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92046



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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.

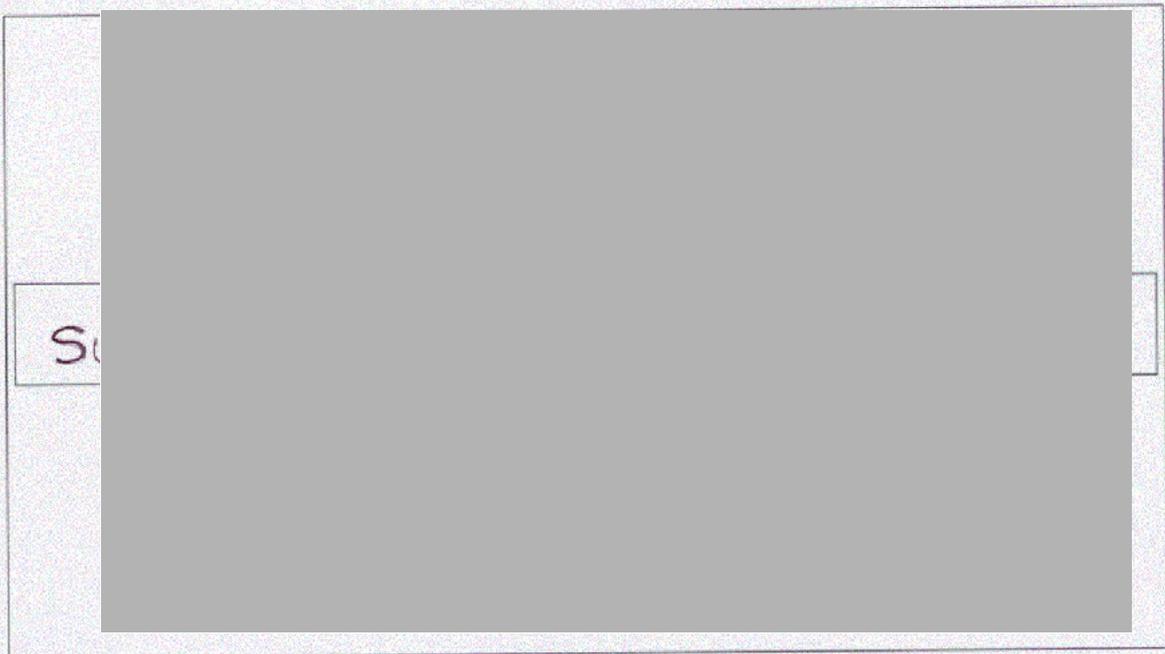
**YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.**

Merit

**TOTAL 15**

**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 takes around 365.25 days to orbit the sun, and due to its  $23.5^\circ$  axial tilt, only one hemisphere faces the sun directly throughout the year. In summer in the Southern Hemisphere, the lower half of Earth is facing upward toward the sun, where it receives the majority of the sun's solar rays. However, during this time, the Northern Hemisphere is facing away from the sun, due to the axial tilt, so it receives a less direct form of solar radiation from the sun. This becomes opposite in June to August, when the Southern Hemisphere is facing down away from the sun and the Northern Hemisphere is facing towards the sun. The angle of which a region on Earth is facing the sun determines the amount of sunlight and Solar radiation it receives. This affects day length, temperature and causes seasons as the Earth orbits and rotates around the sun.

