

Name: _____

Preliminary Physics

Lesson 6
Cosmic Engine

In **Theory**. This booklet is your best friend.



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0466 342 939



garyzhanghsc@gmail.com



www.hscsynergyeducation.weebly.com

Summary of Key Words

Account

Account for: state reasons for, report on. Give an account of: narrate a series of events or transactions

Analyse

Identify components and the relationship between them; draw out and relate implications

Apply

Use, utilise, employ in a particular situation

Assess

Make a judgement of value, quality, outcomes, results or size

Calculate

Ascertain/determine from given facts, figures or information

Clarify

Make clear or plain

Classify

Arrange or include in classes/categories

Compare

Show how things are similar or different

Construct

Make; build; put together items or arguments

Contrast

Show how things are different or opposite

Deduce

Draw conclusions

Define

State meaning and identify essential qualities

Demonstrate

Show by example

Describe

Provide characteristics and features

Discuss

Identify issues and provide points for and/or against

Distinguish

Recognise or note/indicate as being distinct or different from; to note differences between

Evaluate

Make a judgement based on criteria; determine the value of

Examine

Inquire into

Explain

Relate cause and effect; make the relationships between things evident; provide why and/or how

Extract

Choose relevant and/or appropriate details

Extrapolate

Infer from what is known

Identify

Recognise and name

Interpret

Draw meaning from

Investigate

Plan, inquire into and draw conclusions about

Justify

Support an argument or conclusion

Outline

Sketch in general terms; indicate the main features of

Predict

Suggest what may happen based on available information

Propose

Put forward (for example a point of view, idea, argument, suggestion) for consideration or action

Recall

Present remembered ideas, facts or experiences

Recommend

Provide reasons in favour

Revision

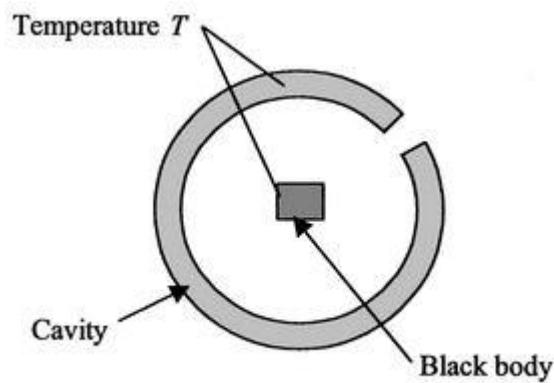
Question 1

a) Define a blackbody.

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b) Below is a diagram of a blackbody. Explain how it works.



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c) A blackbody needs to maintain a thermal equilibrium. Explain how this achieved.

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d) Identify an object that operates similarly to a blackbody.

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e) Explain how the temperature of a star can be estimated.

Question 2

What is the difference between apparent magnitude and absolute magnitude?

Question 3

What is the luminosity of a star?

Question 4

State the relationship between apparent brightness and luminosity.

Lesson Dotpoints

By the end of the lesson, you should understand the following concepts:

Relationship Between Stars

- Describe a Hertzsprung – Russell diagram as the graph of a star’s luminosity against its colour or surface temperature

