Part 1

Pre-lab

1.

2.

```
function E2lam(en,unit,ew,n)
%Ezra Alcon-Kirshman
%optics 211
%energy to wavelength converter
%to use run function with "en" as energy in meV and n as index of refraction

c=3e8; %speed of light in a vacuum in m/s
h=4.136e-15; %planck's constant
E= en/1000; %converts the Energy from meV to eV

lambda1 = h*c/E; %calculates the wavelength corresponding to E in meters
lambda = lambda1/n; %takes refractive index into account
lambda_um = lambda/10^-6; %computes the wavelength in microns
lambda_nm = lambda/10^-9; %computes the wavelength in nanometers

head=['the wavelength corresponding to an energy of',num2str(ew),unit, ' and
an index of refraction of ',num2str(n), ' is:']; %converts the energy value
to a string and surrounds it with text
ans1=[num2str(lambda), 'm']; %converts the wavelength value to a string and
provides units
ans2=[num2str(lambda_um), 'um'];
ans3=[num2str(lambda_nm), 'nm'];

disp(head) %Displays an answer heading in the command window
disp(ans1) %Displays the wavelength in microns
disp(ans2) %Displays the wavelength in microns
disp(ans3) %Displays the wavelength in nanometers


function Wave2Energy(wv,unit,ew,n)
%Ezra Alcon-Kirshman
%optics 211
%wavelength to energy converter
% to use run function with "wv" as wavelength in nm and n as index of
refaction


c=3e8; %speed of light in a vacuum in m/s
h=4.136e-15; %planck's constant
w = wv*10e-10;


EeV = (h*c)/(w*n); % converts wavelength to energy in eV
EmeV = EeV.*1000; %converts eV to meV
jo = EeV*(1.6022e-19); %converts eV to J
head=['the energy corresponding to a wavelength of ',num2str(ew),unit, 'and
an index of refration of ', num2str(n), ' is:']; %converts the wavelength to
a string and surrounds it with text
ans1 = [num2str(EeV), ' eV'];
```

```
ans2 = [num2str(EmeV), ' meV'];
ans3 = [num2str(jo),'J'];

disp(head) %Displays an answer heading in the command window
disp(ans1) %Displays an answer in eV in the command window
disp(ans2) %Displays an answer in meV in the command window
disp(ans3) %Displays an answer in J in the command window
```

3. I think my comments on my code explain clearly what is happening and how everything is calculated

```
OPT211_lab4_test('meV',295,1)
the wavelength corresponding to an energy of295meV and an index of refraction
of 1 is:
4.2061e-06m
4.2061um
4206.1017nm
>> OPT211_lab4_test('um',4.2,1)
the energy corresponding to a wavelength of 4.2um and an index of refraction
of 1 is:
0.29543 eV
295.4286 meV
4.7334e-20J
>> OPT211_lab4_test('Dm',4.2,1)
Warning: please imput valid unit, for more help review
help file.
> In OPT211_lab4_test (line 59)
>> OPT211_lab4_test('Dm',4.2,1)
Warning: please input valid unit, for more help review
help file.
> In OPT211_lab4_test (line 59)
>>
```

(the "warning" shows up as an actual warning using the warning command)

Mid-lab

a.

the wavelength corresponding to an energy of3.97e-20J and an index of refraction of 1 is:
5.0075e-06m
5.0075um
5007.5155nm

b.

the energy corresponding to a wavelength of 5umand an index of refration of 1 is:
0.24816 eV
248.16 meV
3.976e-20J

c.

the wavelength corresponding to an energy of248meV and an index of refraction of 1 is:
5.0032e-06m
5.0032um
5003.2258nm

d.

the energy corresponding to a wavelength of 1.5635e-06m and an index of refraction of 3.2 is:
0.248 eV
248.0013 meV
3.9735e-20J

e.
the wavelength corresponding to an energy of0.248eV and an index of refraction of 3.2 is:
1.5635e-06m
1.5635um
1563.5081nm
f.
Warning: please imput valid unit, for more help review
help file.
> In OPT211_lab4_test (line 59)
g.
the energy corresponding to a wavelength of 550nm and an index of refraction of 1 is:
2.256 eV
2256 meV
3.6146e-19J
h.
the energy corresponding to a wavelength of 352.6nm and an index of refraction of 1.56 is:
2.2558 eV
2255.7703 meV
3.6142e-19J
i.
the wavelength corresponding to an energy of1.9e-13J and an index of refraction of 1 is:
1.0463e-12m
1.0463e-06um
0.0010463nm
j.
the energy corresponding to a wavelength of 9999999988m and an index of refraction of 1 is:
1.2408e-16 eV
1.2408e-13 meV
1.988e-35J

2.

