10. [9 points] A box is to be constructed with a square base. The height of the box and the side length of the square base must add up to 3 meters (m).

- Find the height and side length of the square base, in m, that lead to a box of maximum volume.
- What is the maximum volume in this case, in cubic meters?

In your solution, make sure to carefully define any variables and functions you use, use calculus to justify your answers, and show enough evidence that the values you find do in fact maximize the volume.

11. [6 points] Suppose that $C = h(T)$ is the daily cost, in dollars, to heat a certain house if the average outside temperature that day is T degrees Fahrenheit (°F). The function $h(T)$ is invertible and differentiable.

a. [3 points] Complete the following sentence to give a practical interpretation of $h'(40) = -0.1$.

If one day the average outside temperature is $40°\text{F}$ *and the next day it is* $37°\text{F}$*, ...*

b. [3 points] Complete the following sentence to give a practical interpretation of $(h^{-1})'(3.6) = -8$.

If the cost to heat the house increased from \$3.60 *on one day to* \$3.70 *the next day, ...*

12. [10 points] Again suppose that $C = h(T)$ is the daily cost, in dollars, to heat a certain house if the average outside temperature that day is T degrees Fahrenheit (°F). Some values of $h(T)$ and its derivative $h'(T)$ are given in the table below.

T	5	8	18	30	55
$h(T)$	8	7.2	5	3.3	1.4
$h'(T)$	-0.3	-0.25	-0.2	-0.11	-0.05

The function $h(T)$ is invertible and differentiable. Also, $h''(T)$ exists and is positive for all T.

a. [2 points] Find the linear approximation $L(T)$ of $h(T)$ near $T = 8$.

b. [1 point] Use your formula for $L(T)$ to approximate $h(10)$.

c. [2 points] Is your answer in part **b.** an overestimate or underestimate of the actual value, or is there not enough information to decide? Briefly explain.

d. [3 points] Suppose that the quadratic approximation $Q(T)$ of $h(T)$ near $T = 25$ is given by

$$Q(T) = 3.9 - 0.15\,(T - 25) + 0.003\,(T - 25)^2.$$

Find the values of $h(25)$, $h'(25)$, and $h''(25)$.

e. [2 points] Use the table to compute $(h^{-1})'(5)$.