Name: _____

Hertzsprung Russel

Date:

Time:

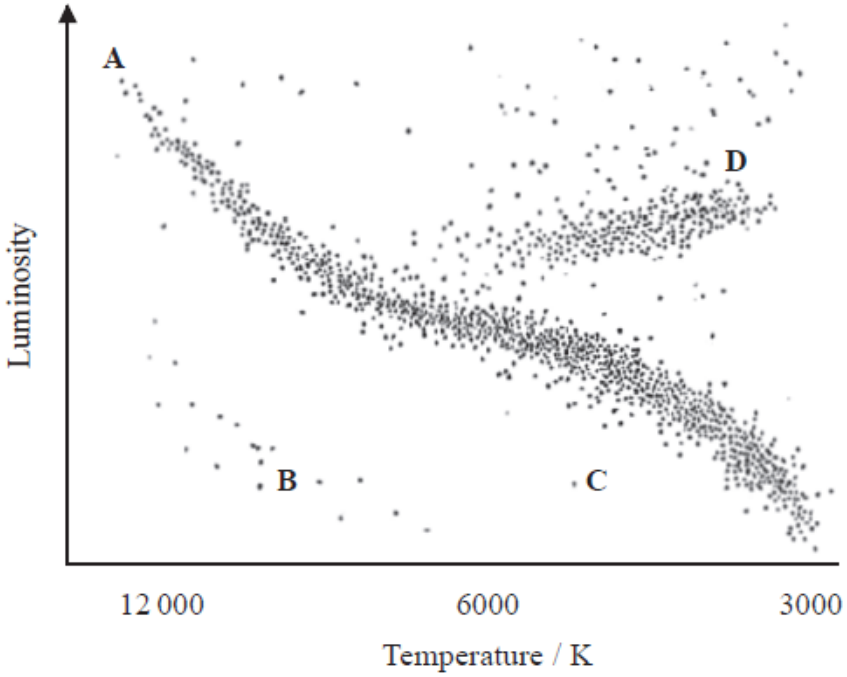
Total marks available:

Total marks achieved: _____

Questions

Q1.

This question refers to the Hertzsprung-Russell diagram below.



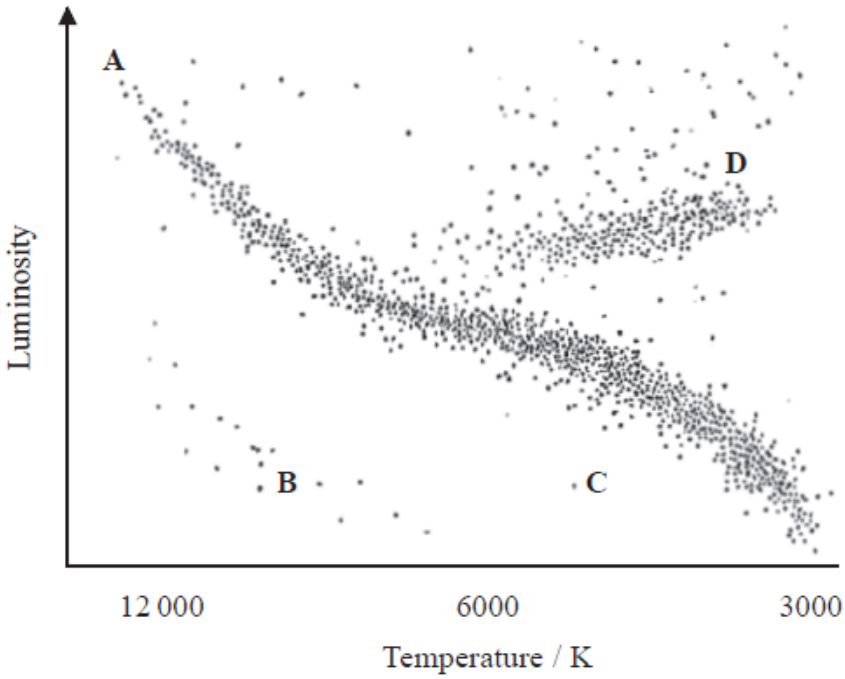
Which letter, **A**, **B**, **C** or **D**, indicates the region where a blue giant star would be shown?

