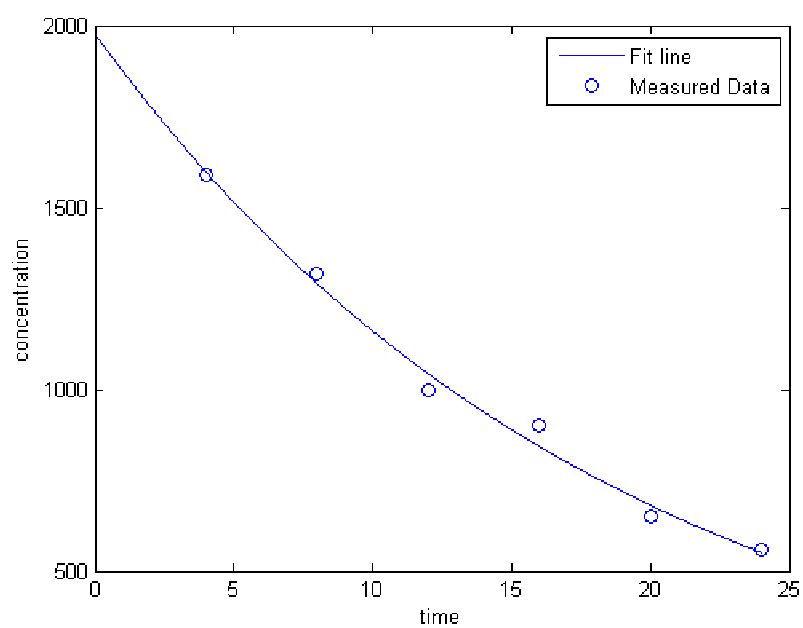
Homework 4

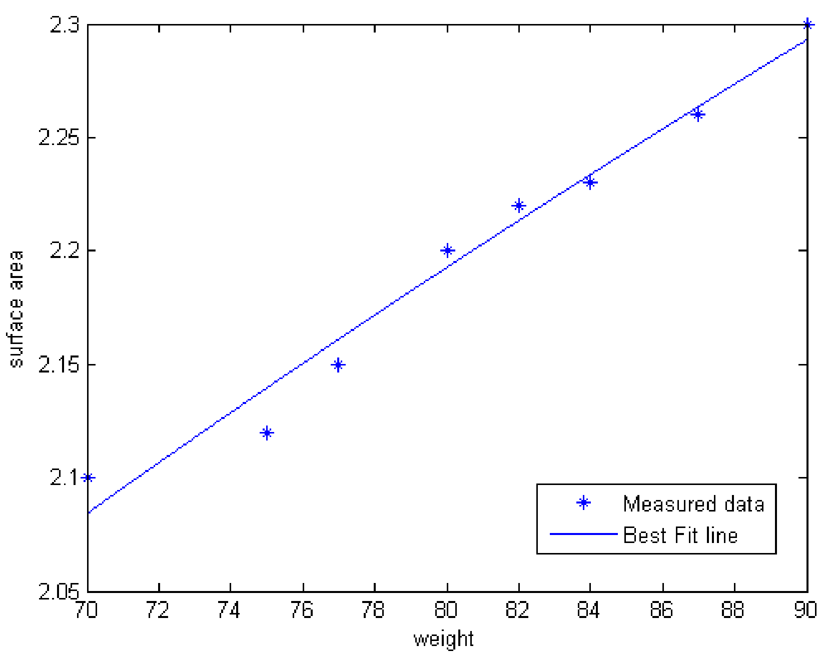
1.

```
EDU>> t = [4 8 12 16 20 24];
EDU>> c = [1590 1320 1000 900 650 560];
EDU>> logc = log(c)

logc =

    7.3715    7.1854    6.9078    6.8024    6.4770    6.3279

EDU>> linearfit  = [6 sum(t) sum(logc); sum(t) sum(t.^2) sum(t.*logc)]

linearfit =

  1.0e+003 *

    0.0060    0.0840    0.0411
    0.0840    1.4560    0.5601

EDU>> linearcoeff = rref(linearfit)

linearcoeff =

    1.0000         0    7.5902
         0    1.0000   -0.0532

EDU>> a = linearcoeff(1,3)

a =

    7.5902

EDU>> b = linearcoeff(2,3)

b =

   -0.0532

EDU>> aN = exp(a);
EDU>> aN = exp(a)

aN =

  1.9786e+003

EDU>> x = [0:0.0001:24];
EDU>> y = aN.*exp(b.*x);
```