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

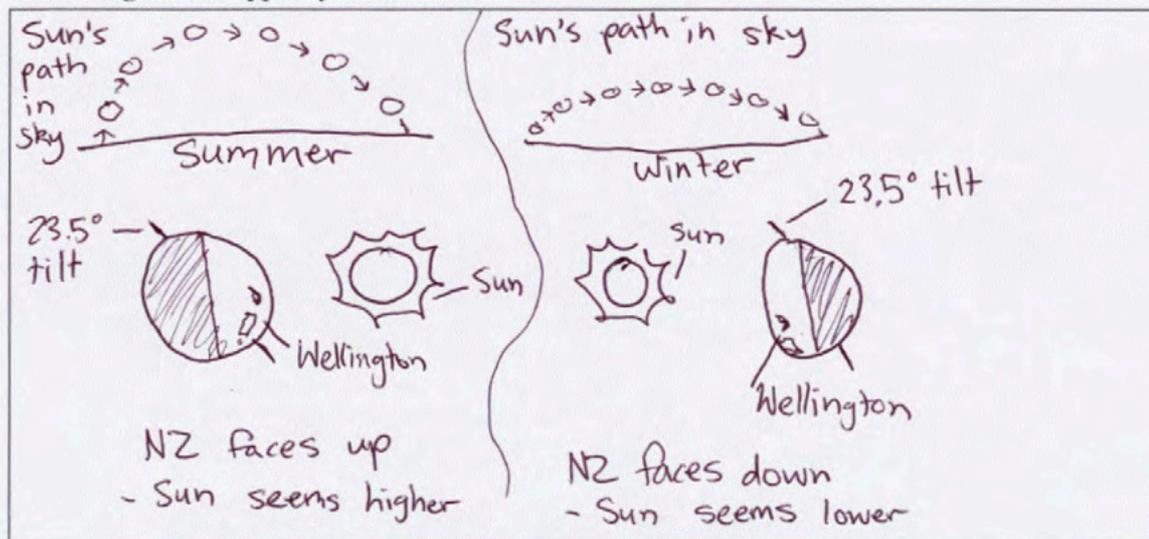
	Summer day	Winter day
Time of sunrise	6:01 a.m.	7:45 a.m.
Time of sunset	8:55 p.m.	5:05 p.m.

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.



In Summer, the city of Wellington in the Southern Hemisphere is facing toward the sun at a more direct angle, so as the Earth rotates, the sun seems to move across high in the sky. Because of this direct angle, Wellington continues to face the sun for a longer period of time as the Earth rotates, as seen in the data above showing an almost 15 hours of sunlight during the 24-hour rotation period. In contrast, during the winter Wellington is facing downward away from the

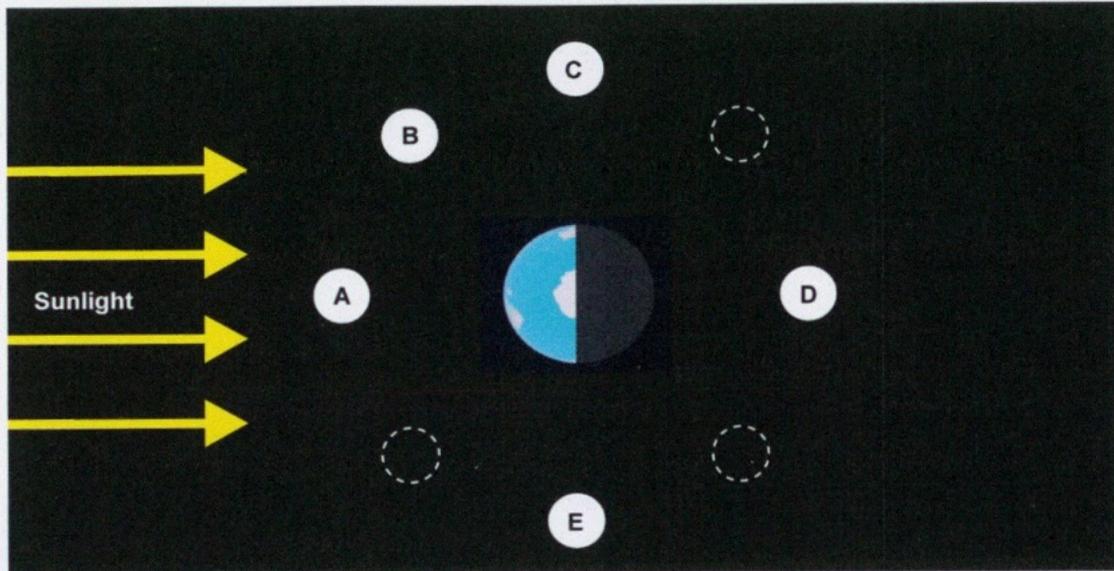
sun's direct angle of sunlight making the sun's path in the sky appear lower. As the Earth rotates on its axis, it takes less time to reach a point away from the sun compared to summer, so the sunlight hours are shorter. This can also be seen in the graph through the later sunrise and earlier sunset, totalling only almost 9 hours of daylight in the winter.

