1. Given the infinite series

$$(1)\ \sum_{n=1}^{\infty} \frac{3 - \cos n}{n} \qquad (2)\ \sum_{n=1}^{\infty} \frac{\sqrt{n}}{n^2 + 1} \qquad (3)\ \sum_{n=1}^{\infty} \frac{\sqrt{n}}{2n + 1},$$

(A) (1) diverges, (2) diverges, (3) diverges

(B) (1) diverges, (2) converges, (3) diverges

(C) (1) converges, (2) diverges, (3) diverges

(D) (1) diverges, (2) diverges, (3) converges

(E) (1) converges, (2) converges, (3) diverges

2. When the Ratio Test is applied to the two infinite series

$$(1)\ \sum_{n=1}^{\infty} \frac{\sqrt{n}}{n + 1} \qquad (2)\ \sum_{n=1}^{\infty} \frac{n!}{3^n},$$

the information it provides is

(A) (2) diverges, no information on (1)

(B) (1) diverges, (2) converges

(C) (1) and (2) both converge

(D) (1) diverges, no information on (2)

(E) (1) converges, (2) diverges

3. Which one of the following series is conditionally convergent?

(A) $\sum_{n=1}^{\infty} \frac{3-(-1)^n}{n^2+3}$ (B) $\sum_{n=1}^{\infty} \frac{(-1)^n}{n^2+3}$ (C) $\sum_{n=1}^{\infty} \frac{3}{n+3}$

(D) $\sum_{n=1}^{\infty} \frac{3-(-1)^n}{n+3}$ (E) $\sum_{n=1}^{\infty} \frac{(-1)^n}{n+3}$

4. Given the infinite series

(1) $\sum_{n=1}^{\infty} \sqrt{\frac{n^2+1}{2n^5-n^3}}$ (2) $\sum_{n=1}^{\infty} \frac{n^3}{3^n}$,

(A) The n-th Term Test shows that (1) diverges and the Limit Comparison Test shows that (2) diverges

(B) The Ratio Test shows that (1) converges and the n-th Term Test shows that (2) diverges

(C) The Ratio Test shows that (1) diverges, and the Comparison Test shows that (2) converges

(D) The Comparison Test shows that (1) diverges, and the n-th Root Test shows that (2) converges

(E) The Limit Comparison Test shows that (1) converges, and the Ratio Test shows that (2) converges

5. Let $\sum a_n$, $\sum b_n$ be two infinite series. Which one of the following statements must be true?

(A) If $a_n \geq b_n \geq 0$ for all n, and $\sum b_n$ diverges, then $\sum a_n$ diverges

(B) If $a_n \geq b_n \geq 0$ for all n, and $\sum b_n$ converges, then $\sum a_n$ converges

(C) If $\sum a_n$ is an alternating series which converges, then $\sum a_n$ converges absolutely

(D) If $\sum a_n$ is an alternating series which converges, then $\sum a_n$ converges conditionally

(E) If $\lim_{n \to \infty} \frac{a_n}{b_n} = r$, where $0 < r < 1$, then $\sum a_n$ converges

6. The radius of convergence of the series $\sum_{n=1}^{\infty} \frac{n^2 x^n}{(n+1)2^n}$ is

(A) $\frac{1}{2}$ (B) ∞ (C) 2 (D) 1 (E) 0

7. The degree 6 term of the Maclaurin series for $e^{-(x^2)}$ is

(A) $\frac{1}{6!}x^6$ (B) $-x^6$ (C) $-\frac{1}{6}x^6$ (D) $-\frac{1}{6!}x^6$ (E) $\frac{1}{6}x^6$

8. The 4^{th} order Taylor polynomial for $f(x) = \cos^2 x$ at $a = 0$ is

(A) $1 - x^2 + \frac{1}{4}x^4$ (B) $1 - x^2 + \frac{1}{12}x^4$ (C) $1 - 2x^2 + 3x^4$