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for question = 1 mark)

Q2.

This question refers to the Hertzsprung-Russell diagram below.

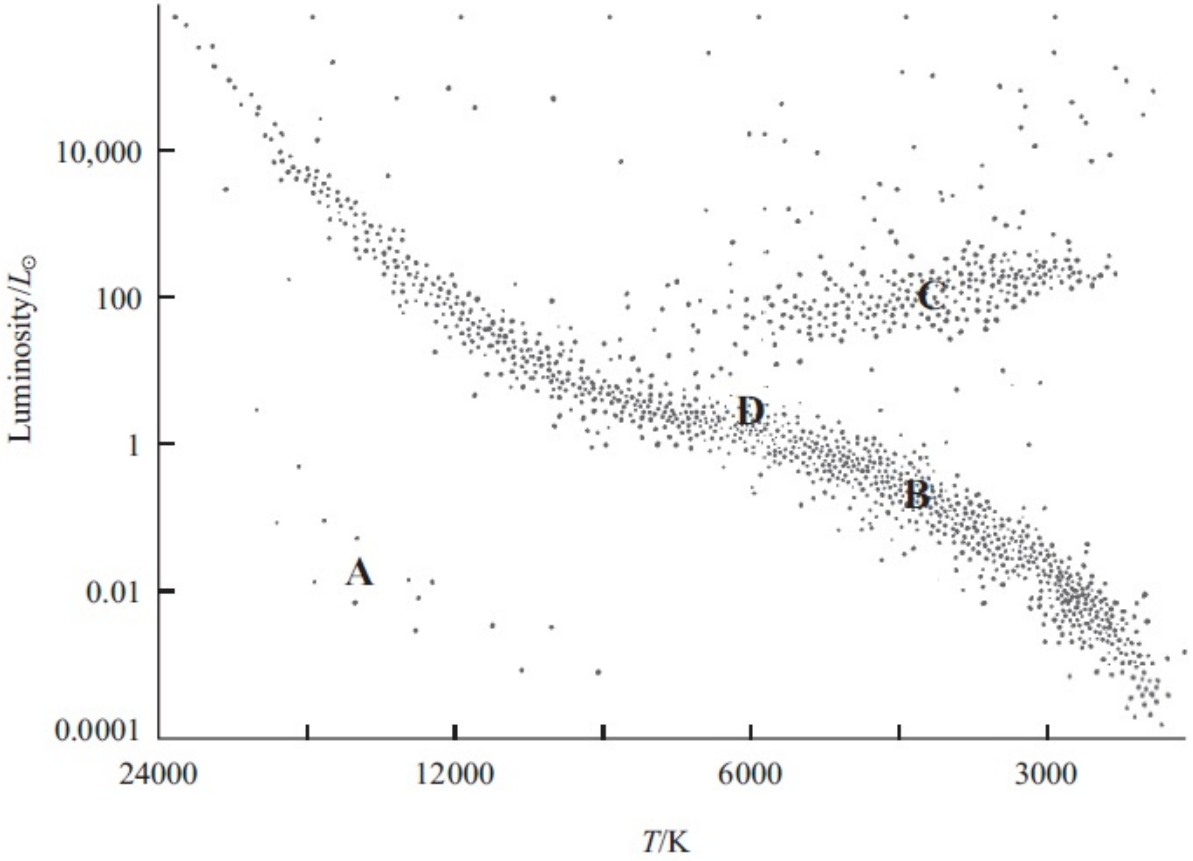


Which letter, **A**, **B**, **C** or **D**, indicates the region where a white dwarf star would be shown?

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for question = 1 mark)

Q3.