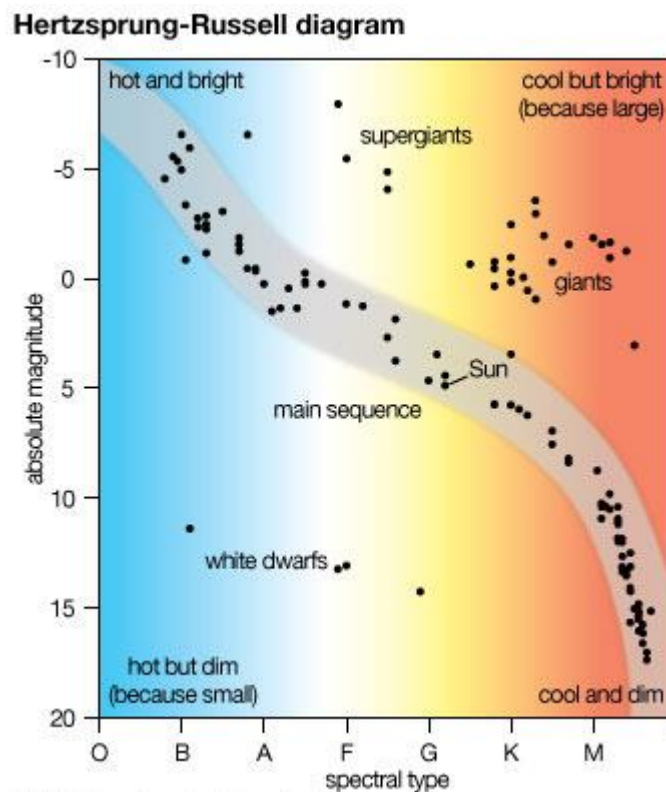
1. Relationship Between Stars

CHECKPOINT:

- Describe a Hertzsprung – Russell diagram as the graph of a star’s luminosity against its colour or surface temperature

⚙️ Hertzsprung – Russell Diagrams

- Not all stars are the same due to their life cycles
- The Hertzsprung – Russell diagram is a tool to show the _____ and _____ between stars
- Below is an example of a Hertzsprung – Russell diagram:



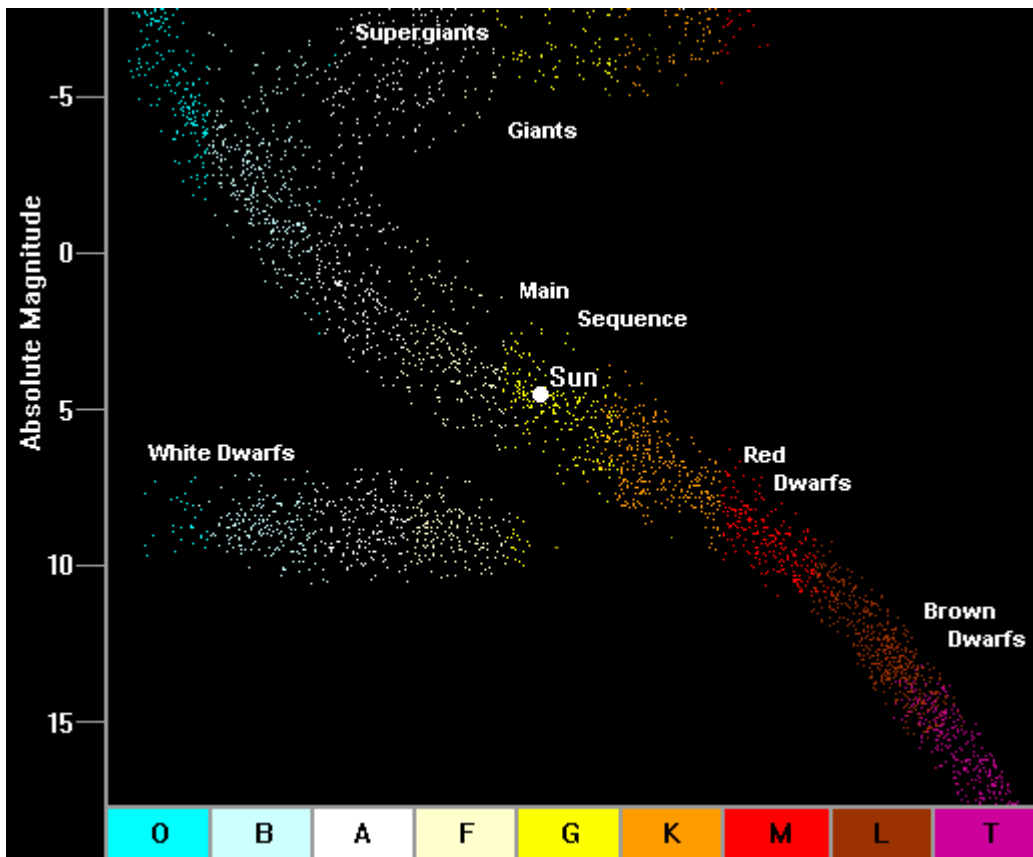
- In the above diagram it can be seen that each star is represented by a dot
- The position of the star on the diagram tells us two things which are its:

