Advanced Mathematics for Engineers, Laboratory Problems

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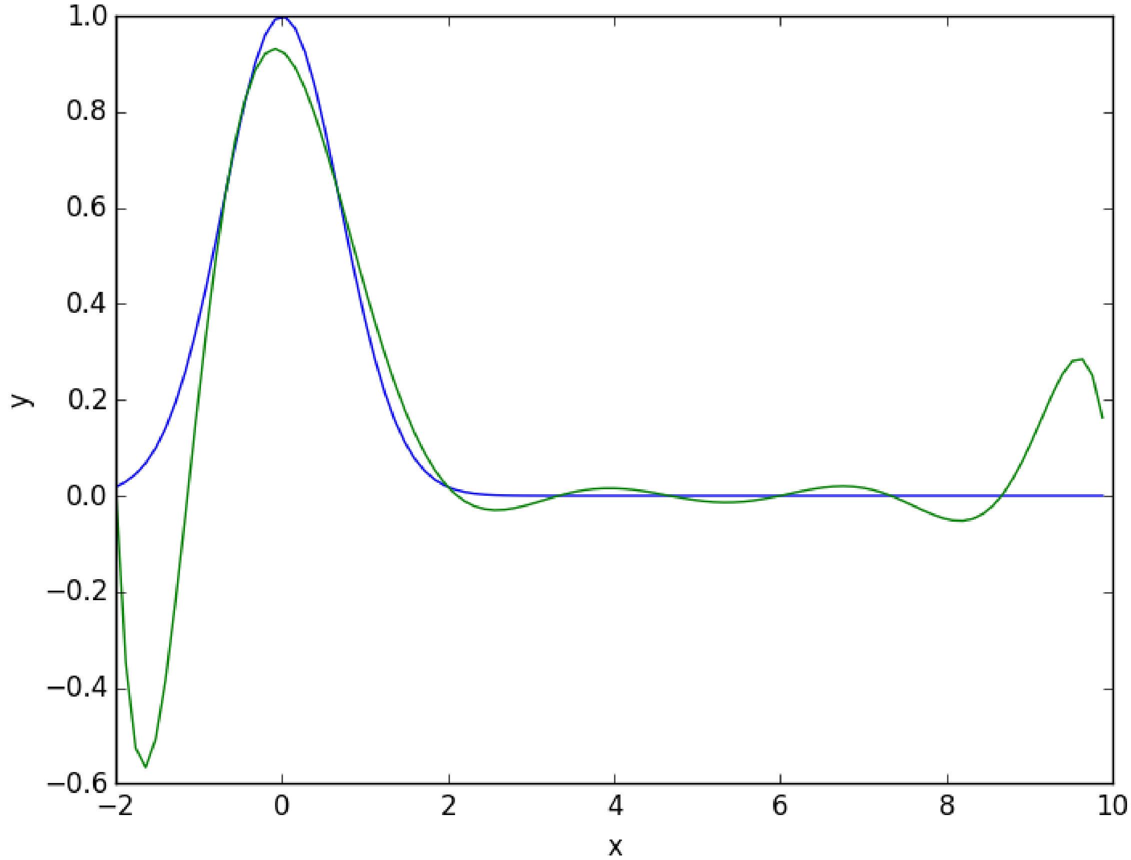
Problem 5.9

b)



