- Please see the course webpage for the answer key.

Find the **Sum** for each of the following series.

1. $1-2+\frac{4}{2!}-\frac{8}{3!}+\frac{16}{4!}-\frac{32}{5!}+\dots$

2. $\frac{1}{3\pi}-\frac{1}{18\pi^2}+\frac{1}{81\pi^3}-\frac{1}{324\pi^4}+\dots$

3. $\sum_{n=0}^{\infty}\frac{(-1)^n\ (\ln 9)^n}{2^{n+1}\ n!}$

4. $1-\frac{1}{3}+\frac{1}{5}-\frac{1}{7}+\frac{1}{9}-\dots$

5. $-\frac{\pi^2}{2!}+\frac{\pi^4}{4!}-\frac{\pi^6}{6!}+\frac{\pi^8}{8!}-\dots$

6. $\sum_{n=0}^{\infty}\frac{(-1)^n\ \pi^{2n}}{9^n\ (2n+1)!}$

7. $\sum_{n=0}^{\infty}\frac{(-1)^n\ \pi^{2n}}{2^{4n}\ (2n)!}$

8. $\frac{1}{6}-\frac{1}{2\cdot 6^2}+\frac{1}{3\cdot 6^3}-\frac{1}{4\cdot 6^4}+\dots$

9. $\sum_{n=0}^{\infty}\frac{1}{3!\pi^n}$

10. $\sum_{n=0}^{\infty}\frac{(-1)^{n+1}\ \pi^{2n+1}}{9\ (2n)!}$

11. $\pi^2-\frac{\pi^4}{3!}+\frac{\pi^6}{5!}-\frac{\pi^8}{7!}+\dots$

12. $\sum_{n=0}^{\infty}\frac{(-1)^{n+1}\pi^{2n}}{4^n(2n+1)!}$

13. $\sum_{n=0}^{\infty}\frac{(-1)^n 3^{n+1}(\ln 4)^n}{n!}$

14. $1-e+\frac{e^2}{2!}-\frac{e^3}{3!}+\frac{e^4}{4!}-\dots$

15. $-\pi+\frac{\pi^3}{3!}-\frac{\pi^5}{5!}+\frac{\pi^7}{7!}-\dots$

16. $-1+\frac{1}{2}-\frac{1}{3}+\frac{1}{4}-\frac{1}{5}+\dots$

17. $-\frac{2}{2}+\frac{2}{3}-\frac{2}{4}+\frac{2}{5}-\frac{2}{6}+\dots$

18. $1+1-\frac{\pi^2}{2!}+\frac{\pi^4}{4!}-\frac{\pi^6}{6!}+\frac{\pi^8}{8!}-\dots$

19. $\frac{1}{2!}-\frac{1}{3!}+\frac{1}{4!}-\frac{1}{5!}+\dots$

20. $\sum_{n=0}^{\infty}\frac{(-1)^n}{(2n+1)\ 3^n}=\sum_{n=0}^{\infty}\frac{(-1)^n}{(2n+1)\ (\sqrt{3})^{2n}}$

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21. Find the MacLaurin Series for $\ln(1+6x)$.

P.S.

Hint: $\ln(1+6x) = \displaystyle\int \frac{6}{1+6x}\,dx$. Yes, solve for $+C$.

22. Find the MacLaurin Series for $\ln(9+x^2)$.

P.S.

Hint: $\ln(9+x^2) = \displaystyle\int \frac{2x}{9+x^2}\,dx$. Yes, solve for $+C$.

23. Show that the MacLaurin Series for $\dfrac{1}{2}\left(e^x - e^{-x}\right) = \displaystyle\sum_{n=0}^{\infty} \frac{x^{2n+1}}{(2n+1)!}$

24. Show that the MacLaurin Series for $\dfrac{1}{2}\left(e^x + e^{-x}\right) = \displaystyle\sum_{n=0}^{\infty} \frac{x^{2n}}{(2n)!}$

25. Use Series to Estimate $\displaystyle\int_0^1 x^3 \sin\left(x^2\right)\,dx$ with error less than $\dfrac{1}{100}$. Justify.

26. Use Series to Estimate $\displaystyle\int_0^1 x^4 e^{-x^3}\,dx$ with error less than $\dfrac{1}{10}$. Justify.

27. Estimate $\dfrac{1}{\sqrt{e}}$ with error less than $\dfrac{1}{100}$. Justify.

28. Estimate $\sin(1)$ with error less than $\dfrac{1}{1000}$. Justify. Hint: $7! = 5040$

29. Estimate $\arctan\left(\dfrac{1}{2}\right)$ with error less than $\dfrac{1}{100}$. Justify.