## 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.

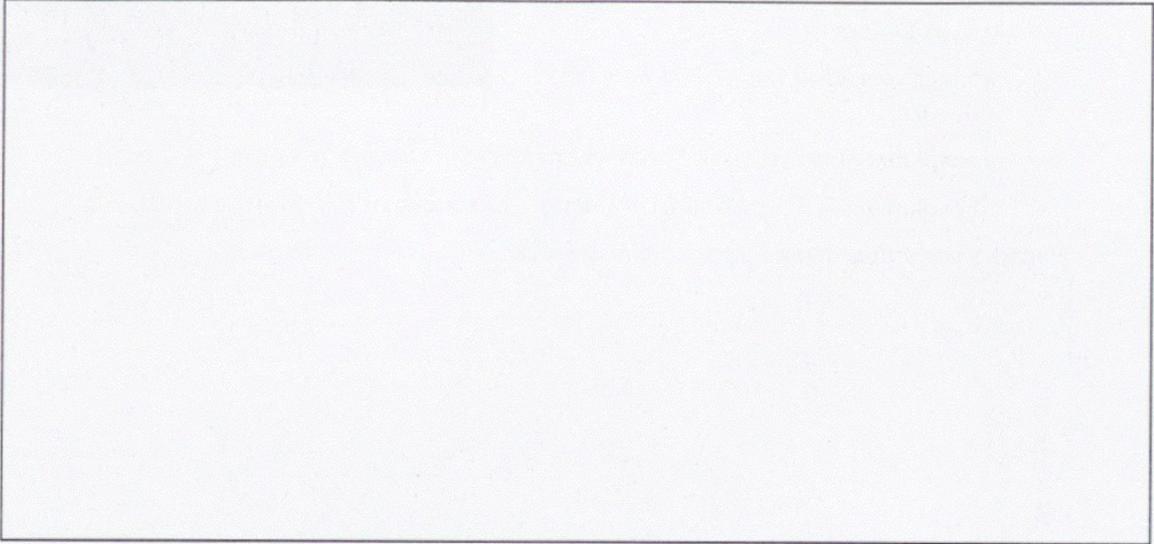
Position	Description of the moon phase	OR	Drawing of the moon phase
A	New moon from Earth's perspective, whole facing side dark.		
B	<del>First</del> Last quarter moon, because sun is lighting up 3/4 side,		
C	Half moon lit by sun		
D	Full moon from Earth because sun has lit up face facing Earth.		
E	Half moon lit by sun		

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

Include in your answer:

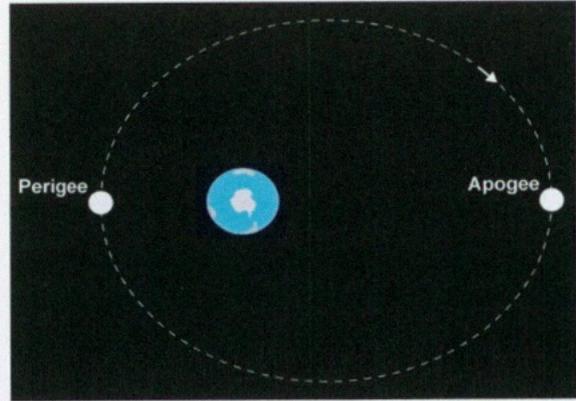
- why we see the Moon
- why the Moon appears to have different shapes over time, as seen from Earth
- how the Moon appears in the Southern Hemisphere as compared to the Northern Hemisphere.

*You may use a diagram to support your answer.*



We see the part of the moon that the sun lights up, and because the moon orbits the Earth, we see the different angles of sunlight hitting it. The moon is tidally locked, meaning that its rotation matches its orbit around Earth. This means that from Earth we can only ever see one side of the moon, and whether it's lit up by the sun or not. Whether or not the Southern or Northern Hemisphere can see the moon appear depends on the time of year due to the Earth's axial tilt in relation to the sun and the time of day which can make the moon appear more obvious. The angle of the hemispheres during the year decides

