Paper Reference(s) 1AS0/01
Pearson Edexcel Level 1/Level 2 GCSE (9–1)

Total Marks

Astronomy
PAPER 1: Naked-eye Astronomy

Wednesday 14 June 2023 – Afternoon

Time: 1 hour 45 minutes

In the boxes below, write your name, centre number and candidate number.

Surname					
Other names					
Centre Number					
Candidate Number					

Y71932A

Pearson

YOU MUST HAVE

Calculator, ruler

YOU WILL BE GIVEN

Diagram Booklet
Formulae and Data Booklet

INSTRUCTIONS

Answer ALL questions.

Answer the questions in the spaces provided in this Question Paper or in the separate Diagram Booklet – 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.

In questions labelled with an ASTERISK (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

There may be spare copies of some diagrams.

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.

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) A student makes sketches of groups of bright stars in the night sky.

(i) Look at Figure 1 for Question 1(a)(i) in the Diagram Booklet. The bright stars shown in Figure 1 are part of the group of stars called:
(1 mark)

☐ A Cassiopeia

☐ B Orion

☐ C Southern Cross

☐ D Ursa Major

(continued on the next page)

1(a) continued.

(ii) Look at Figure 2 for Question 1(a)(ii) in the Diagram Booklet. The bright stars shown in Figure 2 are part of the group of stars called:
(1 mark)

☐ A Cassiopeia

☐ B Orion

☐ C Southern Cross

☐ D Ursa Major

(continued on the next page)

1(a) continued.

(iii) Look at Figure 3 for Question 1(a)(iii) in the Diagram Booklet. The bright stars shown in Figure 3 are part of the group of stars called:
(1 mark)

☐ A Cassiopeia

☐ B Orion

☐ C Southern Cross

☐ D Ursa Major

(continued on the next page)

1(a) continued.

(iv) Which ONE of the following groups of stars is an example of an asterism?
(1 mark)

☐ A Cassiopeia

☐ B Orion

☐ C Southern Cross

☐ D Ursa Major

(continued on the next page)

1 continued.

(b) Look at Figure 4 for Question 1(b) in the Diagram Booklet. It shows a sketch of part of the night sky.

(i) An astronomy student watches a meteor shower for several hours.

The student records the trail of each meteor as a short line.

Draw on Figure 4 to show the finished sketch of the meteor shower.
(1 mark)

(ii) Label on Figure 4 the position of the RADIANT of the meteor shower.

Use the label R.
(1 mark)

(Total for Question 1 = 6 marks)

2 (a) A student sees a moving curtain of coloured light in the night sky.

This is caused by:
(1 mark)

☐ A a galaxy

☐ B a nebula

☐ C a planet

☐ D an aurora

(b) Which ONE of the following has the largest radius?
(1 mark)

☐ A celestial sphere

☐ B Earth

☐ C Moon

☐ D Sun

(continued on the next page)

2 continued.

(c) The point directly above an observer's head is called their: (1 mark)

☐ A cardinal point

☐ B horizon

☐ C hour angle

☐ D zenith

(d) Which ONE of the following observations is caused by libration? (1 mark)

☐ A a lunar eclipse

☐ B a solar eclipse

☐ C being able to see 59% of the Moon's surface

☐ D being unable to see the far side of the Moon

(continued on the next page)

2 continued.

(e) From which place on the Earth would the Sun be directly overhead at noon on 21st March?
(1 mark)

☐ A Antarctic Circle

☐ B Equator

☐ C North Pole

☐ D Tropic of Capricorn

(f) Which ONE of the following is the shortest period of time?
(1 mark)

☐ A leap year

☐ B sidereal day

☐ C synodic day

☐ D synodic month

(continued on the next page)

2 continued.

(g) A constellation is called ‘zodiacal’ if: (1 mark)

☐ A it is on the celestial equator

☐ B it is on the ecliptic

☐ C it is near to one of the celestial poles

☐ D it never sets for an observer on the Earth

(Total for Question 2 = 7 marks)

3 (a) Look at Figure 5 for Question 3(a) in the Diagram Booklet. It shows a photograph of the Sun's disc, taken just before sunset.

(i) The Sun's disc does not appear to be perfectly circular.

Explain why the Sun's disc does not appear to be perfectly circular.

Look at the blank page for Question 3(a)(i) in the Diagram Booklet. You may include a clearly labelled diagram in your answer. (2 marks)

(continued on the next page)

3(a) continued.

(ii) The Sun's disc appears to be an orangey-red colour.

Explain why the Sun's disc appears to be an orangey-red colour.
(2 marks)

(continued on the next page)

3 continued.