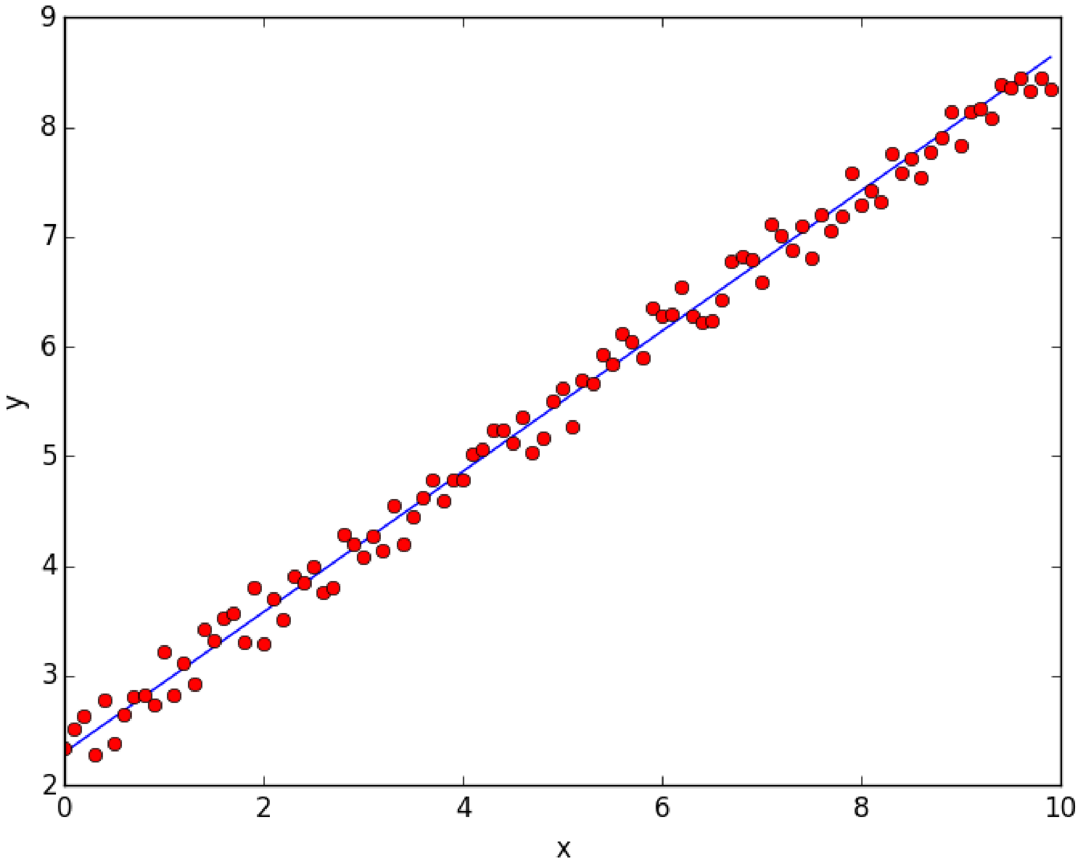

```
c)
maximum deviation: 0.634025332357

d)
maximum deviation of taylor series with c = 0: 1.88827128486e+11
maximum deviation of taylor series with c = 4: 354.936464804
```

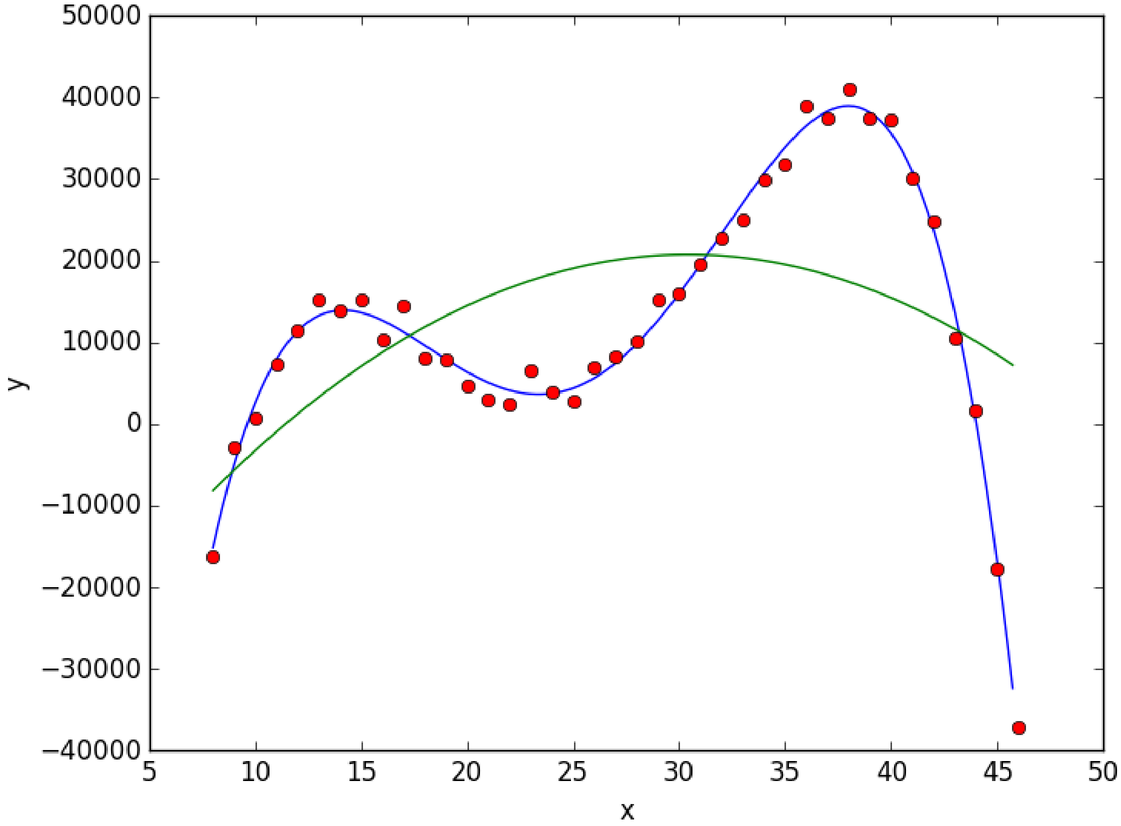
Problem 5.10

```
b)
coefficients:
[ 0.64  2.3 ]

approximated coefficients:
[ 0.63139257  2.33442881]
```