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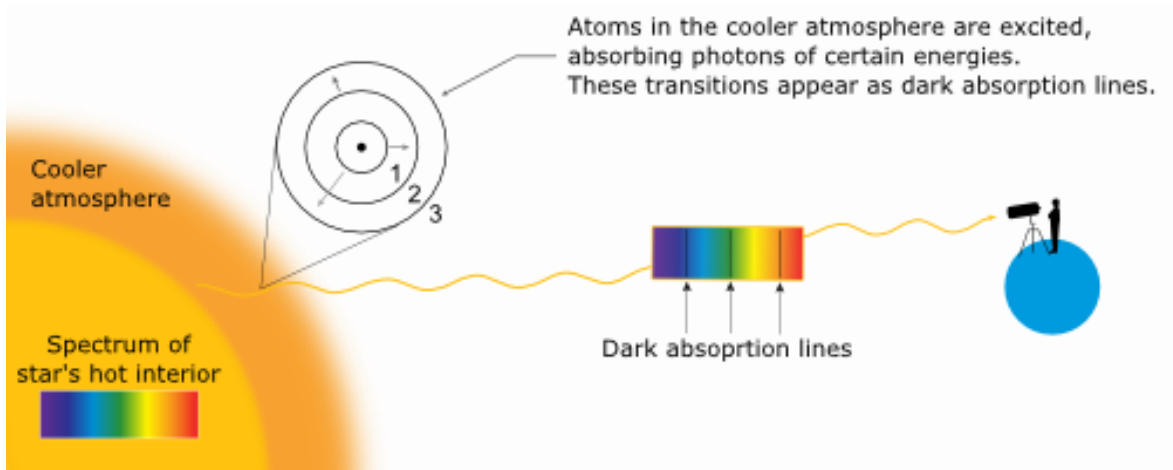
- You have already learn't the definition of luminosity. Explain what it is.

- Luminosity is the same as absolute _____
- As seen the stars are grouped into **spectral class** or **type**

⚙ HR Diagrams - Spectral Class



- In the diagram above it can be seen that the spectral class can be represented through colours
- Each spectral class represents different colours of star
- Spectral class is derived from _____



- The above diagram shows the physics behind the absorption spectrum for stars
- The process of detecting a stars colour is shown below:
 1. The hottest part of the star is the _____. This means that most of the radiation is produced in the high density regions of the star.
 2. As light is produced it move outwards towards the cooler parts of the star. This is known as the low density region of the star.

- What happens to light in the low density region?

- Why can light be absorbed in the cooler region?

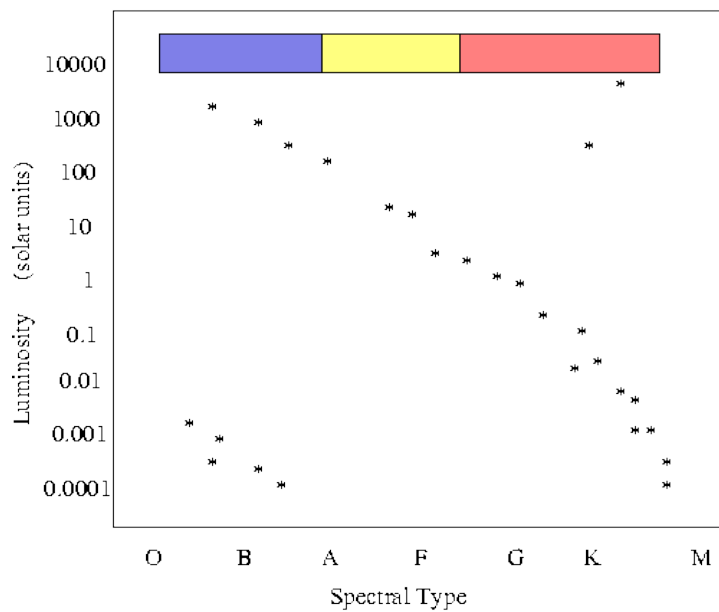
3. Therefore, when looking at stars you see an absorption spectrum due to the absorption

- It can be concluded that the spectral class corresponds to the _____ of a star
- It is important to remember that the range from blue to red where blue is the _____ and red is the _____

- Fill in the table below.

