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SUPERVISOR'S USE ONLY

Level 2 Earth and Space Science, 2019

91192 Demonstrate understanding of stars and planetary systems

9.30 a.m. Wednesday 27 November 2019
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of stars and planetary systems.	Demonstrate in-depth understanding of stars and planetary systems.	Demonstrate comprehensive understanding of stars and planetary systems.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

If you need more room for any answer, use the extra space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Achievement

TOTAL 11

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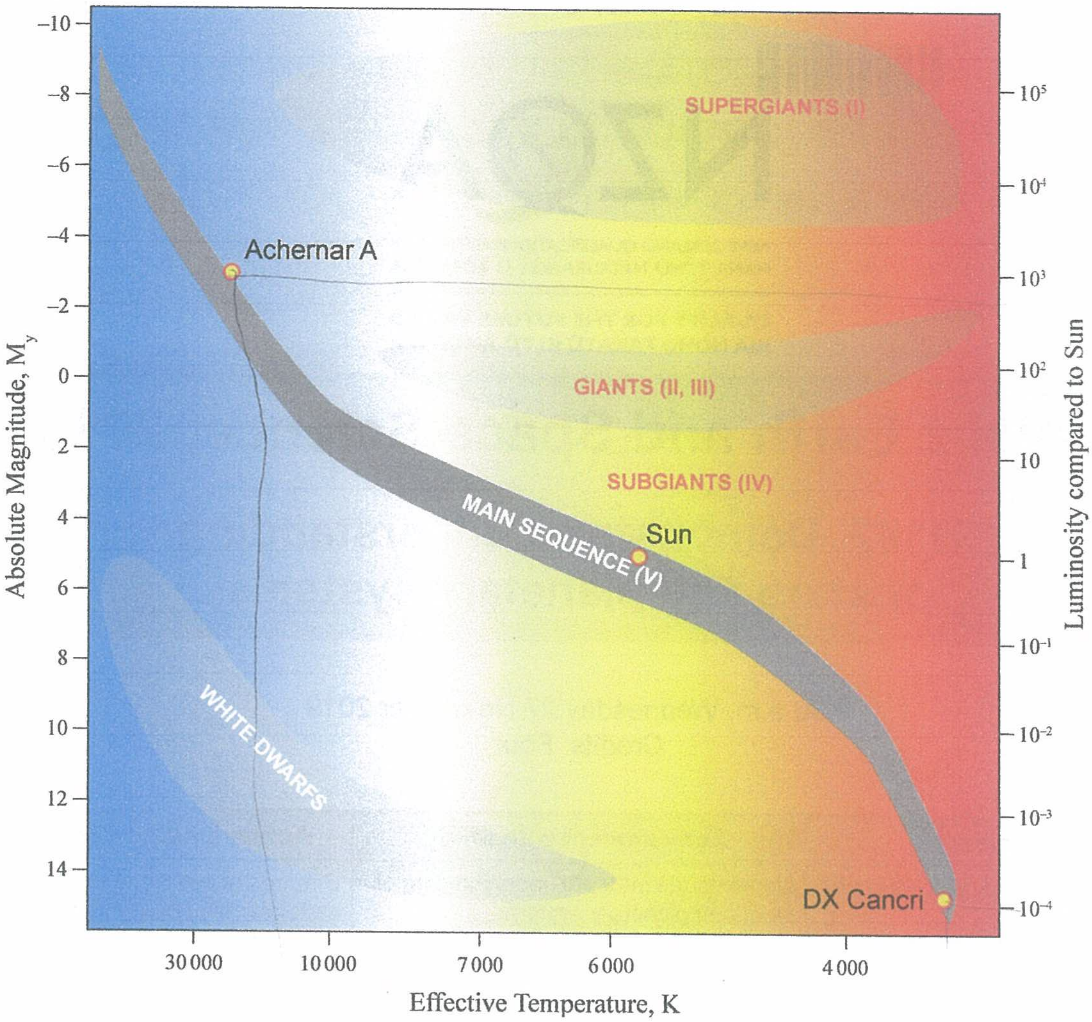
RESOURCE

Hertzsprung-Russell (HR) Diagram



Adapted from: http://astronomy.swin.edu.au/cosmos/h/hertzsprung-russell+diagram

QUESTION ONE: FIRST CONFIRMED VIEW OF A NEWBORN PLANET

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An observatory in Chile recently confirmed an image of a forming planet around a star known as PDS 70. The star is blacked out to show the bright spot just to the right of the centre of the image.

www.eso.org/public/news/eso1821/

The forming planet is a few times larger than Jupiter and has similar properties to the outer planets of our solar system. However, the surface of the planet has a temperature of around 700 K, making it much hotter than any planet in our solar system.

Explain, in detail, each stage in the formation of this planet.

In your answer, you should consider:

- accretion - chunks - big chunks
- solar wind

- the main stages in the formation of this planet
- why the material in this planet is likely to be different to any inner planets - too hot for rock
- possible reasons why this planet is so much hotter than Jupiter.

