

Name:

- 1) With $f_c(z) = z^2 + c$, which of the following statements are true?
- The Mandelbrot set is the set of complex numbers such that $f_c^n(c) \rightarrow \infty$.
 - The Mandelbrot set is the set of complex numbers such that $f_c^n(c) \leq 2$ for all n . (You have shown in the homework that if $f_c^n(c) > 2$ then c is not in the Mandelbrot set).
 - The Mandelbrot set is the set of complex numbers such that $f_c^n(c)$ stays bounded.
- 2) True or False?
- Every quadratic polynomial is conjugated to the polynomial $f_c(z) = z^2 + c$.
 - Every cubic polynomial is conjugated to a polynomial $g_c(z) = z^3 + c$.
 - Every cubic polynomial is conjugated to a polynomial $g_{a,b}(z) = z^3 - 3a^2z + b$.
- 3) True or False?
- The union of the Julia set and the Fatou set is the entire complex plane.
 - The Fatou set is the complement of the Mandelbrot set.
- 4) Who was historically first to have made pictures of the Mandelbrot set?
- John Hubbard.
 - Douady and Hubbard.
 - Benoit Mandelbrot.
 - Brooks and Matelski.
- 5) A fixed point of a quadratic map $f(z)$ is defined to be stable, if (only one answer applies):
- $f'(z) < 1$.
 - $|f'(z)| \leq 1$.
 - $|f'(z)| = 0$.
 - $|f'(z)| < 1$.
- 6) True or False?
- The Ulam map $f(z) = 4z(1 - z)$ is in the complex plane conjugated to $f_{-2}(z) = z^2 - 2$.
 - The Julia set of the polynomial $f_0(z) = z^2$ is the circle with radius 1.
 - The filled in Julia set of the polynomial $f(z) = 4z^2$ is the disc of radius 1/2.
- 7) True or False? The Ulam map $f(z) = 4z(1 - z)$ restricted to its Julia set is conjugated to $x \mapsto 2x \pmod{1}$.
- 8) Which of the following dynamical systems is called the **Newton iteration** to find the root $f(z) = 0$:
- $T(z) = 1 - f(z)/f'(z)$
 - $T(z) = z - f'(z)/f(z)$
 - $T(z) = 1 - f'(z)/f(z)$
 - $T(z) = z - f(z)/f'(z)$
- 9) In order to find a fixed point of a map S , we can try to apply the Newton method to one of the following:
- $T(z) = S(z) - z$
 - $T(z) = S'(z) - z$
 - $T(z) = z - S(z)/S'(z)$.
- 10) True or False? The Mandelbrot set is a fractal because its dimension has shown to be smaller than 2 and bigger than 1.