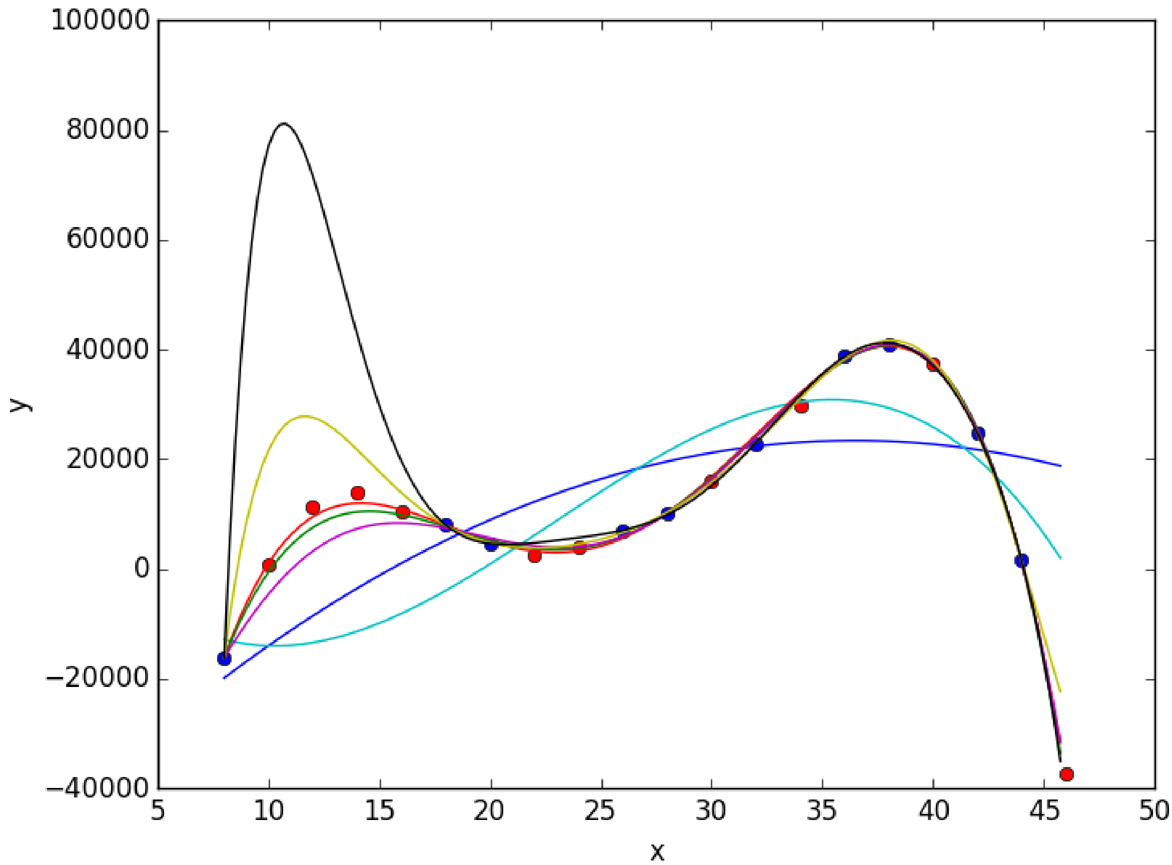



```
d)
error of degree 4 polynomial: 101457690.277
error of degree 2 polynomial: 7711489909.2
```

