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91192

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NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
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QUALIFY FOR THE FUTURE WORLD
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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.

Merit

TOTAL 16

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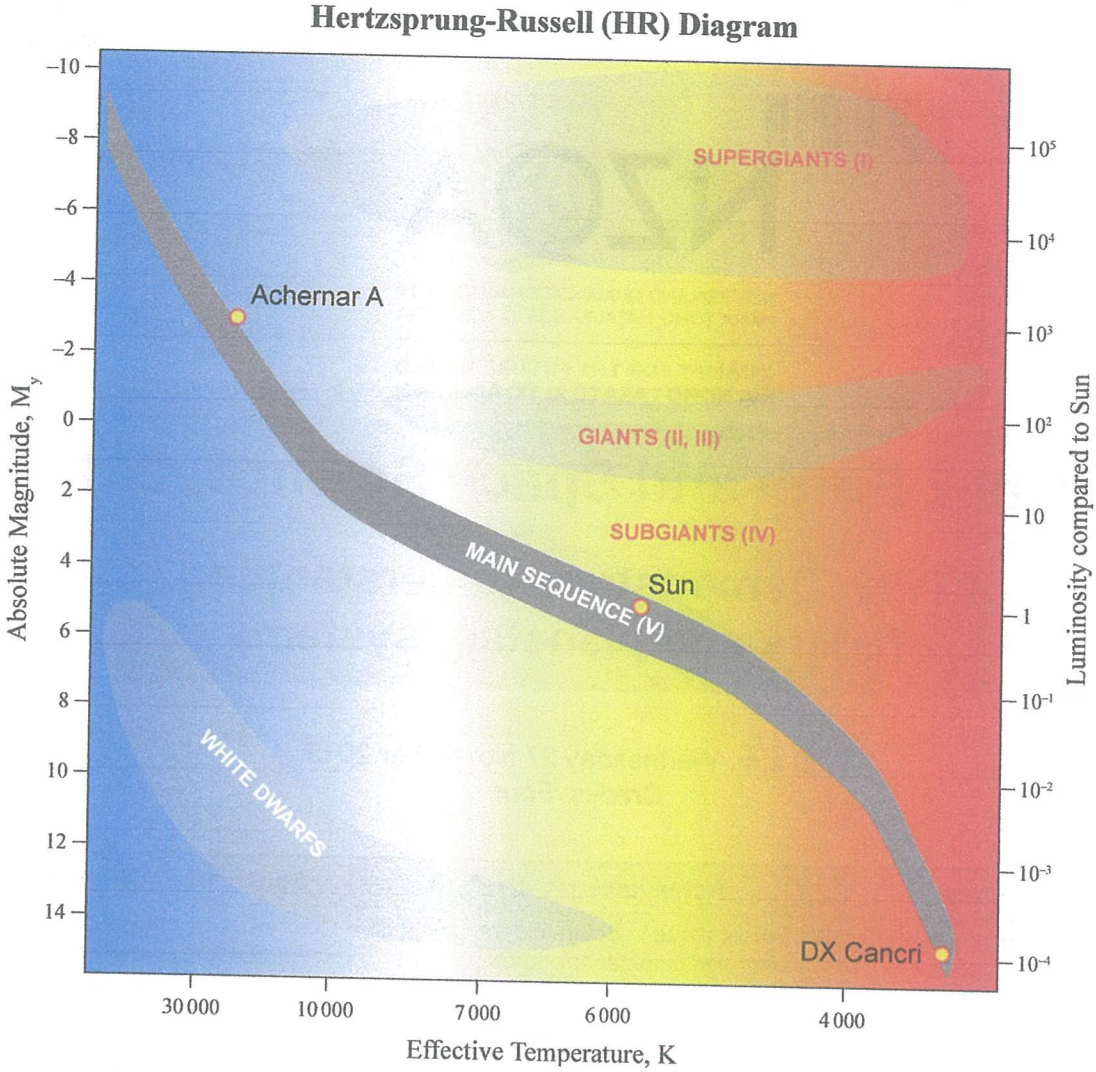
RESOURCE



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:

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

A diagram may assist your explanation.