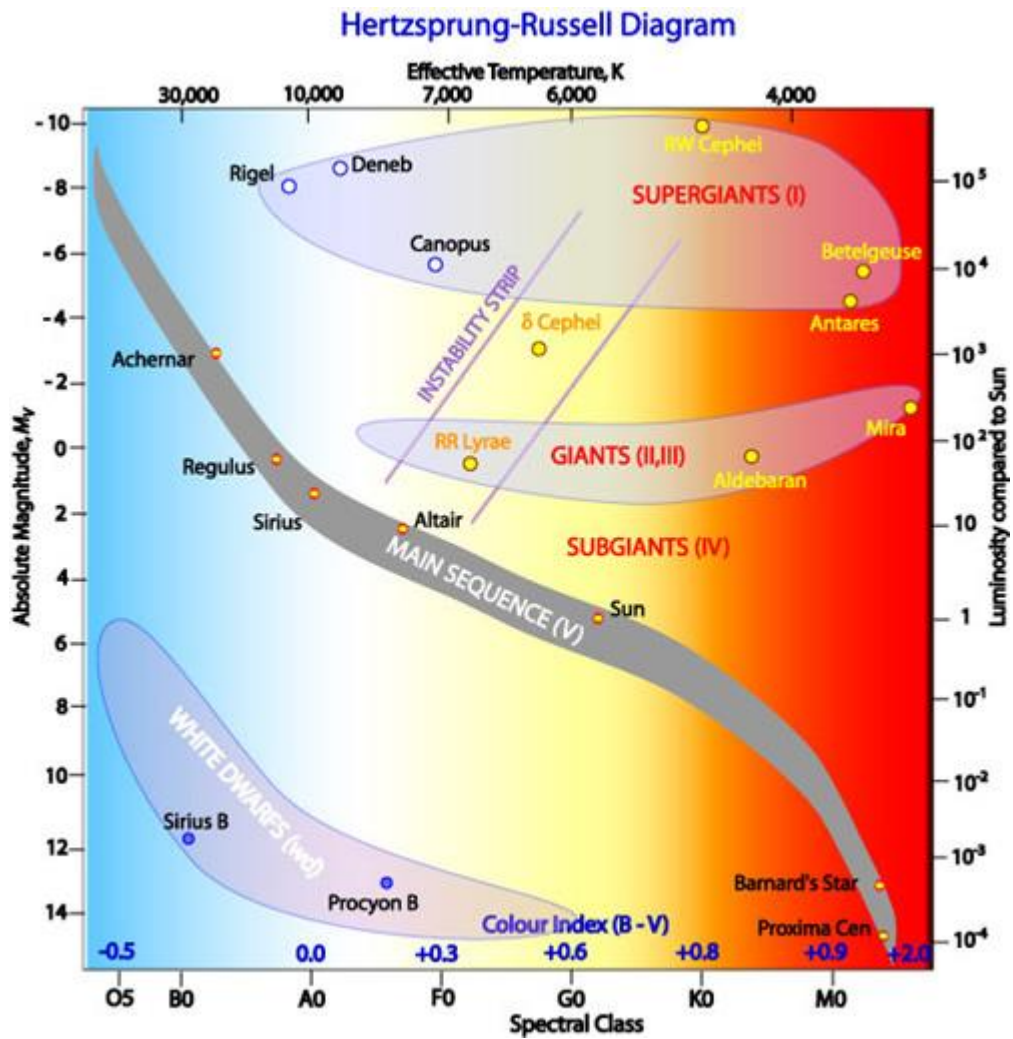
Classification	Temperature	Colour
O	40,000	
B	20,000	Light Blue
A	10,000	
F	7,500	Yellow-White
G	5,500	
K	4,000	Orange
M	3,000	

