1. Consider \( \lim_{(x,y) \to (0,0)} \frac{6xy}{x^2+y^2} \)

(1) The limit is 0.

(2) The limit is 3.

(3) The limit is all values between -3 and 3.

(4) The limit does not exist.

2. Let \( w = f(x, y) \) with \( x = u^2 + 2uv \) and \( y = u^2 - v^2 \). If \( f_x(5, -3) = -1 \) and \( f_y(5, -3) = 6 \), the rate of change of \( w \) with respect to \( v \) at \( (u, v) = (1, 2) \) is

(1) -26.

(2) 5.

(3) 6.

(4) -22.

3. Let \( A \) be a series whose partial sum is \( S_n = 2 + (-1)^n \sin \left( \frac{1}{n} \right) \). Then

(1) \( A \) converges to 1.

(2) \( A \) converges to 2.

(3) \( A \) converges to 3.

(4) \( A \) diverges.
4. A region $D$ in the first quadrant of the $xy$-plane is bounded by the curves $x = 2\sqrt{y}$ and $y = x$. The value of $\iint_D x\,dA$ is

(1) $8/3$.
(2) $1/12$.
(3) $16/3$.
(4) $23/12$.

5. For the function $f(x, y) = -y^3 + 2x^3 + 6y^2 - 6x + 4$

(1) $(1, -1)$ and $(1, 0)$ are local minima.
(2) $(-1, 0)$ and $(-1, 4)$ are saddle points.
(3) $(1, 0)$ is a local minimum and $(-1, 4)$ is a local maximum.
(4) $(1, 0)$ is a local maximum and $(-1, 4)$ is a local minimum.

6. The rates of change of a function $f(x, y, z)$ at a point $P_0$ in the direction of the vectors $\frac{1}{\sqrt{3}}(\vec{i} + \vec{j} + \vec{k})$, $\vec{i}$ and $-\vec{j}$, respectively, are $2, 1$ and $1$. The rate of change of $f$ at $P_0$ in the direction $\frac{3}{\sqrt{5}} \vec{i} + \frac{4}{\sqrt{5}} \vec{k}$ is

(1) $\frac{8\sqrt{3} - 5}{5}$.
(2) $-\frac{3}{\sqrt{5}} \vec{j} + \frac{8\sqrt{3}}{5} \vec{k}$.
(3) $\frac{3}{\sqrt{5}} \vec{j} + \frac{8(\sqrt{3} - 1)}{5} \vec{k}$.
(4) $\frac{8\sqrt{3} + 3}{5}$.

7. The volume of a solid is given by $V = \int_{-1}^1 \int_{-\sqrt{1-y^2}}^{\sqrt{1-y^2}} \int_0^{\sqrt{2-x^2-y^2}} dz\,dx\,dy$. The volume is also given by

(1) $\int_0^1 \int_{0}^{2\pi} \int_0^{\sqrt{2-\rho^2}} rdz\,d\theta d\rho$.
(2) $\int_{\pi/2}^{\pi} \int_0^{2\pi} \int_0^{\sqrt{2}} \rho^2 \sin(\phi) d\rho d\phi d\phi$.
(3) $\int_0^{\sqrt{2}} \int_0^{\sqrt{2-\rho^2}} \int_0^{2\pi} rd\theta dz\,d\rho$.
(4) $\int_0^{\sqrt{2}} \int_0^{2\pi} \int_0^{\pi/4} \rho^2 \sin(\phi) d\phi d\theta d\rho$. 

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8. The value of \( I = \int_0^1 \int_y^{\sqrt{2-y^2}} y\sqrt{x^2+y^2} \, dx \, dy \) is

(1) \( \frac{1}{4\sqrt{2}} \).
(2) \( \frac{1}{4} - \frac{1}{4\sqrt{2}} \).
(3) \( \frac{1}{\sqrt{2}} \).
(4) \( 1 - \frac{1}{\sqrt{2}} \).

9. Evaluate \( I = \int_0^{2\pi} \int_{\sqrt{\pi}/2}^{\sqrt{\pi}} \sin(x^2) \, dx \, dy \)

(1) 0.
(2) 2.
(3) -1.
(4) \( 1 - \frac{1}{\sqrt{\pi}} \).

10. A solid is bounded by the surfaces \( z = \sqrt{4 - x^2 - y^2} \), \( z = \sqrt{1 - x^2 - y^2} \) and \( z = 0 \). The mass density of the solid is \( \rho(x, y, z) = x^2 + y^2 + z^2 \). The mass of the solid is

(1) \( \int_0^\pi \int_0^{2\pi} \int_1^{\sqrt{4}} \rho^3 \sin \phi \, d\rho \, d\theta \, d\phi \).
(2) \( \int_0^{\pi/2} \int_0^{2\pi} \int_1^{2} \rho^2 \sin \phi \, d\rho \, d\theta \, d\phi \).
(3) \( \int_0^{\pi/2} \int_0^{2\pi} \int_1^{2} \rho^3 \sin \phi \, d\rho \, d\theta \, d\phi \).
(4) \( \int_0^\pi \int_0^{2\pi} \int_1^{2} \rho^2 \sin \phi \, d\rho \, d\theta \, d\phi \).

11. Let \( A \) and \( B \) denote the infinite series

\[
A = \sum_{n=1}^{\infty} \frac{7}{n + 4n+1} \quad \text{and} \quad B = \sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n} \frac{n^2}{\sqrt{n^3}}
\]

(1) \( A \) diverges and \( B \) converges .
(2) \( A \) converges and \( B \) diverges .
(3) Both series converge .
(4) Both series diverge.
12. The first four terms of Taylor series generated by \( f(x) = \frac{1}{x} \) at \( x = 1 \) are

(1) \( 1 - (x - 1) + 2(x - 1)^2 - 6(x - 1)^3 \).
(2) \( \frac{1}{x} - \frac{(x-1)}{x^2} + \frac{2}{x^3} (x-1)^2 - \frac{6}{x^4} (x-1)^3 \).
(3) \( \frac{1}{x} - \frac{(x-1)}{x^2} + \frac{1}{x^3} (x-1)^2 - \frac{1}{x^4} (x-1)^3 \).
(4) \( 1 - (x - 1) + (x - 1)^2 - (x - 1)^3 \).

13. The power series representation of \( f(x) = \frac{2x^3}{x^3-1} \) is

(1) \( \sum_{n=0}^{\infty} -2x^{n+3} \).
(2) \( \sum_{n=0}^{\infty} 2x^{n+3} \).
(3) \( \sum_{n=0}^{\infty} -2x^{n+2} \).
(4) \( \sum_{n=0}^{\infty} 2x^{n+2} \).

14. The open interval of convergence of the series \( \sum_{n=1}^{\infty} \frac{3^n (x+4)^n}{\sqrt{n}} \) is

(1) \( (-\frac{13}{3}, -\frac{11}{3}) \).
(2) \( (\frac{11}{3}, \frac{13}{3}) \).
(3) \( (-5, -3) \).
(4) \( (-7, -1) \).