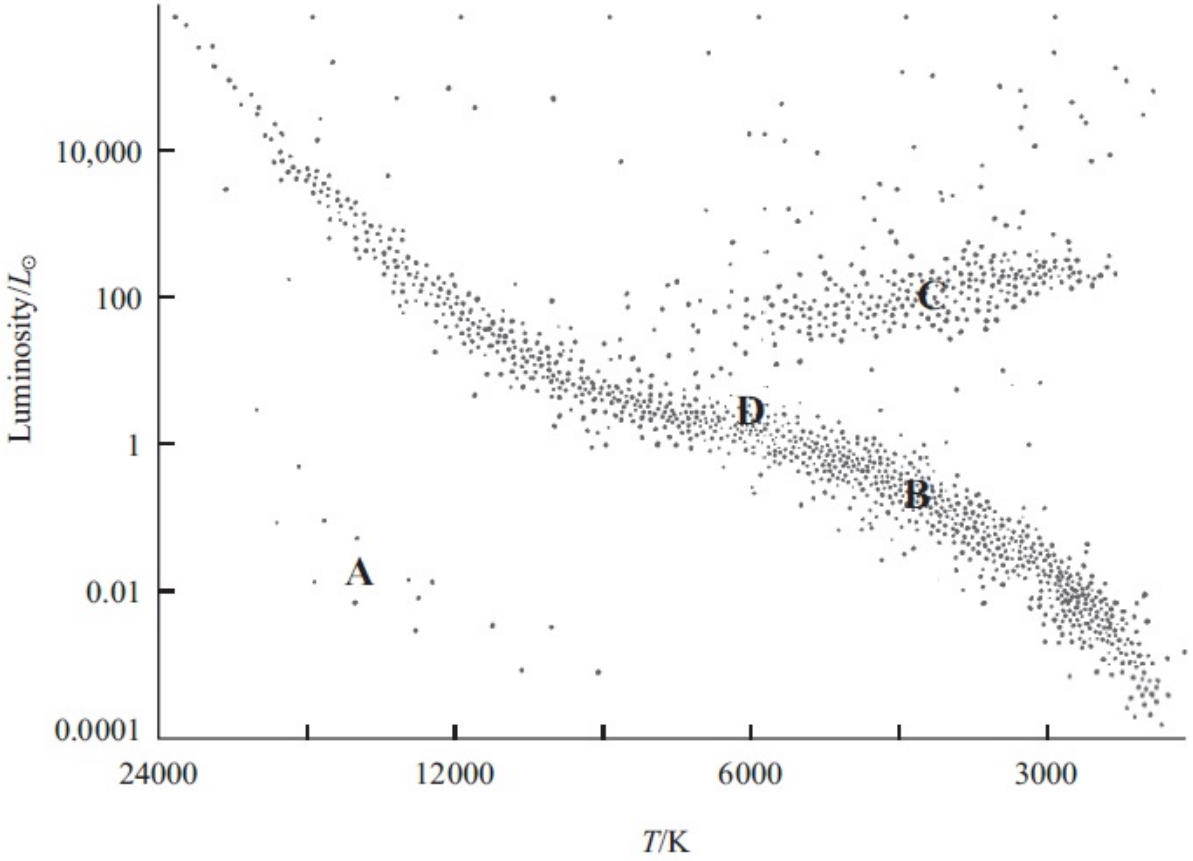


Which letter A, B, C or D represents the region on the diagram where a white dwarf star would be shown?

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for question = 1 marks)

Q4.



Which letter A, B, C or D represents the region on the diagram where our Sun would be shown?

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for question = 1 marks)

Q5.

A star is estimated to have approximately the same surface temperature as the Sun, but less than 1% of the Sun's luminosity.