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

After the proto star has formed, particles in the remaining protoplanetary disc will begin to accrete into small masses. As a certain mass orbits the sun, it will increase in size as it's gravity pulls in more particles. Once it has completely cleared it's neighbouring area of any dust or debris, this mass can be called a planet.

The material in this planet is likely different to other inner planets of other star systems. We can tell this because of its size. Most inner planets are small because they are made of rare heavy elements like iron, nickel or silicon. (These planets are closer to the sun due to their high melting points). Because there is such a small amount of these elements, the planets comprised of them are restricted in size. The forming planet around PDS 70 is different as it is so huge. Many times the size of other inner planets. Thus we can conclude it must be made of a material that is much more abundant than the usual heavy

metals. If it has similar properties to the outer planets of solar system, it is likely ~~comprised~~ made of mostly Hydrogen and Helium. This planet is likely so hot due to the fact it is so much closer to its ~~sum~~ sun compared to Jupiter, which is considered an outer planet. Because it is closer it absorbs more of the sun's energy making it hotter. The other reason it is so hot is due to it being a forming planet. is it clears ~~its~~ the area surrounding its orbit of material, this planet's gravity will pull in things like asteroids or meteors, along with other material. This continual bombardment of material will heat up the surface temp of the planet as they collide with it.

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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.

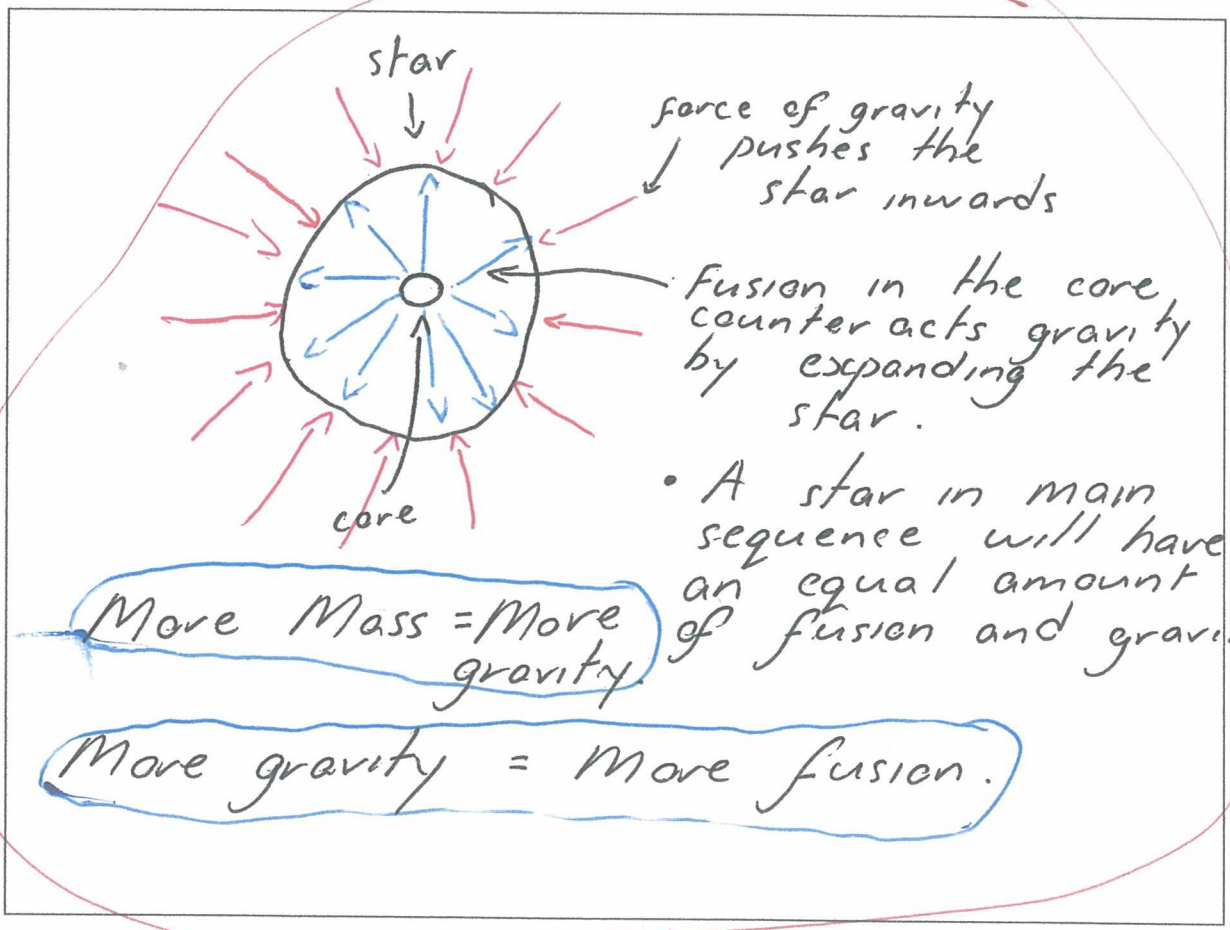
Star	Colour	Temperature	Luminosity
Achernar A	Blue	High +20,000°c very hot	very high.
DX Cancri	Red	Low less than 4,000. cool.	low

