

91192



911920



NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KĪA NOHO TAKATŪ KI TŌ ĀMUA AO!

2

SUPERVISOR'S USE ONLY

Tick this box if you
have NOT written
in this booklet

☐

Level 2 Earth and Space Science 2021

91192 Demonstrate understanding of stars and planetary systems

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.

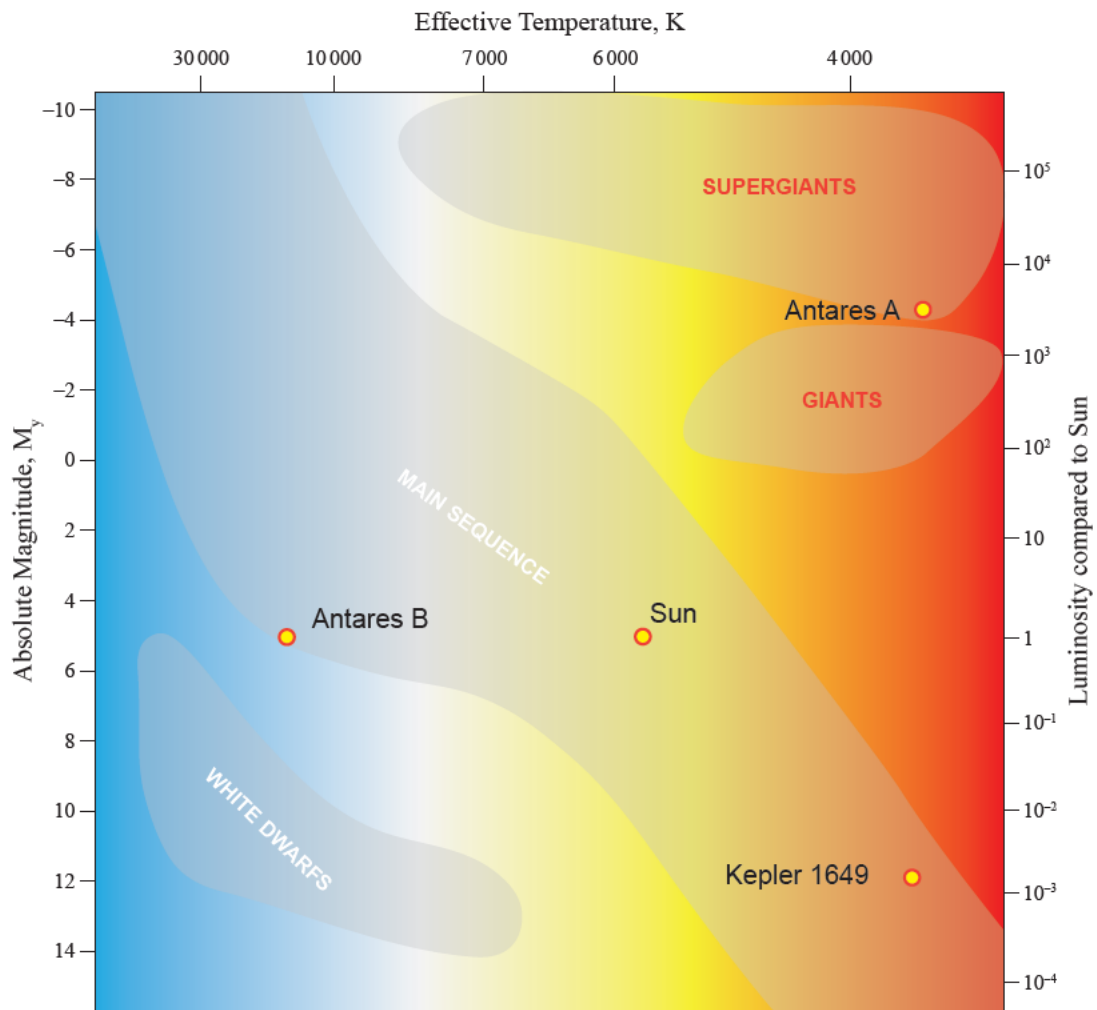
If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–16 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (XXXX). This area may be cut off when the booklet is marked.

