1. Write the equations of the lines that are tangent and normal to the planar curve $2x^3 + 2y^3 - 9xy = 0$ at $(1, 2)$.

2. Suppose that $f(x, y) = \arctan(y/x)$ and $\mathbf{u}$ is the unit vector in the direction of $3\mathbf{i} + 4\mathbf{j}$. Calculate $D_{\mathbf{u}}f(-3, 3)$

3. Locate all local maxima, minima, and saddle points of $f(x, y) = 2x^3 - 3x^2 + y^2 - 12x + 10$.

4. Find the maximum and minimum values (if either exists) of $x^2 + y^2 + z^2$ subject to the constraint $3x + 2y + z = 6$.

5. The plane $x + y + z = 12$ intersects the paraboloid $z = x^2 + y^2$ in an ellipse. Find the highest and lowest points on this ellipse.