- bigger star
- bigger solar wind

A diagram may assist your explanation.

More space for this answer is available on the following pages.

Around the star is gas and dust, bits of gas and dust begin to accrete into small chunks. These small chunks then collide with one another to form bigger chunks. As the chunks begin to get larger and have more mass, they have their own gravity which pulls more and more in. Planets inside the frostline are made up of rock. ~~gas cannot be in.~~ and planets outside the frostline are mainly gas. This is because gas cannot be that close to the ~~star~~ star, it is too hot for those planets. ~~As the~~ When the star begins fusing, it sends out a blast, a solar wind, blowing all the remaining gas and dust out. The outer planets catch alot of this making them larger than the inner planets. The star of this solar system is more than likely bigger than ours, it would have more gas and dust sitting around the star to be formed into planets and have a hotter sun making the planets hotter than ours.

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QUESTION TWO: ACHERNAR A AND DX CANCRI

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Achernar A and DX Cancri are both main sequence stars.

(a) Use the HR diagram on page 2 to describe the characteristics of each star in terms of colour, temperature, and luminosity.

Star	Colour	Temperature	Luminosity
Achernar A	Blue	20 000	$10^{2\frac{1}{2}}$
DX Cancri	Red	3 000	10^{-4}

(b) Use the table above to help explain in detail the similarities and differences between Achernar A and DX Cancri.

In your answer, you should consider:

- the effects of the difference in the mass of each star bigger mass, fuse faster
- the energy source and output of each star H → He
- which star will have a longer life cycle. red giant.

A diagram may assist your explanation.

Dx cancri has a small mass compaired to Achernar A. Achernar A is a blue star and Dx cancri is a red dwarf. Both of these stars are main sequence. Achernar A is much larger and hotter so it is fusing its fuel, H → He, much faster. Dx cancri is a smaller mass cooler star, because of its lower mass and heat, it is fusing its fuel at a much slower rate than Achernar A. Due to Achernar A being so hot and having a large surface, it makes it more luminos. Dx cancri is cooler and has a small surface area making it not very luminos. Dx cancri will have a longer life cycle due to the fact it fuses its fuel very slowly, it will stay a main sequence star for much longer than Achernar A before becoming a planetary nebulea *① and the hot core being left behind, a ~~white dwarf~~ neutron star. Achernar A, fuses its fuel alot faster and will spend a lot less time as a main sequence star fusing H → He before becoming a supergiant, fusing He → Fe. It will then become a blackhole once the star stops fusing and the hydrostatic equilibrium ~~and~~ is no longer balanced, the gravity makes

More space for this answer is available on the following page.

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the star collapse in on itself

* ① when the star stops fusing and the outer layers float away

A4

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QUESTION THREE: NEUTRON STAR OR WHITE DWARF?

The largest possible white dwarf is thought to be 1.4 solar masses. A white dwarf of this size would result from a main sequence star of about 8 solar masses. A star of more than 8 solar masses may end up as a neutron star.

Adapted from: http://cronodon.com/SpaceTech/WhiteDwarf.html
https://i.imgur.com/XY3nJ9D.jpg

Explain, in detail, the reasons a star may end up as either a white dwarf or a neutron star.

In your answer you should consider:

- how the mass and volume of a star may change during its life cycle
- the role that gravity plays in the birth, life, and eventual death of stars.

A diagram may assist your answer.

More space for this answer is available on the following pages.

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throughout a star's lifecycle its mass changes as it goes through different lifecycle stages. The star begins as a GMC (giant molecular cloud) with all the dust and gas it will have. After the gases begin CCC (collapse, contraction, compression) thei GMC starts to gain its own gravity, it is then a protostar. It begins to heat up more and more until it reaches 10 000 k and begins fusing. Gravity plays an important part in hydrostatic equilibruim, the energy from the fusion pushing outwards is balanced by the gravity pulling inwards. Without the gravity, the stars outer layes would drift away. When ~~large m~~ super giants stop fusing and have no energy pushing outwards, gravity is what causes the star to collapse in on itself before going supernova and becoming a black hole.

Achievement Exemplar 2019

Subject	L2 Earth and Space Science	**Standard**	91192	**Total score**	11

Q	**Grade score**	**Annotation**
1	A4	The candidate has described how gravity is involved in planet formation, why outer planets are mainly formed of gases, and the role of the solar wind in forming outer planets.
2	A4	This response has a completed table and refers to the mass, rate of fuel use, and life cycles of the two stars. For Merit, there would need to be reference to how mass leads to greater gravity, and in turn increased fuel use, temperature, and luminosity.
3	A3	The candidate has described how stars form from material in a nebula and stated the role of gravity in nuclear fusion.

Confirmation of check	**Y / N**
This exemplar has been checked for similarities with current online exemplars.	Y