Part 2

2.1

2.2

```
%Ezra A-K
%OPT 211
%loop test

%loop 5 times
for ijk=1:5
    x=ijk %display index value of ijk as x
    pause(1) %wait 1 second
end
```

```
OPT211_lab4_part2_Ezra_AK

x =

     1
```

```
x =

     2


x =

     3


x =

     4


x =

     5

>>
```

2.3

```
xx=ones(1,10) % Define an array of ones and display it

for ijk=1:10 % Select the ijk'th entry of the array
    xx(ijk)= ijk % Replace the ijk'th entry of the array with the index, ijk
and displays xx each time
end

>> OPT211_lab4_part2_Ezra_AK

xx =

     1     1     1     1     1     1     1     1     1     1


xx =

     1     1     1     1     1     1     1     1     1     1


xx =

     1     2     1     1     1     1     1     1     1     1


xx =

     1     2     3     1     1     1     1     1     1     1


xx =
```

```
     1     2     3     4     1     1     1     1     1     1

xx =

     1     2     3     4     5     1     1     1     1     1

xx =

     1     2     3     4     5     6     1     1     1     1

xx =

     1     2     3     4     5     6     7     1     1     1

xx =

     1     2     3     4     5     6     7     8     1     1

xx =

     1     2     3     4     5     6     7     8     9     1

xx =

     1     2     3     4     5     6     7     8     9    10

>>
```

As the loop runs it replaces the index of the all 1's matrix with the index value up until 10. By doing this it transforms 1 1 1 1 1 1 1 1 1 1 → 1 2 3 4 5 6 7 8 9 10 .

```
n=10;
yy=zeros(n,n) % Define and show an nxn "empty" matrix of zeros

for ijk=1:n % Select each individual row of the matrix
    for lmn=1:n  % loop through from 1 to n
    yy(ijk,lmn)=n*(ijk-1)+lmn; % Select an individual column from the current
row and change the value of this data point
    end
end
yy

yy =

     1     2     3     4     5     6     7     8     9    10
    11    12    13    14    15    16    17    18    19    20
    21    22    23    24    25    26    27    28    29    30
    31    32    33    34    35    36    37    38    39    40
    41    42    43    44    45    46    47    48    49    50
    51    52    53    54    55    56    57    58    59    60
```