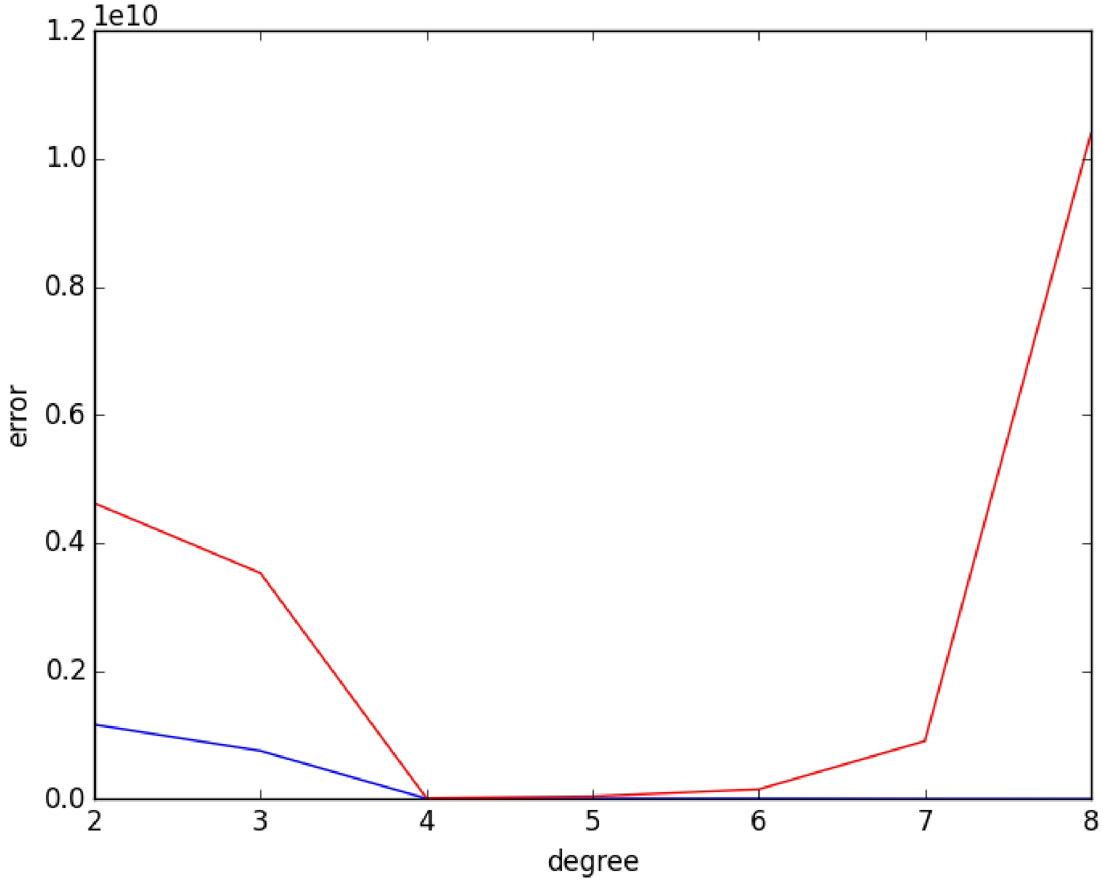


Problem 5.11

c)



d)



e)
The deviation to the original approximated function (where all data points were used) minimizes the more evenly the points of X and T are distributed. The reason for that is that when there's a large interval of test points only, the approximated function has no bounds at all in that interval and can deviate as much as it needs to, without increasing the error.
The results seems to be the the best with polynomials of degree 4 and 5.