- (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.*

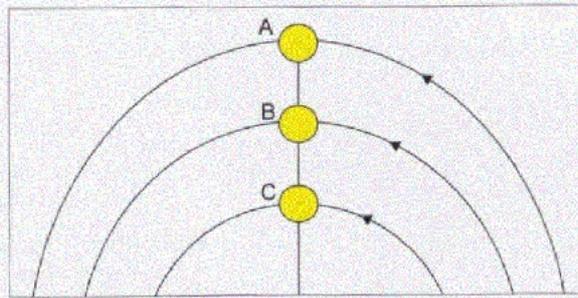
The moon takes around 27.5 days to orbit the Earth, however, due to the Earth's elliptical orbit around the sun, the moon takes time to "catch up" and reach its original placement. This means that the full phase change of the moon takes around 29.5 days. A full moon occurs when the moon is on the opposite side of Earth from the sun, and the sun lights up the face of the moon that is visible on Earth. Because the moon is tidally locked as I

previously mentioned, Earth sees the same face / side of the moon all the time. The size apparent size of the moon changing is caused by the sunlight hitting a part of the moon that we view from Earth. Also, because the moon's orbit is elliptical, when the moon passes through its Perigee, it appears to be closer than it looks when the moon orbits through the wider sides of the elliptical shape. Also, when it passes through the Apogee, which is the furthest distance from Earth, the moon appears apparently smaller.

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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**

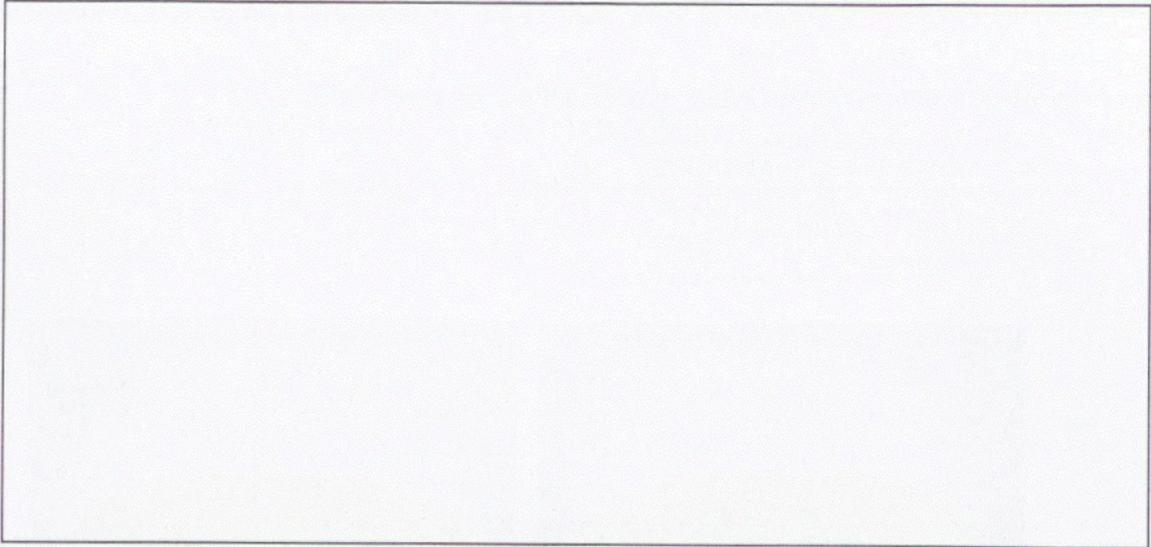
Adapted from: <https://c8.alamy.com/comp/P9BFC7/path-of-the-sun-throughout-the-year-in-the-northern-hemisphere-P9BFC7.jpg>

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.

