1. (There is no partial credit for this problem. Make sure your answer is correct.) Find the equation of the plane through \((2, 2, 3)\), \((2, 0, 2)\), and \((5, 1, 1)\).

2. (There is no partial credit for this problem. Make sure your answer is correct.) Find the equations of the line through \((6, 4, 2)\) and \((3, 4, 7)\).

3. Graph and name \(x^2 - y^2 = 1\) in 2-space.

4. Graph and name \(\frac{x^2}{16} + \frac{y^2}{9} + \frac{z^2}{25} = 1\) in 3-space.

5. What are the equations of the line tangent to the curve which is parameterized by \(\mathbf{r}(t) = (3t^3 + 2) \mathbf{i} + 6t^2 \mathbf{j} + (4t^3 + 2t) \mathbf{k}\) at \(t = 1\)?

6. Find the equation of the plane tangent to the surface \(z = x^2 + 3y^3\) at the point where \(x = 2\) and \(y = -2\).

7. (There is no partial credit for this problem. Make sure your answer is correct.) Let \(\mathbf{a} = 2 \mathbf{i} + 4 \mathbf{j} + 6 \mathbf{k}\) and \(\mathbf{b} = 3 \mathbf{i} + 4 \mathbf{j} + \mathbf{k}\). Find vectors \(\mathbf{u}\) and \(\mathbf{v}\) with \(\mathbf{b} = \mathbf{u} + \mathbf{v}\), \(\mathbf{u}\) parallel to \(\mathbf{a}\), and \(\mathbf{v}\) perpendicular to \(\mathbf{a}\).

8. Find the point on \(5x + y + z + 17 = 0\) which is closest to \((1, 2, 3)\).

9. An ant walks along the curve \(\mathbf{r}(t) = t \cos t \mathbf{i} + t \sin t \mathbf{j} + t \mathbf{k}\), for \(0 \leq t\). Where does the ant touch \(x^2 + y^2 + z^2 = 1\)?

10. Find the length of the curve \(\mathbf{r}(t) = \frac{t^3}{3} \mathbf{i} + \frac{t^2}{2} \mathbf{j}\) for \(0 \leq t \leq 1\).

11. Find the directional derivative of \(f(x, y) = x^3 \ln y\) at the point \((1, 2)\) in the direction of \(\mathbf{u} = \frac{1}{\sqrt{2}}(\mathbf{i} - \mathbf{j})\).

12. Sand is pouring onto a conical pile in such a way that at a certain instant the height is 200 inches and is increasing at 4 inches per minute and the radius is 50 inches and is increasing at 3 inches per minute. How fast is the volume increasing at that instant? (The volume of a cone is \(\frac{1}{3} \pi r^2 h\).)

13. Find all local maximum points, all local minimum points, and all saddle points of \(f(x, y) = x^2 y - 6y^2 - 3x^2\).