 **HR Diagrams - Temperature**

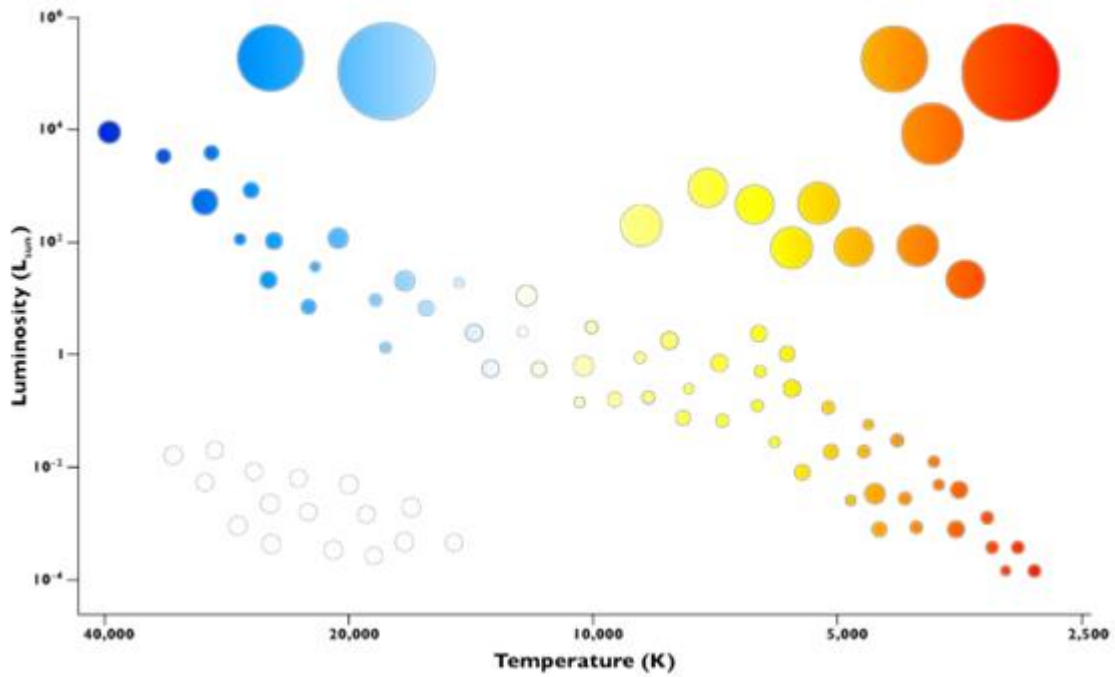


- On the diagram above, **label** the direction in which temperature increases

- Temperature is measured in _____
- The highest temperature is towards the _____
- The lowest temperature is towards the _____
- It is common for the horizontal axis to have either spectra type or temperature. However, both can be shown like the following:



⚙️ HR Diagrams – Regions of Stars



- As seen on the diagram above, stars are NOT randomly plotted on the diagram
- This indicates there are:

- What can be said about the luminosity of stars and the **mass or size** of them?

- What can be said about the luminosity of stars and their **temperature**?