(b) Noctilucent clouds are white clouds that shine brightly in the evening sky, just after sunset.

Look at Figure 6 for Question 3(b) in the Diagram Booklet. It is a photograph of some noctilucent clouds.

Astronomers believe that noctilucent clouds are made when ice crystals form around pieces of dust in the Earth's upper atmosphere.

(i) State ONE possible source of dust in the Earth's upper atmosphere. (1 mark)

_____

_____

(continued on the next page)

3(b) continued.

(ii) Observers at latitudes greater than 70 °N cannot see noctilucent clouds during the summer months.

Explain the astronomical reason for this.
(2 marks)

(Total for Question 3 = 7 marks)

4 (a) Bob visits a seaside town and makes a note of the times of high tide on a particular day.

The town had a morning high tide at 02:15 and an afternoon high tide at 13:57

(i) Explain why most places near the sea have two high tides every 24 hours.

Look at the blank page for Question 4(a)(i) in the Diagram Booklet. You may include a clearly labelled diagram in your answer. (3 marks)

(continued on the next page)

4(a) continued.

(ii) Calculate the time of the morning low tide at Bob's location.
(2 marks)

Time of low tide = _____

(continued on the next page)

4 continued.

(b) (i) Bob observes the high tides for several days.

He concludes that a spring tide will soon happen.

He can tell this because:
(1 mark)

☐ A both the high and low tides are getting higher

☐ B both the high and low tides are getting lower

☐ C the high tides are getting higher and the low tides are getting lower

☐ D the high tides are getting lower and the low tides are getting higher

(continued on the next page)

4(b) continued.

(ii) Bob makes his observations seven days before the spring tide.

State the phase of the Moon at the time of Bob's observations. (1 mark)

(continued on the next page)

4(b) continued.

(iii) Describe how the phase of the Moon will change over the next seven days.
(2 marks)

(Total for Question 4 = 9 marks)

5 (a) Many early civilisations built large stone circles that appear to line up with astronomical objects in the sky.

(i) State ONE possible reason why people may have built these stone circles.
(1 mark)

(continued on the next page)

5(a) continued.

(ii) Many stone circles in the Northern Hemisphere have stones aligned with a line pointing north-east to south-west.

Which ONE of the following aligns with the north-east to south-west direction?
(1 mark)

☐ A midsummer sunset

☐ B midwinter sunset

☐ C Sun at noon

☐ D sunrise at the vernal equinox

(continued on the next page)

5(a) continued.

(iii) Some stone circles contain stones that almost line up with bright stars.

Describe ONE astronomical reason why these stones do not line up exactly with bright stars. (2 marks)

(continued on the next page)

5 continued.

(b) Look at Figure 7 for Question 5(b) in the Diagram Booklet. It shows a series of images of the Sun, taken at the Callanish stone circle in Scotland, over a period of one year.

Each image of the Sun was taken at noon on days that were approximately one week apart.

(i) State the approximate date when the image of the Sun at the top of the pattern, labelled 'X', was taken.
(1 mark)

(continued on the next page)

5(b) continued.

(ii) The solar images in Figure 7 form a ‘figure of 8’ pattern.

Explain why the pattern appears to have this shape.

Look at the blank page for Question 5(b)(ii) in the Diagram Booklet. You may include a clearly labelled diagram in your answer.
(2 marks)

(continued on the next page)

5(b) continued.

(iii) Point ‘X’, at the top of the pattern in Figure 7, is at an altitude of 55¼°.

Calculate the latitude of the Callanish stone circle.
(3 marks)

Latitude = _____ °

(Total for Question 5 = 10 marks)

6 Look at Figure 8 for Question 6 in the Diagram Booklet. Annabel set up a sundial on a piece of level ground, as shown.

She used a compass to help her align the sundial.

Annabel recorded the time shown on the sundial at ten-minute intervals around midday.

(continued on the next page)

6 continued.

Table 1 shows her results.

TABLE 1

Reading Number	Clock Time (h:min)	Sundial Time (h:min)
1	11:30	11:38
2	11:40	11:48
3	11:50	11:57
4	12:00	12:08
5	12:10	12:18
6	12:20	12:29
7	12:30	12:38

(a) Look at Figure 9 for Question 6(a) in the Diagram Booklet. Plot a graph on Figure 9 of Annabel's Sundial Time readings.

Use the data in Table 1.

The labels on the Clock Time axis have been marked for you.
(3 marks)

(continued on the next page)

6 continued.

(b) Annabel used her readings and the following information to calculate her longitude.

