1.) Let $S(t)$ denote the sunlight intensity in Boston in April 2019, in watts per square meter, t days after the beginning of the month, where $0 \leq t \leq 30$. (Recall that April has 30 days.) Some values of $S(t)$ are shown in the table:

t	0	5	10	15	20	25	30
$S(t)$	6.4	7.1	8.9	8.6	9.1	10.4	10.3

An unshaded maple sapling's vertical growth rate $R(t)$, in centimeters per day, is approximated by $R(t) = 0.126 \cdot S(t)^{1.2}$.

a.) The tree's height at the beginning of April 2019 was 4.210 meters. Using a midpoint sum with 3 intervals, estimate the tree's height, with units, at the end of April.

b.) Write an expression in terms of $S(t)$ that is **equal** to the tree's height at the end of April. (Your answer should contain an integral, and should **not** be in terms of $R(t)$.)

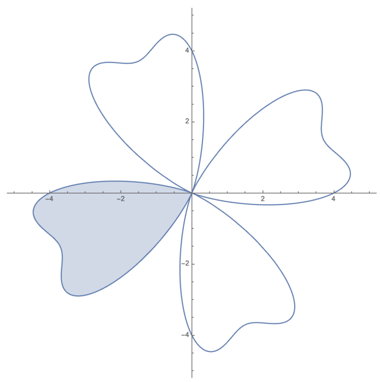
c.) Estimate $S'(5)$, including units in your answer.

d.) Use part (c) to estimate $R'(5)$, including units in your answer.

2.) The *four-leaf clover curve*, pictured below, is given in polar coordinates by the equation

$$r(\theta) = 3 + 2\sin(4\theta) + \cos(8\theta),$$

where $0 \le \theta \le 2\pi$.



a.) What is the smallest value of θ at which $r(\theta) = 0$?

b.) Find the area of the shaded leaf of the clover, accurate to three decimal places.

c.) Suppose a bug travels along the shaded leaf of the clover, counterclockwise, at constant unit speed. Find the bug's velocity vector when it is at the point $(-3, 0)$.

d.) Find the point on the shaded leaf that is furthest from the origin.

3.) Let $y = f(x)$ be the solution of the differential equation

$$\frac{dy}{dx} = (1 + x + y)^{-1}$$

with initial condition $f(0) = 1$. The function f is continuous on the domain $[0, \infty)$.

a.) Use Euler's method to approximate $f(0.3)$, starting at $x = 0$ with a step size of 0.1.

b.) Use the second-degree Taylor polynomial about $x = 0$ to approximate $f(0.3)$

c.) What is the global minimum of f on the interval $[0, \infty)$?