So far we have learned 4 methods for testing convergence/divergence of a SERIES:

- **Geometric Series: a geometric series is convergent if and only if the ratio is between -1 and 1.**
- **Divergence Test: if the sequence does not converge to 0, the series diverges.**
- **Harmonic Series: the harmonic series diverges.**
- **Telescoping Series: find a formula for the sequence of partial sums, then determine the behavior of the sequence partial sums.**

Verify your answer with WolframAlpha:
https://www.wolframalpha.com/examples/math/calculus/sequences/

Determine whether each series is convergent or divergent using one of the above four methods (at least 1 of the methods can give you a conclusive answer). State clearly which method/s you apply. **If the series is convergent, find its sum.**

1) $3-4+\frac{16}{3}-\frac{64}{9}+\quad\ldots$

2) $2+0.5+0.125+0.03125+\quad\ldots$

3) $\sum_{k=1}^{\infty}\frac{10^k}{(-9)^{k-1}}$

4) $\sum_{k=1}^{\infty}\frac{(-3)^{k+1}}{4^k}$

5) $\sum_{k=0}^{\infty}(-\pi)^k e^{-k}$

6) $\sum_{k=2}^{\infty}\frac{2^{3k+1}}{3^{2k-1}}$

7) $\sum_{k=1}^{\infty}\ln\left(\frac{k+1}{k}\right).$

8) $\sum_{k=1}^{\infty}\frac{1}{k(k+1)}.$

9) Let $a_n=\frac{n}{2n+1}$. Use one of the above four methods to determine whether the series $\sum_{n=1}^{\infty}a_n$ is convergent or divergent. If the series is convergent, compute its sum.

10) $\frac{1}{3}+\frac{1}{6}+\frac{1}{9}+\frac{1}{12}+\frac{1}{15}+ \quad \ldots$

11) $\frac{1}{3}+\frac{2}{9}+\frac{1}{27}+\frac{2}{81}+\frac{1}{243}+\frac{2}{729}+ \quad \ldots$

12) $\sum_{n=1}^{\infty}\frac{n(n+2)}{(n+3)^2}$

13) $\sum_{n=1}^{\infty}\frac{2^n+3^n}{5^n}$

14) $\sum_{n=1}^{\infty}\sqrt[n]{2}$

15) $\sum_{n=1}^{\infty}\ln\left(\frac{n+1}{2n+1}\right)$

16) $\sum_{n=1}^{\infty}\frac{1}{1+\left(\frac{2}{3}\right)^n}$

17) $\sum_{n=1}^{\infty}(\cos 1)^n$

18) $\sum_{n=1}^{\infty}\arctan n$

19) $\sum_{n=1}^{\infty}\left(\frac{3}{5^n}+\frac{2}{n}\right)$

20) $\sum_{n=1}^{\infty}\frac{2^n}{n^2}$

21) $\sum_{n=1}^{\infty}n\sin\left(\frac{1}{n}\right)$

22) $\sum_{n=1}^{\infty}\left[\frac{5}{n(n+1)}-(-1)^n\frac{3}{2^n}\right]$