Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9–1)

Centre Number | | | | | |

Candidate Number | | | | |

Wednesday 3 June 2020

Afternoon (Time: 1 hour 45 minutes) | Paper Reference **1AS0/01**

Astronomy

Paper 1: Naked-eye Astronomy

You must have:
Formulae and Data Sheet (enclosed)
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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Pearson

Formulae and Data Sheet

Formulae

Equation of Time = Apparent Solar Time (AST) – Mean Solar Time (MST)	
Kepler's 3rd law:	$\frac{T^2}{r^3}$ = a constant
Magnification of telescope:	magnification = $\frac{f_o}{f_e}$
Distance modulus formula:	$M = m + 5 - 5 \log d$
Redshift formula:	$\frac{\lambda - \lambda_0}{\lambda_0} = \frac{v}{c}$
Hubble's law:	$v = H_0 d$

Data

Mass of Earth	6.0×10^{24} kg
Mean diameter of Earth	13 000 km
Mean diameter of Moon	3500 km
Mean diameter of Sun	1.4×10^6 km
One Astronomical Unit (AU)	1.5×10^8 km
Mean Earth to Moon distance	380 000 km
One light year (l.y.)	9.5×10^{12} km
One parsec (pc)	3.1×10^{13} km = 3.26 l.y.
Sidereal day of Earth	23 h 56 min
Synodic day of Earth	24 h 00 min
Temperature of solar photosphere	5800 K
Hubble Constant	68 km/s/Mpc
Speed of light in vacuum	3.0×10^8 m/s

Name	Type of body	Mean distance from Sun/AU	Sidereal period/Earth year	Mean temperature /°C	Diameter /1000 km	Mass/ Earth mass	Ring system	Moons
Mercury	planet	0.38	0.24	170	4.9	0.055	no	none
Venus	planet	0.72	0.62	470	12.1	0.82	no	none
Earth	planet	1.0	1.0	15	12.8	1.00	no	1: the Moon
Mars	planet	1.5	1.9	–50	6.9	0.11	no	2 small moons: Deimos and Phobos
Ceres	dwarf planet	2.8	4.6	–105	0.95	1.5×10^{-4}	no	none
Jupiter	planet	5.2	11.9	–150	143	318	yes	4 major moons: Ganymede, Callisto, Europa, Io >60 others
Saturn	planet	9.5	29.5	–180	121	95	yes	5 major moons: including Titan, Iapetus >55 others
Uranus	planet	19.1	84.0	–210	51	15	yes	5 major moons: including Titania, Oberon >20 others
Neptune	planet	30.0	165	–220	50	17	yes	1 major moon: Triton >12 others
Pluto	dwarf planet	39.5	248	–230	2.4	2.2×10^{-3}	no	1 major moon: Charon >4 other moons
Haumea	dwarf planet	43.1	283	–241	1.4	6.7×10^{-4}	no	2
Eris	dwarf planet	67.8	557	–230	2.3	2.8×10^{-3}	no	at least 1

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 (a) Figure 1 shows a photograph of the Moon with four features labelled.

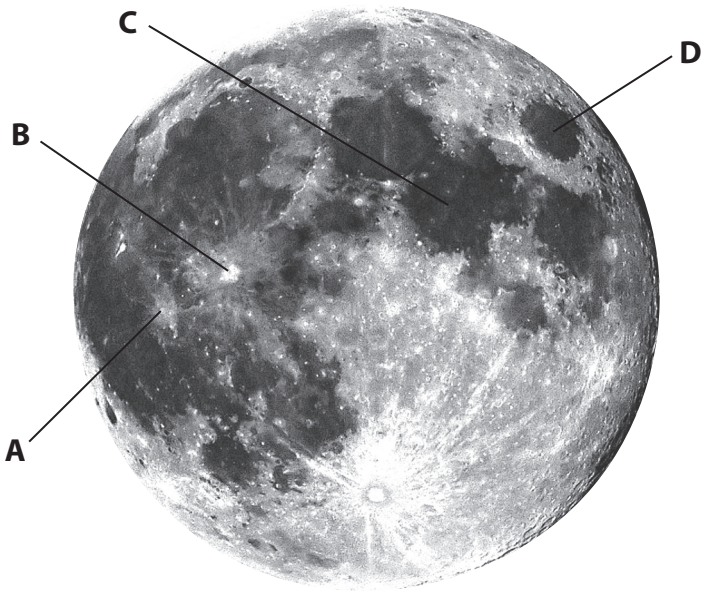

Figure 1

Which of these features is named?

(i) Copernicus

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(ii) the Sea of Crises

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(iii) the Sea of Tranquility

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(b) Figure 2 shows a sketch of part of the constellation of Pegasus.