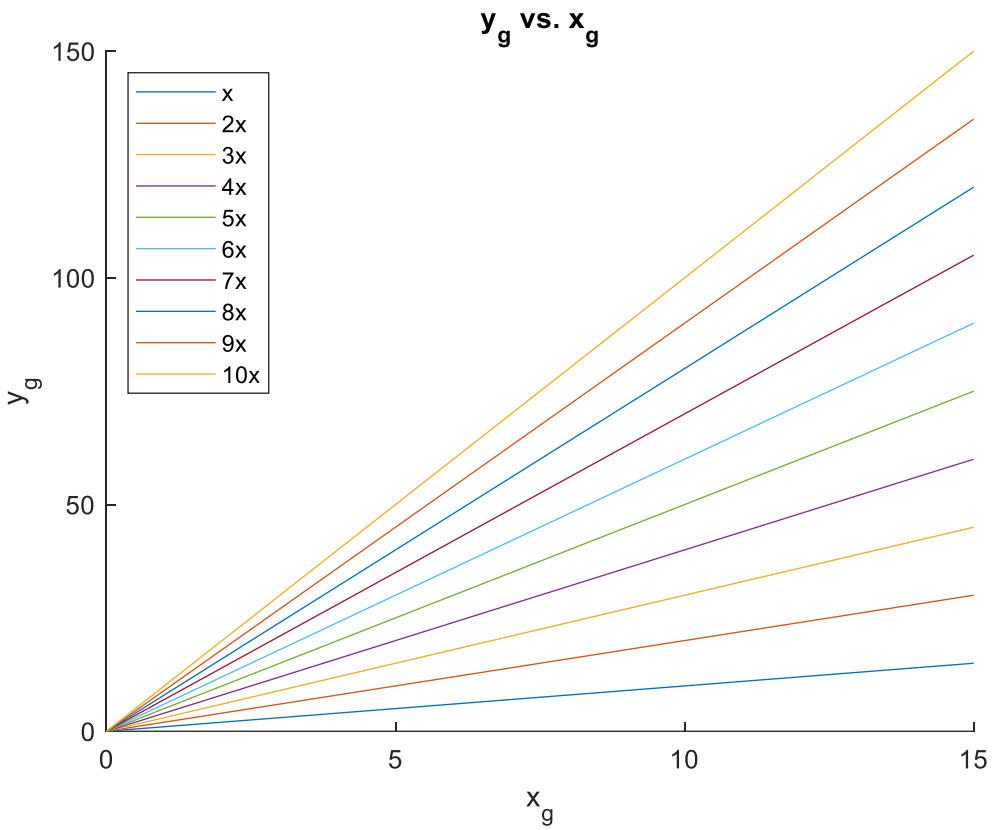
```
    61    62    63    64    65    66    67    68    69    70
    71    72    73    74    75    76    77    78    79    80
    81    82    83    84    85    86    87    88    89    90
    91    92    93    94    95    96    97    98    99   100

>>
```

```
n=10; % Number of points in the variable array
e=15; % Endpoint of variable array
t=10; % Number of functions in family to produce
xg=linspace(0,e,n); % Define independent variable
figure % Open a figure window
hold on % Allow for multiple plots within that figure window

for gg=1:t  % Loop through from 1 to t
    yg(gg,:)=xg*gg; % Calculate member of function family
    plot(xg,yg(gg,:))
end
%plot(xg,yg') % Plots entire family of functions from a single command
legend('x','2x','3x','4x','5x','6x','7x','8x','9x','10x','Location','northwes
t')  % Creates figure legend
xlabel('x_g')
ylabel('y_g')
title('y_g vs. x_g')
hold off % Ends open plotting on the current figure window
yg % Displays the answer matrix so we can see how Matlab generated it and
what it looks like
```



```
OPT211_lab4_part2_Ezra_AK

yg =

  Columns 1 through 5

         0    1.6667    3.3333    5.0000    6.6667
         0    3.3333    6.6667   10.0000   13.3333
         0    5.0000   10.0000   15.0000   20.0000
         0    6.6667   13.3333   20.0000   26.6667
         0    8.3333   16.6667   25.0000   33.3333
         0   10.0000   20.0000   30.0000   40.0000
         0   11.6667   23.3333   35.0000   46.6667
         0   13.3333   26.6667   40.0000   53.3333
         0   15.0000   30.0000   45.0000   60.0000
         0   16.6667   33.3333   50.0000   66.6667

  Columns 6 through 10

    8.3333   10.0000   11.6667   13.3333   15.0000
   16.6667   20.0000   23.3333   26.6667   30.0000
   25.0000   30.0000   35.0000   40.0000   45.0000
   33.3333   40.0000   46.6667   53.3333   60.0000
   41.6667   50.0000   58.3333   66.6667   75.0000
   50.0000   60.0000   70.0000   80.0000   90.0000
   58.3333   70.0000   81.6667   93.3333  105.0000
```

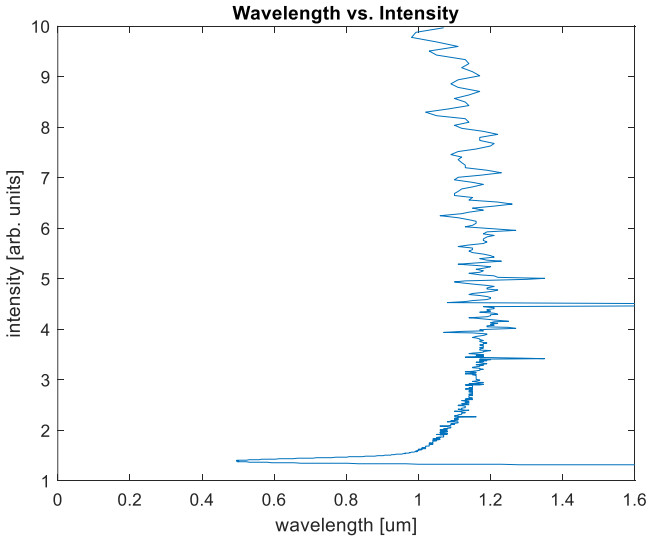
```
   66.6667   80.0000   93.3333  106.6667  120.0000
   75.0000   90.0000  105.0000  120.0000  135.0000
   83.3333  100.0000  116.6667  133.3333  150.0000

>> OPT211_lab4_part2_Ezra_AK

yg =

  Columns 1 through 5

         0    1.6667    3.3333    5.0000    6.6667
         0    3.3333    6.6667   10.0000   13.3333
         0    5.0000   10.0000   15.0000   20.0000
         0    6.6667   13.3333   20.0000   26.6667
         0    8.3333   16.6667   25.0000   33.3333
         0   10.0000   20.0000   30.0000   40.0000
         0   11.6667   23.3333   35.0000   46.6667
         0   13.3333   26.6667   40.0000   53.3333
         0   15.0000   30.0000   45.0000   60.0000
         0   16.6667   33.3333   50.0000   66.6667

  Columns 6 through 10

    8.3333   10.0000   11.6667   13.3333   15.0000
   16.6667   20.0000   23.3333   26.6667   30.0000
   25.0000   30.0000   35.0000   40.0000   45.0000
   33.3333   40.0000   46.6667   53.3333   60.0000
   41.6667   50.0000   58.3333   66.6667   75.0000
   50.0000   60.0000   70.0000   80.0000   90.0000
   58.3333   70.0000   81.6667   93.3333  105.0000
   66.6667   80.0000   93.3333  106.6667  120.0000
   75.0000   90.0000  105.0000  120.0000  135.0000
   83.3333  100.0000  116.6667  133.3333  150.0000

>>
```



