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

Total Marks

Astronomy
PAPER 1: Naked-eye Astronomy

Wednesday 12 June 2024 – Morning

Time: 1 hour 45 minutes

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

Surname						
Other names						
Centre Number						
Candidate Number						

V75500A

Pearson

YOU MUST HAVE

Formulae and Data Booklet (enclosed)
Calculator, ruler

YOU WILL BE GIVEN

Diagram 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.

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) Look at Figure 1 for Question 1(a) in the Diagram Booklet. It shows an image of the full Moon.

Three features have been labelled **X**, **Y** and **Z**.

(i) Feature **X** is a: (1 mark)

☐ A crater

☐ B mare

☐ C terra

☐ D volcano

(continued on the next page)

1(a) continued.

(ii) Feature Y is a:
(1 mark)

☐ A crater

☐ B mare

☐ C terra

☐ D volcano

(iii) Feature Z is a:
(1 mark)

☐ A crater

☐ B mare

☐ C terra

☐ D volcano

(continued on the next page)

1 continued.

(b) A student writes a description of how some astronomical objects appear when viewed with the naked eye.

Identify each object from its description.

(i) A moving, green curtain of light. (1 mark)

☐ A aurora

☐ B galaxy

☐ C meteor

☐ D supernova

(continued on the next page)

1(b) continued.

(ii) A bright star that suddenly appeared in the night sky and then faded after several weeks. (1 mark)

☐ A aurora

☐ B galaxy

☐ C meteor

☐ D supernova

(continued on the next page)

1(b) continued.

(iii) A bright streak of light moving across the sky in one second. (1 mark)

☐ A aurora

☐ B galaxy

☐ C meteor

☐ D supernova

(Total for Question 1 = 6 marks)

2 (a) Which term is used to describe:

(i) the Moon passing in front of Venus and blocking its light?
(1 mark)

☐ A apogee

☐ B elongation

☐ C occultation

☐ D transit

(ii) Venus passing in front of the Sun's disc?
(1 mark)

☐ A apogee

☐ B elongation

☐ C occultation

☐ D transit

(continued on the next page)

2(a) continued.

(iii) the angle between Venus and the Sun, measured from the Earth? (1 mark)

☐ A apogee

☐ B elongation

☐ C occultation

☐ D transit

(continued on the next page)

2 continued.

(b) Different naked-eye techniques can be used to help observe a faint star.

(i) In which naked-eye technique does the observer look at the faint star with their peripheral vision? (1 mark)

☐ A averted vision

☐ B dark adaptation

☐ C indirect sight

☐ D night vision

(continued on the next page)

2(b) continued.

(ii) In which naked-eye technique does the observer wait 20 minutes in dark conditions and avoid looking at any bright light? (1 mark)

☐ A averted vision

☐ B dark adaptation

☐ C indirect sight

☐ D night vision

(continued on the next page)

2(b) continued.

(iii) State ONE reason why a pinhole camera would NOT be suitable for observing a faint star.
(1 mark)

(Total for Question 2 = 6 marks)

3 (a) The Moon is an oblate spheroid and has a mean diameter of 3 475 km

What is the Moon's polar diameter? (1 mark)

☐ A 3 475 km

☐ B 6 950 km

☐ C greater than 3 475 km

☐ D less than 3 475 km

(continued on the next page)

3 continued.

(b) Which features on the Moon are caused by:

(i) impacts from space rocks?
(1 mark)

☐ A canyons

☐ B craters

☐ C maria

☐ D mountains

(continued on the next page)

3(b) continued.

(ii) large plains of magma that have turned solid?
(1 mark)

☐ A canyons

☐ B craters

☐ C maria

☐ D mountains

(continued on the next page)

3 continued.

(c) The Moon takes 27·3 days to orbit once around the Earth.

(i) What is this time period called? (1 mark)

☐ A calendar month

☐ B sidereal month

☐ C solar month

☐ D zodiacal month

(continued on the next page)

3(c) continued.

(ii) Calculate the angle through which the Moon appears to move in one hour against the background stars.
(1 mark)

Angle = _____ °

(continued on the next page)

3(c) continued.

(iii) State TWO reasons why it is difficult to observe the movement of the Moon against the background stars with the naked eye.
(2 marks)

1 _____

2 _____

(Total for Question 3 = 7 marks)

4 (a) The geocentric model is an early model of the universe.