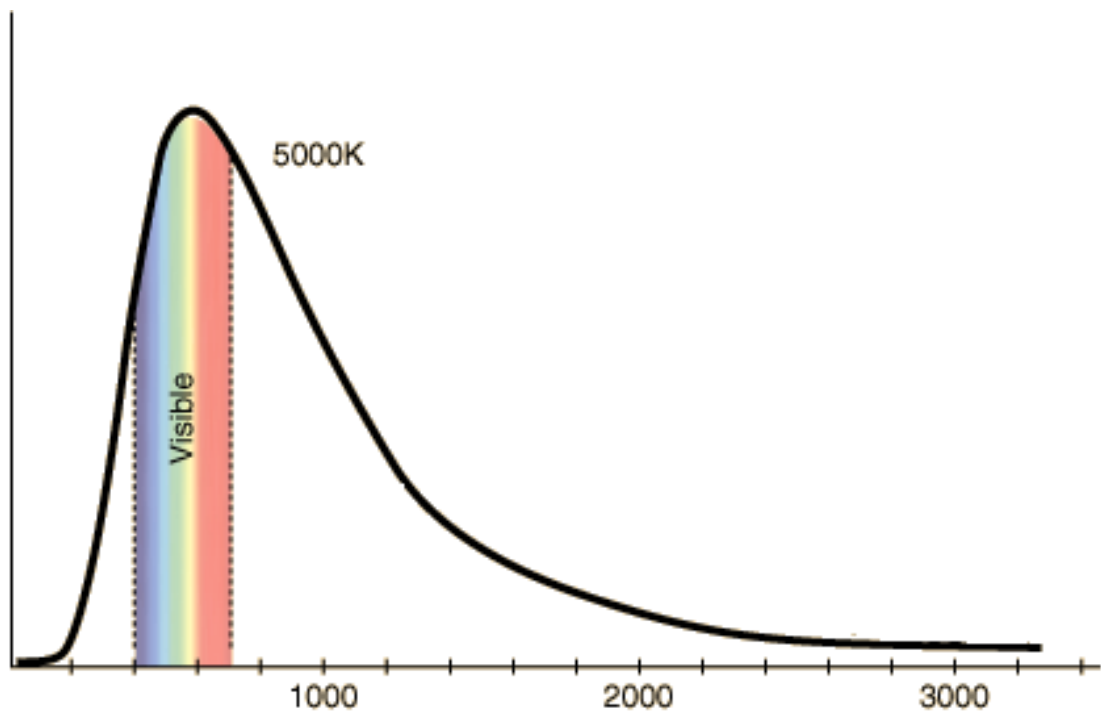
- Stars fall into one of the five groups:

1	Main Sequence
2	Red Giants
3	Red Super Giants
4	Blue Giants
5	White Dwarfs

- **Label** the regions of stars in the Hertzsprung Russell Diagram above
- **Label** where the sun is on the Hertzsprung Russell Diagram above
- Under which region is the sun?

- Stars are one of the closest objects to emulate a _____

- For each of the following stars, **draw** an intensity vs wavelength curve showing how they act as blackbodies. The sun has already been plotted on the curve. Label the horizontal and vertical axis.
- Red Giants
 - Red Super Giants
 - Blue Giants
 - White Dwarfs



Applications 1.1

Question 1

- b) Sketch a Hertzsprung/Russell diagram on the axes below. Be sure to label the axes and mark the regions where Main Sequence, Red Giant and White Dwarf stars would be found on the diagram. (4 marks)



- c) Explain how astronomers can determine the temperature of a star by examining the light emitted by the star. (3 marks)

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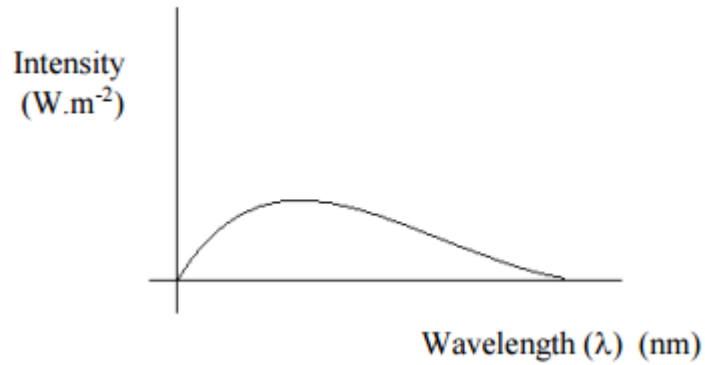
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Question 2 (Pymble Ladies College Trial – Qu 22)

The diagram below represents a graph of Intensity of radiation emitted from the Sun as a function of Wavelength.