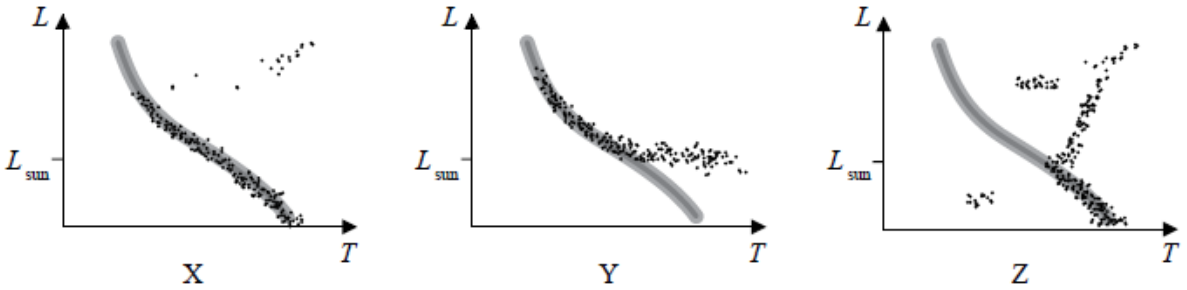
The star is best classified as a

- ☒ **A** main sequence star.
- ☒ **B** red dwarf star.
- ☒ **C** red giant star.
- ☒ **D** white dwarf star.

(Total for Question = 1 mark)

Q6.

Hertzsprung-Russell diagrams are shown for three star clusters.



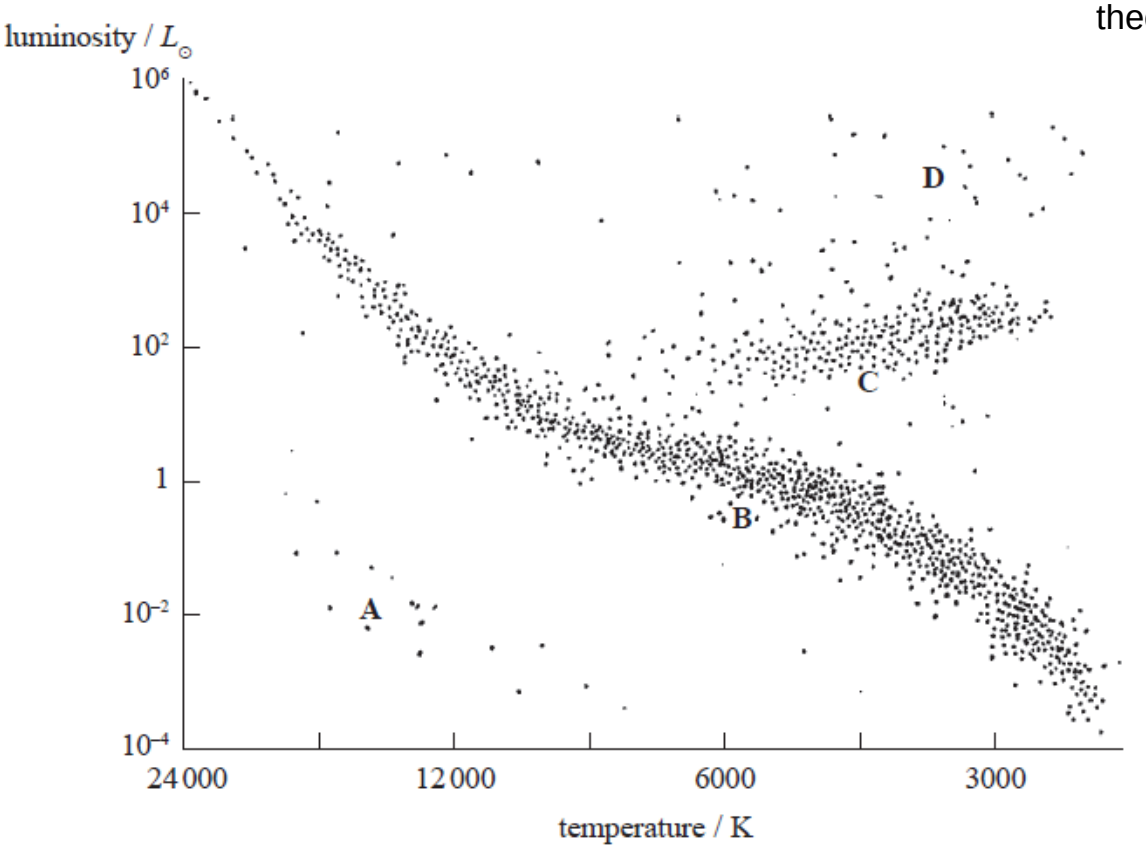
Choose the row that correctly identifies the relative ages of the three clusters.

