{3} + i)^{2014}\).

4. [1pt for (a), 2pts each for (b) and (c)]

   For a complex number \( z \neq 0 \), show that \( z^w \) has:

   (a) One value if \( w \) is an integer.
   
   (b) Exactly \( q \) different values if \( w = p/q \) is a rational number, where \( p \) and \( q \) are integers, \( q > 0 \), and \( \gcd(p, q) = 1 \) (i.e, \( p/q \) is in lowest terms).
   
   (c) Infinitely many different values if \( w \) is not a rational number.

5. [2pts each]

   (a) Show that the function \( f(t) = e^{it} \), \( 0 \leq t \leq 2\pi \), describes the unit circle \(|z| = 1\) traversed in the counterclockwise direction (as \( t \in \mathbb{R} \) increases from 0 to \( 2\pi \)).
   
   (b) Describe the curve \( f(t) = e^{-it} + 1 - i \), \( 0 \leq t \leq 2\pi \).
   
   (c) What kind of object does \(|z + 1| - |z - 1| = \pm 2\) define?
   
   (d) Let \( f(z) = i\frac{z}{1+z^2} \). What is the set \( \{ \Im(f(z)) = 0 \} \)?