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

RESOURCE

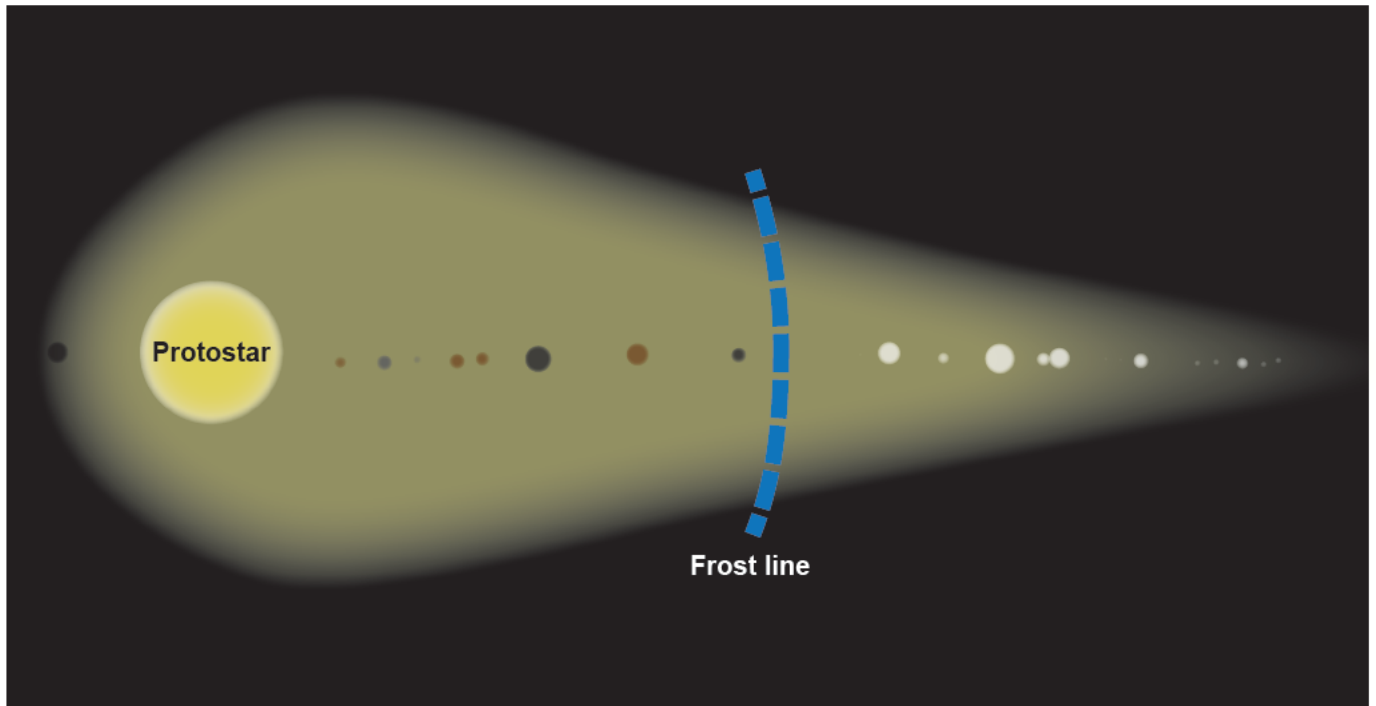
Hertzsprung-Russell (HR) diagram

Adapted from: http://www.atnf.csiro.au/outreach/education/senior/cosmicengine/stars_hrdiagram.html

**This page has been deliberately left blank.
The examination continues on the following page.**

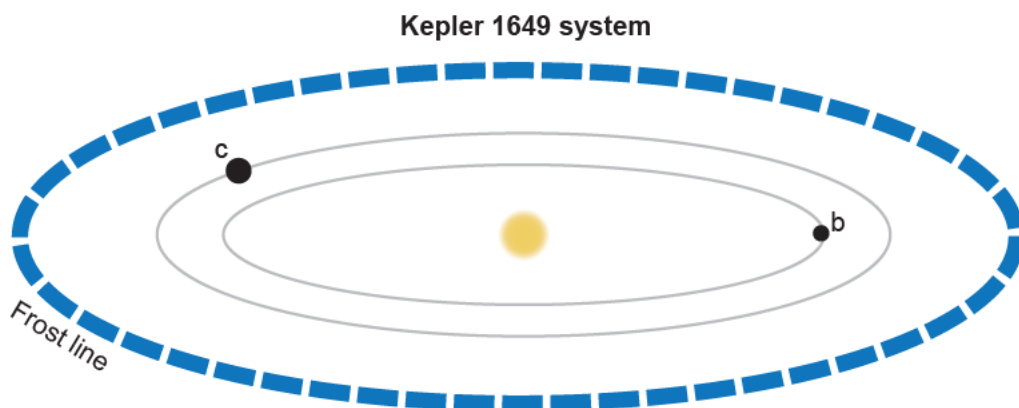
QUESTION ONE: THE FORMATION OF EARTH-LIKE EXO-PLANETS

The diagram below shows the relationship between planet formation and the frost line.



- (a) Define what is meant by the term “frost line” in relation to planet formation.

In 2020, the Kepler Telescope revealed that the star Kepler 1649, a red dwarf star, had two orbiting planets. The innermost planet, Kepler 1649b, is a small Venus-sized planet, while the outermost Kepler 1649c is an Earth-like planet. There is no evidence of any other planets.




(b) Explain how rocky planets such as Kepler 1649b and 1649c are formed.

In your answer you should consider:

- the role of gravity
- the role of the frost line.

An annotated diagram may assist your explanation.




*There is more space for
your answer to this question
on the following page.*

(c) Discuss the possible reasons why the Kepler solar system has NO gaseous planets.

In your answer you should consider:

- the role of solar winds in planet formation
- the star type of Kepler 1649.

An annotated diagram may assist your explanation.



QUESTION TWO: ANTARES IN SCORPIO

Antares A, also known as Rehua, is the brightest star in the constellation Scorpio. It is part of a binary star system, made of Antares A and Antares B.

Antares A is thought to be 12 solar masses, whilst Antares B is 7 solar masses.



Source: <https://earthsky.org/brightest-stars/antares-rivals-mars-as-the-scorpions-heart>

- (a) Complete the table below using the Hertzsprung-Russell diagram on page 2.

Star	Luminosity	Temperature	Colour
Antares A			
Antares B			


- (b) Explain why Antares A is more luminous than Antares B.

In your answer you should consider:

- what is meant by the term luminosity
- the relevant stages of each star's life cycle.

An annotated diagram may assist your explanation.

*There is more space for
your answer to this question
on the following page*



- An annotated diagram may assist your explanation.*

Earth and Space Science 91192, 2021

QUESTION THREE: T-TAURI STARS

T-Tauri stars are a group of very young protostars, having a similar mass to the Sun, or even smaller. They represent an early stage in stellar evolution.



Source: <https://phys.org/news/2016-06-t-tauri-stars.html>

- (a) Describe what is meant by the term protostar.

- (b) Explain the role of gravity and energy changes in the formation of these protostars.

An annotated diagram may assist your explanation.

*Question Three continues
on the following page.*

- An annotated diagram may assist your explanation.*

[illegible]

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

QUESTION
NUMBER

91192