

Na11. Romberg Integration.

Overview: Romberg integration can be adapted to be useful in many different situations. You will be required to modify the Romberg algorithm module from the book in several ways. Then you will be asked to use it to work problems 6.1 #7, 10, and 11.

Program specifications: In your module romberg.py, define the romberg method as follows:

```
def romberg(f, a, b, tol=1.0e-6, maxn = 21, show=False):
```

The parameters are as follows:

f	The function that is to be integrated.
a, b	The limits of integration
tol	The error tolerance needed to terminate normally
maxn	The maximum number of iterations
show	If True, the table is written out when doing the Richardson extrapolation

Each problem should consist of a distinct subroutine call. Each routine will define a function to be integrated, and will have a call to the same Romberg method, but with distinct parameter values. Note that one problem requires a table lookup to get values of the function. Here, you will find it especially useful to set the value of maxn so that you use all of the table values possible in your answer.

Input: There is no external input for these problems.

Output: The output for each problem should consist of the following parts:

<Title>
<Description>
<Solution>
<Blank line>

The <title> includes the problem number and source.

The <description> tells what function is being integrated, any substitutions you made, and a short explanation of what you had to do to solve the problem. Write in complete sentences.

For problem 7, the <solution> includes the entire table (show = True). The final line is
"The integral is <value> using <number> panels."

For problem 10, the solution includes the entire table. Use a tolerance of $1E-9$. The final line is

"The integral is <value> with error < <tol>."

For problem 11, the solution consists of a table with entries

<Theta> < Value > <Difference>

Label the table nicely, and print answers to 6 decimal places. Do not print the Richardson extrapolation table for each integral.

Checklist:

Modules: **trapezoid, romberg**

Main Program file: One call to romberg for each of the three problems.