(D) $1 - x^2 + \frac{1}{3}x^4$ (E) $1 + \frac{1}{4}x^4$

9. $\displaystyle\sum_{n=1}^{\infty} \frac{\left(-\frac{1}{2}\right)^n}{n} =$

(A) $e^{-\frac{1}{2}}$ (B) diverges (C) $\ln 2 - \ln 3$

(D) $\tan^{-1}\left(\frac{3}{2}\right)$ (E) $\sin\left(\frac{1}{2}\right)$

10. The coefficient of x^3 in the Maclaurin series for $\sqrt{(1 + x)^3}$ is

(A) $\frac{1}{2}$ (B) $\frac{1}{8}$ (C) $-\frac{1}{8}$ (D) $-\frac{1}{16}$ (E) $\frac{3}{32}$

11. The approximate value of $(1.2)^{3/2}$ obtained by using the 2^{nd} order Taylor polynomial for $f(x) = x^{3/2}$ at $a = 1$ is

(A) 1.315 (B) 1.33 (C) 1.215 (D) 1.205 (E) 1.425

12. According to Taylor's theorem, the size of the error in the approximation to $(1.2)^{3/2}$ referred to in question 11 is equal to

(A) $\frac{1}{16} c^{3/2}$, where $1 < c < 1.2$

(B) $\frac{1}{2000} c^{3}$, where $0 < c < 0.2$

(C) $\frac{3}{1000\, c^{3/2}}$, where $1 < c < 1.2$

(D) $\frac{1}{16} c^{3}$, where $0 < c < 0.2$

(E) $\frac{1}{2000\, c^{3/2}}$, where $1 < c < 1.2$

13. $\int_0^1 \sin(x^2)\,dx =$

(A) $\frac{1}{2} - \frac{1}{6(3!)} + \frac{1}{10(5!)} - \frac{1}{14(7!)} + \cdots$

(B) $\frac{1}{3} - \frac{1}{7(3!)} + \frac{1}{11(5!)} - \frac{1}{15(7!)} + \cdots$

(C) $1 - \frac{1}{3!} + \frac{1}{5!} - \frac{1}{7!} + \cdots$

(D) $\frac{1}{2} - \frac{1}{4(3!)} + \frac{1}{6(5!)} - \frac{1}{8(7!)} + \cdots$

(E) $1 - \frac{1}{2!} + \frac{1}{4!} - \frac{1}{6!} + \cdots$

14. The ellipse $9x^2 + 10y^2 = 90$ has

(A) eccentricity $\frac{1}{10}$, and a focus at $(1,0)$

(B) eccentricity $\sqrt{10}$, and a focus at $(\sqrt{10}, 0)$

(C) eccentricity $\frac{1}{\sqrt{10}}$, and a focus at $(1,0)$

(D) eccentricity $\frac{\sqrt{19}}{10}$, and a focus at $(\sqrt{19}, 0)$

(E) eccentricity $\sqrt{\frac{19}{10}}$, and a focus at $(\sqrt{19}, 0)$

15. Suppose Q is a point on the circumference of a circle of radius 1 centered at the origin O, as shown in the diagram. Let R be the point with coordinates (2,0), and let P be the midpoint of the line segment QR. As Q moves around the circle, P traces out a curve whose parametric equations in terms of the angle t shown in the diagram are

(A) $x = \frac{3}{2}$, $y = \sin t$

(B) $x = \frac{3}{2} - \cos t$, $y = \tan t$

(C) $x = 1 + \frac{1}{2}\cos t$, $y = \frac{1}{2}\sin t$

(D) $x = 1 + \cos t$, $y = \sin t$

(E) $x = \frac{3}{2}\cos t$, $y = \frac{1}{2}\sin t$

16. The curve given by the parametric equations

$$x = 4 \sin t, \qquad y = 2 \cos t, \qquad 0 \le t \le \pi,$$

most closely resembles

(A) (B) (C) (D) (E)

17. P is the point on the curve

$$x = \sqrt{t^2 + 3}, \quad y = t^3$$

given by $t = 1$. The tangent line to the curve at P has the equation

(A) $y = 6x - 11$ (B) $y = 12x - 23$ (C) $y = 3x - 5$

(D) $y = 2x - 3$ (E) $y = 4x - 7$