The Equation of Time on the day of her observations was –3 minutes.

She calculated her longitude to be 2¾°E.

Evaluate the accuracy of Annabel's method for finding her longitude from her readings of Sundial and Clock Time.
(6 marks)

Answer space continues on the next 2 pages.

6(b) continued.

6(b) continued.

(Total for Question 6 = 9 marks)

7 Mercury is an inferior planet.

(a) State what is meant by an 'inferior' planet.
(1 mark)

(continued on the next page)

7 continued.

(b) Look at Figure 10 for Question 7(b) in the Diagram Booklet. It shows the planet Mercury at several positions in its orbit, labelled A, B, C and D.

(i) At which ONE of the four positions labelled in Figure 10 (A, B, C or D) will Mercury appear to be in the full phase to an observer on Earth?
(1 mark)

☐ A Position A

☐ B Position B

☐ C Position C

☐ D Position D

(continued on the next page)

7(b) continued.

(ii) At which ONE of the four positions labelled in Figure 10 (A, B, C or D) will Mercury appear to be in the crescent phase to an observer on Earth?
(1 mark)

☐ A Position A

☐ B Position B

☐ C Position C

☐ D Position D

(continued on the next page)

7(b) continued.

(iii) One OTHER planet in the solar system shows phases when viewed from Earth.

Name this other planet.
(1 mark)

_____

_____

(continued on the next page)

7 continued.

(c) An astronomer wishes to make some NAKED-EYE observations of the planet Mercury.

Design a suitable observing programme that will allow her to make these observations safely.
(6 marks)

Answer space continues on the next 2 pages.

7(c) continued.

7(c) continued.

(continued on the next page)

7 continued.

(d) Look at Figure 11 for Question 7(d) in the Diagram Booklet. It shows the orbit of a moon around a planet.

Four points in the moon's orbit have been labelled (A, B, C and D).

Look at Table 2 for Question 7(d) in the Diagram Booklet. Complete Table 2 to show the visibility of the moon for an observer on the Earth.

You may put one or two ticks in each row.

The first row has been completed for you.
(3 marks)

(Total for Question 7 = 13 marks)

8 (a) In 1178 Gervase of Canterbury wrote the following account of the appearance of the crescent Moon one evening:

“The upper edge of the Moon seemed to split in two and a flaming torch jumped up, throwing out, for a considerable distance, fire, hot coals and sparks. Meanwhile the main part of the Moon moved and throbbed like a wounded snake. Afterwards the Moon went back to its proper shape. Then, the Moon from point to point, along its whole length, took on a blackish appearance”.

Look at Figure 12 for Question 8(a) in the Diagram Booklet. It shows a modern photograph of the area of the Moon that Gervase wrote about in 1178.

(continued on the next page)

8(a) continued.

(i) Describe the astronomical event that took place at this area of the Moon in 1178.
(2 marks)

(continued on the next page)

8(a) continued.

(ii) State ONE reason why it is still possible to see the effects of this event, hundreds of years after it happened.
(1 mark)

(continued on the next page)

8(a) continued.

(iii) Look at Figure 13 for Question 8(a)(iii) in the Diagram Booklet. It shows an image of the Moon's surface.

The Moon's North Pole is at the top of the image.

The event of 1178 is thought to have taken place just to the north-west of the Sea of Tranquillity.

Draw on Figure 13 the possible position of this event.

Use the label X.
(2 marks)

(continued on the next page)

8 continued.

(b) Astronomers have proposed many theories for the formation of the Earth's Moon.

One of these theories is called the Giant Impact Hypothesis.

This hypothesis suggests that the Moon was formed after a collision between the Earth and another planet-sized body.

State TWO pieces of evidence that suggest that the Giant Impact Hypothesis is correct.
(2 marks)

Answer space continues on the next page.

1 _____

_____

_____

8(b) continued.

2 _____

_____

_____

(continued on the next page)

8 continued.

(c) The Greek astronomer Eratosthenes used observations of a lunar eclipse to estimate the size of the Moon compared to the Earth.

Look at Table 3 for Question 8(c) in the Diagram Booklet. Measurements from a similar experiment are summarised in Table 3.

(i) From earlier observations Eratosthenes had calculated that the diameter of the Earth was around 14 000 km.

Analyse Eratosthenes' observations in order to determine a value for the diameter of the Moon.

Show each stage in your working clearly.
(3 marks)

Answer space continues on the next page.

8(c)(i) continued.

Diameter of the Moon = _____ km

(continued on the next page) Turn over

8(c) continued.