On the same diagram, sketch the Intensity vs Wavelength graph for a typical blue Super Giant. (1 mark)

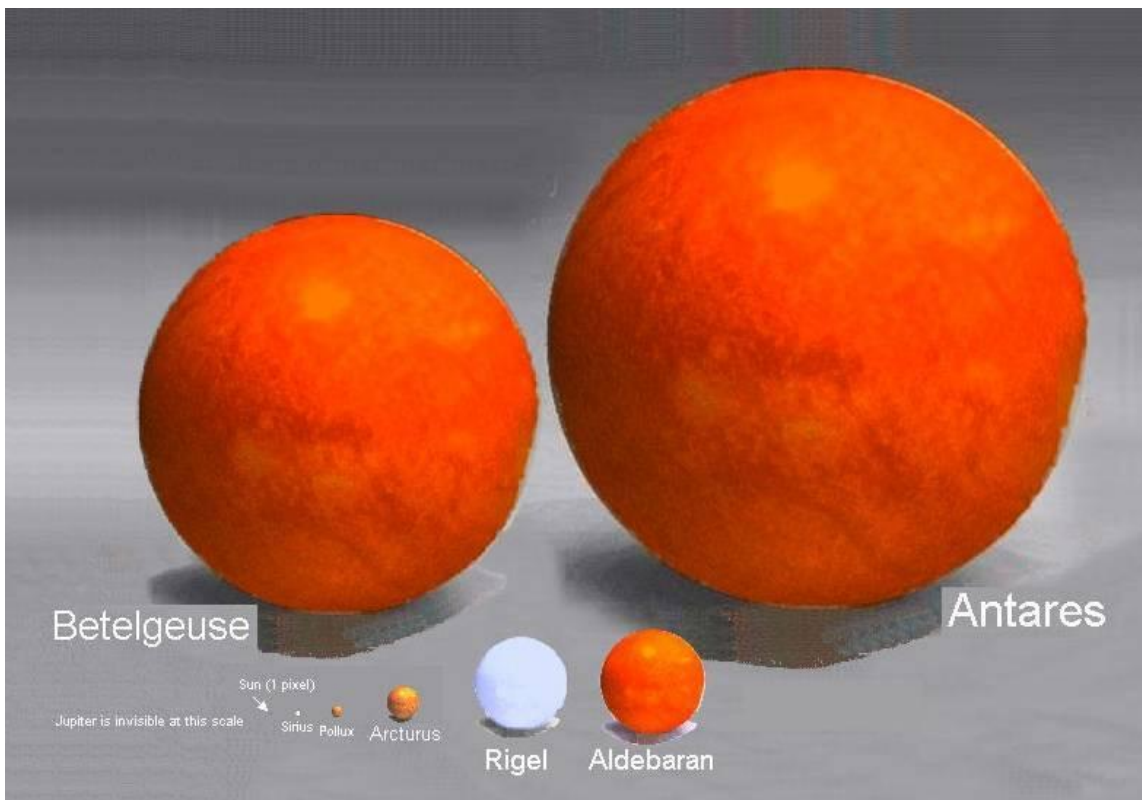
2. Comparing Star Sizes

CHECKPOINT:

- Describe a Hertzsprung – Russell diagram as the graph of a star’s luminosity against its colour or surface temperature

