1. $\displaystyle\int_0^\infty \frac{dx}{\sqrt{x}(x+9)}$

(a) converges to $\dfrac{\pi}{3}$ _____ (correct)

(b) converges to $\dfrac{\pi}{9}$

(c) converges to π

(d) diverges

(e) converges to 0

2. $\displaystyle\int_0^2 \frac{dx}{(x-1)^2}$

(a) diverges _____ (correct)

(b) converges to -2

(c) converges to 2

(d) converges to 1

(e) converges to -1

3. Consider the convergent sequence $\{a_n\}$, where $a_1 = \sqrt{6}$, $a_{n+1} = \sqrt{6 + a_n}$ for $n \geq 1$. The sequence converges to

   (a) 3 _____(correct)
   (b) 6
   (c) -2
   (d) 1
   (e) -1

4. $\displaystyle\sum_{n=1}^{\infty}(e^{-n} + e^{-2n}) =$

   (a) $\dfrac{e+2}{e^2-1}$ _____(correct)
   (b) $\dfrac{e+1}{e^2+1}$
   (c) $\dfrac{1}{e-1}$
   (d) $\dfrac{1}{e+1}$
   (e) $\dfrac{e^2+2}{e^2+1}$

5. Which of the following series is/are **convergent**?

$$\text{I. } \sum_{n=2}^{\infty} \frac{1}{n(\ln n)^2} \qquad \text{II. } \sum_{n=1}^{\infty} \frac{1}{n^{2025/2026}} \qquad \text{III. } \sum_{n=1}^{\infty} \frac{1}{(n+1)(n+2)}$$

(a) I and III only _____(correct)

(b) I and II only

(c) II and III only

(d) I only

(e) II only

6. Consider the series $\displaystyle\sum_{n=1}^{\infty} \frac{4n^2+7}{n^{5/2}+5n+1}$.

(a) The series diverges by the limit comparison test with $\displaystyle\sum_{n=1}^{\infty} \frac{1}{\sqrt{n}}$ _____(correct)

(b) The series converges by the comparison test with $\displaystyle\sum_{n=1}^{\infty} \frac{1}{n^2}$

(c) The series converges as $\displaystyle\lim_{n\to\infty} \frac{4n^2+7}{n^{5/2}+5n+1} = 0$

(d) The series converges by the limit comparison test with $\displaystyle\sum_{n=1}^{\infty} \frac{1}{n^2}$

(e) The series converges by the limit comparison test with $\displaystyle\sum_{n=1}^{\infty} \frac{1}{n^{5/2}}$

7. The least number of terms required to approximate the sum of the series $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n!}$ with an error of less than 0.001 is

   (a) 6 (correct)
   (b) 5
   (c) 4
   (d) 3
   (e) 7

8. The series $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}\ n^2}{n^3+1}$

   (a) converges conditionally (correct)
   (b) diverges
   (c) converges absolutely
   (d) diverges by the Alternating series test
   (e) converges absolutely by the Integral test

9. Which of the following series is/are **convergent**?

$$\text{I. } \sum_{n=1}^{\infty} \frac{99^n}{n!} \qquad \text{II. } \sum_{n=1}^{\infty} \left(\frac{1}{e} - e^{-n}\right)^n \qquad \text{III. } \sum_{n=2}^{\infty} \frac{n}{\ln n}$$

(a) I and II only (correct)
(b) II only
(c) III only
(d) II and III only
(e) I only

10. The coefficient of x^2 in the n^{th} degree Maclaurin polynomial of $f(x) = \dfrac{-x + \sin x}{x^3}$ is

(a) $\dfrac{1}{120}$ (correct)
(b) $-\dfrac{1}{6}$
(c) $\dfrac{1}{20}$
(d) $-\dfrac{1}{5}$
(e) $-\dfrac{1}{80}$

11. The interval of convergence of $\displaystyle\sum_{n=2}^{\infty} \frac{(x-1)^n}{2^n\sqrt{n}}$ is

(a) $[-1,3)$ _____(correct)

(b) $[-1,3]$

(c) $(-1,3)$

(d) $(-1,3]$

(e) $(-\infty,\infty)$

12. A power series representation for $f(x) = \dfrac{1}{(5-x)^2}$ centered at $c=2$ is

(a) $\displaystyle\sum_{n=0}^{\infty} \frac{n+1}{3^{n+2}}(x-2)^n$ _____(correct)