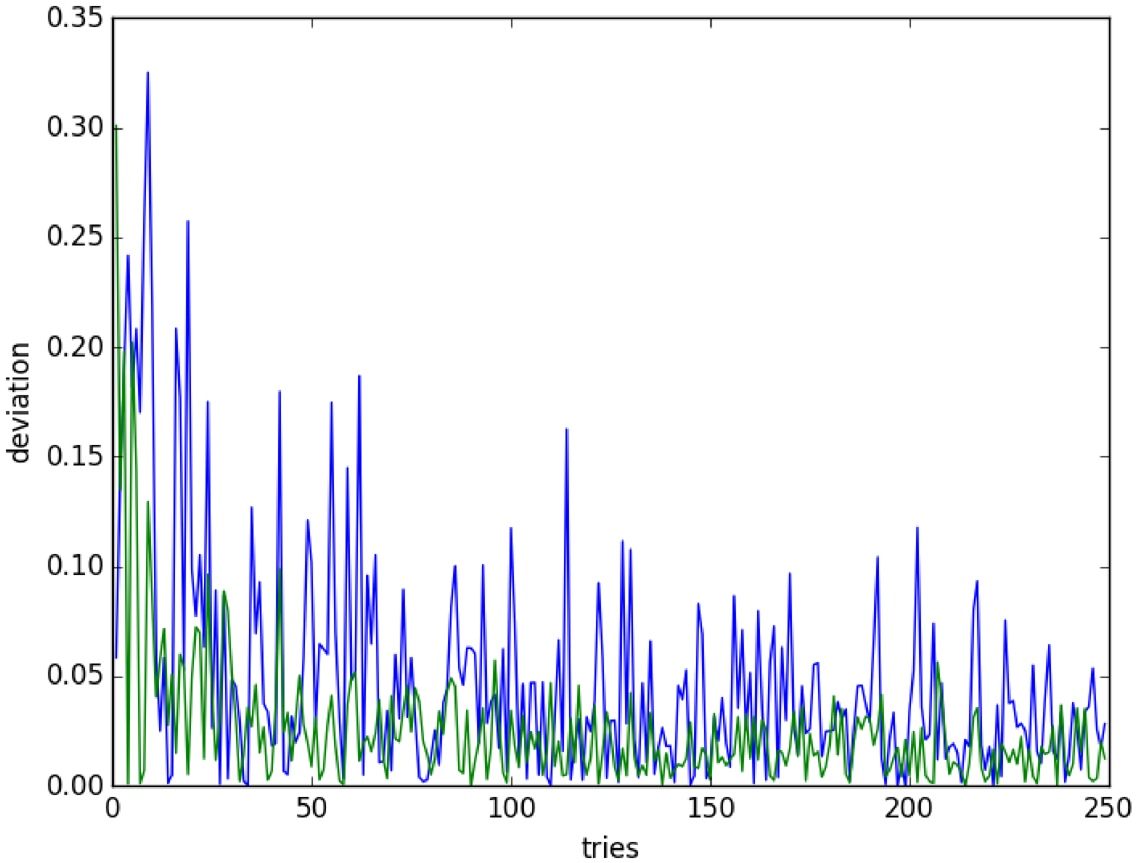
f)
It makes sense because the approximated function is supposed to be close to all data values, and even the points "in between" which are not part of both the training and test data.

Problem 7.12

```
a)
naive method:
estimated area: 3.14241702843
tries: 7141.0

mean value method:
estimated area: 3.14239623321
tries: 658.0
```

b)



