1) Express the double integral
\[ \int \int_{R} x^2y - x \ dA \]
as an iterated integral and evaluate it, where \( R \) is the first quadrant region enclosed by the curves \( y = 0, y = x^2 \) and \( y = 2 - x \).  
\textbf{b)} Find an equivalent iterated integral expression for the double integral in 1a), where the order of integration is reversed from the order used in part 1a).  (Do \textbf{not} evaluate this integral.)

2) Calculate the line integral
\[ \int_{C} F \cdot dr, \]
where \( F(x, y) = y^2xi + xyj \), and \( C \) is the path starting at \((1, 2)\), moving along a line segment to \((3, 0)\) and then moving along a second line segment to \((0, 1)\).

3) Evaluate the integral
\[ \int \int_{R} y\sqrt{x^2 + y^2}dA \]
with \( R \) the region \( \{(x, y): 1 < x^2 + y^2 < 2, \ 0 < y < x\} \).

4a) Show that the vector field
\[ F(x, y) = \left\langle \frac{1}{y} + 2x, -\frac{x}{y^2} + 1 \right\rangle \]
is conservative by finding a potential function \( f(x, y) \).

\textbf{4b)} Let \( C \) be the path described by the parametric curve \( r(t) = <1 + 2t, 1 + t^2> \) for \( 0 \leq t \leq 1 \). Use your answer from 4a) to determine the value of the line integral
\[ \int_{C} F \cdot dr. \]

5a) Find the equation of the tangent plane at the point \( P = (1, 1, -1) \) in the level surface \( f(x, y, z) = 3x^2 + xyz + z^2 = 1 \).

\textbf{b)} Find the directional derivative of the function \( f(x, y, z) \) at \( P = (1, 1, -1) \) in the direction of the tangent vector to the space curve \( r(t) = (2t^2 - t, t^2, t^2 - 2t^3) \) at \( t = 1 \).

6) Find the absolute maxima and minima of the function
\[ f(x, y) = x^2 - 2xy + 2y^2 - 2y \]
in the region bounded by the lines \( x = 0, y = 0 \) and \( x + y = 7 \).