1. For which values of x does the following equality hold:
$\frac{20}{1-9x} = 20 + 180x + 1620x^2 + \cdots$?
   a. $-1 < x < 1$
   b. $0 < x \leq 1$
   c. $0 < x \leq \frac{1}{9}$
   d. $\frac{-1}{9} < x < \frac{1}{9}$
   e. NOTA

2. Find the interval of convergence of the following series: $\sum_{k=0}^{\infty} \frac{(-1)^k \cdot x^2}{e^k}$.
   a. $[0, 0]$
   b. $(-e^{1/2}, e^{1/2})$
   c. $(-e^{1/2}, e^{1/2}]$
   d. $(-\infty, \infty)$
   e. NOTA

3. Evaluate: $\sqrt[3]{12\sqrt[3]{12\sqrt[3]{12\ldots}}}$
   a. $2\sqrt[3]{18}$
   b. $2\sqrt{3}$
   c. 6
   d. 12
   e. NOTA

4. Evaluate: $\sqrt{12+\sqrt{12+\sqrt{12+\ldots}}}$
   a. $\sqrt{5}-1$
   b. $1+\sqrt{5}$
   c. 3
   d. 4
   e. NOTA

5. Consider a sequence $\{a_n\}$ of real numbers for which $\sum_{n=1}^{\infty} a_n$ converges. Which of the following must be true?
   I. If $\{b_m\}$ is a subsequence of $\{a_n\}$, then $\sum_{m=1}^{\infty} b_m$ converges.
   II. $\sum_{n=1}^{\infty} {a_n}^2$ converges.
   III. $\sum_{n=1}^{\infty} |a_n|$ converges.
   a. I only
   b. I, II
   c. II only
   d. I, II, III
   e. NOTA

6. Evaluate the following limit: $\lim_{n\to\infty} \sum_{i=1}^{3n} \left(\frac{1}{n} \cdot \left(1 + \frac{i}{n}\right)^3\right)$
   a. $\frac{81}{4}$
   b. $\frac{85}{4}$
   c. $\frac{93}{4}$
   d. $\frac{255}{4}$
   e. NOTA

7. Find the Maclaurin series of $f(x) = 3^x$.
   a. $\frac{3}{e}\sum_{k=0}^{\infty} \frac{x^k}{k!}$
   b. $\sum_{k=0}^{\infty} \frac{(3x)^k}{k!}$
   c. $\sum_{k=0}^{\infty} \frac{(ln(3)\cdot x)^{3k}}{k!}$
   d. $\sum_{k=0}^{\infty} \frac{(ln(3)\cdot x)^{k}}{k!}$
   e. NOTA

8. Compute $\sum_{n=1}^{\infty} \frac{n^2}{2^{2n}}$.
   a. $\frac{4}{9}$
   b. $\frac{20}{27}$
   c. 2
   d. 6
   e. NOTA

9. Find the interval of convergence of the following series: $\sum_{n=1}^{\infty} \frac{(x-4)^{2n}}{n \cdot 4^n}$.
   a. $(2,6)$
   b. $(0,8)$
   c. $(-4,12)$
   d. $(-8,20)$
   e. NOTA

10. Evaluate: $\int_0^{\infty} (e^{-x}|sin(x)|)\, dx$
   a. $\frac{e^{-\pi}+1}{2}$
   b. 1
   c. $\frac{e^{\pi}+1}{2(e^{\pi}-1)}$
   d. $\frac{e^{-2\pi}+e^{-\pi}+1}{2}$
   e. NOTA

For problems 11 and 12:
Several people are trying to find the area under $f(x) = e^x$ from $x = 0$ to 6.

11. Ben finds the exact area, while Zhao uses a Trapezoidal Approximation with 2 equal subdivisions. By how much do Ben's and Zhao's values differ?
   a. $2e^6 + 4$
   b. $\frac{1}{2}e^6 + 3e^3 + \frac{5}{2}$
   c. $\frac{1}{2}e^6 + \frac{3}{2}e^3 + \frac{1}{2}$
   d. $\frac{3}{2}e^6 + \frac{3}{2}e^3 + \frac{3}{2}$
   e. NOTA

12. Henrik and Jonathan integrate a 2nd degree Taylor Series to approximate $\int_0^6 f(x)\, dx$. Jonathan centers his about 0, while Henrik centers hers about 6. Whose area approximation is more accurate, and by how much do they differ from each other?
   a. Henrik, $e^6 - 61$
   b. Henrik, $18e^6 - 54$
   c. Jonathan, $24e^6 - 60$
   d. Jonathan, $60e^6 - 54$
   e. NOTA

13. Evaluate: $\sum_{n=4}^{\infty} \frac{n-1}{n^3+10n^2+19n-}$

a. $\frac{1}{9}$
b. $\frac{1}{10}$
c. $\frac{1}{11}$
d. $\frac{1}{12}$
e. NOTA

14. Evaluate: $2 + \frac{3}{2+\frac{3}{2+\dots}}$

a. -1
b. $1+\sqrt{3}$
c. 3
d. 5
e. NOTA

15. Evaluate: $\sum_{n=0}^{\infty} \frac{(n+2)^2}{n!}$

a. $4e$
b. $6e$
c. $8e$
d. $10e$
e. NOTA

16. Which of the following series is/are absolutely convergent?

I. $\sum_{n=2}^{\infty} \frac{1}{n \ln n}$

II. $\sum_{n=2}^{\infty} \frac{1}{\ln(n!)}$

III. $\sum_{n=2}^{\infty} \frac{1}{(\ln \quad)^n}$

a. None
b. III only
c. I and II
d. I, II, III
e. NOTA

17. Let $f(x) = \frac{xe^x}{1-x^2}$. Let the 4th degree Maclaurin series approximation of $f(x)$ be $M_4(x)$. Evaluate $M_4(1)$.

