According to the Standards:

Instructional programs from preK-grade 12 should enable students to:
- Recognize and use connections among mathematical ideas
- Use the language of mathematics to express mathematical ideas precisely
- Select, apply and translate among mathematical representations to solve problems

In grades 9-12 students should
1. Students should develop an increased capacity to link mathematical ideas and a deeper understanding of how more than one approach to the same problem can lead to equivalent results.

Calculus Scope and Sequence: Infinite Series
**Keywords:** convergence, ratio test
Description: This activity will demonstrate the use of the ratio test to discuss the convergence of an infinite series.

The Ratio Test: For any series $\displaystyle\sum_{n=1}^{\infty} a_n$ ***If*** $\displaystyle\lim_{n\to\infty}\left|\frac{a_{n+1}}{a_n}\right| = L$ ***then:***

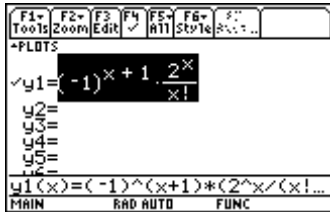- $\displaystyle\sum_{n=1}^{\infty} a_n$ ***is absolutely convergent when L < 1***

- $\displaystyle\sum_{n=1}^{\infty} a_n$ ***is divergent when L > 1***

- ***The ratio test provides no information when L = 1***

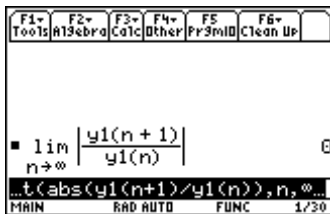Study the convergence of the series: $\displaystyle\sum_{n=0}^{\infty} (-1)^{n+1}\frac{2^n}{n!}$

- The limit function is found in F3-Calc-#3 and requires three arguments: lim(function, variable, limiting value)
- The Absolute Value is found in CATALOG, it is the first item
- The factorial key (!) is found in 2nd-5 (MATH)-Probability-#1
- ∞ key is found on the keyboard: <diamond> - catalog
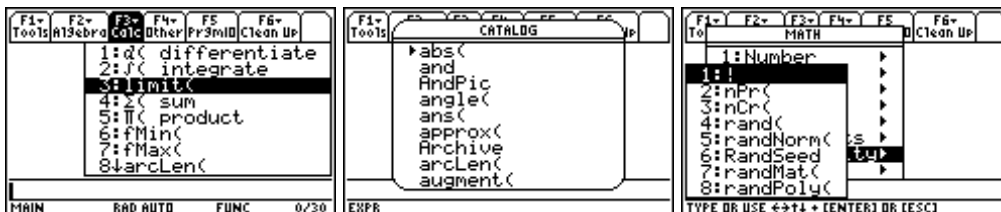
Store the series formula in Y= using x, in place of *n* for convenience

```
F1▾  F2▾ F3  F4  F5▾ F6▾  ⌐
Tools Zoom Edit ✓ All Style ░░ ░
⌐PLOTS
        x + 1   2ˣ
✓y1=(-1)    ·───
                x!
y2=
y3=
y4=
y5=
y1(x)=(-1)^(x+1)*(2^x/(x!...
MAIN      RAD AUTO     FUNC
```

Evaluate the limit:

```
F1▾   F2▾  F3▾  F4▾  F5    F6▾
Tools Algebra Calc Other PrgmIO Clean Up



   ■       | y1(n + 1) |
     lim    |─────────|            0
     n→∞    |  y1(n)  |
 ..t(abs(y1(n+1)/y1(n)),n,∞…
MAIN      RAD AUTO     FUNC    1/30
```

Thus, by the conditions of the ratio test, the series is ***absolutely convergent***