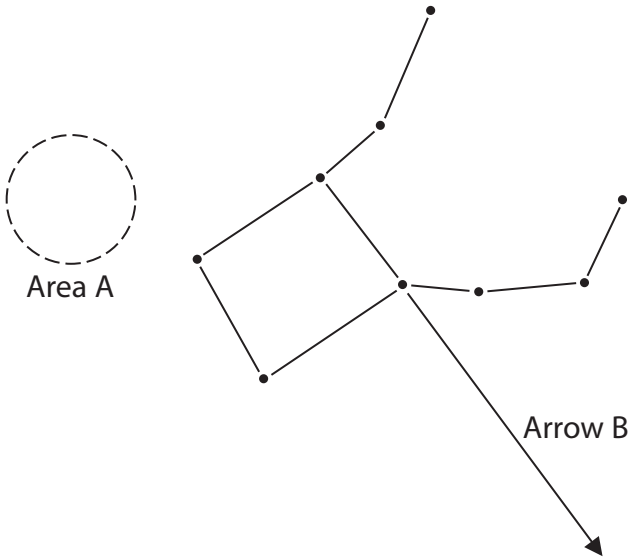

Figure 2

(i) In Area A there is a faint patch of light. This is the:

(1)

☒ **A** Andromeda galaxy

☒ **B** Milky Way galaxy

☒ **C** Orion nebula

☒ **D** Triangulum galaxy

(ii) Arrow B points to the bright star called:

(1)

☒ **A** Aldebaran

☒ **B** Fomalhaut

☒ **C** Polaris

☒ **D** Sirius

(c) Which of the following **cannot** show the observer's horizon?

(1)

☒ **A** computer program

☒ **B** phone app

☒ **C** planisphere

☒ **D** star map

(Total for Question 1 = 6 marks)

2 Figure 3 shows a star chart containing the constellation of Virgo.

The ecliptic has been drawn on the chart.

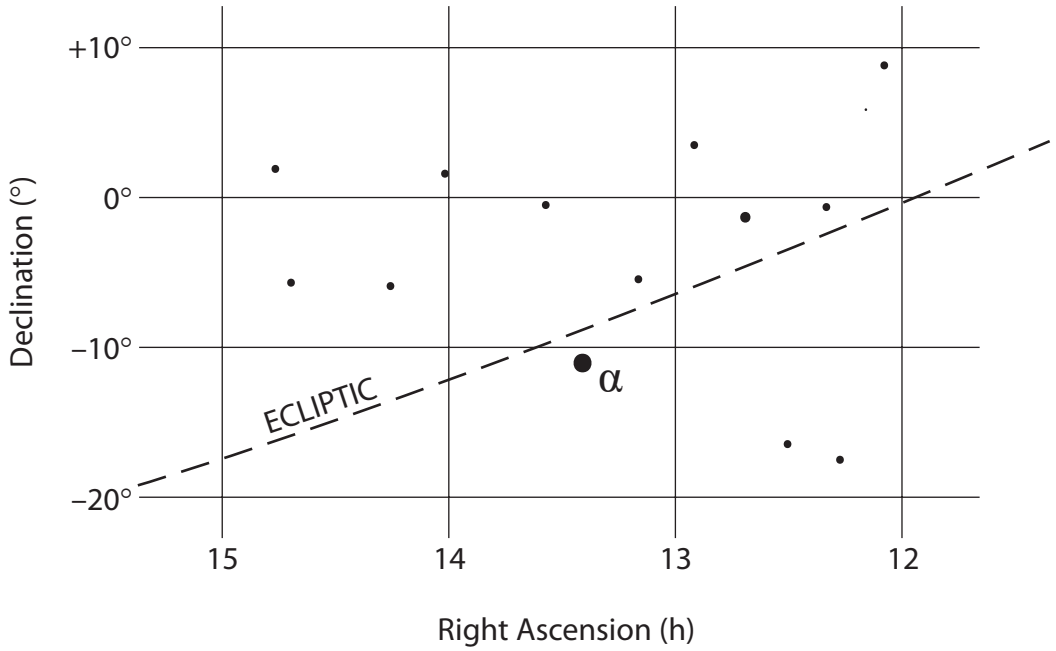

Figure 3

(a) Which of the following is the name of the region that lies a few degrees either side of the ecliptic?

(1)

☒ **A** Celestial Equator

☒ **B** observer's meridian

☒ **C** observer's zenith

☒ **D** Zodiacal Band

(b) Draw on Figure 3 the position of the Sun at the Autumnal Equinox.

Use the label **P**.

(1)

(c) State the Right Ascension and Declination of the star labelled α in Figure 3.

(1)

Right Ascension (h : min)

Declination (°)

(d) (i) In which season is the constellation of Virgo easiest to observe?

(1)

- ☒ **A** autumn
- ☒ **B** spring
- ☒ **C** summer
- ☒ **D** winter

(ii) State a reason for your answer.

(1)

(e) Figure 4 shows part of a grid from a star chart.