a. $\frac{7}{2}$
b. $\frac{14}{3}$
c. $\frac{9}{2}$
d. $\frac{17}{3}$
e. NOTA

18. Evaluate: $\sum_{n=1}^{\infty}\left(\frac{1}{n}\cdot\left(-\frac{1}{2}\right)^n\right)$

a. $\ln\frac{1}{3}$
b. $\ln\frac{2}{3}$
c. $-\ln\frac{5}{3}$
d. $-\ln 2$
e. NOTA

19. Evaluate: $\sum_{x=0}^{20}\frac{1}{x^2+7x+12}$

a. $\frac{7}{24}$
b. $\frac{1}{3}$
c. $\frac{3}{8}$
d. $\frac{5}{12}$
e. NOTA

20. Consider the series a_n given by $a_i(x) = \sqrt[i]{x+1} - \sqrt[i]{x}$. Evaluate $\sum_{k=1}^{\infty} a_k(1)$.

a. $\sqrt{\pi}$
b. $2\sqrt{\pi}$
c. $\frac{1+\sqrt{5}}{2}$
d. $1+\sqrt{5}$
e. NOTA

21. Define A_n as the area of 1 petal of the curve $r = \sin(n\theta)$. Find $\lim_{n\to\infty}(n \cdot A_n)$.

a. $\frac{\pi}{8}$
b. $\frac{\pi}{4}$
c. $\frac{\pi}{2}$
d. DNE
e. NOTA

22. Find the sum of the reciprocals of the triangular numbers, beginning with 1.

a. $\frac{5}{3}$
b. 2
c. $\frac{\pi^2-1}{3}$
d. $\frac{\pi^2}{3}$
e. NOTA

23. Evaluate $\lim_{n\to\infty} \sum_{k=2n}^{8n} \frac{1}{k\cdot(\ln k - \ln n)}$.

a. $\ln 3$
b. $\ln 4$
c. 3
d. 4
e. NOTA

24. If $f(x) = 2x + \frac{2}{3}x^3 + \frac{6}{5}x^5 + \frac{6}{7}x^7 + \frac{10}{9}x^9 + \frac{10}{11}x^{11} + \cdots$, evaluate $f\left(\frac{\sqrt{3}}{3}\right)$.

a. $\frac{2\sqrt{3}}{3} - \frac{\ln 3}{2}$
b. $\frac{2\sqrt{3}}{3}$
c. $\frac{3\sqrt{3}+\pi}{6}$
d. $\frac{\sqrt{3}}{2} + \sin\left(\frac{\sqrt{3}}{3}\right)$
e. NOTA

25. Consider the sequence $a_n = \frac{2^n + e^{n-1}}{n^{2019} + 2^n + e^n}, n > 0$. Find $\lim_{n\to\infty} a_n$.

a. 0
b. e^{-1}
c. 2
d. DNE
e. NOTA

26. Mike drops a basketball from 5 feet in the air. The ball always bounces off the ground to a height of $\frac{3}{5}$ its previous height. What is the total vertical distance travelled by the ball once the ball has stopped moving?
    a. 10
    b. 12.5
    c. 15
    d. 17.5
    e. NOTA

27. Find the Taylor Series expansion of $f(x) = x \cdot \sin x$ about $x = 0$.
    a. $\sum_{n=0}^{\infty} \frac{(-1)^n x^{2n+2}}{(2n+1)!}$
    b. $\sum_{n=0}^{\infty} \frac{(-1)^{n+1}\, 2 \cdot x^{2n+2}}{(2n+1)!}$
    c. $\sum_{n=0}^{\infty} \frac{(-1)^{n+1}\, 2^{2n-1} \cdot x^{4n+2}}{(2n+1)!}$
    d. $\sum_{n=0}^{\infty} \frac{(-1)^n 2^{2n} \cdot x^{4n+2}}{(2n+1)!}$
    e. NOTA

28. Find the Taylor Series expansion of $f(x) = \frac{\sin(2x^2)}{2}$ about $x = 0$.
    a. $\sum_{n=0}^{\infty} \frac{(-1)^n x^{2n+2}}{(2n+1)!}$
    b. $\sum_{n=0}^{\infty} \frac{(-1)^n\, 2 \cdot x^{2n+2}}{(2n+1)!}$
    c. $\sum_{n=0}^{\infty} \frac{(-1)^n\, 2^{2n-1} \cdot x^{4n+2}}{(2n+1)!}$
    d. $\sum_{n=0}^{\infty} \frac{(-1)^n\, 2^{2n} \cdot x^{4n+2}}{(2n+1)!}$
    e. NOTA

29. Evaluate: $\lim_{n\to\infty} \sum_{x=0}^{n} \sqrt{\frac{x^2}{n^4} - \frac{x^4}{n^6}}$
    a. $\frac{1}{3}$
    b. $\frac{\pi}{4}$
    c. 1
    d. Diverges
    e. NOTA

30. Let $A_n = \int_0^\pi \sin(nx)\,dx$. Find $\sum_{n=0}^{\infty} A_n$.

a. $-2\ln 2$
b. $2\ln 2$
c. 2
d. Diverges
e. NOTA