1. Determine whether the following sum converges.

$$\frac{5}{2} + \frac{5 \cdot 7}{2 \cdot 5} + \frac{5 \cdot 7 \cdot 9}{2 \cdot 5 \cdot 8} + \frac{5 \cdot 7 \cdot 9 \cdot 11}{2 \cdot 5 \cdot 8 \cdot 11} + \cdots$$

2. The *root test* says that if $\sqrt[n]{|a_n|} = |a_n|^{1/n}$ converges to a number less than 1, then $\sum a_n$ converges. Use the root test to show that $\sum \frac{n^2}{1.01^n}$ converges. (Note: it's handy to know that $n^{1/n} \to 1$ as $n \to \infty$.) Which is easier for this problem, the root test or the ratio test?

3. Show that $\sum_{n=1}^{\infty} \frac{\sin(n\pi/3)}{n}$ converges.

4. Show that $\sum_{n=1}^{\infty} \frac{\cos(n\pi)}{n}$ *without using the alternating series test* by grouping terms into consecutive pairs and showing that the infinite sum of these "pair-sums" converges.