1. Find

$$\sum_{n=1}^{\infty} \left[\arctan(n+1) - \arctan(n)\right].$$

Hint: write out the first several terms, and look for cancellation.

2. The notation $0.\overline{9}$, by definition, represents the infinite sum

$$0.9 + 0.09 + 0.009 + \cdots.$$

Find the sum of this infinite series.

3. Suppose a rubber ball, when dropped from a given height, returns to a fraction p of that height. How long does it take for a ball dropped from 10 meters to come to rest? Assume the ball takes $\sqrt{2h/g}$ seconds to fall to the ground, and the time it takes to bounce up to a given height is equal to the time it takes to come back down.

4. Show that $\sum_{n=2}^{\infty} \frac{1}{n \ln n \ln \ln n}$ diverges.