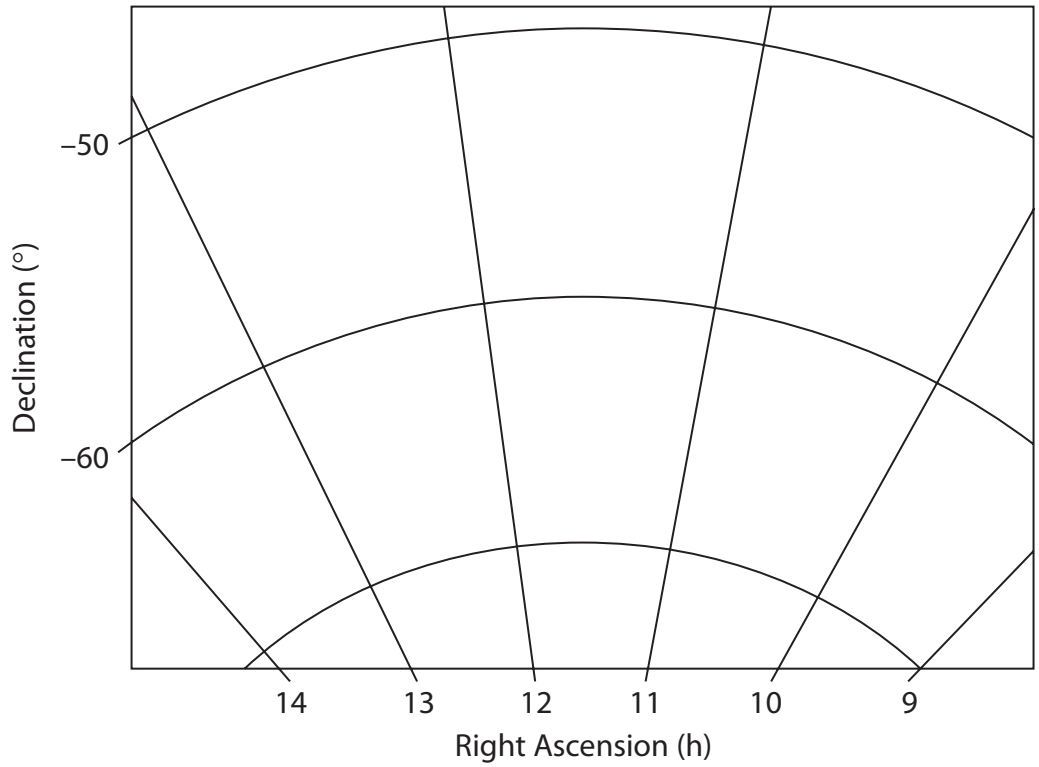

Figure 4

Analyse Figure 4 to determine whether the grid shows part of the Northern or Southern hemisphere of the Celestial Sphere and explain your answer.

(2)

(Total for Question 2 = 7 marks)

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3 (a) People have divided the Earth's surface using several lines that have astronomical significance.

(i) Which line separates the Earth into its Northern and Southern hemispheres?

(1)

☒ **A** Equator

☒ **B** Prime Meridian

☒ **C** Tropic of Cancer

☒ **D** Tropic of Capricorn

(ii) Which line joins all locations with a latitude of 23½°S?

(1)

☒ **A** Equator

☒ **B** Prime Meridian

☒ **C** Tropic of Cancer

☒ **D** Tropic of Capricorn

(iii) Which line joins all locations with a longitude of 0°?

(1)

☒ **A** Equator

☒ **B** Prime Meridian

☒ **C** Tropic of Cancer

☒ **D** Tropic of Capricorn

(b) An observer on the Earth makes some measurements of four bright stars. His results are shown in Figure 5.

Star	Declination (°)	Hour angle (h : min)
α	–3	+4:30
β	+5	+3:00
γ	+55	–0:30
δ	+78	0:00

Figure 5

(i) Which star is located nearest to the North Celestial Pole?

(1)

☒ **A** Star α

☒ **B** Star β

☒ **C** Star γ

☒ **D** Star δ

(ii) Which star culminated 3 hours before these observations were made?

(1)

☒ **A** Star α

☒ **B** Star β

☒ **C** Star γ

☒ **D** Star δ

(iii) Which star is nearest to the Celestial Equator?

(1)

☒ **A** Star α

☒ **B** Star β

☒ **C** Star γ

☒ **D** Star δ

(iv) Which star is crossing the observer's meridian at this time?

(1)

☒ **A** Star α

☒ **B** Star β

☒ **C** Star γ

☒ **D** Star δ

(Total for Question 3 = 7 marks)

