ASSIGNMENT 1 - Sam Byford - 300609708

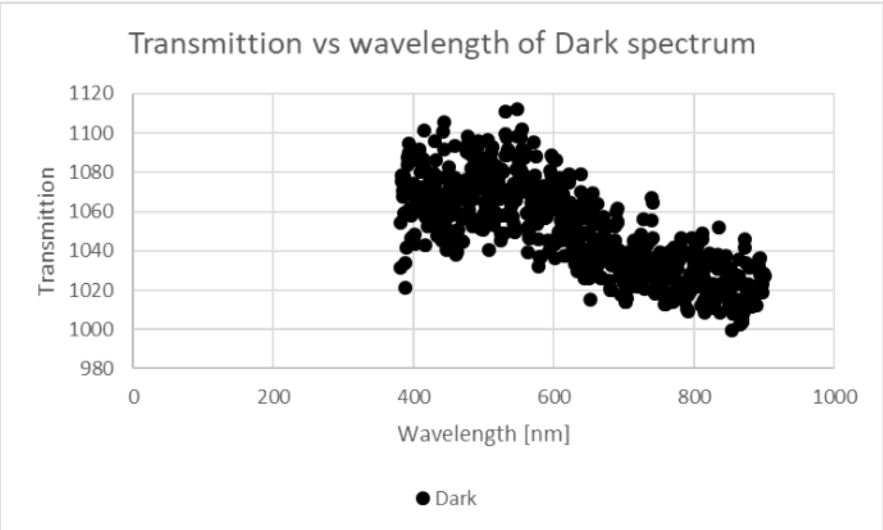
Sunday, 5 March 2023 2:11 PM

1)
A)
NA = n*sin(Theta max)
n= 1
Sin(Theta max) = 0.5*D/f [by using trigonometry]
For 75mm: sin(Theta max) = 0.5*30mm / 75mm = 0.2
For 150mm: sin(Theta max) = 0.5*30mm / 150mm = 0.1

NA (75mm) = 0.2
NA (150mm) = 0.1

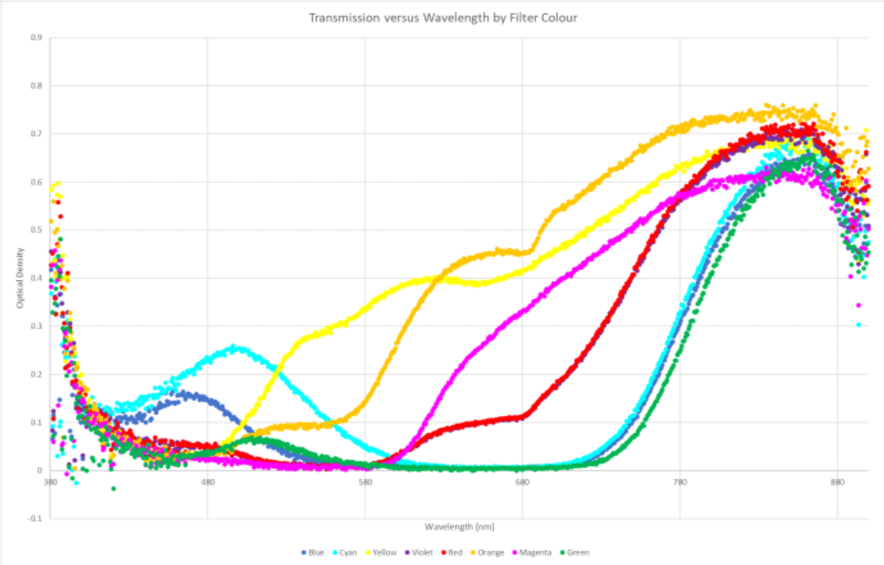
B)
Assuming n=1 through air
NA = n*sin(Theta max) = n*0.5*D/f
f=0.5*n*D/NA
f=0.5*1*30/0.2
f=75mm

2)
A)