(b) $\displaystyle\sum_{n=0}^{\infty} 5^{1-n}(x-2)^n$

(c) $\displaystyle\sum_{n=0}^{\infty} 5^{2-n}(x-2)^n$

(d) $\displaystyle\sum_{n=0}^{\infty} \frac{n}{3^{n+2}}(x-2)^n$

(e) $\displaystyle\sum_{n=0}^{\infty} \frac{n+2}{5^{n+2}}(x-2)^n$

13. A Maclaurin series for $\displaystyle\int_0^x \cos(t^2)\,dt$ is

(a) $\displaystyle\sum_{n=0}^{\infty}(-1)^n\frac{x^{4n+1}}{(4n+1)(2n)!}$ (correct)

(b) $\displaystyle\sum_{n=0}^{\infty}(-1)^n\frac{x^{4n+1}}{(4n+1)(2n+1)!}$

(c) $\displaystyle\sum_{n=0}^{\infty}(-1)^n\frac{x^{2n+1}}{(2n+1)(2n)!}$

(d) $\displaystyle\sum_{n=0}^{\infty}(-1)^n\frac{x^{4n}}{(2n)!}$

(e) $\displaystyle\sum_{n=0}^{\infty}(-1)^n\frac{x^{2n+1}}{(4n+1)(2n)!}$

14. $\displaystyle\int_0^1 \frac{e^x-e^{-x}}{e^x+e^{-x}}\,dx =$

(a) $\displaystyle\ln\frac{e^2+1}{2e}$ (correct)

(b) $\displaystyle\ln\frac{e^2-1}{2e}$

(c) $\displaystyle\ln\frac{e^2-1}{e}$

(d) $\displaystyle\ln\frac{e^2+1}{e}$

(e) $\displaystyle\ln\frac{e^2+1}{e^2-1}$

15. $\displaystyle\int_0^1 \frac{\sqrt{\arctan x}}{1+x^2}\,dx =$

(a) $\dfrac{\pi\sqrt{\pi}}{12}$ _____(correct)

(b) $\dfrac{\pi\sqrt{\pi}}{6}$

(c) $\dfrac{\pi\sqrt{\pi}}{4}$

(d) $\dfrac{\pi\sqrt{\pi}}{3}$

(e) $\dfrac{\pi\sqrt{\pi}}{2}$

16. $\displaystyle\int_1^2 \frac{1+x-x^2}{x^2+x^3}\,dx =$

(a) $\dfrac{1}{2} - \ln\dfrac{3}{2}$ _____(correct)

(b) $\dfrac{1}{2} + \ln\dfrac{3}{2}$

(c) $\dfrac{3}{2} + \ln 2$

(d) $\dfrac{3}{2} - \ln 2$

(e) $\dfrac{2}{3} - \ln 2$

17. The volume of the solid generated by revolving the region bounded by the graphs of $y = \dfrac{1}{x^2}$, $y = 0$, $x = 1$, and $x = 2$ about the $y-$axis, is equal to

(a) $2\pi \ln 2$ (correct)

(b) $\pi \ln 2$

(c) $\dfrac{\pi}{2} \ln 2$

(d) $\dfrac{3\pi}{2} \ln 2$

(e) $4\pi \ln 2$

18. The area of the region bounded by the graph of $f(x) = x^3 - 2x^2 + 2x$ and its tangent line at the point $P(1, 1)$, is equal to

(a) $\dfrac{1}{12}$ (correct)

(b) $\dfrac{1}{8}$

(c) $\dfrac{1}{6}$

(d) $\dfrac{1}{4}$

(e) $\dfrac{1}{2}$

19. If $f(x) = \int_x^{x^2-1} \sin(\frac{\pi}{2}t^2)\,dt$, then $f'(2) =$

(a) 4 (correct)
(b) 1
(c) 2
(d) 3
(e) 0

20. $\int_0^{\pi^2} \sin\sqrt{x}\;dx =$

(a) 2π (correct)
(b) 6π
(c) π
(d) 4π
(e) 8π