(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
- the energy source and output of each star
- which star will have a longer life cycle.

A diagram may assist your explanation.



Achernar A will have a much greater mass than DX Cancri. Because Achernar A is big, it has a lot of gravity trying to compress the star. Thus, it has a huge rate of fusion to balance the pull of gravity. Because of its high rate of reaction it is very hot, thus very luminous and blue. DX Cancri is very small, thus it doesn't have much gravity. Because of this its rate of fusion is much lower as not much outwards force is needed to counter act its small gravity. Because it burns much slower than Achernar A, it is much cooler and so appears red and less luminous.

Both stars are main sequence so burn H → He. Achernar A produces much more energy than DX Cancri due to its size. However because it needs to → burns hotter, Acherar A burns through its supply of hydrogen much faster than DX Cancri, who will slowly run out of fuel over a much longer period of time. This means Achernar A will have a much shorter life span

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

Than DX Cancri.

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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.

White Dwarfs form from small-medium sized stars, whilst neutron stars form from super large stars. As a star runs out of its main fuel source of hydrogen, it exits the main sequence and begins to burn He → C or oxygen or silicon. This change leads to the star to expand as a greater volume of fuel is brought to the core, increasing fusion causing expansion. ~~The mass of a star stays the same throughout its life, however its make up of elements will progress into heavier elements as it runs out of hydrogen and helium.~~

Once a star has expanded it becomes a red giant. At this point a small star ~~white~~ will continue to expand to the point where its outer layers drift so far away from its core that they are no longer part of the star. This forms a Nebula from the outer layers, leaving the core without any fuel. Thus the core, by itself, slowly looses heat to space. Thus creating a white Dwarf. ||

Super Massive stars on the other hand die in a ~~m~~ very different way. After

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running out of H, they to expand becoming red giants. However due to their immense gravity, they can ~~fuse~~ create so much heat in their core that they will continue fusing elements up until Iron. Once they reach iron fusion requires stops, as iron is too much energy to fuse. This suddenly causes fusion to stop all together which means the stars gravity suddenly pulls everything together and as all this mass hits the core at HUGE speeds ~~a~~ the star suddenly explodes in a super nova as the strong force holding atoms together breaks. This process of condensing will ~~st~~ compress the core so much that electrons ~~fease into~~ and protons fuse into neutrons and are packed so tightly that they touch. This is how ~~these~~ Neutron stars are formed.

If a star has enough mass its core will shrink into a singularity, forming a black hole.

Gravity is they key to all process in a star. It causes particles to accrete a form a star. It causes fusion to occur. And it is what catalyses the death of a star.

M5

Merit Exemplar 2019

Subject	L2 Earth and Space Science	Standard	91192	Total score	16

Q	Grade score	Annotation
1	M5	The candidate has gained a Merit point for explaining how collisions of materials onto the newly forming planet have caused it to have a very high surface temperature.
2	M6	This response explains how increased gravity due to a larger mass leads to a greater rate of nuclear fusion. The response also explains how increased fuel use leads to a shorter lifespan. Linking the above points would have led to an E7 for this question.
3	M5	The candidate has explained how larger main sequence stars end their lives as neutron stars as a result of their greater mass which has given them a greater force of gravity in their cores.

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