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NZQA | Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 2 Earth and Space Science 2024

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 (▨). This area will be cut off when the booklet is marked.

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

RESOURCE

HR (Hertzsprung-Russell) diagram

Effective temperature, K

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

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The assessment begins on the following page.

QUESTION ONE: SIRIUS AND ANTARES

Sirius is the brightest star in the night sky. Māori know the star as Takurua, and it signifies winter. Antares is also one of the brightest night-time stars, and also features in Māori culture, as it is closely linked with summer. It is known as Rehua.

(a) Complete the following table using the HR diagram shown on page 2.

Star	Apparent Magnitude	Absolute Magnitude	Luminosity	Temperature (K)
Sirius	–1.46			
Antares	+0.96			

(b) Using the stars Sirius and Antares as examples, explain in detail the difference between the apparent and absolute magnitude values of the two stars.

In your answer you should consider:

- the meaning of apparent magnitude
- the meaning of absolute magnitude
- what this would mean in terms of the star's appearance from the Earth
- the relative distance from the Earth.

An annotated diagram may assist your answer.

(c) Explain, in detail, how the absolute magnitude / luminosity and temperatures can account for the current stages in the life cycles of Sirius and Antares.

In your answer you should consider:

- the relationship between absolute magnitude, luminosity, and temperature
- fuel use
- star size
- current life cycle stage.

An annotated diagram may assist your answer.

QUESTION TWO: EARTH-LIKE EXOPLANETS

The TRAPPIST-1 planetary system is about 40 light years from our solar system. The system is made up of a single dwarf red star known as TRAPPIST-1, and seven Earth-like rocky planets that orbit the star. TRAPPIST-1 is only 8% of the size of the Sun.

The planets are all made up of similar material to Earth with e, f, and g thought to be in the 'habitable zone'.

Source: https://esahubble.org/images/heic1802d/

(a) Explain what is meant by the term 'habitable zone' when referring to planets e, f, and g?

(b) Explain, in detail, how the rocky planets have been formed.

In your answer you should consider:

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

An annotated diagram may assist your answer.

(c) Scientists have yet to detect any signs of a gas giant in this system.

Explain, in detail, why it is possible that no gas giant has been found.

In your answer you should consider:

- how gas giants are formed
- the star type of TRAPPIST-1
- how active TRAPPIST-1 was as a young star.

QUESTION THREE: CANOPUS

Canopus, known in Māori culture as Atutahi, is the second brightest star in the night sky. Its mass is approximately 8 times that of the Sun, and its radius is approximately 70 times that of the Sun.

(a) Describe what is meant by a 'giant molecular cloud'.

(b) Once Canopus became a star, it remained in the main sequence as a blue star for approximately 30 million years.

Explain, in detail, the processes that would have taken place during formation and this period of its main sequence life span.

In your answer you should consider:

- star formation
- the role of gravity
- the energy processes that would have been taking place
- fuel use.

An annotated diagram may assist your answer.

Question Three continues on the next page.

(c) Canopus has moved out of the main sequence and is now in decline, eventually destined to die.

Explain, in detail, the likely pathway Canopus may take towards its eventual death.

In your answer you should consider:

- fuel use
- the role of gravity
- star mass.

An annotated diagram may assist your answer.

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

QUESTION NUMBER