SUPERVISOR'S USE ONLY

1

92046

920460

Draw a cross through the box (☒) if you have NOT written in this booklet

+

NZQA | Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 1 Physics, Earth and Space Science 2025

92046 Demonstrate understanding of the effect on the Earth of interactions between the Sun and the Earth-Moon system

Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of the effect on the Earth of interactions between the Sun and the Earth-Moon system.	Explain the effect on the Earth of interactions between the Sun and the Earth-Moon system.	Analyse the effect on the Earth of interactions between the Sun and the Earth-Moon system.

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.

Show ALL working.

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

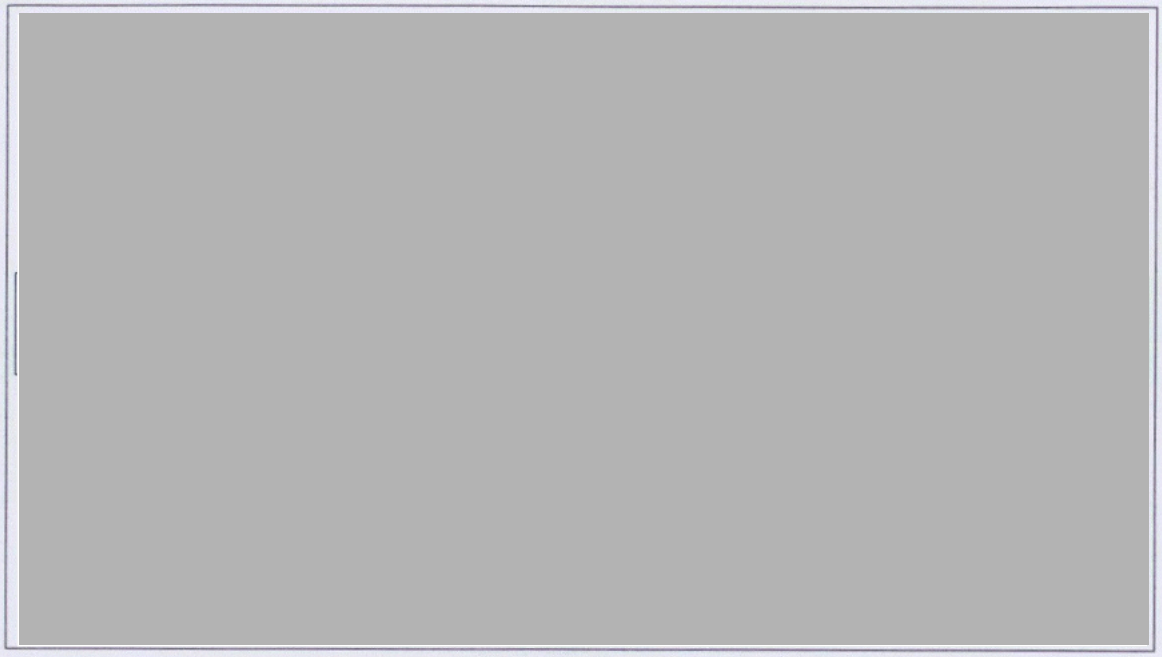
YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Excellence

TOTAL 22

QUESTION ONE: SEASONS

(a) Label the seasons that occur in the **Southern Hemisphere** in the diagram below.



Adapted from: https://quizlet.com/338281989/earths-seasons-solstices-and-equinoxes-diagram/

(b) Below is a graph of average monthly temperatures for Wellington last year.

Source: https://www.weather2visit.com/australia-pacific/new-zealand/wellington.htm

Explain the differences in average monthly temperatures for Wellington for 2024.

Include in your answer:

- why the Earth experiences seasons (include length of orbit and axial tilt)
- a comparison of the differences in the amount of solar radiation throughout the year
- why the temperature changes throughout the year.

