1. The temperature on a plate of metal is a function $T(x, y)$ of the position (x, y) on the plate. Suppose that T is in degrees fahrenheit and x and y are in inches. Suppose also that we know

$$T(3, 1) = 51.7°\text{F},$$

$$T_x(3, 1) = -3.2°\text{F/in}, \qquad T_x(3, 1) = 1.9°\text{F/in}$$

   (a) Use this information to approximate the temperature at each of the following points:

$$(3.4, 1.6) \qquad (3.5, 0.8) \qquad (2.7, 0.4)$$

   (b) Recall that the partial derivatives give us the "instantaneous" rate of change of temperature with repect to position as we pass through a point in the x- or y-direction. What do you think the rate of change might be when passing though $(3, 1)$ in the direction of the vector $\langle 2, 5\rangle$? How about when passign through $(3, 1)$ in the direction of $\langle 4, 10\rangle$?

2. The temperature on a plate of metal is a function $T(x, y)$ of the position (x, y) on the plate. Suppose that T is in degrees fahrenheit and x and y are in inches. Suppose also that we know

$$T(3, 1) = 51.7°\text{F},$$

$$T_x(3, 1) = -3.2°\text{F/in}, \qquad T_x(3, 1) = 1.9°\text{F/in}$$

(a) Use this information to determine the directional derivative in the direction of the vector $\langle -2, 1 \rangle$.

(b) What is the maximum rate of increase in temperature possible from the point $(3, 1)$? In what direction of travel through $(3, 1)$ is that maximum rate of increase obtained?

(c) Give a vector in the direction one could pass through $(3, 1)$ in order to be experiencing no change in temperature at that point.

3. The pressure in kilopascals (kPa) at the point (x, y, z), each in feet, is given by

$$P(x, y, z) = x^4 + 2y^3 + x^2z + 4yz^3$$

(a) Determine the rate of change of pressure at $(1, 2, 1)$ and in the direction of the vector $\langle -2, 1, 2 \rangle$.

(b) Determine the direction in which the pressure is increasing most rapidly at $(3, 1, 2)$. Determine the rate at which pressure is increasing, in that direction and at that point.

(c) Determine a direction that one could go from $(2, 2, 2)$ to experience no change in pressure.