

1. The temperature of a gas in  $^{\circ}F$  is given by  $T = x^2 - 5xy + y^2z$ , with  $x, y, z$  in feet.
  - (a) What is the rate of change in the temperature at the point  $(1, 2, 3)$  in the direction of  $\vec{v} = 2\hat{i} + \hat{j} - 2\hat{k}$ ?
  - (b) What is the direction of maximum rate of change of temperature at the point  $(1, 2, 3)$ ?
  - (c) What is the maximum rate of change of temperature at the point  $(1, 2, 3)$ ?
2. Find the maximum and minimum values of  $x^2 + y^2 - 2x - 2y$  on the disk of radius  $\sqrt{8}$  centered at the origin, that is, on the region  $\{x^2 + y^2 \leq 8\}$ . *Explain your reasoning!*