Name: _____ Date: _____ Period: _____

PDN

# Spectra Analysis

1. What is an absorption line?

2. What is the electromagnetic spectrum?

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1. What is an absorption line?

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# Wien's Law

A blackbody is an idealized object that absorbs all electromagnetic radiation (light) falling on it and re-emits that radiation in a continuous (smooth) spectrum. So, the blackbody curve for a spectrum has no absorption lines or noise. A blackbody curve ONLY depends on the temperature of an object, and nothing else.

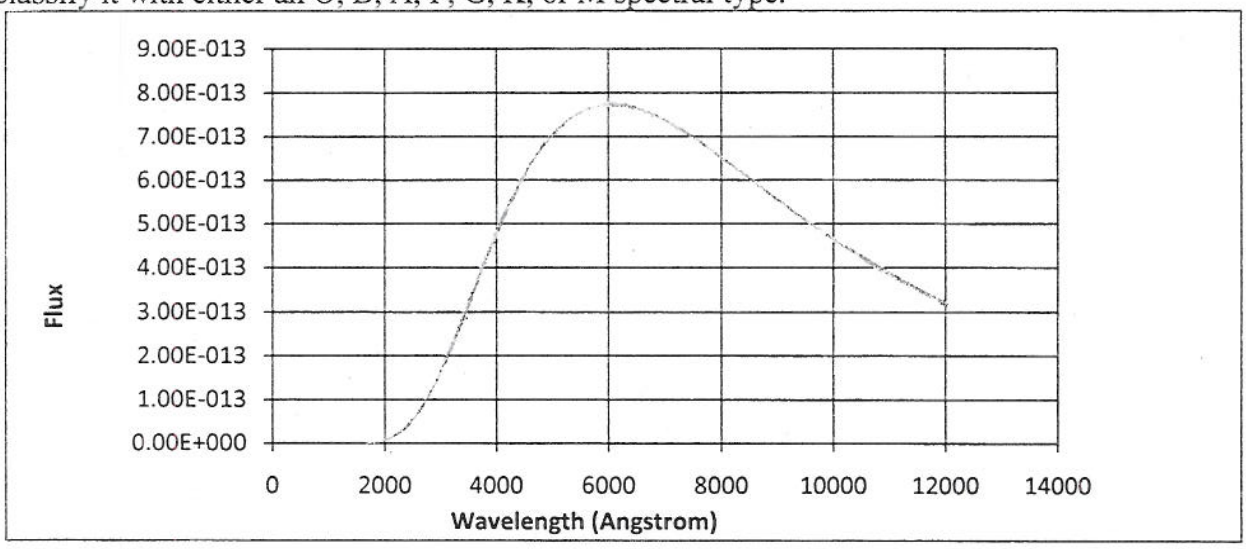
Wien's Law is used to calculate the temperature of a blackbody curve:

$$\lambda_{peak} = \frac{b}{T}$$

$\lambda_{peak}$ = peak wavelength,
$b = 2.9 \times 10^{-3}$ m·K (Wien's displacement constant)
T = temperature

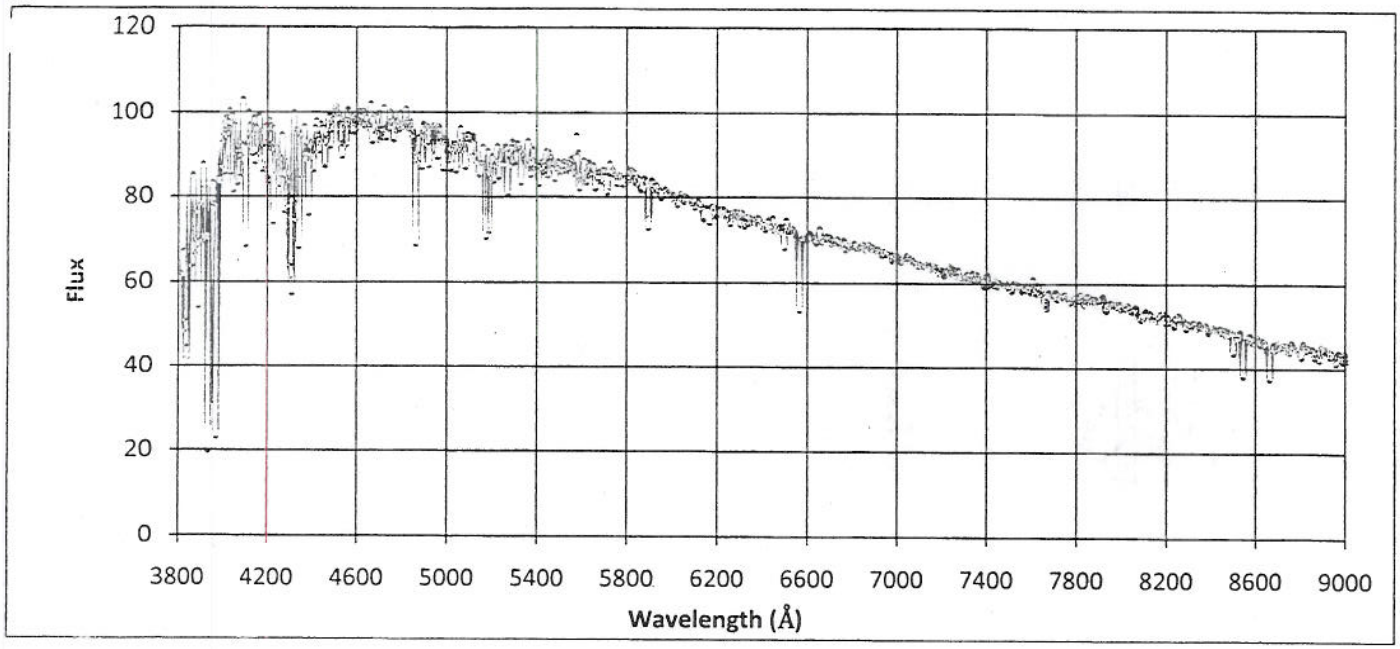
REMEMBER: In doing these calculations, be sure to be using the correct units! ($1\text{Å} = 10^{-9}$m)