The Earth experiences seasons due to its 23.5° axial tilt relative to its ~365 day orbit around the Sun. This means that hemispheres are tilted toward, away from or neither to the Sun. When the Southern Hemisphere is tilted toward the Sun, it recieves more solar radiation at a direct angle which makes it focused and more intense. This is Summer and the more intense Sunlight means that temperatures are higher, as seen in Wellington in Dec-Feb were some of the hottest months at ~15°C Dec and ~17°C in Jan and Feb. When the Southern Hemisphere is tilted away from the Sun, it recieves less solar radiation at a less direct angle so spread over a larger ~~distance~~ area making it less intence. This is Winter and as least intense Sunlight heats the atmosphere less leading to lower average temperatures. This can be seen in Wellington as Winter is Jun-Aug which were the coldest months at ~9°C, ~8.3°C and ~9°C respectively.

In between is Spring and Autumn where the Southern hemisphere is tilted toward or away from the Sun very little or not at all. It's tilted toward closer to Summer and tilted away closer to Winter, which has similar effects on amount and intensity of solar radiation but less extreme. This is why in Autumn temperatures trend down from 16°C (Mar) to 11°C (May) as the Southern Hemisphere goes from tilting toward in Summer to tilting away in winter. The vice versa applies in Spring with temperatures trending up from 10°C (Sep) to 13°C (Nov).

(c) Wellington experiences changes in daylength throughout the year. In the summer, the days are longer; in the winter, the days are shorter.

	Summer day	Winter day
Time of sunrise	6:01 a.m.	7:45 a.m.
Time of sunset	8:55 p.m.	5:05 p.m.

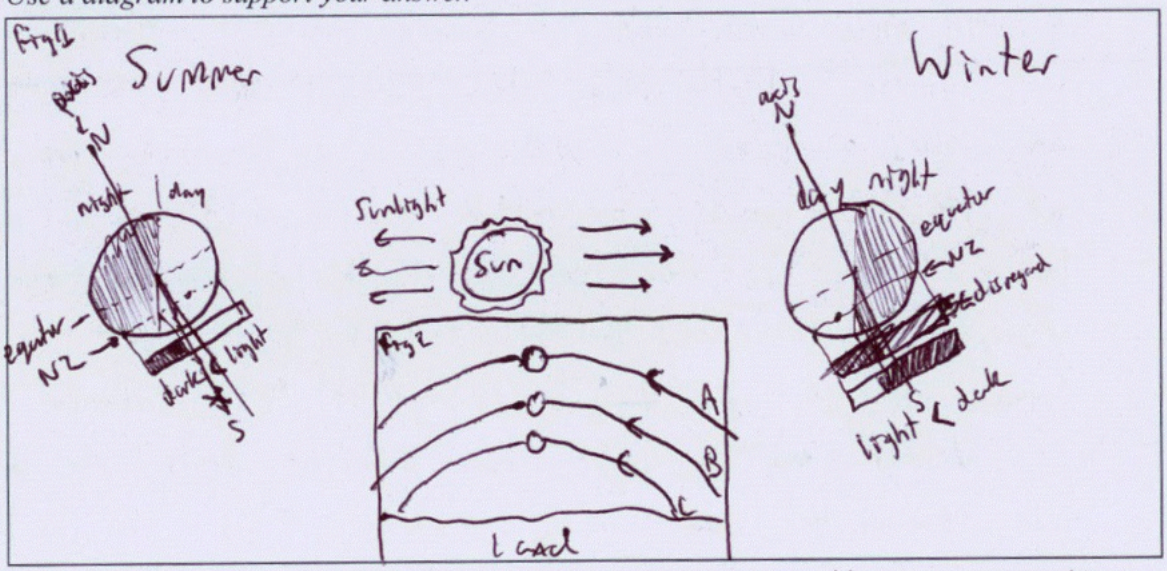
day length ~15 hrs ~ 9 hrs

Using the data above, discuss why this happens.