⚙ Size of Stars

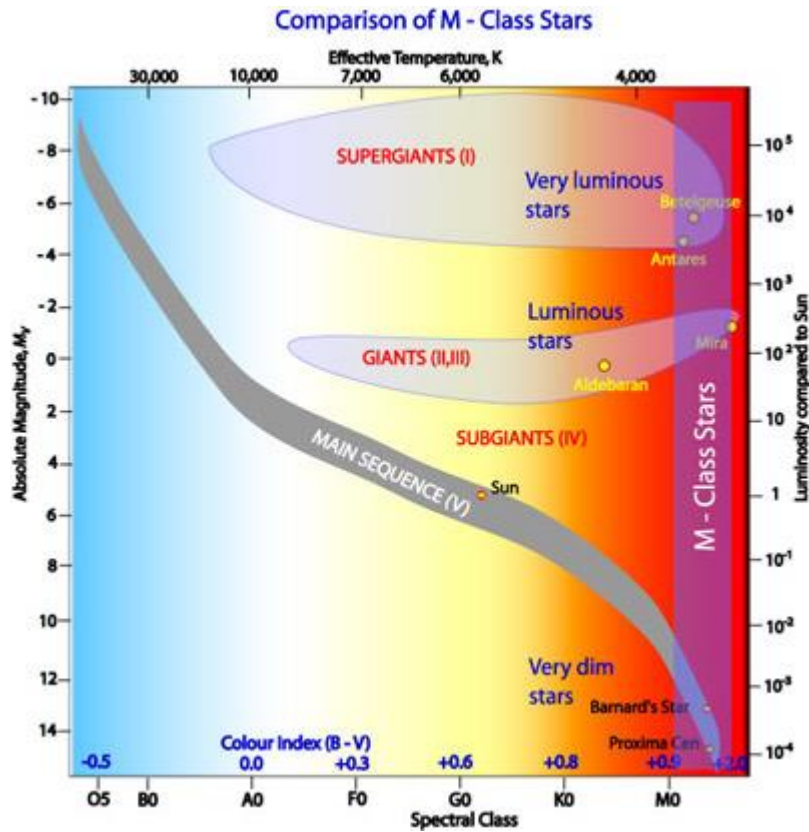
- The diagram below shows stars ranging from white dwarfs to red supergiants



- Using the diagram above, estimate which class of stars does each star belong to. Answer in the table below.

Star	Classification
Antares	
Betelgeuse	
Aldebaran	
Rigel	
Arcturus	
Pollux	
Sirus	
Sun	

⚙️ Differing Luminosity



- By using the spectral class we are able to compare the sizes of stars along with their temperature and luminosity
- On the diagram above five M class stars shown and each of them belong to a different region of stars. **Identify** these stars.

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- What is their relationship in terms of **temperature**?

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- What is their relationship in terms of **colour**?

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- It can be seen that their luminosities range from 14 to -6.
 - Explain their differing luminosities.

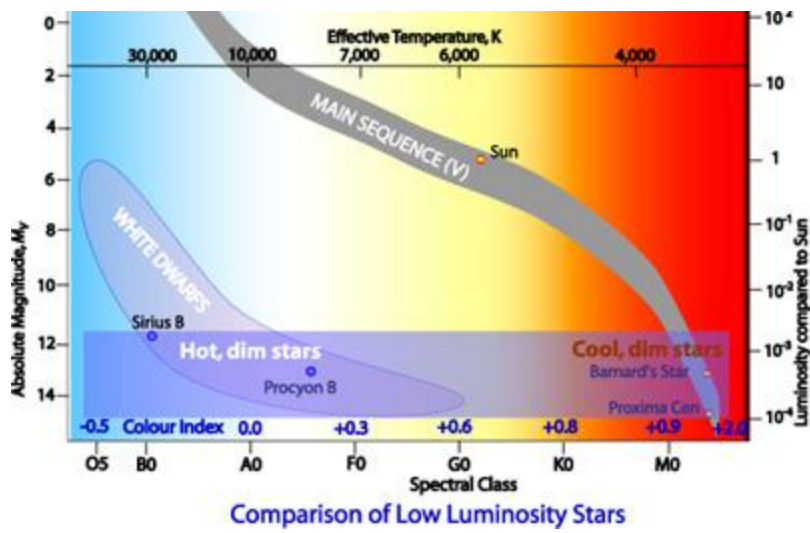
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Similar Luminosity



- Order the stars in the blue band from hottest to coldest.

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- Main sequence stars are generally larger than dwarf stars. Using this knowledge explain why Procyon B has a similar luminosity to Barnard's Star.

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