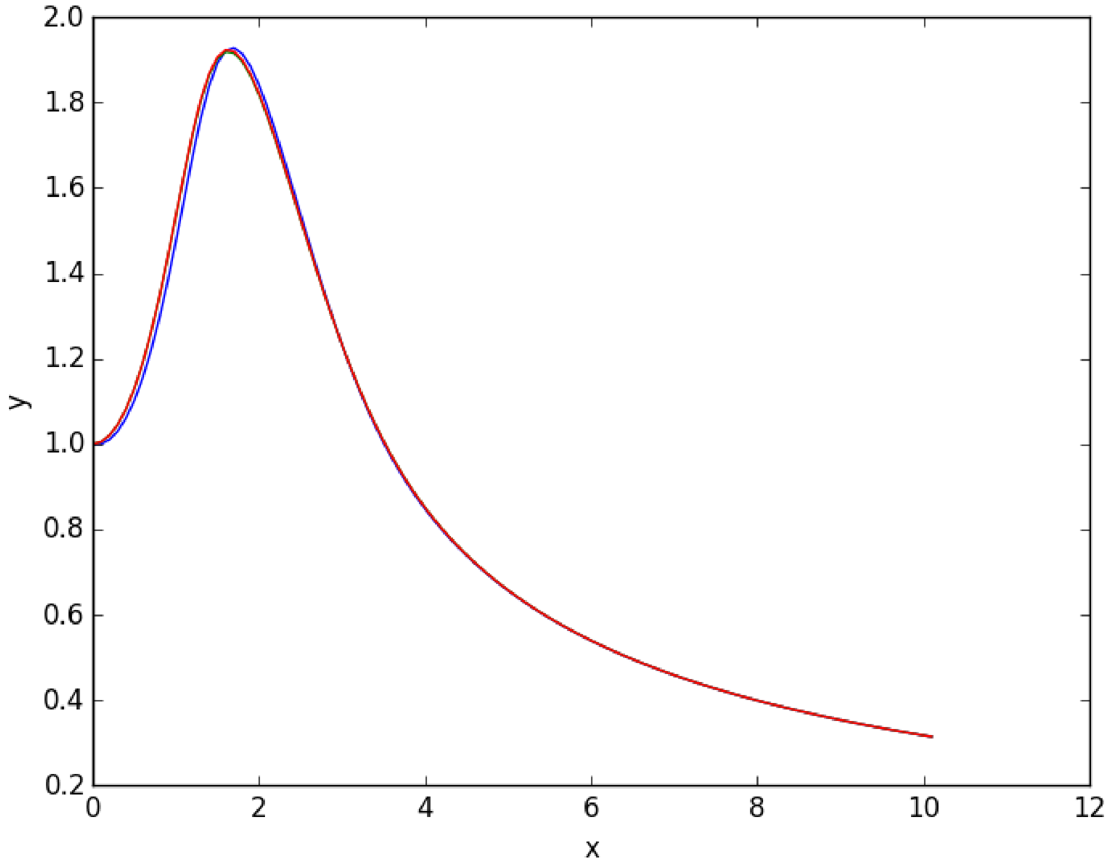
The deviation tends to get smaller, yet it doesn't converge.

```
c)
estimated area of 4D unit sphere: 4.93493975904

average tries for 2d unit circle: 4928.92
average tries for 4d unit sphere: 14141.112
```

Problem 7.14

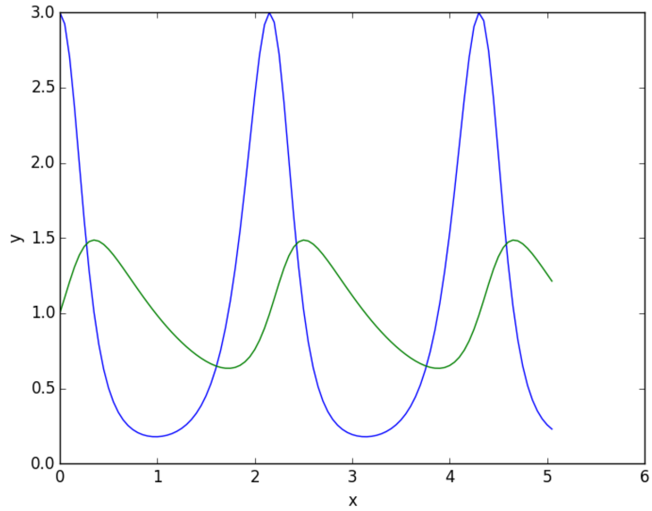
a)



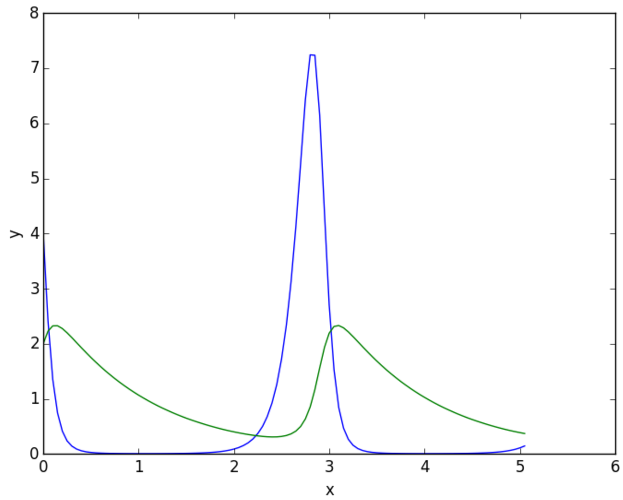

```
b)
euler: 0.656662162824
heun: 0.657837825456
runge-kutta: 0.657541150858
```