Include in your answer:

- why the Earth experiences day and night
- how the height of the Sun changes throughout the year
- why the daylength changes throughout the year.

Use a diagram to support your answer.



The Sun illuminates the half of the Earth that is facing it. As the Earth rotates on its axis, an area like Wellington will rotate through the lit, day side and dark, night side every ~24 hours. The daylength is not constant throughout the year though. In Summer when the hemisphere is tilted toward the Sun, a larger portion of one's rotation around the Earth is light than it is dark, as shown in the left side of the diagram 1. The Sun also appears higher in the sky because its path takes longer, diagram 2 path A. This is why Summer daylength in Wellington is 15 hrs, more than

In Winter when the S hemisphere is tilted away from the Sun, a higher proportion of the day is in darkness than daylight, shown in the right of diagram 1. One is ~~looking~~ facing more away from the Sun. ~~and since~~ In Wellington in Winter was 9hrs day length, much less than half (12hrs). Similarly, the ~~S~~unday length is shorter so the path the Sun takes across the sky is shorter so it appears lower in the sky. Path C in diagram 2.

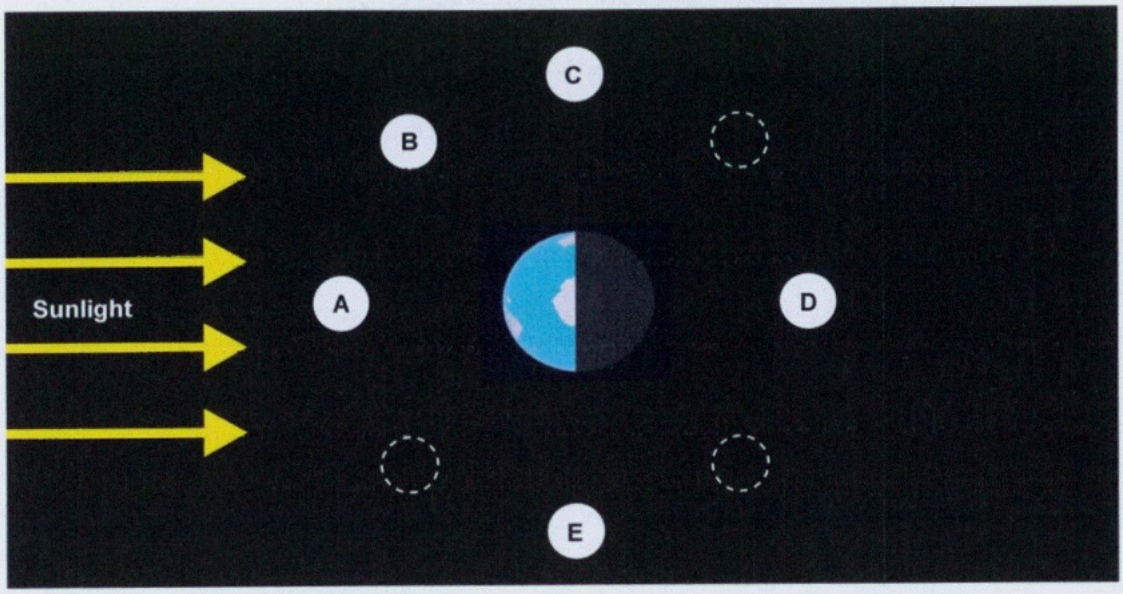
Throughout the year, the day length ~~varies~~ goes between these extremes of 15 hrs in Summer and 9hrs in Winter. The Sun also appears in between path A and path C in the sky accordingly, with the middle path B occuring in the middle (equinox) of Spring and Autumn.

QUESTION TWO: MOON PHASES

The Moon changes its appearance over time, going from new moon to new moon about once every month.

(a) The diagram below shows Earth as viewed towards the South Pole, with possible positions of the Moon when it is in its various phases.

NOTE: distances and sizes are not to scale.



Use the diagram to describe OR draw how the Moon will appear for the positions shown.