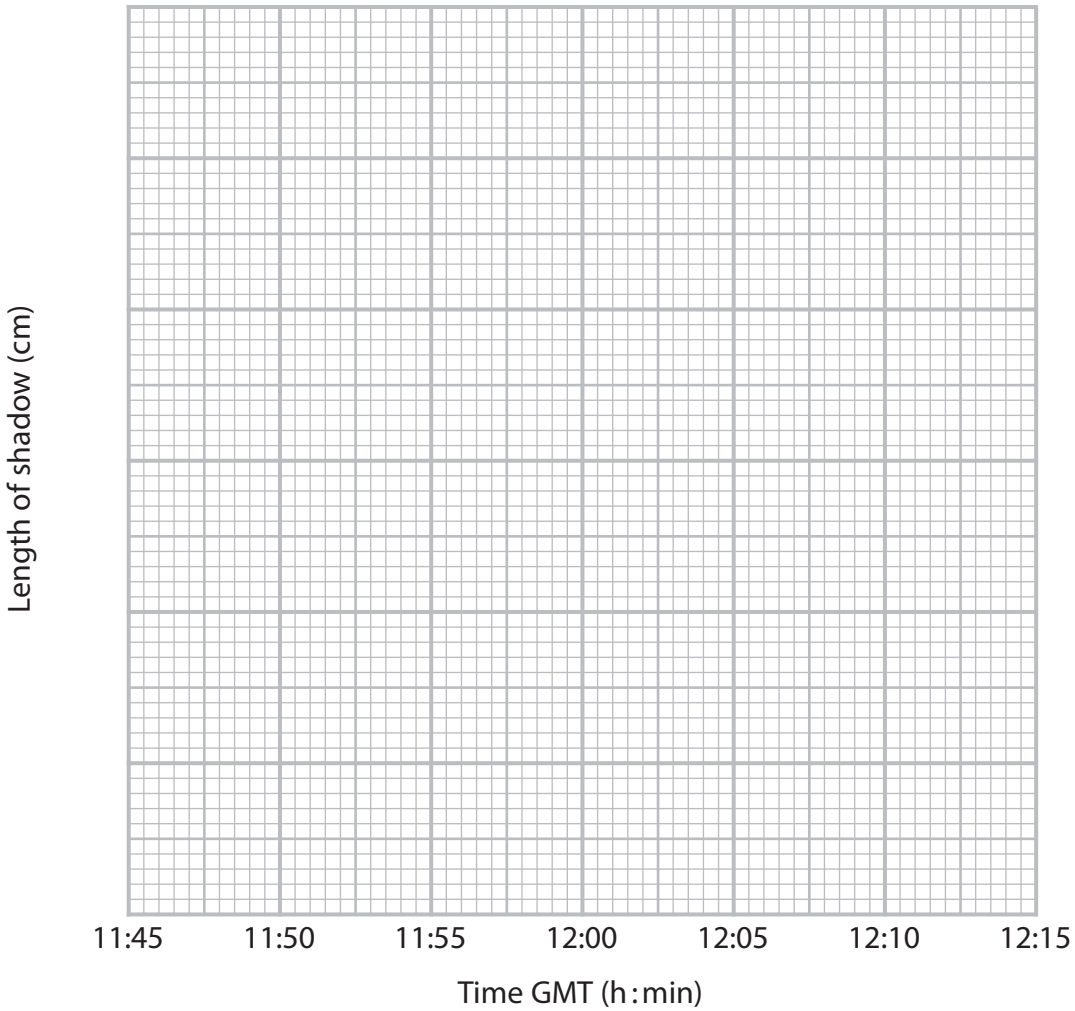
4 A student performs a shadow stick experiment to determine her longitude. Figure 6 shows her results.

Time GMT (h : min)	Length of shadow (cm)
11:45	102.2
11:50	100.1
11:55	98.4
12:00	97.7
12:05	97.8
12:10	98.8
12:15	101.0

Figure 6

(a) (i) Plot a graph of the student's results and draw a line of best fit.

(3)



(ii) State the time of local noon at the student's location.

(1)

(iii) Calculate the student's longitude.

The Equation of Time on this date was 0 minutes.

(2)

Longitude =

(b) (i) The 'lunar distance' method can be used to measure longitude.

Which of the following measurements must be taken in this method?

(1)

☒ **A** The angular distance across the Moon's disc

☒ **B** The angular distance between the Moon and certain bright stars

☒ **C** The angular distance between the Moon and the horizon

☒ **D** The angular distance between the Moon and a comet

(ii) Sailors on a ship can use observations of the Sun and the time on an accurate clock to find their longitude.

Describe in detail this method for finding longitude.

You may include a clearly labelled diagram in your answer.

(3)

(Total for Question 4 = 10 marks)

5 (a) State **one** reason why it is easier to observe a meteor shower with the naked-eye than with a telescope.

(1)

(b) State the reason why meteor showers appear to originate from one area in the sky.

(1)

(c) Major meteor showers include the Perseids, the Leonids and the Geminids.

State how meteor showers get their names.

(1)

(d) Design a naked-eye experiment to determine the position of a meteor shower's radiant.

