## Friday, March 15

# Clicker Questions

# Clicker Question 1

**Types of convergence**

The series $\sum_{n=1}^{\infty} \frac{\sin(3^n)}{3^n}$ is . . .

**We can rule out . . .**

C and D: conv. always $\implies$ *one* of absolutely conv. or conditionally conv., but *never both*

E: absolutely conv. always $\implies$ conv.

A. . . . both absolutely convergent and convergent, but not conditionally convergent.

B. . . . both conditionally convergent and convergent, but not absolutely convergent.

C. . . . convergent, but neither absolutely convergent nor conditionally convergent.

D. . . . absolutely convergent and conditionally convergent and convergent.

E. . . . both absolutely convergent and conditionally convergent, but not convergent.

# Clicker Question 2

## The limit in the Ratio Test

If you apply the Ratio Test to the series

$$\sum_{n=3}^{\infty} \frac{(n-1)!}{2^{n(n-1)}},$$

what is $\lim_{n\to\infty} \frac{|a_{n+1}|}{|a_n|}$ ?

A. $\infty$

B. $1$

C. $0$

D. $1/2$

E. none of the above

## (and so the series converges)

$$\lim_{n\to\infty} \frac{|a_{n+1}|}{|a_n|} = \lim_{n\to\infty} \frac{n!/2^{(n+1)n}}{(n-1)!/2^{n(n-1)}}$$

$$= \lim_{n\to\infty} \frac{n!}{(n-1)!} \frac{2^{n^2-n}}{2^{n^2+n}}$$

$$= \lim_{n\to\infty} n \cdot \frac{1}{2^{(n^2+n)-(n^2-n)}}$$

$$= \lim_{n\to\infty} n \cdot \frac{1}{2^{2n}} = \lim_{n\to\infty} \frac{n}{4^n} = 0.$$