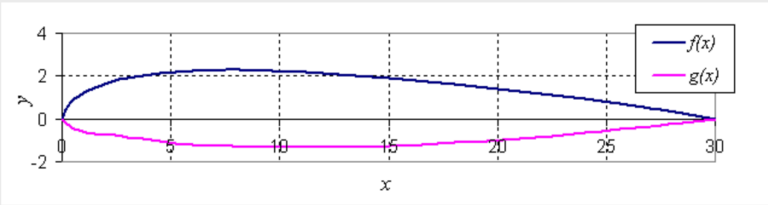
Application Problem 4: Integration

Design of new aircrafts requires knowing the volume occupied by the aircraft's body. Although the geometry of modern flying machines is extensively modeled prior to manufacturing, they also undergo extensive experimental tests in wind tunnels. As a result from those experiments, the configuration of the fuselage and airfoils may slightly change; at this stage, the volume has to be determined from measurements.

One of the ways to compute the volume is based on preliminary computations of cross-sectional areas which appear to be curvilinear regions bounded by the aircraft's surfaces characterized numerically.

The profile of the airfoil is shown in the following figure:



The upper and lower surfaces are the graphs of the functions f and g respectively. Measured data (in meters) for the upper and lower surfaces are listed in the table:

x	$f(x)$	$g(x)$
0	0	0
0.375	0.801	-0.369
0.75	1.083	-0.513
1.5	1.473	-0.678
2.25	1.74	-0.783
3	1.929	-0.876
4.5	2.157	-1.05
6	2.25	-1.191
7.5	2.28	-1.284
9	2.265	-1.338
12	2.142	-1.344
15	1.923	-1.251
18	1.641	-1.101
21	1.308	-0.9
24	0.924	-0.648
27	0.504	-0.369
28.5	0.276	-0.21
30	0	0

Calculate the cross-sectional area of this airfoil from this data.

Rubric: Each of the following categories will be classified as Achieved or Opportunity. All categories must earn an Achieved ranking in order for the Application Problem to earn an Achieved Ranking.

Transforming the scenario into a mathematical problem.

- Recognizes information that is relevant to the scenario.
- Correctly relates relevant information.

Correctly implementing a relevant numerical technique.

- Chooses and appropriate numerical technique for solving the problem.
- Correctly implements the chosen numerical technique for solving the problem.
- Gives appropriate explanation as to why technique was chosen.

Clearly communicating your process and results.

- Provides necessary information to motivate and put the question in context.
- States the question and explains why it is important and interesting.
- Explains data.
- Explanation of mathematical interpretation of problem.
- States what methods are used to arrive at the solution AND why they were chosen.
- States solution of the problem.
- Interprets meaning of the solution and puts it in context of the background information.
- Clear and concise.
- All variables are clearly defined.
- Units for all quantities are given.