	Youngest ⟶ Oldest		
☒ **A**	X	Z	Y
☒ **B**	Y	X	Z
☒ **C**	Y	Z	X
☒ **D**	Z	X	Y

(Total for question = 1 mark)

Q7.

Four regions **A**, **B**, **C** and **D** are labelled on the Hertzsprung-Russell diagram.



Which region includes the position of the Sun?

(1)

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for question = 1 mark)

Q8.

Describe the characteristics of a main sequence star.

(2)

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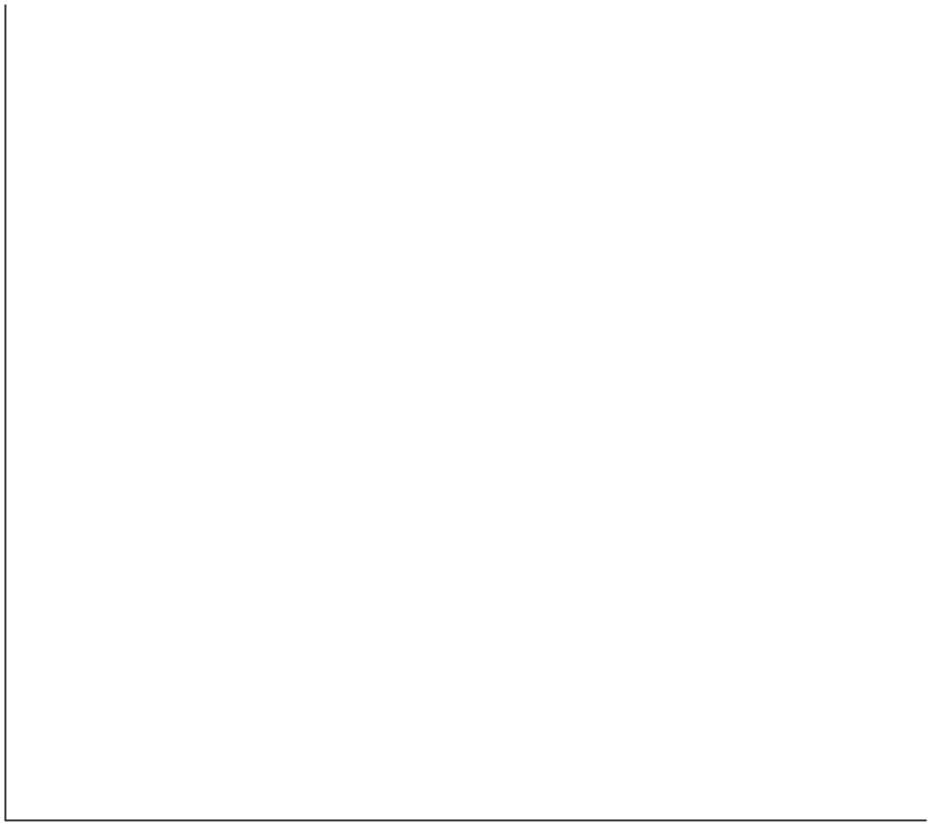
Q9.

The Hertzsprung-Russell diagram is a diagram used by astronomers to illustrate the properties of stars.

