Physics 3344 **Professor Scalise**
Spring 2000 **Assignment #8**

Due: 21 March 2000

1. The year 2000 is a leap year, that is, we add a day to the end of February. To see why this decision is controversial, consider the current rule for leap years. Every 4 years, add a day; but every 100 years, don't add a day; but every 400 years, do add a day.

   If you add a day every 4 years, that's like adding $\frac{1}{4}$ of a day to each year. If you don't add a day every 100 years, that's like subtracting $\frac{1}{100}$ of a day to each year, and so on.

   $$1 \text{ year} = (365 + \frac{1}{4} - \frac{1}{100} + \frac{1}{400} + - \ldots) \text{ days}$$

   The length of one year, according to Stephen Jay Gould (at least in one part of his book – there are some contradictions), is $(365.242199 \pm 0.000001)$ days.

   (a) What is the precision of this measurement in seconds?
   (b) Give the length of one year in days, hours, minutes, and seconds.
   (c) Find the dates that Pope Gregory XIII omitted to create the Gregorian calendar and realign earthly and celestial time.
   (d) What are the next two rules in the sequence? (The denominators in the fractions must be divisible by all the previous denominators and they should be "round" numbers - easy to remember.)

2. Trees move faster at night than in the daytime.

   (a) Explain the context in which this statement makes sense.
   (b) How much faster do trees in Dallas move at night than in the daytime?

3. Consider the following riddle: A person walks one mile south, then one mile east, then one mile north, and winds up exactly at the starting point. What color are the bears? The answer is "white" because the North Pole is one starting point that makes the riddle true. There are actually infinitely many starting points. Catagorize them.

4. Find the real value of x that minimizes the function $f(x) = x^x$:

   (a) exactly
   (b) numerically

5. The two solutions to the equation $x^2 = -1$ are $\pm i$. Find i^i:

   (a) exactly
   (b) numerically

6. (a) Warm up by showing that $0.\overline{142857} = \frac{1}{7}$.
   (b) Then find the reduced rational form of $0.\overline{012345679}$ (the 8 is missing). Hint: both the numerator and denominator are less than 100.
   (c) Bonus: find the reduced rational form of $0.\overline{0123456789}$ (with the 8). Hint: the numerator is over 10 million and the denominator is over 1 billion. Mathematica might prove useful.

7. Read Marion & Thornton, Chapter 10.