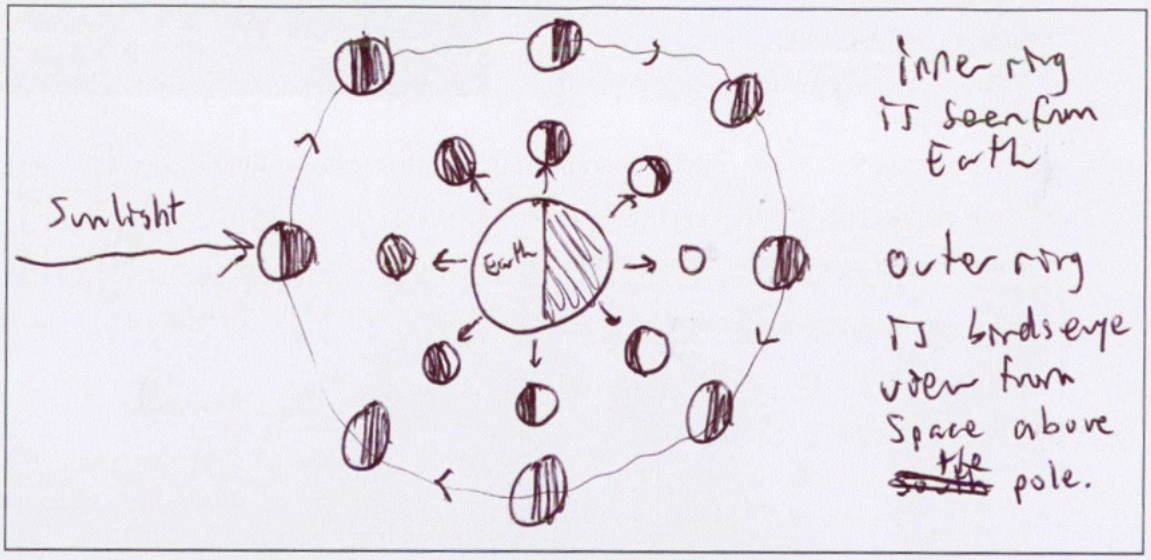
Position	Description of the moon phase OR	Drawing of the moon phase
A		
B	¾ on the left illuminated	
C		
D		
E		

(b) Explain why viewers on Earth observe different phases of the Moon over time.

Include in your answer:

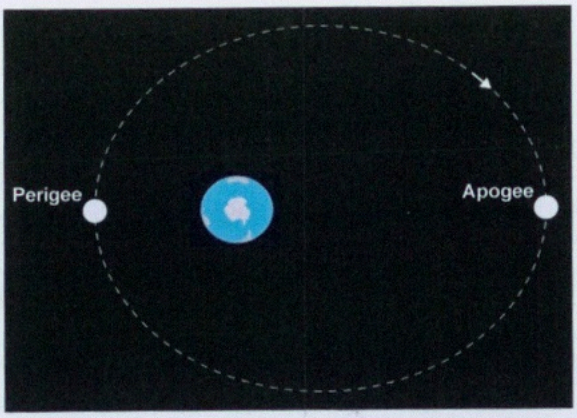
- why we see the Moon
- why the Moon appears to have different shapes over time, as seen from Earth
- how the Moon appears in the Southern Hemisphere as compared to the Northern Hemisphere.

You may use a diagram to support your answer.



Viewers on Earth see the Moon because the side that is lit by the Sun reflects this light and it reaches Earth and our eyes. Over time each lunar month it orbits around the Earth and is in different positions. When in line with the Sun, viewers only see the dark side of the Moon as the illuminated side is facing the Sun, this is a new Moon. When opposite the Sun, we fully see the illuminated side as a full moon. At right angles, only half of the illuminated side is facing us so we see a First or Last Quarter, which appears as the left or right half being lit. In between these, it waxes (the lit section increases) and wanes (the lit section decreases). Either hemisphere see the Moon rotated 180° compared to the other, because it is like one is up-side down facing the moon. for example the first quarter may be seen on the left in South or right in North hemisphere.