Label the axes below and use them to sketch a Hertzsprung-Russell diagram.
Your diagram should include labelled regions where the following stars are found:

- main sequence
- red giants
- supergiants
- white dwarfs

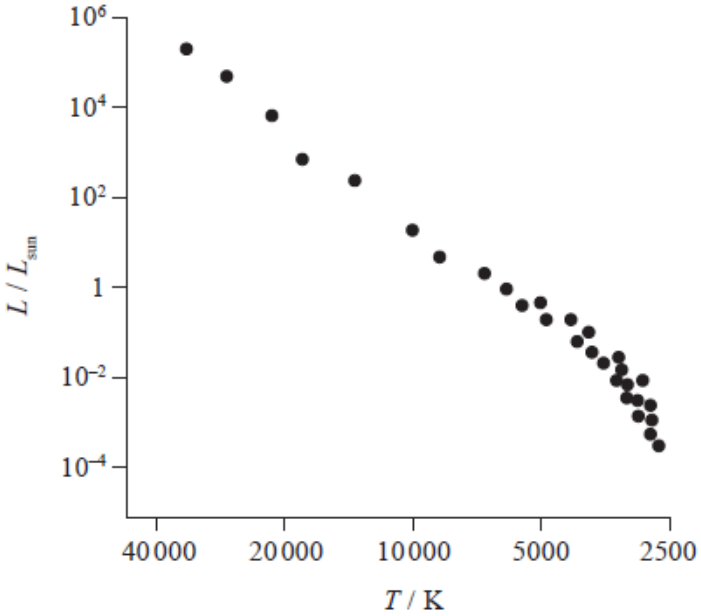
(4)



Q10.

The Hertzsprung-Russell (H-R) diagram is a plot of luminosity against temperature for a range of stars.

The H-R diagram below shows a number of main sequence stars.



(i) Label the position of our Sun on the diagram.

(1)

(ii) Label on the diagram the regions in which white dwarf and red giant stars would be located.

(2)

*(iii) Stars known as white dwarf stars have small surface areas. Explain how astronomers have deduced this.

(3)

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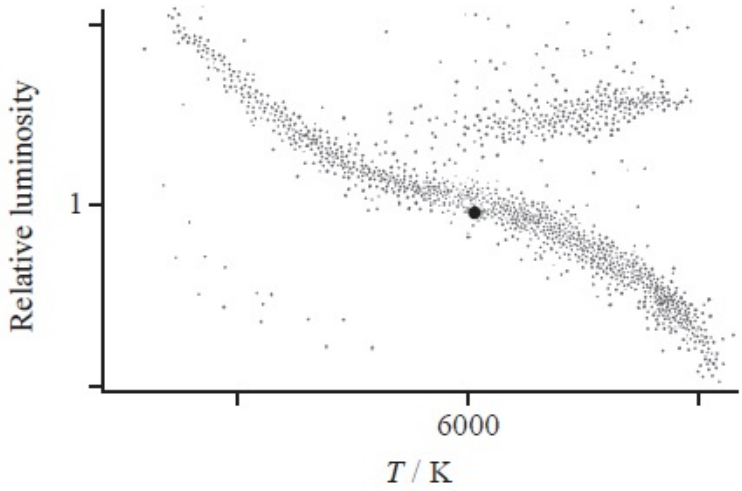
(Total for question = 6 marks)

Q11.

This Hertzsprung-Russell diagram is a plot of relative luminosity against temperature for a large number of stars.



The position of the Sun, at a surface temperature of about 6000 K and a relative luminosity of 1, is marked on the diagram.

(a) Complete the temperature and relative luminosity scales by adding values at the positions shown.

(2)

(b) The Sun is an example of a main sequence star.

(i) State the fusion process taking place in the core of all main sequence stars.

(1)

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(ii) Draw a circle where the most massive main sequence stars are located on the diagram and explain why they are found in this position.

(3)

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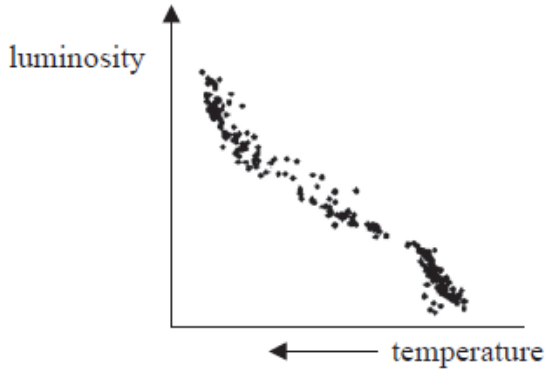
(Total for Question = 6 marks)

