Problems 1 – 3: Find the plane tangent to the graph of the function $f(x,y) = \frac{36}{1 + x^2 + y^2}$ at the point $(x,y) = (1,2)$. Write the equation of the plane in the form $z = Ax + By + C$ and find the values of $A$, $B$ and $C$ in problems 1, 2 and 3:

1. (3 points) $A =$
   a. $-4$
   b. $-2$
   c. $0$
   d. $2$
   e. $4$

2. (3 points) $B =$
   a. $-4$
   b. $-2$
   c. $0$
   d. $2$
   e. $4$

3. (3 points) $C =$
   a. $-4$
   b. $3$
   c. $6$
   d. $9$
   e. $16$

4. (3 points) If the function $f(x,y) = \frac{36}{1 + x^2 + y^2}$ represents the height of a mountain and you are at the point $(x,y) = (1,2)$, in what direction should you walk to go directly down hill?
   a. $(-4,-2)$
   b. $(-2,-4)$
   c. $(4,2)$
   d. $(2,4)$
   e. None of these
Problems 5 – 7: Find the plane tangent to the graph of the equation \( xe^z + z e^{xy} = 2 \) at the point \((x, y, z) = (0, 1, 2)\). Write the equation of the plane in the form \( z = Ax + By + C \) and find the values of \( A, B \) and \( C \) in problems 5, 6 and 7:

5. (3 points) \( A = \)
   a. \(-2 - e\)
   b. \(2 + e\)
   c. \(-2 - e^2\)
   d. \(2 - e^2\)
   e. 0

6. (3 points) \( B = \)
   a. \(-2 - e\)
   b. \(2 + e\)
   c. \(-2 - e^2\)
   d. \(2 - e^2\)
   e. 0

7. (3 points) \( C = \)
   a. 2
   b. \(-e\)
   c. \(\frac{1}{e}\)
   d. \(\frac{2}{e}\)
   e. \(e^2\)

8. (5 points) Below is the contour plot of a function \( f(x, y) \). If you start at the point \((2, 5)\) and move along a curve whose tangent vector is always \( \vec{v} = \nabla f \), draw the curve in the plot.
9. (12 points) Find all critical points of the function \( f(x, y) = 1 + 2xy - x^2 - \frac{1}{9}y^3 \) and classify each as a local maximum, a local minimum or a saddle point.
10. (12 points) Find the point on the paraboloid \( z - \frac{1}{2}x^2 - \frac{1}{2}y^2 = 0 \) which is closest to the point \((1, 2, 1)\).