You only need to have the hold if the plotting is done inside the loop. If it is outside of the loop then it will only plot the finished product and not all of the pieces separately.

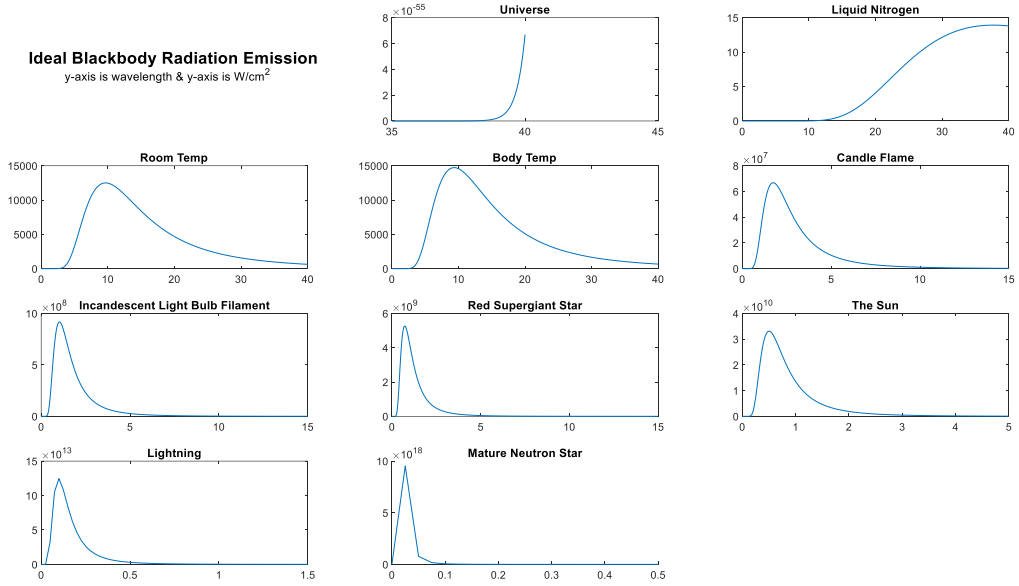
Post-lab

a.



```
bbspec = textread('OPT_lab4_text.txt');

x = bbspec(:,1);
y = bbspec(:,2);

plot(y,x)
title('Wavelength vs. Intensity')
xlabel('wavelength [um]')
ylabel('intensity [arb. units]')
xlim([0 1.6]);
```

b.



(Over all graph title made with the editor)

```
n=11;

[BBFilename, BBText] = uigetfile('*.xlsx'); % Opens up a window and allows
you to select a file
[BBD, BBT]= xlsread([BBText BBFilename]); % Reads the file you selected

% x=BBD(:,1);
% y=BBD(:,AAH);

hold on
for AAH=2:n
    subplot(4,3,(AAH))
    plot(BBD(:,1),BBD(:,AAH))
    %title(num2str(AAH-1))
end
subplot(4,3,2);
title('Universe')
xlim([35 45])
```

```
subplot(4,3,3);
title('Liquid Nitrogen')
subplot(4,3,4);
title('Room Temp')
subplot(4,3,5);
title('Body Temp')
subplot(4,3,6);
title('Candle Flame')
xlim([0 15])
subplot(4,3,7);
title('Incandescent Light Bulb Filament')
xlim([0 15])
subplot(4,3,8);
title('Red Supergiant Star')
xlim([0,15])
subplot(4,3,9);
title('The Sun')
xlim([0 5])
subplot(4,3,10);
title('Lightning')
xlim([0 1.5])
subplot(4,3,11);
title('Mature Neutron Star')
xlim([0 0.5])
hold off
```

2. About an hour and a half outside of the lab.
3. an hour or so, I was helping someone else at the same time.