(c) The Moon's orbit is elliptical, taking about 27.5 days to go from one perigee to the next. When a full moon occurs at the same time that the Moon appears to be its largest size, it is called a super full moon. In 2025, this occurs on only 6 November and 5 December.



Explain why a super full moon is not observed every month.

Include in your answer:

- what causes a full moon, and how often it occurs
- an explanation of why the Moon's apparent size changes over time
- an explanation of why a super full moon may occur only 1–3 times a year.

You may use a diagram to support your answer.

A full moon occurs when the moon is on the opposite side of the Earth to the Sun so that all of what is illuminated by the Sun is reflected to Earth, seen as a full white circle. This occurs slightly more than one moon rotation of the Earth (27.3days) plus a small distance so it catches up with the Earths rotation about the Sun.

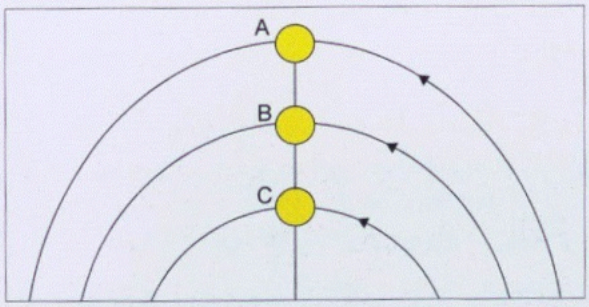
The Moons apparent size changes over time because its orbit is eliptical and it changes its distance ~~away~~ slightly. When it is closest, it is Perigee and appears larger.

When it's further away, it is Apogee and appears the Smallest.

In order for a Super full moon to occur, the perigee must align with the position in orbit to be a full moon. These cycles take different lengths of time which makes them uncommon to line up, and so a Super full moon occurs 1-3 times per year.

Question Three continues on the following page.

QUESTION THREE: EQUINOXES AND SOLSTICES



Apparent path of the Sun throughout a year as seen from the Southern Hemisphere

(a) Use the diagram above to label A, B, and C as being winter solstice, equinox, and summer solstice.

A	Summer Solstice
B	equinox
C	Winter Solstice

(b) During a winter solstice, **Auckland (latitude 37°S)** experiences a longer day than **Invercargill (46°S)**, while the opposite is true for the summer solstice. During an equinox they experience similar daylengths.

The Sun rising at different times of the year in the Southern Hemisphere

Adapted fom: https://c8.alamy.com/comp/P9BFC7/path-of-the-sun-throughout-the-year-in-the-northern-hemisphere-P9BFC7.jpg

Using the above diagram, discuss why Auckland and Invercargill experience differences in daylength throughout the year.

Include in your answer:

- definitions of winter solstice, equinox, summer solstice
- why the location of sunrise and sunset appear to change throughout the year
- why Auckland and Invercargill experience different daylengths during the solstices but similar during an equinox.

You may use a diagram to support your answer.