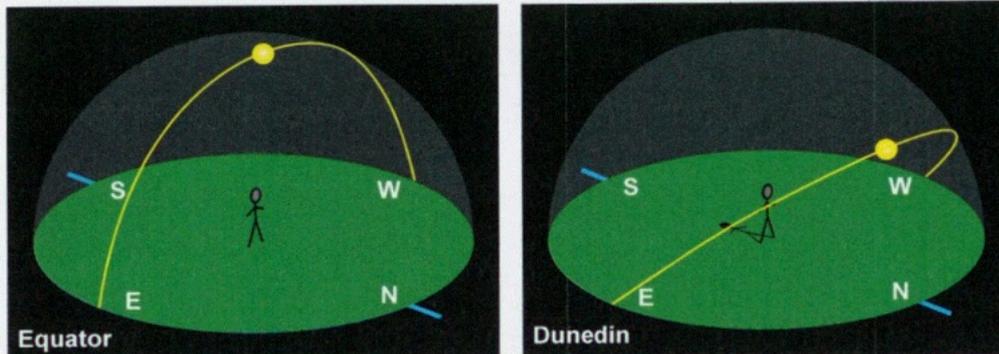


A winter solstice occurs in the Southern Hemisphere during June to August in Winter, and causes the shortest day of the year. Summer solstice occurs during December to February and causes the longest day of the year in summer. Equinoxes occur during Autumn and Spring, and cause days of similar or equal length. The apparent path of the sun and the location it appears to rise and set from is determined by the angle of which the Earth faces the sun. In summer the more direct facing angle causes the sun to appear higher in its path, and increases sunlight hours which is the summer solstice. In winter the sun appears lower and causes less sunlight hours because the Southern Hemisphere is facing downward and away from the sun. The equinoxes in Autumn and Spring make the sun appear at a medium height in comparison, and due to the

- (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  $0^\circ$  and Dunedin  $46^\circ\text{S}$ .

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

Location	Sun angle
Equator	$90^\circ$
Dunedin	$43^\circ$



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 angle of the sun at the equator is more direct and appears overhead because the Earth's axial tilt only majorly affects the angle of sunlight received by the regions with higher latitudes in either Hemisphere. The shadows at the equator would most likely not be visible because the sunlight angle lies overhead of objects, causing a short angle that could only be visible with objects that hold an offset angle not matching the  $90^\circ$ . The angle of the sun in Dunedin appears at almost a  $45^\circ$  angle which is half the

amount the equator receives. This is because Dunedin sits at a latitude between the equator, and the south pole at around  $46^{\circ}\text{S}$ . During noon at the spring equinox in Dunedin, the sun is at a medium angle compared to the equator, because it is facing the sun at a more equal angle which causes days of similar or equal length. The shadows cast at this time ~~cause~~ <sup>occur when</sup> the sunlight hits an object from its highest angle, at noon, and shadows appear on the opposite side that isn't lit on the object. These shadows begin longer in the morning and evening, and become shorter in Dunedin at noon because the sun is more overhead at a higher angle. The equator doesn't experience these shifts because it sits at a more constant and equal angle facing the sun throughout the day, even as the Earth rotates on its axis.

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

QUESTION  
NUMBER

- 2b the angle of which the moon appears to be visible, because of the varying latitudes.
- 2c A super full moon may only occur 1-3 times a year because it requires the moon to be at its perigee to Earth at the same time the phase is a full moon. The 27.5 days the moon takes to reach the perigee doesn't match up with the 29.5 days the moon takes to fully change phase/complete the phase cycle. That is why a super full moon doesn't occur at every full moon, but only 1-3 times a year possibly.
- 3b angle the Southern Hemisphere is facing, the days are similar or equal length because the angle isn't directly toward or away from the Sun, but somewhere in between. This angle of Earth contrasts the daylengths between the Northern and Southern Hemisphere during the Summer and Winter Solstices, but also some regions which have different latitudes, such as Auckland and Invercargill. Although the variation isn't as significant as is viewed of the two Hemispheres, the difference

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

QUESTION  
NUMBER

in Latitude will affect the angle those regions receive the sun's rays, affecting daylength during the solstices. However, during the equinoxes, the Earth is at a more even angle with the sun, and the small difference in Latitude doesn't affect the daylengths or cause variations in sunlight hours. The angle the Earth faces the sun is changed by its position around the elliptical path, and the  $23.5^\circ$  axial tilt that causes different Hemispheres to face the sun seasonally.



## Merit

**Subject:** L1 Physics, Earth and Space Science

**Standard:** 92046

**Total score:** 15

Q	Grade score	Marker commentary
One	M5	Candidate has explained the differences in solar radiation and daylength. However, they did not explain why the Southern Hemisphere experiences four seasons or differences in the height of the Sun.
Two	M5	Candidate has explained the changes in the Moon's appearance and apparent size during its orbit around the Earth. However, they did not explain different phases of the Moon in relation to the positions of the Sun, Earth, and Moon.
Three	M5	Candidate explains shadow at one location, as well as the differences in Sun angle between two locations. However, they did not explain the changing location of sunrise and sunset, or how the tilt of the Earth affects the height of the Sun throughout the year.