1. Determine whether each of the following series is convergent or divergent.

   (a) $\displaystyle\sum_{n=1}^{\infty}(-1)^n \arctan\left(\frac{3-n}{n+3}\right)$

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

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

   (d) $\displaystyle\sum_{n=1}^{\infty}\frac{3}{n^{0.72}}$

2. Find the sum of the series.

   (a) $\displaystyle\sum_{n=1}^{\infty}\frac{3^n+(-4)^{n-1}}{12^n}$

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

3. Find the radius and interval of convergence of the following series:

$$\sum_{n=0}^{\infty}\frac{5^n n^3}{3^n n!}(x-3)^n.$$

4. Find a power series representation for $f(x)=\dfrac{x}{(1-2x)^2}$.

5. Find the 3rd degree Taylor polynomial of $g(x)=\sqrt{2x+5}$ at 2.

6. For $f(x)=\dfrac{x}{1+x^2}$, what is the value of $f^{(2005)}(0)$?

7. Approximate $\displaystyle\int_0^{\frac{1}{2}}\frac{1}{1+x^3}$ with an error less than 0.01.

8. Find an equation of the plane that contains both the point $(1,1,2)$ and the line $x=1-2t$, $y=1+3t$, $z=-2-t$.

9. Find parametric equations for the line that is parallel to the planes $x-y=0$ and $2x+2y-z=3$, and passes through the point $(2,3,-1)$.

10. Find the cosine of the angle between the planes $x-y+z=0$ and $2x+2y-3z=5$.

11. Find the distance of the center of the sphere $x^2+y^2+z^2+6x-2z+2y=1$ from the plane $x+2y-2z=3$.

12. Determine whether the lines L_1 and L_2 are parallel, skew, or intersecting. If they intersect, find the point of intersection.

$$L_1: \frac{x-2}{3}=\frac{1-y}{2}=\frac{z-2}{2} \qquad L_2: \frac{x}{3}=\frac{y+1}{2}=\frac{z+1}{2}$$

13. Find the area of the triangle with vertices $P(1, 2, 3)$, $Q(0, 1, 3)$ and $R(-1, 2, -1)$.

14. Let $\mathfrak{R}$ be the region in the xy-plane bounded by the curve $x = -t^3$, $y = t^2 + 2t$ and the x-axis.

   (a) Sketch the region $\mathfrak{R}$. Label x- and y-intercepts of the curve, if any, on your graph.

   (b) Set up a formula that computes the length of the boundary of $\mathfrak{R}$.

   (c) Find the area of $\mathfrak{R}$.

15. Let $\mathbf{r}(t) = \langle t^2, t, t^3 - 3\rangle$ and $P = (1, 1, -2)$.

   (a) Find parametric equations for the tangent line to $\mathbf{r}(t)$ at P.

   (b) Find an equation of the normal plane at P.

   (c) Find the unit tangent vector $\mathbf{T}$ at P.

   (d) Find the curvature κ at P.

16. The acceleration vector of a moving particle is given by $\mathbf{a}(t) = 2\mathbf{i} - (6t - 2)\mathbf{k}$. If its initial velocity is $\mathbf{v}(0) = 3\mathbf{j}$ and the position vector at $t = 2$ is $\mathbf{r}(2) = -\mathbf{i} + 5\mathbf{j} + 5\mathbf{k}$, what is the initial position $\mathbf{r}(0)$?

17. Sketch the domain of the function $f(x, y) = \ln(y^2 - x^4)$.

18. Sketch level curves of $f(x, y) = -x^2 + 2x - y$ for $k = 0, 1, 2, 4$.

19. Find an equation of the tangent plane to the surface $z = x^2 - \sqrt{3x + y^2}$ at $(1, 1, -1)$.

20. For $f(x, y) = \ln(x + y^2)$, estimate the value $f(0.1, -1.1)$.

21. If $R = [0, 6] \times [0, 4]$, use a Riemann sum with $m = 3$ and $n = 2$ to estimate the value $\displaystyle\iint_R x^2 - xy\, dA$. Take the sample point to be the upper left corners of the subrectangles.

22. Evaluate the double integrals.

   (a) $\displaystyle\iint_R \frac{2xy \ln x}{1 + y^2}\, dA$, where $R = [1, 2] \times [0, 1]$.

   (b) $\displaystyle\iint_D x + 2y\, dA$, where D is the region bounded by $y = x$ and $y = x^2$.

   (c) $\displaystyle\int_0^1 \int_y^1 2\cos(x^2)\, dx\, dy$.

23. Find the volume of the solid enclosed by the planes $z = x + y + 1$, $x = 0$, $y = 0$, $x + y = 1$ and $z = 0$.

24. Find the center of mass of the lamina that occupies the triangular region D with vertices $(0, 0)$, $(1, 2)$, $(3, 0)$ and has the density function $\rho(x, y) = 2y$.