1. Find the area of the parallelogram with vertices at the points \((3,1,0),(6,5,2),(4,5,1)\) and \((1,1,-1)\).

2. Find the parametric equations of the line of intersection of the planes: \(3x + 2y + z = 2\) and \(2x - y + z = 4\).

3. Find the equation of the tangent plane to the surface: \(z + \arctan \left( \frac{x}{y} \right) = 0\), at the point \(\left(1,-1,\frac{\pi}{4}\right)\).

4. The volume \(V\) of a right circular cylinder of radius \(r\) and height \(h\) is given by \(V = \pi r^2 h\). Suppose the height is measured at 10 cm and the radius is measured at 5 cm, each with a possible error of 0.01 cm. Use differentials to estimate the largest possible error in calculating the volume. (Leave the answer in terms of \(\pi\)).

5. (a) Evaluate: \(\int\int_D \sqrt{1-x^2-y^2} \, dA\), where \(D\) is the sector in the first quadrant of the circle \(x^2+y^2=1\) between \(y=0\) and \(y=x\).

(b). Use a double integral to find the area of the region bounded by the graph of the equation \(r=3\cos(2\theta)\).

6. Find the length of the asteroid: \(x^{2/3} + y^{2/3} = 1\), shown below.
7. a. Show that the limit: 
\[
\lim_{{(x,y)\to(0,0)}} \left( \frac{xy^2}{x^3 + y^3} \right)
\]
does not exist.

b. Let \( f(x, y, z) = xyz \), using the chain rule (credit will not be given for any other method), calculate \( \frac{\partial f}{\partial s} \), where \( x = s^2, y = s + t \) and \( z = t^2 \). Give your answer in terms of \( s \) and \( t \).

8. Use a triple integral to find the volume of the solid that is below the surface \( z = xy \), above the plane \( z = 0 \) and enclosed by the planes \( y = x^2, y = 1 \) and \( x = 0 \).

9. a. Let \( C \) be the unit circle centered about the origin and oriented counter-clockwise as seen from above. Let \( \mathbf{F}(x, y) \) be the vector field \( -yi + xj \). Use an appropriate parameterization to evaluate \( \int_C \mathbf{F} \cdot d\mathbf{r} \).

b. Evaluate the line integral \( \int_C 9x \, ds \), where \( C \) is the curve given by the parametric equations \( x = t^3, y = t \) and \( 0 \leq t \leq 1 \).

c. Evaluate \( \int_C x^2y^2 \, dx + 2x^3 \, dy \), where \( C \) is the triangle consisting of the line segments from \( (0,0) \) to \( (2,0) \), from \( (2,0) \) to \( (0,1) \), and from \( (0,1) \) to \( (0,0) \). You are required to evaluate this line integral in two ways, first directly and then by using Green’s theorem.

10. If \( \mathbf{F}(x, y) = \left( 3x^2 + 4xy \right)i + \left( 2x^2 - 2y \right)j \), find a function \( f \) such that \( f = \nabla \mathbf{F} \). Then, using this function \( f \), evaluate the line integral \( \int_C \mathbf{F} \cdot d\mathbf{r} \), where \( \mathbf{r}(t) = (2t+1)i + (t-1)j \) and \( 0 \leq t \leq 1 \).
Answers

1. 9

2. \( x = -2 - 3t, \ y = t, \ z = 8 + 7t \), where \( t \) is any real number.

3. \( z = \left( \frac{\pi + 2x + 2y}{4} \right) \)

4. \( \frac{5\pi}{4} \approx 3.927 \)

5. a. \( \frac{\pi}{12} \)   \hspace{1cm} b. \( \frac{9\pi}{2} \)

6. 6

7. a. Along the line \( y = x \) the limit is \( \frac{1}{2} \) and along the \( y \) axis the limit is 0.
   
   b. \( st^2 (3s + 2t) \)

8. \( \frac{1}{6} \)

9. a. \( 2\pi \)   \hspace{1cm} b. \( \frac{1}{6}(10^{\sqrt{2}} - 1) \)   \hspace{1cm} c. \( \frac{8}{15} \)

10. \( f(x, y) = x^3 + 2x^2y - y^2 + k \), where \( k \) is a constant that takes any real value.
    \( \int_C \mathbf{F} \cdot d\mathbf{r} = f(3, 0) - f(1, -1) = 29 \).