1. Compute the distance from $P(3,-1,2)$ to the line $\begin{cases} x+y-z=-1 \\ 2x-y+z=4 \end{cases}$.

2. Given $|\vec{a}|=3$, $|\vec{b}|=4$, $|\vec{c}|=5$, $\vec{a}+\vec{b}+\vec{c}=\vec{0}$, compute $|\vec{a}\times\vec{b}+\vec{b}\times\vec{c}+\vec{c}\times\vec{a}|$.

3. Compute $L=\lim_{x\to 0}(|\vec{a}+x\vec{b}|-|\vec{a}-x\vec{b}|)/x$.

4. Compute the distance from point $P(1,2,-1)$ to the line $L:(x-1)/2=(y+1)/(-1)=(z-2)/3$.

5. Find and classify the critical points of $f(x,y)=e^{-x}(x-y^3+3y)$.

6. Find points on $C:\begin{cases} x^2+y^2=2z^2 \\ x+y+3z=5 \end{cases}$ with extremal distances to the xOy plane.

7. Given $A(1,3,4)$, $B(3,5,6)$, $C(2,5,8)$, $D(4,2,10)$, compute V_{ABCD}.

8. A plane passes through the z-axis and forms an angle of $\pi/3$ with the plane $2x+y-\sqrt{5}z=0$. Find the equation of the plane.

9. Prove that $L_1: x/1=y/2=z/3$ and $L_2:(x-1)/1=(y+1)/1=(z-2)/1$ are skew lines, find their common perpendicular, and compute the distance between them.

10. Find the extreme points and extreme values of $z=z(x,y)$ from $x^2-6xy+10y^2-2yz-z^2+18=0$.

11. Find the minimum and maximum values of u given: $\begin{cases} u=x^2+y^2+z^2 \\ z=x^2+y^2 \\ x+y+z=4 \end{cases}$.

12. Find the maximum value of xyz subject to $x^2/a^2+y^2/b^2+z^2/c^2=1$.

13. For $z=f(x,y)=\begin{cases} 0, & x^2+y^2=0 \\ (x^2+y^2)\sin(1/\sqrt{x^2+y^2}), & x^2+y^2\neq 0 \end{cases}$, study: Continuity, Partial Derivatives, Differentiability, Continuity of Partial Derivatives.

14. Compute $\iint_D(x^2-|x|\arctan y+x^3e^y)dxdy$, where $D=\{(x,y)\mid x^2+y^2<1\}$.

15. A thin plate occupies region D bounded by $y=x^2$ and $y=x$, with density $\mu(x,y)=x^2y$. Find the centroid.

16. Compute $\iint_D(x^2+y^2)d\sigma$, where $D=\{(x,y)\mid 0\le y\le \sin x,\ 0\le x\le\pi\}$.

17. Compute $\iint_D e^{\max\{b^2x^2,a^2y^2\}}d\sigma$, where $D=\{(x,y)|-a\le x\le a,-b\le y\le b\}$.

18. Compute $\lim_{r\to 0}[\iint_D e^{x^2-y^2}\cos(x+y)d\sigma]/(\pi r^2)$, where $D=\{(x,y)|x^2+y^2\le r^2\}$.

19. Compute $I=\int_0^1\int_0^{1-x}\int_{x+y}^1(\sin z)/z\,dzdydx$.

20. Prove $\int_0^1 dx\int_x^1 dy\int_x^y f(x)f(y)f(z)dz=\frac{1}{6}(\int_0^1 f(t)dt)^3$.

21. Let Σ be the finite part of $z=(x^2+y^2)/2$ cut by $z=2$. Compute $\iint_\Sigma zdS$.

22. Let Σ be the outer surface of $x^2+y^2+z^2=9$. Compute $\iint_\Sigma zdxdy$.

23. Compute $I=\oint_D xydx+z^2dy+zxdz$, where D is the intersection of $z=\sqrt{x^2+y^2}$ and $x^2+y^2=2ax$ $(a>0)$, oriented counterclockwise when viewed from positive z-axis.

