FOR THIS EXAM
COMPUTERS AND CALCULATORS ARE NOT ALLOWED.

(1) 36 Points. Let \( \mathbf{v} = 3\mathbf{i} - \mathbf{j} - 4\mathbf{k} \) and \( \mathbf{w} = 5\mathbf{i} + 3\mathbf{j} - \mathbf{k} \).
(a) Find \( 2\mathbf{w} - 3\mathbf{v} \).
(b) Find \( ||\mathbf{w}|| \).
(c) Find \( \mathbf{v} \cdot \mathbf{w} \).
(d) Find \( \mathbf{v} \times \mathbf{w} \).
(e) Find \( \cos \theta \) where \( \theta \) is the angle between \( \mathbf{v} \) and \( \mathbf{w} \).
(f) Find the direction cosines for the vector \( \mathbf{w} \).

(2) 16 Points. Match the following equations with their contour diagrams on the graphics page:
(a) \( z = 4 - x^2 \)  
(b) \( z = \sqrt{\frac{x^2}{4} + \frac{y^2}{9}} \)
(c) \( z = 3\sqrt{\frac{36 + 9x^2 - 4y^2}{36}} \)  
(d) \( 3x - 2y + 4z = 24 \)

(3) 12 Points. Describe in words the surfaces which are the graphs of the 4 equations in question (2) above.

(4) 12 Points. Find an equation for the ellipse which has center at \((-3, 1)\) and vertices at \((-7, 1), (1, 1), (-3, 2)\) and \((-3, 0)\).

(5) 14 Points. Sketch a graph of the equation \( y - 3 = \frac{x^2}{4} + \frac{z^2}{4} \) and identify this surface by name.

(6) 10 Points. Are the following statements true or false?
(a) A function \( f(x, y) \) can be a decreasing function of \( x \) with \( y \) held fixed, and be an increasing function of \( y \) with \( x \) held fixed.
(b) The graph of the equation \( 2y + 3z = 6 \) is a plane that is parallel to the \( z \)-axis.
(c) The length of the vector \( -3\mathbf{v} \) is three times the length of the vector \( \mathbf{v} \).
(d) If \( \mathbf{v} \) and \( \mathbf{w} \) are any two vectors, then \( ||(\mathbf{v} \times \mathbf{w}) + (\mathbf{w} \times \mathbf{v})|| = 0 \).
(e) If the contours of \( f(x, y) \) are all parallel lines, then the surface for \( z = f(x, y) \) is a plane.