Geocentric means:
(1 mark)

☐ A all planets orbit the Earth

☐ B all planets orbit the Sun

☐ C the Earth is flat

☐ D the Sun lies on the Celestial Equator

(continued on the next page)

4 continued.

(b) Look at Figure 2 for Question 4(b) in the Diagram Booklet. It shows part of a star chart.

Each month, the position of Mars was marked on the chart.

These positions show the path that Mars appeared to take in a six-month period against the background stars.

The apparent path of Mars is shown by a solid curve in Figure 2.

(i) State the Right Ascension and Declination of Mars on 12th May. Use information from Figure 2. (2 marks)

Right Ascension = _____ h _____min

Declination = _____°

(continued on the next page)

4(b) continued.

(ii) Name the dashed line on the star chart in Figure 2.
(1 mark)

(continued on the next page)

4(b) continued.

(iii) During these observations Mars appeared to move in a retrograde direction against the background stars.

State the number of months that Mars appeared to move in a retrograde direction against the background stars.

Use information from Figure 2.
(1 mark)

Number of months = _____

(continued on the next page)

4 continued.

(c) The astronomer Ptolemy proposed a geocentric model with the addition of epicycles.

Explain how these epicycles helped to account for the apparent retrograde motion of Mars.

Look at the blank page for Question 4(c) in the Diagram Booklet. Use the blank page for a clearly labelled diagram in your answer.
(3 marks)

Answer space continues on the next page.

4(c) continued.

(Total for Question 4 = 8 marks)

5 (a) Look at Table 1 for Question 5(a) in the Diagram Booklet. It shows part of a tide chart for a port in Scotland.

The levels of high and low tides are shown from 19th October to 31st October.

(i) Explain why there are two high tides each day.

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

Answer space continues on the next page.

5(a)(i) continued.

(continued on the next page)

5(a) continued.

(ii) Look again at Table 1 for Question 5(a) in the Diagram Booklet. Analyse the data in Table 1 in order to determine the date when the Moon's phase was either first or last quarter.
(2 marks)

(continued on the next page)

5 continued.

(b) The Greek astronomer Aristarchus used a total lunar eclipse to estimate the diameter of the Moon.

Look at Figure 3 for Question 5(b) in the Diagram Booklet. It shows the Moon passing through the Earth's shadow during a total lunar eclipse.

The Moon is shown at each of the four umbral contacts.

The time at which the Moon reaches each umbral contact is labelled.

Calculate an approximate value for the diameter of the Moon.

Use information from Figure 3 and the Formulae and Data Booklet.

Give your answer in km.
(3 marks)

Answer space continues on the next page.

5(b) continued.

Diameter of the Moon = _____km

(continued on the next page)

Turn over

5 continued.

(c) State TWO reasons why a total lunar eclipse appears to take longer than a total solar eclipse, when viewed from the Earth.
(2 marks)

1

2

(Total for Question 5 = 9 marks)

6 The following is an extract from an article about astronomy.

“It is thanks to the astronomical observations made by Tycho Brahe, that Johannes Kepler was able to discover the laws of planetary motion.”

(a) Explain why Tycho Brahe’s observations were so important in the development of Kepler’s three laws of planetary motion.
(2 marks)

(continued on the next page)

6 continued.

One of Kepler's laws of planetary motion can be stated as:

"The line between the Sun and a planet sweeps out equal areas in equal times."

(b) Explain how this statement can be used to describe how the orbital speed of a planet changes during its elliptical orbit.

Look at the blank page for Question 6(b) in the Diagram Booklet. Use the blank page for a clearly labelled diagram in your answer.

(3 marks)

Answer space continues on the next page.

6(b) continued.

(continued on the next page)

6 continued.

(c) Kepler's third law of planetary motion can be written as:

$$\frac{T^2}{r^3} = \text{constant}$$

Look at Table 2 for Question 6(c) in the Diagram Booklet. It shows the mean orbital radius and orbital period for some of the moons of Jupiter.

Calculate the orbital period of Ganymede.

Give your answer in days.

(3 marks)

Answer space continues on the next page.

6(c) continued.

Orbital period = _____ days

(continued on the next page)

6 continued.