(ii) Calculate the percentage error in this value for the diameter of the Moon.
(2 marks)

Use information from the Formulae and Data Booklet.

Use the equation:

$$\text{Percentage error} = \frac{(\text{calculated diameter} - \text{true diameter})}{\text{true diameter}} \times 100\%$$

Answer space continues on the next page.

8(c)(ii) continued.

Percentage error =

$$\frac{\text{(calculated diameter – true diameter)}}{\text{true diameter}} \times 100\%$$

Percentage error = _____

(Total for Question 8 = 12 marks)

9 St. Helena is a small island in the South Atlantic Ocean.

St. Helena has a latitude of 16°S.

Look at Figure 14 for Question 9 in the Diagram Booklet. A view from St. Helena is shown.

(a) An astronomer tries to view some bright stars from a location on St. Helena.

(i) State TWO reasons why St. Helena is a good site for astronomical observation. (2 marks)

1 _____

_____

2 _____

_____

(continued on the next page)

9(a) continued.

(ii) The star Mintaka is located very near to the Celestial Equator.

Estimate the maximum altitude of the star Mintaka for an observer on St. Helena.
(1 mark)

Maximum altitude = _____ °

(continued on the next page)

9(a) continued.

(iii) The star Ahfa al Farkadain in the constellation of Ursa Minor has a declination of 77°48′

Show that an observer on St. Helena will never be able to see this star.

Look at the blank page for Question 9(a)(iii) in the Diagram Booklet. You may include a clearly labelled diagram in your answer.
(3 marks)

Answer space continues on the next page.

9(a)(iii) continued.

(continued on the next page)

9(a) continued.

(iv) State ONE difficulty of using naked-eye observations of stars to determine the latitude of St. Helena.
(1 mark)

(continued on the next page)

9 continued.

(b) A ship arrives at St. Helena exactly at local noon.

The chronometer carried on the ship was set to local time at Greenwich at the start of its voyage and now reads 12:22:45.

Calculate the longitude of St. Helena. (3 marks)

Longitude of St. Helena = _____

(continued on the next page) Turn over

9 continued.

(c) In 1761 a group of astronomers sailed to St. Helena. They made observations to test the lunar distance method for finding longitude.

Explain how the lunar distance method can be used to find an observer's longitude.

Look at the blank page for Question 9(c) in the Diagram Booklet. You may include a clearly labelled diagram in your answer.
(3 marks)

Answer space continues on the next page.

9(c) continued.

(Total for Question 9 = 13 marks)

10 For thousands of years, humans have observed objects in the night sky and used models to predict their positions.

(a) The earliest models of the solar system were geocentric.

This means that:
(1 mark)

☐ A the Earth was at the centre

☐ B the Sun was at the centre

☐ C the models used circular orbits

☐ D the models used elliptical orbits

(continued on the next page)

10 continued.

(b) The Greek astronomer Ptolemy recorded the use of a model that included epicycles.

Explain how the introduction of epicycles allowed astronomers to explain the retrograde motion of the planets.

Look at the blank page for Question 10(b) in the Diagram Booklet. You may include a clearly labelled diagram in your answer.
(4 marks)

Answer space continues on the next page.

10(b) continued.

(continued on the next page)

10 continued.

(c) The German astronomer Johannes Kepler proposed three laws.

These laws helped to predict the positions of objects in the solar system.

Look at Figure 15 for Question 10(c) in the Diagram Booklet. It shows an image of Comet Encke, near to its perihelion position on March 10th 2017.

The mean distance between Comet Encke and the Sun is 2·22AU.

(i) Show that Comet Encke has a sidereal period of about 3·3 years.

You are advised to show your working clearly.
(3 marks)

Answer space continues on the next page.

10(c)(i) continued.

(continued on the next page)

10(c) continued.

(ii) Estimate the first date when Comet Encke reached aphelion, after March 2017.
(2 marks)

Month: _____ Year: _____

(continued on the next page)

10(c) continued.

(iii) Estimate the month in 2023 when Comet Encke will reach its perihelion position.
(2 marks)

Month of perihelion = _____

(continued on the next page)

10(c) continued.

(iv) Comet Encke orbits the Sun at a mean distance of 2·22AU and has an orbital period of 3·3 years.

Calculate the orbital period of Comet Encke if it orbited a star with a mass three times that of the Sun, at a mean distance of 2·22AU. (2 marks)

Answer space continues on the next page.

10(c)(iv) continued.

Orbital period = _____

(Total for Question 10 = 14 marks)

TOTAL FOR PAPER = 100 MARKS

END OF PAPER