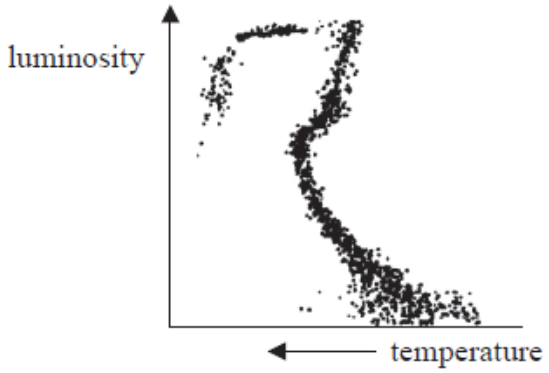
Q12.

(a) The Herzsprung-Russell (H-R) diagram is one of the most important tools in the study of stellar evolution.

The H-R diagrams below are for a young star cluster and an old star cluster.



Young star cluster



Old star cluster

Use the diagrams to describe and explain how the old star cluster is different from the young star cluster.

(6)

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(b) Trigonometric parallax is one way in which stellar distances can be measured.

Astronomers measure the parallax angle for two nearby stars. The parallax angle for star A is 3.74×10^{-6} rad and that for star B is 1.84×10^{-7} rad.

(i) Without calculation, state what can be deduced from this data about the relative distances of the two stars.

(1)

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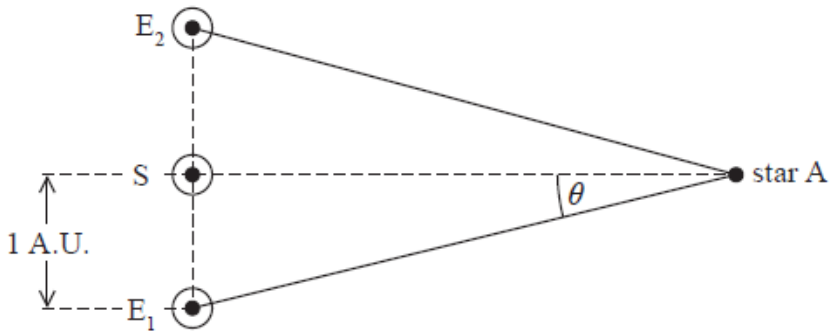
(ii) The diagram shows the parallax angle for star A.

Calculate the distance of star A from the Earth.

1 A.U. is 1.50×10^{11} m

(2)



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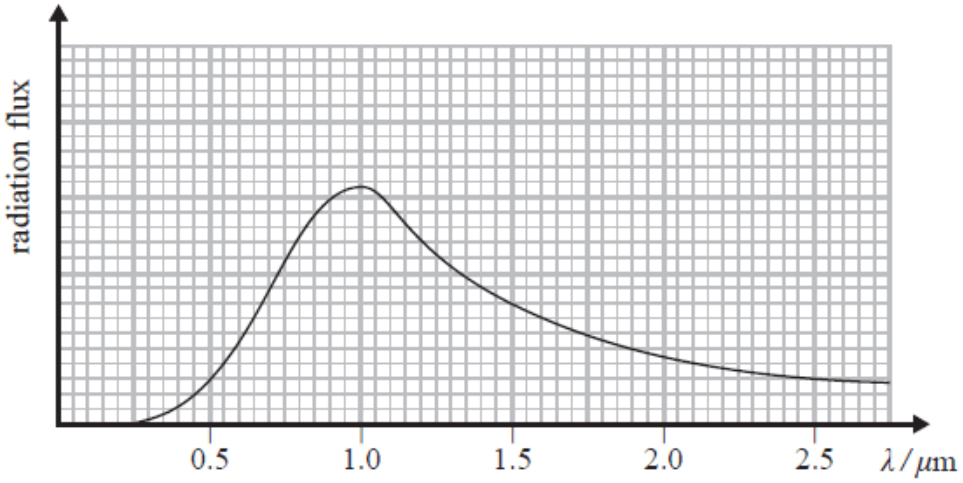
Distance = ...

