2/7/05 QUIZZ NR 1 **Math118, O.Knill**

Name:

Email:

1) Look at the map $T(x) = x^2 + 1$ on the real line. Which of the following sequences form an **orbit** of x with initial condition $x_0 = 0$:

a) $0, 1, 2, 3, 4, ...$

b) $0, 1, 2, 5, 26, ...$

c) $0, 0, 0, 0, 0, ...$

d) $1, 1, 1, 1, ...$

2) Which of the following orbits are periodic cycles of the dynamical system?

a) $(x(t), y(t)) = (\sin(t), \cos(t))$ for the harmonic oscillator differential equation $\frac{d}{dt}x(t) = y(t), \frac{d}{dt}y(t) = -x(t)$.

b) The longest diagonal in a convex billiard table.

c) A single alive cell in the game of life.

d) The point 0 in the logistic map $T(x) = 4x(1 - x)$.

3) Which of the following dynamical systems have a discrete time? We replace "map" or "differential equation" with "system".

a) The game of life

b) The Lorentz system

c) The billiard system.

d) The harmonic oscillator system $\frac{d}{dt}x = y, \frac{d}{dt}x = -x$.

4) There is a sentence attributed to Steven Smale which appears also in the movie "Jurassic Park". The statement is "The wing of a butterfly in X can produce a tornado in Y a few weeks later":

a) X=Rio, Y=Texas
b) X=New York, Y = Los Angeles
c) X=Chicago, Y = New Orleans

5) We have seen the map

$$T(x, y) = ((x + y)/2, 2xy/(x + y))$$

to compute the square root of numbers. The number $2xy/(x + y)$ is called the

a) The geometric mean.
b) The algebraic mean.
c) The harmonic mean.

of x and y.

6) We have seen taht for a computer, iterations of the map $T(x) = 4x(1 - x)$ or the map $S(x) = 4x - 4x^2$ give different results for $T^n(x)$ and $S^n(x)$ if n is large and this happened for identical initial condition x_0. For which n, did we see different results?

a) $n = 1$
b) $n = 10$
c) $n = 100$