Problem 7.15

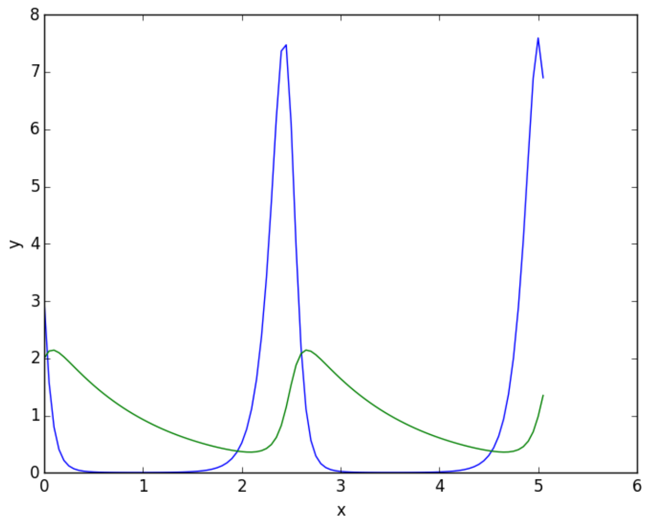
alpha = 10, initially 3 sheep and 1 wolf:



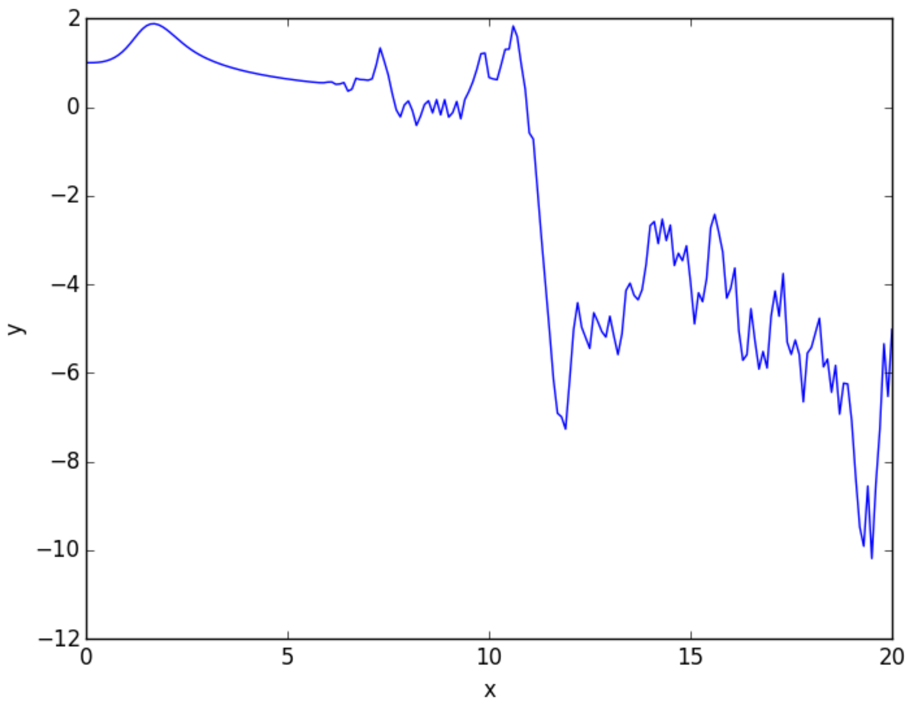
alpha = 9, initially 4 sheep and 2 wolfs:



alpha = 12, initially 3 sheep and 2 wolfs:



Problem 7.16



Since the x parameter is a factor both inside and outside of the sine, the frequency as well as the amplitude increase as x grows. Hence, the fluctuation increases and the slopes get steeper and steeper. Because the step size stays the same, the curve gets "spikier" and slightly inaccurate.
A possible solution could be to decrease the step size.