(c) In addition to finding the distances to stars astronomers are interested in determining the temperatures of stars.

The spectrum of star A is shown below.



Use data from the graph to determine the surface temperature of star A.

(3)

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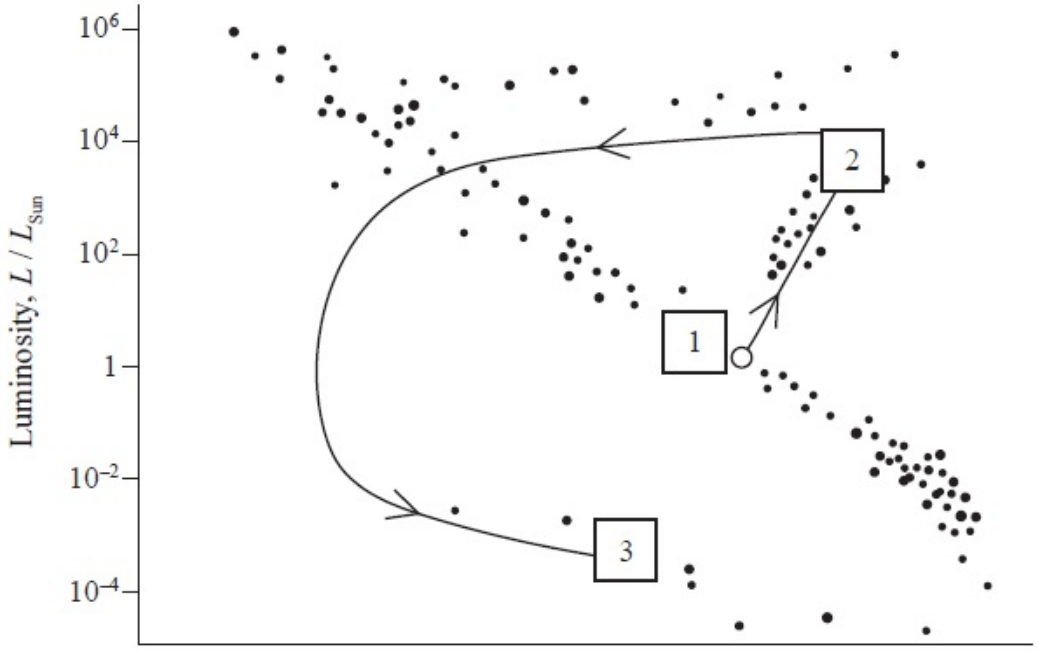
Temperature = ...

(Total for question = 12 marks)

Q13. The Sun has a surface temperature of 5800 K and is approximately 4.5 billion years old.

The Hertzsprung-Russell diagram maps the future evolution of the Sun, from its current position in area 1 of the diagram, through to its final position in area 3 of the diagram.



(a) (i) Complete a suitable temperature scale on the x-axis.

(2)

*(ii) Use the diagram to describe the lifecycle of the Sun starting from its present position in area 1 and concluding in area 3.

(6)

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(b) The energy source for the Sun is the fusion of light nuclei to heavy nuclei. Describe

stage of evolution hydrogen is being converted into helium in the core of the Sun.

(i) State and explain the conditions necessary for fusion to occur in a star.

(3)

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(ii) In a star the fusion of hydrogen into helium takes place in a number of stages. The final stage is:

$$^{3}_{2}\mathrm{He} + {}^{3}_{2}\mathrm{He} \rightarrow {}^{4}_{2}\mathrm{He} + 2 \times {}^{1}_{1}\mathrm{H}$$

Calculate the energy released in MeV when one nucleus of the normal isotope of helium is produced.

(4)

Isotope	Mass / 10^{-27} kg
^{3}He	5.008238
^{4}He	6.646483
^{1}H	1.673534

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Energy released = ... MeV

(Total for Question = 15 marks)