1. Using Wien's Law, calculate the temperature of the object with the following blackbody curve and then classify it with either an O, B, A, F, G, K, or M spectral type.

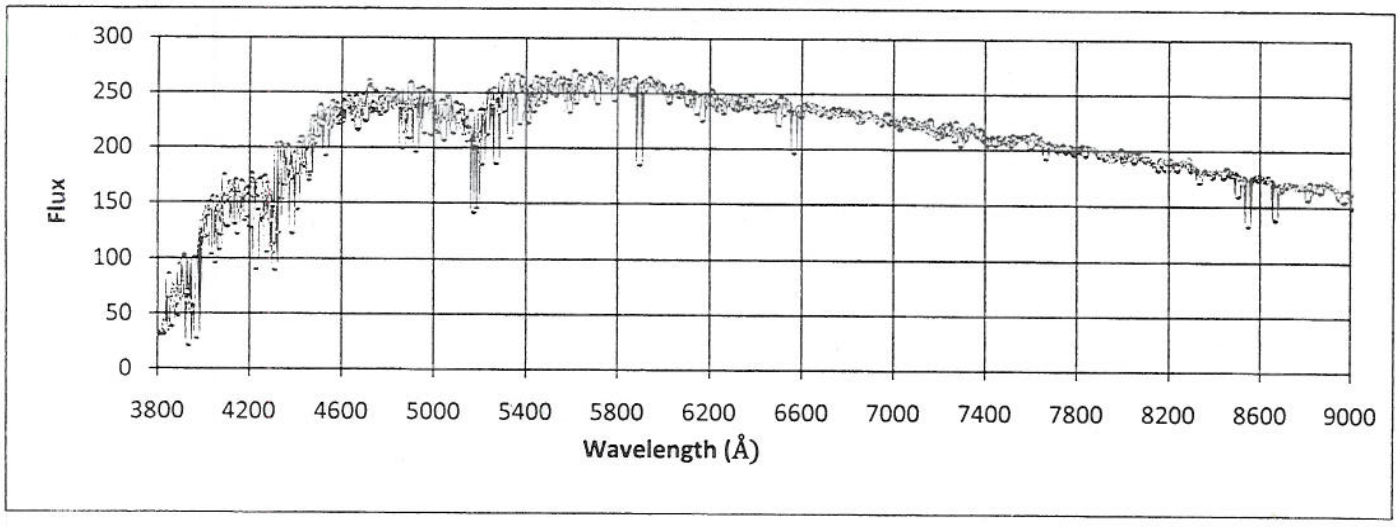


2. Using Wien's Law, calculate the temperature of the stars with the following spectra and then classify them with either an O, B, A, F, G, K, or M spectral type as well as a subtype (0-9). Ex: Our Sun is a G2.

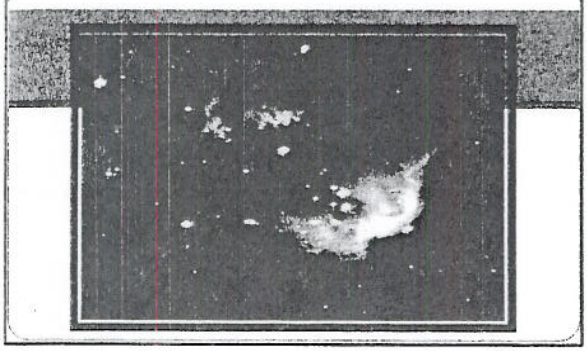
a.




b.