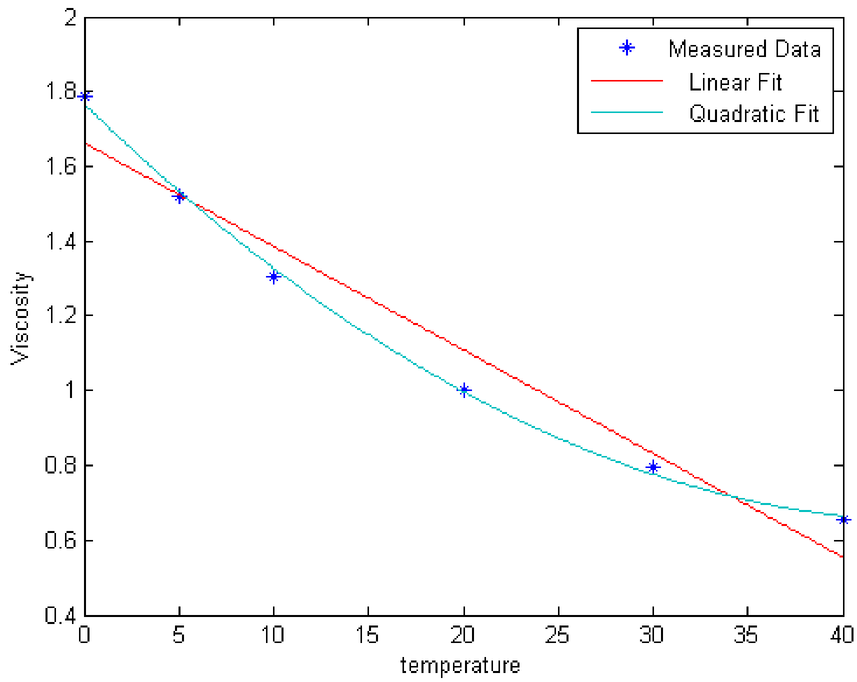
2.

```
EDU>> w = [70 75 77 80 82 84 87 90];
a = [2.1 2.12 2.15 2.2 2.22 2.23 2.26 2.3];
logw = log10(w);
loga = log10(a);
bestfit = [8 sum(logw) sum(loga); sum(logw) sum(logw.^2) sum(logw.*loga)]
fitcoeff = rref(bestfit)
b = fitcoeff(1,3); c = fitcoeff(2,3);
b = 10^b;
y = b.*(x.^c);

bestfit =

    8.0000   15.2416    2.7339
   15.2416   29.0472    5.2120


fitcoeff =

    1.0000         0   -0.3821
         0    1.0000    0.3799

EDU>> x = [70:0.0001:90]; y = b.*(x.^c);
```

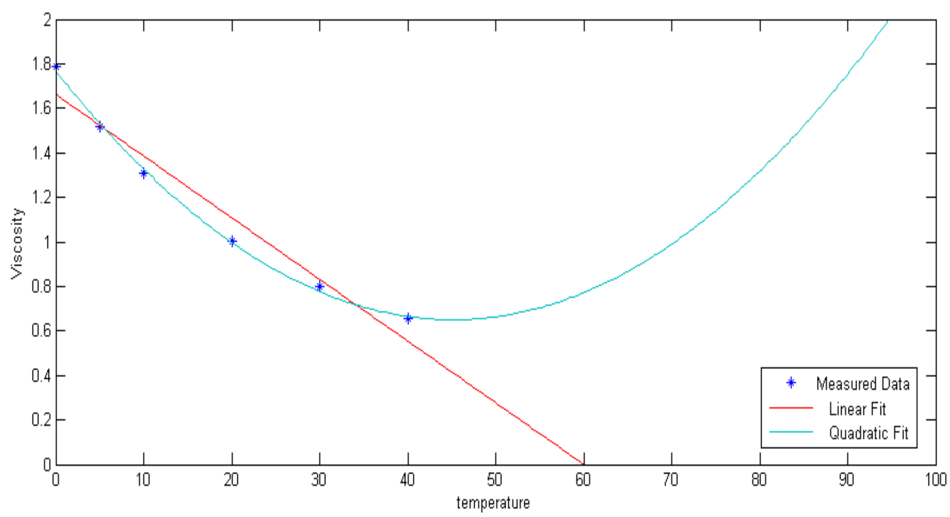


3.

a) I would choose linear and quadratic to compare the extrapolated data with. I would choose these because they are the best fit for linearized data and someone could actually do something with data points like this, like predict a value based on values around it. It looks like the Quadratic approximation gives the best approximation, because it snaps onto the measured data points pretty well as can be seen.



b) As for predicting higher values past temperatures of 50 degrees, the linear might be the better route to take. This data more than likely doesn't take the quadratic route that is in the below graph.



