1) Determine the equation of the plane formed by the line \( x = 2t - 1 \), \( y = 2 - t \), \( z = 4 - 2t \) and the point \((1,-1,-1)\)

2) Determine using the chain rule, the approximate change in the volume \( \Delta V \) for a cylinder of radius 10 and height 10 if the radius is changed by \( \frac{1}{10} \) and the height by \( -\frac{1}{10} \) (recall \( V = \pi r^2 h \))

3) Find and classify the critical points, for \( f(x,y) = x + y + \frac{1}{xy} \)

4) Using Lagrange multipliers find the shortest distance between the plane \( x + 2y + 4z = 20 \) and the origin \((0,0,0)\) (hint: minimize the square of the distance to the origin)

5) Evaluate the line integral \( \int_{(1,0,1)}^{(2,1,0)} \mathbf{F} \cdot d\mathbf{R} \) for the conservative vector field \( \mathbf{F} = (y + z^2)\mathbf{i} + (x + 1)\mathbf{j} + (2xz + 1)\mathbf{k} \) by determining the potential function and the change in this potential.

6) For the vector field \( \mathbf{F} = -yi + xyj \) evaluate the integral \( \oint \mathbf{F} \cdot d\mathbf{R} = \int -ydx + xydy \) around the triangular region enclosed by the curves \( y = -2x + 4 \), \( x = 0 \) and \( y = 0 \) in the first octant.

7) Using Greens Theorem evaluate the integral \( \oint \mathbf{F} \cdot d\mathbf{R} \) in problem (6) as a double integral.

8) Using the Divergence Theorem evaluate \( \iiint_{S} \mathbf{F} \cdot n \, dS \), as a volume integral over the region enclosed by the sphere \( x^2 + y^2 + z^2 = 4 \) for the vector field \( \mathbf{F} = x^2i + xzj + 3zk \)

9) Use Stokes Theorem to evaluate the circulation \( \oint \mathbf{F} \cdot d\mathbf{R} \), as a surface integral, for \( \mathbf{F} = 2xi - 2zj + yk \) around the curve which is the boundary of the triangle cut from the plane \( x + y + z = 1 \), in the first octant, counter clockwise when viewed from above.