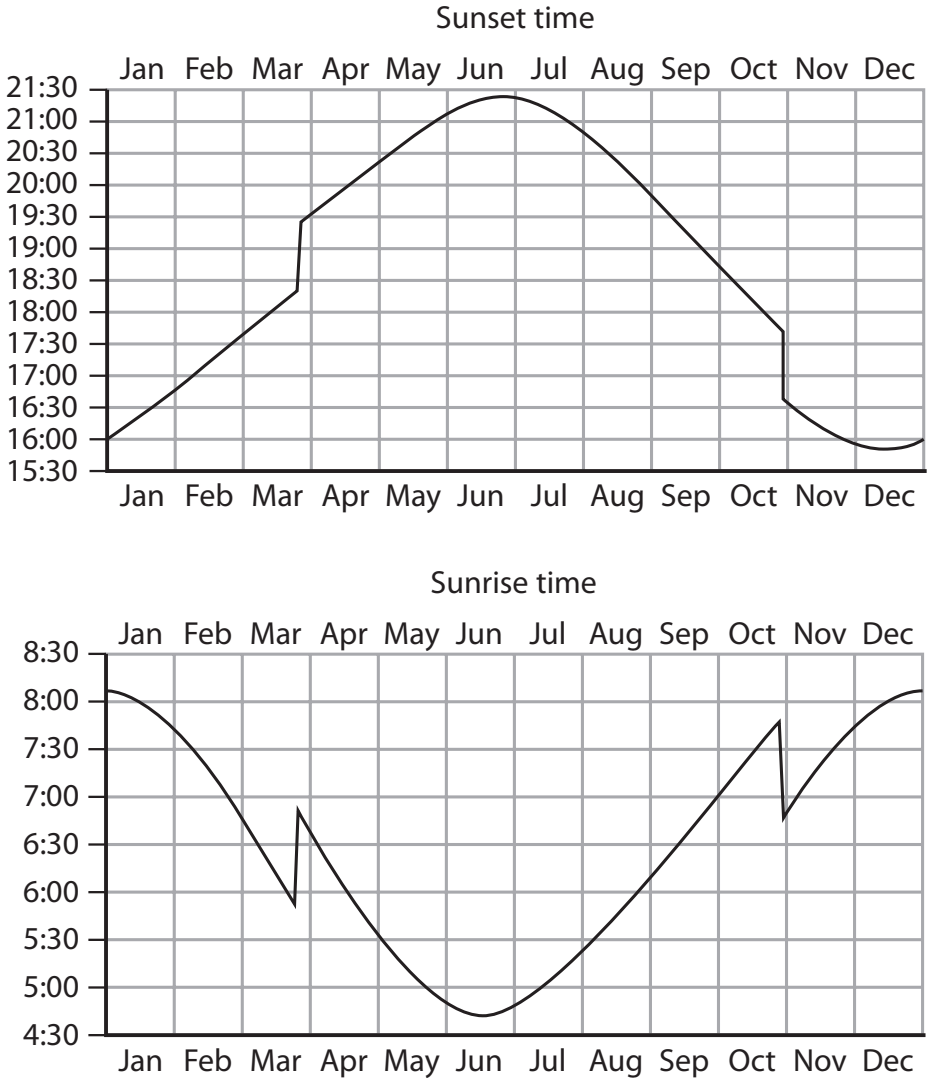
Describe what you would record to find the position of the radiant.

Describe how you would analyse your observations to find its position.

(6)

(Total for Question 5 = 9 marks)

6 (a) Figure 7 shows graphs of the rising and setting times of the Sun, during the year.



(Source: http://www.solipsys.co.uk/cgi-bin/sews.py?ModellingSunriseAndSunsetTimes)

Figure 7

(i) State whether the graphs in Figure 7 relate to a location in the Northern or Southern hemisphere.

(1)

(ii) State the reason for your answer to (i) above.

(1)

(iii) During two months of the year, local clocks were adjusted to allow for daylight-saving time.

Figure 7 shows that these two months were:

(1)

☒ **A** January and December

☒ **B** March and October

☒ **C** June and July

☒ **D** October and December

(iv) State the feature of the graphs in Figure 7 that shows the effect of daylight-saving time.

(1)

(b) Sarah wishes to measure her local time using observations of the Sun. She looks up some values of the Equation of Time, as shown in Figure 8.

Date	Equation of Time (minutes)
7 September	+1
9 September	+2
11 September	+3

Figure 8

(i) On 13th September she observes the Sun with a sundial. It shows a time of 15:01. Estimate her Mean Solar Time (MST) at this time.

(3)

Mean Solar Time = :

(ii) Sarah then takes a further sundial reading 30 days later, on the 13th October.

She suggests that the Equation of Time for the 13th October would be +19 minutes.

Analyse the data in Figure 8 and comment on Sarah's estimate for the Equation of Time on the 13th October.

(2)

(c) To measure Apparent Solar Time accurately, a sundial must be correctly aligned.

State **two** ways of ensuring this.

(2)

1

2

(Total for Question 6 = 11 marks)

7 (a) Describe **two** differences in the appearance of an aircraft and an artificial satellite to a naked-eye observer at night.

(2)

1

2

(b) State **two** differences between seeing conditions and weather.

(2)

1

2

(c) Naked-eye techniques can make use of dark adaptation and averted vision.

Describe each of these techniques.

