1. [8 pts] Evaluate \( \int \int_{R} x^2 y \, dA \) where \( R \) is the region shown.

2. [10 pts] Determine whether the series is convergent or divergent. If possible, find the sum.
   (a) \( \sum_{n=0}^{\infty} \frac{2}{n^3 + 4} \)   
   (b) \( \sum_{n=0}^{\infty} \frac{2 \arctan n}{\pi} \)   
   (c) \( \sum_{n=1}^{\infty} \frac{1}{e^{2n}} \)

3. [8 pts] Determine the equation of the tangent line to the curve \( 2x^3 + y^3 - 5xy = 0 \) at the point \( P(1, 2) \).

4. [10 pts] Determine the parametric and the Cartesian (symmetric) equations for the straight line passing through the points \( P(-1, 0, 3) \) and \( Q(-2, -1, 2) \). Then check whether the point \( R(3, 4, 6) \) belongs to that line.

5. [10 pts] A fly is moving in 3-space with the position function \( \vec{r}(t) = \langle t \cos t, t^2 \sin t, \ln t \rangle \). Suppose the temperature varies in space according to the function \( f(x, y, z) = xy + y + e^z \). What is the rate of change of the temperature that the fly feels at \( t = 2\pi \).

6. [8 pts] Consider the curve \( \vec{r}(t) = \langle t^2, 1, e^{2t} \rangle \), for \( t \geq 0 \). Find the equation of the plane passing through the point \( (x(1), y(1), z(1)) \) and orthogonal to \( \vec{v}(1) \), the velocity at \( t = 1 \).

7. [8 pts] Find the volume of the solid bounded by the cylinder \( x^2 + y^2 = 4 \) and the planes \( z = 0 \) and \( y + z = 3 \). [Suggestion: Use polar coordinates.]

8. [8 pts] Find the Taylor series about \( x = 0 \) for the function \( f(x) = \frac{e^x + e^{-x}}{2} \).
9. [10 pts] Find the absolute minimum and maximum of \( f(x, y) = x^2 + y^2 - 2y \) in the closed triangle \( T \) whose vertices are \((-2, 0), (2, 0), \) and \((2, 4)\).

10. [10 pts] For the power series, \( \sum_{n=0}^{\infty} \frac{(x - 2)^{n+2}}{n + 3} \), determine both the radius of convergence and the interval of convergence.

11. [10 pts] Consider the surface defined as the level set \( x^3 + y^3 + z^3 + 4xyz = 0 \), and \( P(1, -1, 2) \), a point on this surface. Assume that close to \( P \) the surface determines an implicit function \( z = h(x, y) \).

(a) Determine the gradient of \( h \) at \( P \).
(b) Determine a direction at \( P \) (a direction with respect to \( x \) and \( y \)) such that the rate of change of \( h \) is zero.

12. [10 pts] At \( t = 0 \), a parachutist jumps from an airplane whose horizontal velocity is 800 ft/sec. In the figure, \( \vec{r}(t) \) denotes the path traveled by the parachutist. Write the function \( d(t) \) that describes the distance of the man from the jumping point. [Discard air friction and use \( g = 32 \) ft/sec\(^2\) as the value of the acceleration of gravity.]

13. [10 pts] Calculate the iterated integral \( \int_{0}^{1} \int_{y^2}^{1} y \sin(x^2) \, dx \, dy \).

**Bonus** [8 pts] Although we have called this a bonus problem, that does not mean it is very difficult.
Find the area of the region \( R \) enclosed by the two curves \( r = 2 \sin \theta \) and \( r = 2 \cos \theta \).