**91192**

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**2**

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Tick this box if there is no writing in this booklet

# Level 2 Earth and Space Science 2020

## 91192 Demonstrate understanding of stars and planetary systems

9.30 a.m. Tuesday 17 November 2020
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 2–16 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.**

**TOTAL**

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## RESOURCE

**Hertzsprung-Russell (HR) diagram**

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

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**The examination continues on the following page.**

## QUESTION ONE: TYPES OF DWARF

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Kapteyn's Star:
red dwarf
https://twitter.com/reddwarfscience

Van Maanen's Star:
white dwarf
http://kstuemke.blogspot.com/p/van-maanens-star.html

Gliese 229b:
brown dwarf
https://en.wikipedia.org/wiki/Brown_dwarf

*Images are not to scale.*

Gliese 229b, Kapteyn's Star and Van Maanen's Star are all types of dwarf. However, the processes taking place within each are thought to be very different.

(a) (i) Use the HR diagram on page 2 to complete the table below.

| | **Temperature** | **Luminosity** | **Absolute Magnitude** |
|---|---|---|---|
| **Kapteyn's Star** | | | |
| **Van Maanen's Star** | | | |
| **Gliese 229b** | 1000 K | $10^{-6}$ | 18 |

(ii) State a reason why it is not possible to place Gliese 229b on the HR diagram provided.

(b) Compare the initial mass of each type of dwarf from part (a).

Explain in detail the reasons for your comparison.

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(c) Use your previous answers to discuss the energy source for each type of dwarf.

*A diagram may assist your answer.*

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## QUESTION TWO: FIRST REAL IMAGE OF A BLACK HOLE

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https://scdn.slashgear.com/wp-content/uploads/2019/04/nasa-black-hole-1280x720.jpg

In 2019, the first confirmed view of a supermassive black hole in a neighbouring galaxy was made by the Event Horizon Telescope. Supermassive black holes are thought to form in the same way as other black holes, but then grow by pulling in surrounding stellar material.

(a) Describe the type of main sequence stars that are likely to go on to form black holes.

Refer to their position on the HR diagram on page 2.

(b) Explain in detail how the type of fuel changes over this type of star's lifecycle.

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(c) Explain comprehensively the role of gravity in the transition of a main sequence star to a black hole.

*A diagram may assist your answer.*

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## QUESTION THREE: MOON FORMATION THEORIES

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https://www.nasa.gov

For many years, scientists have speculated about the formation of our moon. Exploration of the Earth's moon by NASA in the 1970s helped to gather evidence about how our moon was formed.

(a) Describe the difference between a moon and a planet.

(b) Explain in detail how a moon may form from the surrounding material left over when a planet forms.

*A diagram may assist your answer.*

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**Question Three continues on the following page.**

(c) A more-accepted theory of our moon's formation is the "giant-impact" theory.

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Outline the main stages of the giant-impact theory, and compare this with your answer to part (b).

*A diagram may assist your answer.*

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**Extra paper if required.**
**Write the question number(s) if applicable.**

QUESTION NUMBER

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