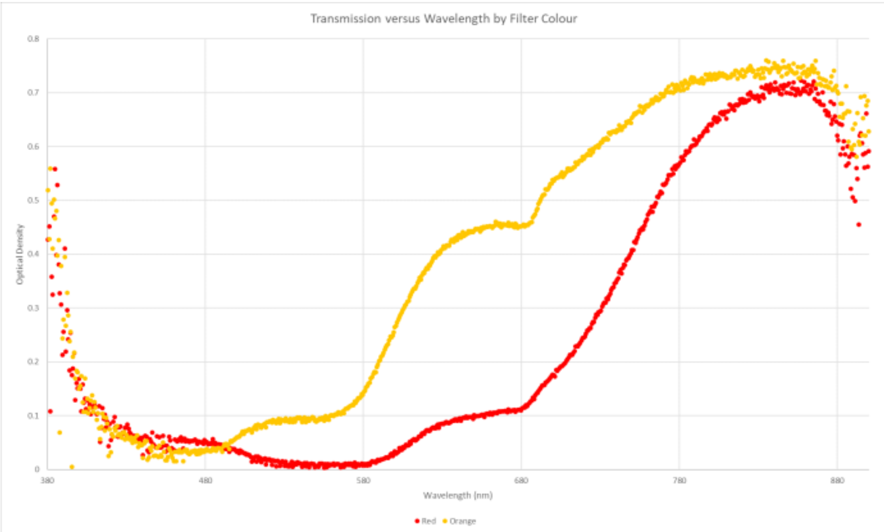


The dark spectrum has more counts of infrared emission. What we used to block the light from the source must not absorb infrared as well as visible.

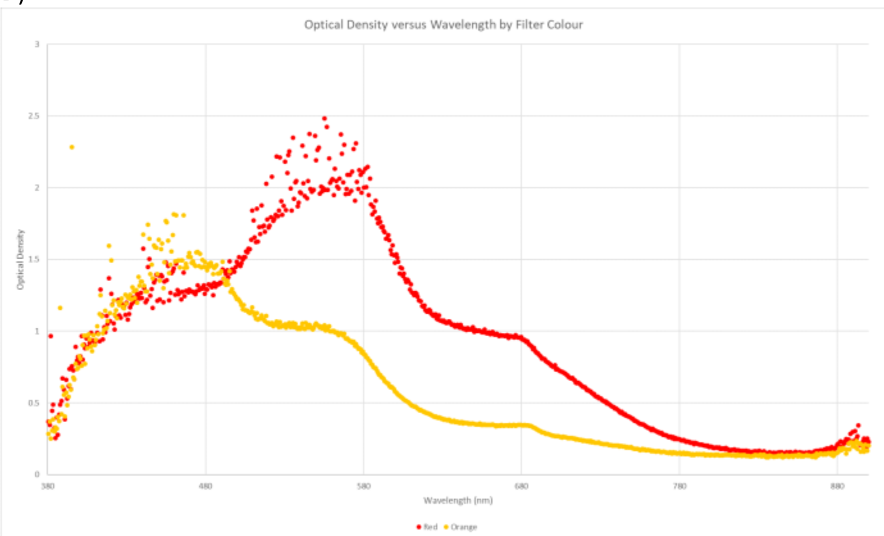
B)



C)



D)



E)

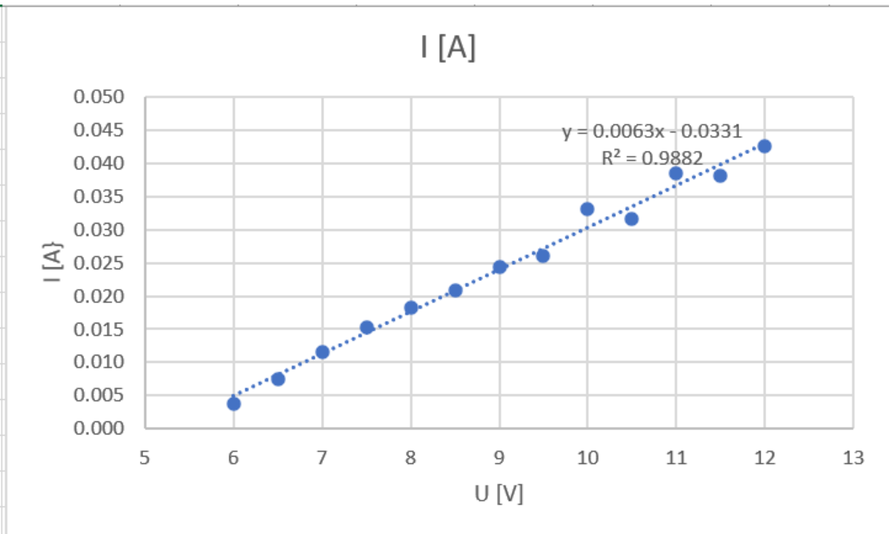
The red and orange filters absorb light of all wavelengths except red and orange respectively. This is why we see more transmission counts around the wavelengths of the red section of the spectrum for the red filter and red and yellow section of the spectrum for the orange filter.