24. Let Σ be the lower side of $z = x^2 + y^2$ where $0 \leq z \leq a^2$. Compute: $\iint_\Sigma (y - x^2 + z^2) dydz + (x - z^2 + y^2) dzdx + (z - y^2 + x^2) dxdy$.

25. Let Σ be the oriented surface $z = x^2 + y^2$ $(0 \leq z \leq 1)$, with normal forming acute angle with positive z-axis. Compute $\iint_\Sigma (2x + z) dydz + z dxdy$.

26. Given $f(0) = 0$, $f'(0) = 1$, and $[xy(x+y) - f(x)y]dx + [f'(x) + x^2 y]dy = 0$ is exact. Find its general solution.

27. Given $f(0) = 1/2$ and $\int_L [e^x + f(x)]ydx - f(x)dy$ is path-independent. Compute from $(0,0)$ to $(1,1)$.

28. For all smooth oriented closed surfaces Σ in $x > 0$, $\iint_\Sigma xf(x)dydz - xyf(x)dzdx - e^{2x}zdxdy = 0$. Given $\lim_{x\to 0^+} f(x) = 1$, find $f(x)$.

29. Compute $I = \iint_\Sigma x^2 dS$, where Σ is part of cylinder $x^2 + y^2 = a^2$ between $z = 0$ and $z = h$ $(h > 0)$.

30. Let Σ be the part of $z = x^2 + y^2$ below $z = 1$. Compute $I = \iint_\Sigma |xyz| dS$.

31. Prove that $(yze^{xyz} + 2x)dx + (zxe^{xyz} + 3y^2)dy + (xye^{xyz} + 4z^3)dz$ is exact and find its potential function.

32. Compute $\lim_{t\to 0}[\iiint_{x^2+y^2+z^2\leq t^2} f(\sqrt{x^2+y^2+z^2})dv]/(\pi t^4)$.

33. Compute $\lim_{n\to\infty} \sum_{i=1}^n \sum_{j=1}^n n/[(n+i)(n^2+j^2)]$.

34. Given $r = \sqrt{x^2+y^2+z^2}$, Σ is outer surface of $x^2+y^2+z^2 = a^2$. Compute $\iint_\Sigma (xdydz + ydzdx + zdxdy)/r^3$.

35. Compute $\iiint_\Omega zdxdydz$, where Ω is bounded by cone $z = (h/R)\sqrt{x^2+y^2}$ and plane $z = h$ $(R > 0, h > 0)$.

36. Compute $S = \sum_{n=0}^\infty (-1)^n (n^2 - n + 1)/2^n$.

37. Expand $f(x) = \cos x$ as a Sine Series on $[0, \pi]$.

38. If $\sum_{n=1}^\infty a_n$ converges, provide counterexamples showing the following may not converge:
    (i) $\sum_{n=1}^\infty |a_n|$
    (ii) $\sum_{n=1}^\infty (-1)^n a_n$
    (iii) $\sum_{n=1}^\infty a_n a_{n+1}$

39. Compute $\lim_{n\to\infty} \frac{1}{n} \sum_{k=1}^n \frac{1}{3^k}(1 + \frac{1}{k})^{k^2}$.

40. Given $f(x) = 2x^2/(1+x^2)$, compute $f^{(6)}(0)$.

41. Find the sum function of $\sum_{n=2}^\infty x^n/(n^2-1)$.

42. Expand $f(x) = \frac{1}{4}\ln((1+x)/(1-x)) + \frac{1}{2}\arctan x - x$ into a power series.

43. Study the power series $\sum_{n=1}^\infty x^{n+1}/[n(n+1)]$.

44. Prove convergence of $\sum_{n=1}^\infty \int_{n\pi}^{(n+1)\pi} (\sin x)/x dx$.