(i) dark adaptation

(1)

(ii) averted vision

(1)

(d) An astronomy student wishes to measure the level of light pollution in his back garden. An extract from his observational plan said:

'Under ideal seeing conditions, I should be able to see stars as faint as magnitude 5. However due to light pollution I am not able to see this limiting magnitude. I plan to measure the limiting magnitude (faintest stars) that I can see by counting the number of observable planets in the night sky.'

Evaluate his proposed method and give reasons why it is not suitable.

Include a detailed alternative plan to determine the effect of light pollution.

(6)

(Total for Question 7 = 12 marks)

8 (a) We can only ever see one side of the Moon from the Earth.

This is because:

(1)

☒ **A** the Earth's rotational period is equal to the Earth's orbital period

☒ **B** the Earth's rotational period is equal to the Moon's orbital period

☒ **C** the Moon's rotational period is equal to the Earth's orbital period

☒ **D** the Moon's rotational period is equal to the Moon's orbital period

(b) State the effect that lunar libration has on the amount of the Moon's surface that is visible from Earth over a period of one month.

(1)

(c) Figure 9 shows a drawing of the lunar disc, indicating the position of the crater Tycho.
An astronomer noticed that this crater appeared to change its position on the lunar disc.
This is caused by lunar libration.

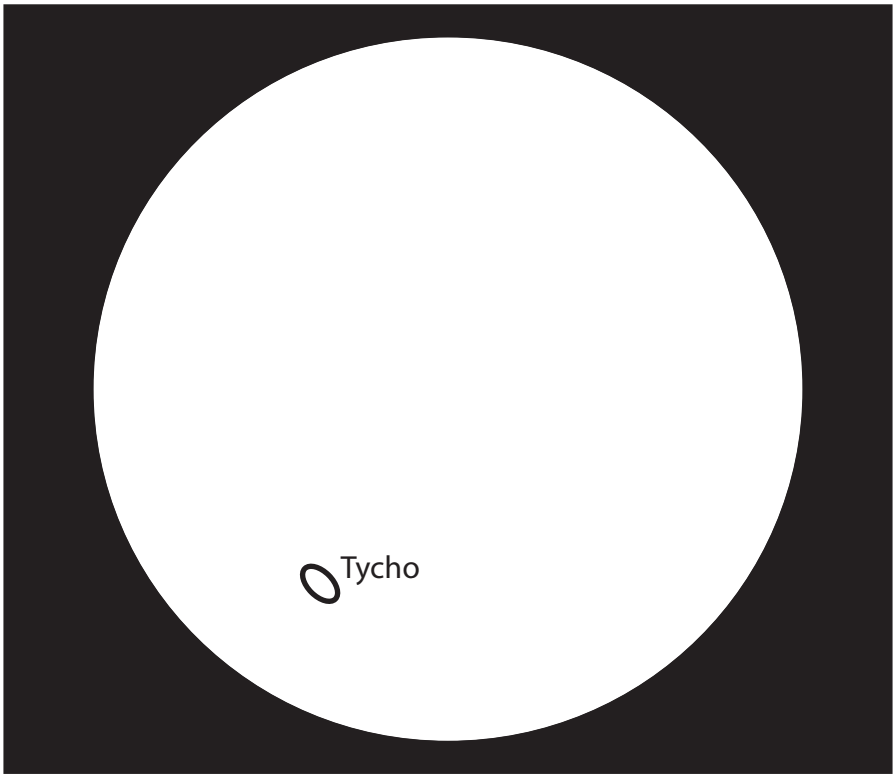


Figure 9

Lunar libration is caused by the Moon's elliptical orbit and by the inclination of its orbit to the ecliptic.

(i) Draw on Figure 9 a possible new position where Tycho could be observed as a result of libration caused by the Moon's elliptical orbit.

Use the label **A**.

(1)

(ii) Draw on Figure 9 a possible new position where Tycho could be observed as a result of libration caused by the Moon's orbital inclination to the ecliptic.

Use the label **B**.

(1)

(d) Some astronomers have suggested that when the Moon formed it was only 34 000 km from the Earth.

Calculate the ratio of the Moon's current distance from the Earth to its distance when it formed.

Use information from the Formulae and Data Sheet.

(1)

Ratio =

(e) Explain what would happen to each of the following if the Moon orbited much closer to the Earth:

(i) the tides on the Earth

(2)

(ii) the lunar phase cycle

(2)

(iii) the appearance of a total solar eclipse

(2)

(Total for Question 8 = 11 marks)