F)

The integration time was set 2/3's the maximum. The maximum integration time the system allowed was 110ms so we used an integration time of around 70ms. We used a number of average spectra of 5, not wanting it to be too high. As seen this affects the data for lower wavelengths on the graph.

3)

U [V]	I [A]
6	0.00377
6.5	0.00756
7	0.01153
7.5	0.01532
8	0.01833
8.5	0.02077
9	0.02446
9.5	0.02600
10	0.03307
10.5	0.03168
11	0.03849
11.5	0.03808
12	0.04267

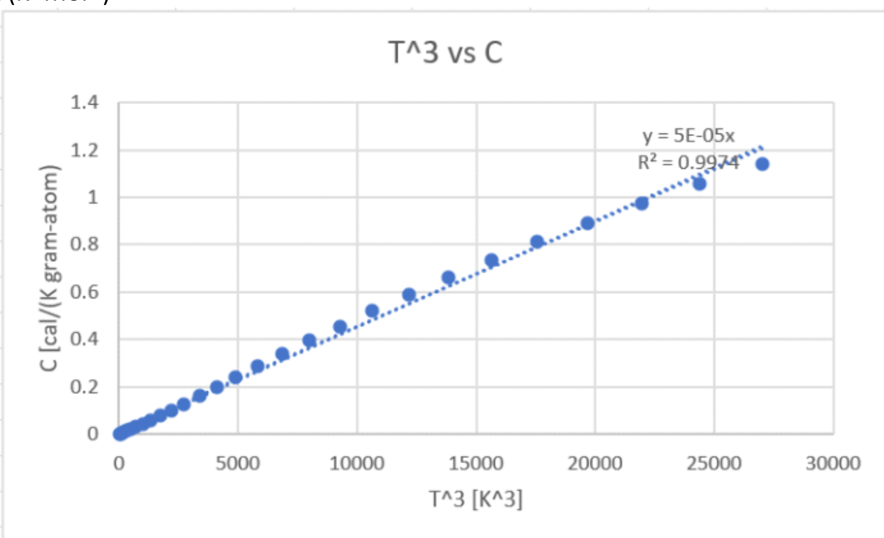


	Slope = Z [A/V]	intercept = Uo [A]
Value	0.006347714	-0.033149893
uncertainty	0.000209046	0.001921628
	0.988210654	0.00141009
	922.04585	11
	0.001833353	2.18719E-05

4)

A) $J/(K*Mol^{-1})$

B)



