SECTION 12.3 (Partial Derivatives)

1. Find all first-order partial derivatives of \( f(x, y, z) = \frac{2}{\sqrt{x^2 + y^2 + z^2}} \)

2. Find the indicated partial derivatives of \( f(x, y, z) = x^2 y - 4x + 3 \sin y \): \( f_{xx}, f_{yy}, f_{xy} \)

3. Find all points at which \( f_x = f_y = 0 \) for the function \( f(x, y) = e^{-x^2 - y^2} \) and interpret the significance of the points graphically.
4. Show that the functions $f_n(x,t) = \sin n\pi x \cos n\pi c t$ satisfy the **wave equation**

\[ c^2 f_{xx} = f_{tt} \] for any positive integer $n$ and any constant $c$.

5. The ideal gas law relating pressure ($P$), temperature ($T$) and volume ($V$) is $P = \frac{cT}{V}$ for some constant $c$. Show that $TP_T = c$.

6. Suppose that $L$ hours of labor and $K$ dollars of investment by a company result in a productivity of $P = L^{0.75} K^{0.25}$. Compute the marginal productivity of labor, defined by $P_L$ and the marginal productivity of capital, defined by $P_K$. 