(1) Find the line of intersection between the planes \( z = 2x - 4y + 2 \) and \( x - y - 2z = 4 \).

(2) Sketch the level sets of the function \( f(x, y, z) = x^2 - y^2 - z^2 \), and calculate the gradient vector at the point \((2, 1, 1)\). Use this to find the tangent plane to \( x^2 = y^2 + z^2 + 2 \).

(3) You are driving anticlockwise around a circular roundabout of radius 10m, at 10m/s. When your car is facing due north, you throw a tennis ball from the car due east at 20m/s, at an angle of \( \pi/3 \) from horizontal. Where does the tennis ball land?

(4) Let \( f(x, y) = x^2 + 2y^2 - 2y + 4 \).
   (a) Find the critical points of \( f \) in the region \( x^2 + y^2 < 4 \), and use the second derivative test to classify them.
   (b) Use Lagrange multipliers to find the extreme points on the boundary \( x^2 + y^2 = 4 \).
   (c) Use your answers above to find the extreme values of \( f \) on \( x^2 + y^2 \leq 9 \).

(5) Change the order of integration to evaluate \( \int_0^8 \int_2^3 \cos(x^4) \, dx \, dy \).

(6) Write down triple integrals over the following regions.
   (a) The region inside the sphere \( x^2 + y^2 + z^2 = 4 \) between the planes the planes \( z = 0 \) and \( z = 1 \).
   (b) The volume inside the cylinder \( x^2 + y^2 \leq 9 \), above \( z = 0 \) and below \( 4x + 2y + z = 100 \).
   (c) The volume of \( z = 8 - 2x^2 - 2y^2 \) in the positive octant.

(7) Integrate the vector field \( \mathbf{F} = (-y, x, z^2) \) over the paraboloid \( z = x^2 + y^2 \) with \( 0 \leq z \leq 4 \).

(8) Let \( C \) be the boundary of the triangle in the plane with vertices \((0, 0), (1, 0)\) and \((1, 3)\). If \( \mathbf{F} = (\sqrt{1+x^3}, 2xy) \), use Green’s Theorem to evaluate \( \int_C \mathbf{F} \cdot d\mathbf{s} \).

(9) Let \( \mathbf{F} = (y^2, x, z^2) \). Let \( S \) be the part of the paraboloid \( z = x^2 + y^2 \), below the plane \( z = 1 \), with the upward pointing normal. Verify Stokes’ Theorem in this case by directly evaluating both integrals.

(10) Let \( E \) be the solid cylinder \( x^2 + y^2 \leq 1 \) with \( 0 \leq z \leq 3 \), and let \( \mathbf{F} = (x, y, -z) \). Verify the divergence theorem by directly evaluating both integrals.