	Slope [A]	intercept
Value	4.51E-05	0
Uncertaint	4.46E-07	#N/A

C) $A=4.51x10^{-5}+-4.46x10^{-7}$

$A = (12\pi/5)N_A k_B/T_D^3)$

$T_D = (A/((12\pi/5)N_A k_B))^{1/3}$

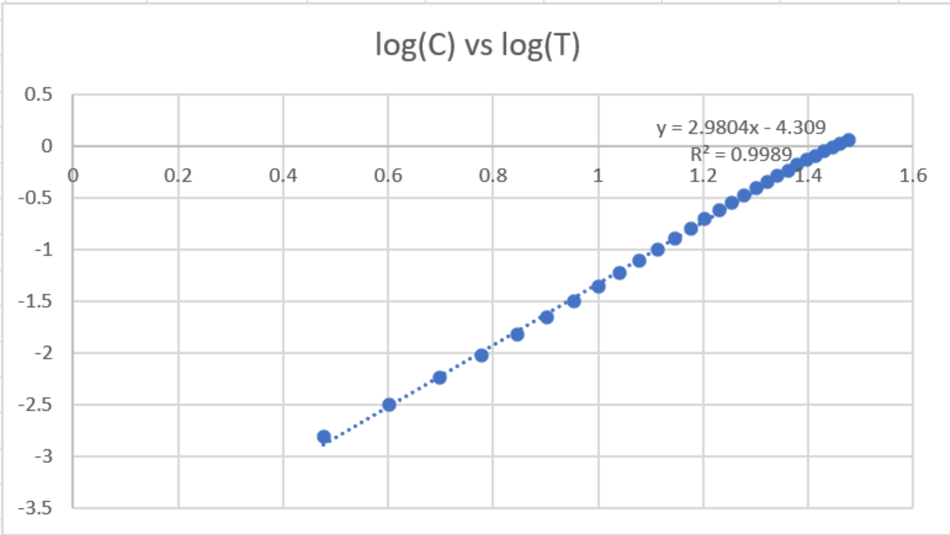
$N_A = 6.02x10^{23}$

$K_B = 1.38x10^{-23}$

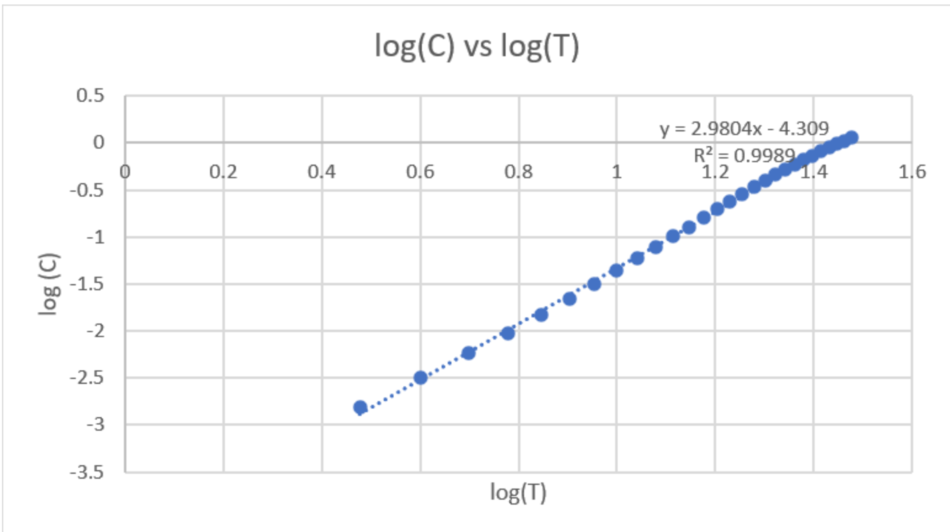
So $T_D = (4.51x10^{-5}+-4.46x10^{-7})/((12\pi/5)(6.02x10^{23})(1.38x10^{-23}))^{1/3}$

$T_D = 0.008963+-0.001924$ K

D) $Log(C) = nlog(t) + log(A)$



	Slope [A]	intercept
Value	2.980437976	-4.30904
Uncertainty	0.0193684	0.022832
	0.998903208	0.027773
	23679.5074	26
	18.26510745	0.020055



	Slope	intercept
Value	2.980437976	-4.30904
Uncertainty	0.0193684	0.022832
	0.998903208	0.027773
	23679.5074	26
	18.26510745	0.020055

We can say n=3 and it shows differently in the data due to experimental error

Since we know Debye's law is true, this means that we can use log(A) from the logarithmic graph to get a better estimate for T_D

$T_D = (A/((12\pi/5)N_A k_B))^{1/3}$
$T_D = (10^{-4.30904}/((12\pi/5)(6.02\text{x}10^{23})(1.38\text{x}10^{-23}))^{1/3}$
$= 0.0092195$ K