9 Figure 10 shows sketches of two stages in the construction of an ancient stone circle.

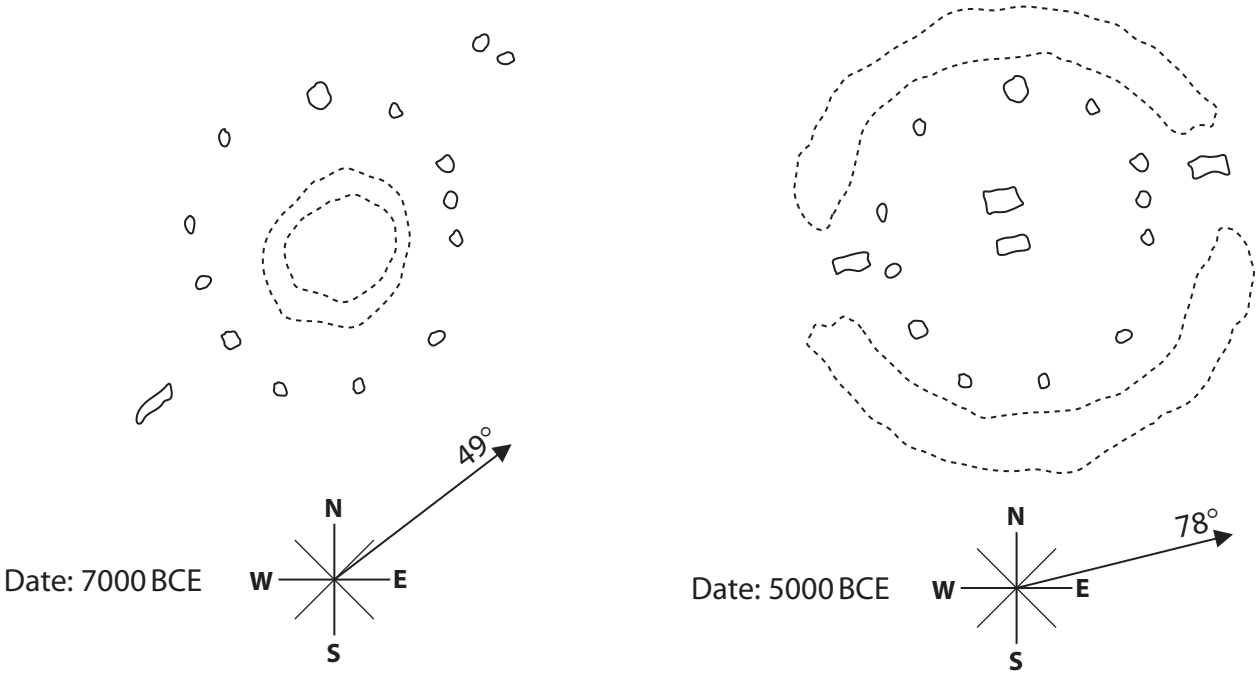


Figure 10

The first sketch shows the circle in 7000 BCE. The axis of the circle is at an angle of 49° from due North.

The second sketch shows the circle in 5000 BCE. The axis of the circle is at an angle of 78° from due North.

(a) (i) It is thought that this stone circle was designed to have an alignment with the star Sirius.

Suggest **one** reason why ancient civilisations may have aligned their stone circles with bright stars such as Sirius.

(1)

(ii) It is thought that this stone circle was rebuilt between 7000 BCE and 5000 BCE, changing its alignment, as shown in Figure 10.

It has been suggested that this was done as a result of precession of the Earth's axis.

Calculate the time taken for the Earth to precess once on its axis.

Use the data in Figure 10.

(3)

Time = years

(b) Some ancient civilisations aligned their stone circles in an East-West direction.

It is thought that they did this using the rising or setting Sun.

State **two** days of the year when the rising or setting Sun can be used to find the exact direction of East or West.

(2)

1

2

(c) (i) Figure 11 shows a sketch of the horizon and night sky. The position of Polaris is shown.

Polaris

Figure 11

The Plough is a bright asterism in the night sky.
Draw a possible position for the Plough on Figure 11 and show how it can be used to locate Polaris.

(2)

(ii) Polaris is currently located close to the North Celestial Pole.

Describe how astronomers can use Polaris to help find their position on the Earth.

You may include a carefully labelled diagram in your answer.

(3)

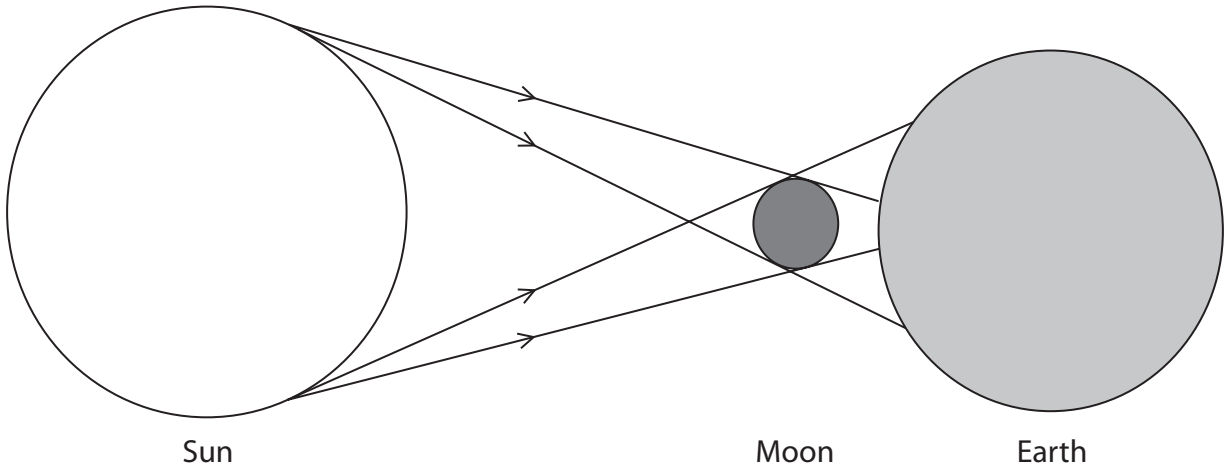
(iii) Describe how the precession of the Earth's axis will affect the use of Polaris for finding positions on the Earth.

