You have 10 minutes for the following problems. Calculators are NOT allowed (they are useless anyway). Please print your name and section number at the top-right corner before you start.

**Problem 1**  (5 points) Indicate whether the following statements are true or false (circle T or F):

[T-F] If \( f : \mathbb{R}^3 \to \mathbb{R}^3 \) is continuous at \( x_0 \), then it is differentiable at \( x_0 \).

[T-F] If \( f : \mathbb{R}^3 \to \mathbb{R}^3 \) is differentiable at \( x_0 \), then all the partial derivatives are continuous at \( x_0 \).

[T-F] If \( f : \mathbb{R}^3 \to \mathbb{R}^3 \) and all the partial derivatives are continuous at \( x_0 \), \( f \) is differentiable at \( x_0 \).

[T-F] In order to get a good linear approximation of a function, we only need the existence of the all the partial derivatives so that we can find the gradient at that point.

[numbered] Let \( f, g : \mathbb{R}^3 \to \mathbb{R} \) and \( k \in \mathbb{R} \). We have:

\[
\nabla \left( \frac{kf}{g} \right) = \frac{k \nabla f + f \nabla k}{g}.
\]

**Problem 2**  (2 points) Find \( Df(1,0) \) where

\[
f(x, y) = \begin{bmatrix}
\tan(x - 1) - e^y \\
x^2 - y^2
\end{bmatrix}.
\]

\[
Df = \begin{bmatrix}
\sec^2(x-1) - e^y \\
2x & -2y
\end{bmatrix}
\]

\[
Df\big|_{(1,0)} = \begin{bmatrix}
1 & -1 \\
2 & 0
\end{bmatrix}
\]

**Problem 3**  (3 points) Let \( f(x, y) = \sin(xy) \). Find the linear approximation of \( f(0.1, 0.1) \).

\[
\nabla f = \begin{bmatrix}
y \cos(xy) \\
x \cos(xy)
\end{bmatrix}, \quad \nabla f\big|_{(0,0)} = 0.
\]

\[
f(0.1, 0.1) \approx \nabla f\big|_{(0,0)} \cdot \begin{bmatrix} 0.1 - 0 \\ 0.1 - 0 \end{bmatrix} = 0.
\]