Most of the following problems are modified versions of homework problems from your text book *Multivariable Calculus* by James Stewart.

14.2a. Sketch the curve described by the parametric equation \( \mathbf{r}(t) = (3 + e^t \sin(t), e^t \cos(t), e^t) \). Find an equation which describes the curve at the point \((0, 1, 1)\). Sketch the tangent line.

14.2b. Problem 50 of §14.2 of Stewart’s *Multivariable Calculus*. (Hint: Consider the function \( f(t) = |\mathbf{r}(t)|^2 \).

15.1a. Problem 30 of §15.1 of Stewart’s *Multivariable Calculus*.

15.1b. Problems 55–60 of §15.1 of Stewart’s *Multivariable Calculus*.

15.1c. Describe the level surfaces of the function \( f(x, y, z) = z^2 + x^2 - 2y^2 \).

15.1d. Sketch the graph of the function \( f(x, y) = 7 - 3x - 4y \).

15.1e. Sketch the graph of the function \( f(x, y) = \sqrt{16 - 16x^2 - y^2} \).

15.1f. Draw the circle of radius two centered at \((1, 1, 1)\) and lying on the plane \( x + y + z = 3 \). (Hint: Find two orthogonal unit vectors which are parallel to the plane. Use MAPLE to graph.)

15.1g. Sketch the graph of the function \( f(x, y) = 2x + 3y \). Sketch the graph described by the equation \( r - |z| = 0 \). Sketch the graph of the intersection of these two surfaces. (HINT: Use MAPLE.)

15.1h. Draw a contour map of the function \( f(x, y) = y/(x^2 + 2y^2) \) showing several level curves.

15.1i. Draw a contour map of the function \( f(x, y) = 4x - y^2 \) showing several level curves.

15.3a. Do parts (a) and (b) of Problem 4 of §15.3 of Stewart’s *Multivariable Calculus*. Replace part (c) with the following problem: Estimate the values of \( f_{xx}(40, 15) \), \( f_{tt}(40, 15) \), \( f_{xt}(40, 15) \), and \( f_{tx}(40, 15) \). (WARNING: These calculations will require some thought - you may wish to consult with your teaching assistant; see also problem 69.)

15.3b. Suppose \( f(x, y) = 25 - 3x^2 - 4y^2 \). Calculate both \( f_x(1, -1) \) and \( f_y(1, -1) \). Sketch (by hand, or, better, using MAPLE) some level curves for the function \( f \). Use these sketches to interpret your answers as slopes.

15.3c. The ellipsoid \( 3x^2 + y^2 + z^2 = 25 \) intersects the plane \( y = 3 \) in an ellipse. Find parametric equations for the tangent line to this ellipse at the point \((2, 3, -2)\).

15.4a. Suppose a tin can is made from a sheet of tin which is .1 cm thick. If the can is 13 cm high and 5 cm in diameter, use differentials to estimate the mass of the can. The density of tin is 7,310 kg/m³.

15.4b. Use the answers you found in Problem 15.3a to find a linear approximation to the wave height function when \( v \) is near 40 knots and \( t \) is near 15 hours.