You may use a clearly labelled diagram in your answer.

(2)

(Total for Question 9 = 13 marks)

10 (a) Figure 12 shows a ray diagram of the Earth, Moon and Sun during a solar eclipse.



Not to scale

Figure 12

(i) Label on Figure 12 a location on the Earth's surface where the eclipse would be seen as total.

Use the label **T**.

(1)

(ii) Label on Figure 12 a location on the Earth's surface where the eclipse would be seen as partial.

Use the label **P**.

(1)

(b) Give **two** reasons why a total solar eclipse can only be observed for a short period of time by an observer standing on the Earth's surface.

(2)

1

2

(c) Which of the following gives the position of the Moon when an annular eclipse is **most** likely to be visible from Earth?

(1)

☒ **A** aphelion

☒ **B** apogee

☒ **C** perihelion

☒ **D** perigree

(d) The Greek astronomer Aristarchus noticed that the Sun and full Moon appear to be the same size in the sky, when viewed from Earth.

Figure 13 gives some data about the Earth, Sun and Moon system.

Mean Earth to Moon distance	384 000 km
Mean diameter of the Moon	3 470 km
Mean diameter of the Sun	1.39×10^6 km

Figure 13

Calculate a value for the mean distance between the Earth and the Sun.

Use the data from Figure 13 and the fact that both the Sun and the Moon have the same apparent diameter.

(3)

Mean distance between the Earth and the Sun = km

(e) A lunar eclipse occurs when the Moon passes into the Earth's shadow. Figure 14 shows a sketch of the Earth's shadow with the umbra and penumbra labelled.

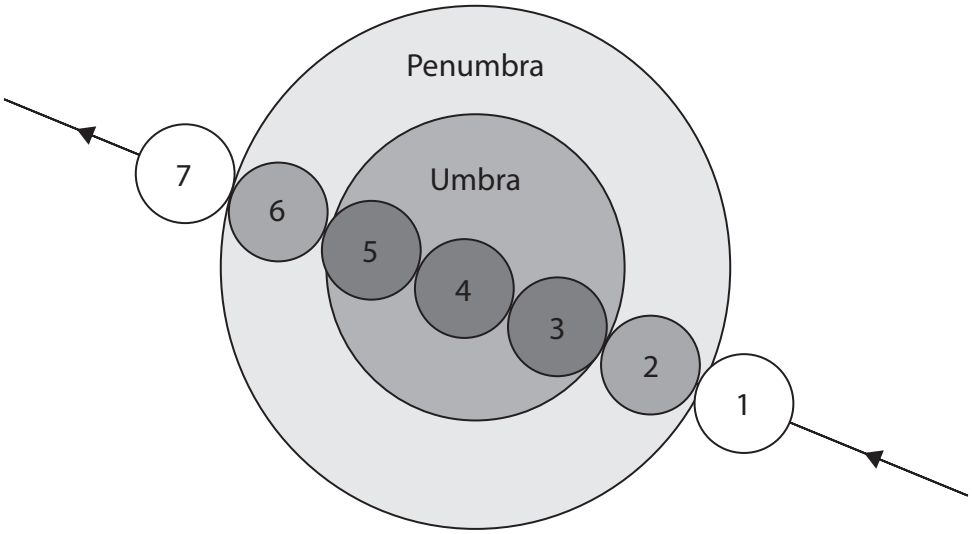


Figure 14

(i) Which label from Figure 14 marks the position of the first umbral contact?

(1)

☒ **A** 1

☒ **B** 2

☒ **C** 4

☒ **D** 5

(ii) Which label from Figure 14 marks the position of the third umbral contact?

(1)

☒ **A** 1

☒ **B** 2

☒ **C** 4

☒ **D** 5

(f) Describe how the astronomer Eratosthenes used observations of a lunar eclipse to estimate the diameter of the Moon.

You may include a carefully labelled diagram in your answer.

(3)

(g) State **one** feature of the Moon's orbit which means that lunar and solar eclipses do **not** occur every month.

(1)

(Total for Question 10 = 14 marks)

TOTAL FOR PAPER = 100 MARKS

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