4.

Error f'(1)-F'(1)	F'(1) Forward Diff	F'(1) Backward Diff	F'(1) Centered Diff	F''(1) Central Diff
$\Delta x = .2$	3.009	2.464	2.7365	2.725
$\Delta x = .1$	2.859	2.587	2.726	2.72

The O( ) estimates for the first two mean that the error of the function is on an order of the step size. The second half say the error is on the order of the step size squared, which since the step size should be small when squared makes it even smaller. So the squared step size has a much smaller error than the single step size.

5.

a) First Point

$$F_F'(0) = \frac{f(x_1) - f(x_0)}{\Delta x} = \frac{32-0}{25} = \frac{32}{25}$$

Last Point

$$F_B'(125) = \frac{f(x_5) - f(x_4)}{\Delta x} = \frac{100-92}{25} = \frac{8}{25}$$

Interior

$$F_c'(x_i) = \frac{f(x_{i+1}) - f(x_{i-1})}{2\Delta x}$$

$$f(25) = \frac{58-0}{2 \cdot 25} = \frac{58}{50}$$

$$f(50) = \frac{78-32}{2 \cdot 25} = \frac{46}{50}$$

$$f(75) = \frac{92-58}{2 \cdot 25} = \frac{34}{50}$$

$$f(100) = \frac{100-78}{2 \cdot 25} = \frac{22}{50}$$

b) we must use all three methods because we can't use the centered approximations on the endpoints. This whole error is of the order Δx, because we have to use the forward and backward methods.

c) EDU>> t = [0 25 50 75 100 125]

t =

    0   25   50   75   100   125

EDU>> y = [0 32 58 78 92 100];
EDU>> t = [0 25 50 75 100 125];
EDU>> f = polyfit(t,y,2)
f =
   -0.0048   1.4000   0.0000

EDU>> dy = gradient(y,25)

dy =   1.2800   1.1600   0.9200   0.6800   0.4400   0.3200

6.

$$F_i(x) = \frac{F(x_{i+1}) - F(x_{i-1})}{2\Delta x}$$

Velocity

$$F_i' = \frac{6030 - 5560}{2 \cdot 2} = 117.5\ m$$

$$F_c' = \frac{0.67 - 0.70}{2 \cdot 2} = -0.0075\ rad$$

$$F_c' = \frac{0.66 - 0.68}{2 \cdot 2} = -0.005\ rad$$

$$F_c' = \frac{6240 - 5800}{2 \cdot 2} = 110\ m$$

$$F_c' = \frac{0.68 - 0.72}{2 \cdot 2} = -0.01\ rad$$

$$F_c' = \frac{5800 - 5370}{2 \cdot 2} = 107.5$$

Acceleration

$$F_c' = \frac{-0.005 + 0.01}{2 \cdot 2} = 0.00125\ rad$$

$$F_c' = \frac{110 - 107.5}{2 \cdot 2} = 0.625\ m$$

7.

```
EDU>> t = [0 0.52 1.04 1.75 2.37 3.25 3.83];
EDU>> x = [153 185 208 249 261 271 273];
EDU>> polyfit(t,x,2)

ans =

  -10.0731   70.1201  151.4961

EDU>> dy = gradient(x,.52)

dy =

   61.5385   52.8846   61.5385   50.9615   21.1538   11.5385    3.8462
```

8.

```
EDU>> v1 = [.4 .7 .77 .88];
EDU>> v2 = [.88 1.05 1.17 1.35];
EDU>> gradient(v1,10)

ans =

    0.0300    0.0185    0.0090    0.0110

EDU>> gradient(v2,15)

ans =

    0.0113    0.0097    0.0100    0.0120
```

Q is the last two results appended with respect to the appropriate T's.