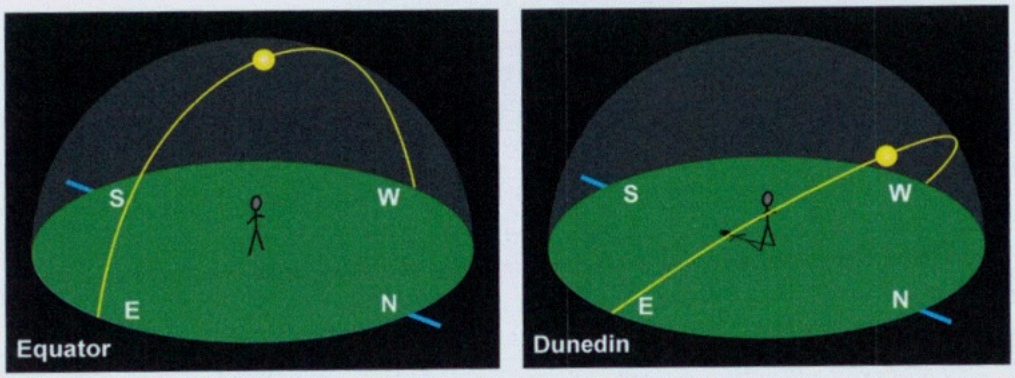
Winter Solstice is the Shortest day in a year. Summer Solstice is the longest day. Equinox is when day length and darkness are equal at 12 hours each. Throughout a year, day length increases and decreases between the two solstices. Areas closer to the equator are facing the Sun at a more direct angle, which reduces variation in day length. This can be seen in Auckland which is 37°S has longer winter solstice and shorter Summer solstice than Invercargill which is further from the equator at 46°S. However, Equinox is still the middle split of ~12-12 hours approximately, which is why Auckland and Invercargill have similar equinox daylengths even though they are at different latitudes.

In equinox, the Suns path is equally split which occurs about East and West, so during this time the Sun rises in East and sets in West. Since it sits in the North direction, the shorter path for Winter solstice will rise further North-East and set further North-West. The opposite or true in Summer Solstice where the Sun rises about South-East and sets about South-West, in the Southern Hemisphere.

(c) The Equator and Dunedin are at different locations on the Earth, and this means that these locations experience differences in the angle of the Sun throughout the year. The Equator has a latitude of 0° and Dunedin 46°S.

Below is a table of the sun angles at noon at the spring equinox.

Location	Sun angle
Equator	90°
Dunedin	43°



Changing angle of the Sun between different locations on Earth

Discuss why these two locations experience differences in the angle of the Sun during the spring equinox.

Include in your answer:

- compare the angle of the Sun at noon between the two locations
- explain why these differences in angles occur
- discuss the differences in shadow lengths and directions between the two locations.

The At Noon, the Sun is at it's middle point in its path across the sky and where one is is most directly facing it. In Spring On the equator at 0°, the Sun appears directly overhead at 90° because the equator is the latitude most directly facing the Sun. These angles, 0° + 90° = 90° add up to 90°. In comparison, in Spring in Dunedin at 46° the latitude is 46° away from the Sun, leading the Sun to appear at 43°. These angles 46° + 43° = 89° almost add up to 90° Similarly because that is the relationship between Sun angle and latitude, they add to 90° when it is Spring equinox because the Earths 23.5° tilt has no

effect as it is tilted to the side, not toward or against the Sun.

The angle of the Sun in the sky then has an effect on shadow length and direction. At 90° in the equator, Sun directly overhead, there are no shadows. During the day the will be the opposite of the Sun direction, so in the West when the Sun is in East and vice versa. They are longest when closest to sunrise and set.

When there is a Sun angle, such as Dunedin 43°, the Sun sits in the North which means shadows are cast to the South. During the day they also mirror the Suns position, but will also be to the South so for example shadows in South West when Sun is in East. The shortest shadow occurs at noon, and they elongate as it gets close to Sun rise or set, Similar to the equator.

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

QUESTION NUMBER

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

QUESTION NUMBER

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

QUESTION NUMBER

92046

Excellence

Subject: L1 Physics, Earth and Space Science

Standard: 92046

Total score: 22

Q	Grade score	Marker commentary
One	E8	Candidate has discussed why Wellington's average monthly temperature changes throughout the year and linked it to differences in solar radiation. Furthermore, they have discussed why Wellington's daylength changes throughout the year.
Two	E7	Candidate has discussed how the Moon phases appear different for the Northern and Southern hemispheres. However, they did not discuss why super full moons do not occur at frequent intervals.
Three	E7	Candidate has discussed why the daylength is different for Auckland and Invercargill. However, they did not discuss the differences in shadow length between two locations based on latitude.