## Harvard Classification



## First Star Classification

- One of the very first classification of stars was made in the 2nd century B.C.
- Certain stars look dimmer than others
- This classification was made by ranking how brightly stars looked in the night sky
  - How brightly a star APPEARS in the sky is known as: **Apparent Magnitude**

## First Star Classification

- But, apparent magnitude is not an intrinsic property of a star, since it relies on how far the star is from the viewer
- An **intrinsic property** of a star is a characteristic that a star has that does not change depending on the viewer
  - For example, an intrinsic property of a high school student is that he has two eyes
  - What are some other examples of intrinsic properties a person could have?

## Harvard Classification Scheme

- Since apparent magnitude was not the best property to use in classifying stars, what property was used for the Harvard classification scheme?

## Harvard Classification Scheme

- Since apparent magnitude was not the best property to use in classifying stars, what property was used in the Harvard classification scheme?

**Temperature**

- Temperature is an intrinsic property of stars, meaning it stays the same no matter where you look at it from

## Harvard Classification Scheme

- The Harvard classification began by looking at photographic plates by eye, very similar to what you saw in your spectroscopes

- This is a picture of the spectrum of the sun
- The dark vertical bands are absorption lines

## Harvard Classification Scheme

- If two stars had similar absorption lines, then they were placed in a group together
- The letters A-Q were used to denote different groups
- Later, all of the letters were dropped except for **O, B, A, F, G, K, and M** in that order
- It turns out that this classification was based on temperature, with O being the hottest and M being the coolest
- These letters are called: **spectral types**

## Harvard Classification Scheme

- An easy way to remember the order of the letters is with the mnemonic:

Oh
Hot Be

Unlike our showers and faucets,
Hot stars are Blue,
And Cold stars are Red

ine
irl/Guy
Cold iss
Me

## Harvard Classification Scheme

- To further subdivide the stars, the number 0-9 were added at the end of the letter. 0 being the hottest subtype and 9 being the coldest subtype

**Pop Quiz**

Rank these 4 stars in order from hottest to coldest:
A7, G2, B1, B9

## Pop Quiz

Rank these 4 stars in order from hottest to coldest:
A7, G2, B1, B9

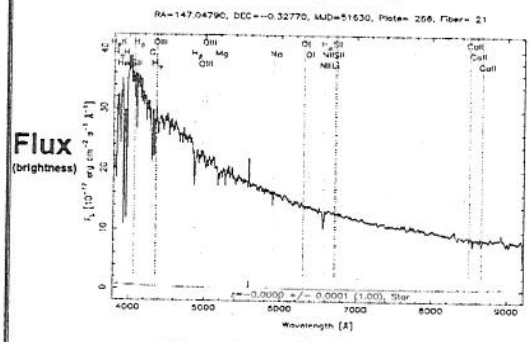
Answer: B1, B9, A7, G2

## Harvard Classification Scheme

- The ranges of temperatures for each spectral type are as follows:

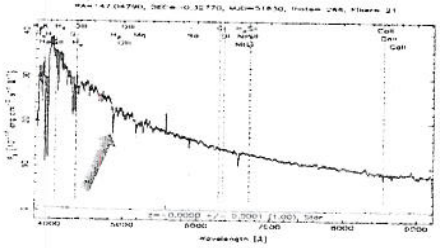
| Spectral Type | Temperature(Kelvin) |
|---|---|
| O | 28,000 – 50,000 |
| B | 10,000 – 28,000 |
| A | 7500 – 10,000 |
| F | 6000 – 7500 |
| G | 5000 – 6000 |
| K | 3500 – 5000 |
| M | 2500 - 3500 |

## How do you read a digital spectrum?



## How do you read a digital spectrum?

- The dips in the graph are the absorption lines
  - A red arrow marks just one of the several absorption lines on the below spectrum



## How do you read a digital spectrum?

- Not all of the squiggly lines in the spectrum are absorption lines
- There is an annoying feature of scientific data that accounts for error is measurements called noise
- In looking at a spectrum, **noise** is a combination of several unwanted frequencies of electromagnetic radiation (light)
- For our purposes, the absorption lines will be easy to see

## Homework

- The mnemonic Oh Be A Fine Girl/Guy Kiss Me is good, but could be better
- Think of a better or more creative mnemonic to use for the letters OBAFGKM in that order
- The class will vote on a winner tomorrow
- The winner will win a very *special* prize!