(d) Moon X orbits Saturn with a mean orbital radius of 0·422 million km.

Explain why Moon X does not have an orbital period of 1·76 days.
(2 marks)

(Total for Question 6 = 10 marks)

7 (a) Look at Figure 4 for Question 7(a) in the Diagram Booklet. It shows a sketch of the asterism known as 'The Plough'.

(i) Draw on Figure 4 the position of the star Polaris.

Use the label **P**.
(1 mark)

(ii) Draw on Figure 4 the position of the star Arcturus.

Use the label **A**.
(1 mark)

(iii) State what is meant by the term 'asterism'.
(1 mark)

(continued on the next page)

7 continued.

(b) A GCSE Astronomy student in London wants to measure the seeing conditions when observing stars.

She decides to observe the star Polaris and counts the number of times the star appears to ‘twinkle’ in a period of time.

She repeats this on four different nights in March.

Look at Table 3 for Question 7(b) in the Diagram Booklet. It shows the student’s results.

The student concludes that the seeing conditions were worst on the night of 12th March.

(i) Analyse Table 3 in order to comment on the accuracy of her conclusion.
(2 marks)

Answer space continues on the next page.

7(b)(i) continued.

(continued on the next page)

7(b) continued.

(ii) Give TWO reasons why Polaris was a suitable star for her investigation. (2 marks)

1 _____

2 _____

(continued on the next page)

7 continued.

(c) Another GCSE Astronomy student wants to investigate the effect of skyglow (light pollution) on the number of stars that are visible in the night sky.

The student designed the following investigation:

1. point a long cardboard tube at the zenith
2. look through the tube and count the number of visible stars
3. lower the tube by approximately 10 degrees and repeat the observation
4. continue lowering the tube and counting the number of visible stars until the tube is pointing at the horizon
5. record the data and plot a graph of the tube's angle from the zenith (x-axis) against the number of observed stars (y-axis).

(continued on the next page)

7(c) continued.

Evaluate the suitability of this method for determining the effect of skyglow on the number of stars visible in the night sky.
(6 marks)

Answer space continues on the next 2 pages.

7(c) continued.

7(c) continued.

(Total for Question 7 = 13 marks)

8 A teacher wants to use a scale model of the Earth, Moon and Sun to demonstrate the scale of the Solar System.

(a) State why a scale model is needed to show the distances between the Earth, Moon and Sun.
(1 mark)

(continued on the next page)

8 continued.

(b) The teacher decides that the distance between the Earth and the Moon should be $10{\cdot}0\,\text{cm}$ in this scale model.

(i) Calculate the distance between the Earth and the Sun for this scale model.

Give your answer in m.

Give your answer to three significant figures.

Use information from the Formulae and Data Booklet.
(3 marks)

Answer space continues on the next page.

8(b)(i) continued.

Earth-Sun distance
in the scale model = _____ m

(continued on the next page)

8(b) continued.

(ii) Proxima Centauri is the nearest star system to the Sun.

It is 4·2 light years from the Sun.

Explain why the teacher's scale model would not be suitable for demonstrating the distance to Proxima Centauri.

Support your answer with a relevant calculation.
(2 marks)

Assume 1 light year (l.y.) = $9{\cdot}5 \times 10^{12}$ km

Answer space continues on the next 2 pages.

8(b)(ii) continued.

Assume 1 light year (l.y.) = $9{\cdot}5 \times 10^{12}$ km

8(b)(ii) continued.

(continued on the next page)

8 continued.

(c) The core of the Earth is approximately **54%** of the Earth's diameter.

Determine which planet has approximately the same diameter as the Earth's core.

Use information from the Formulae and Data Booklet.

Include all stages of your working. (2 marks)

Answer space continues on the next page.

8(c) continued.

Planet = _____

(continued on the next page)

8 continued.

(d) Two astronomers want to determine the Earth's diameter.

They decide to use two shadow sticks situated at different locations on the Earth.

Design an observational programme that would enable the two astronomers to determine the Earth's diameter using two shadow sticks.

Your observational programme should include:

- the readings that the astronomers should take
- how the astronomers will analyse their data to determine the Earth's diameter.

(6 marks)

Answer space continues on the next 3 pages.

8(d) continued.

8(d) continued.

8(d) continued.

(Total for Question 8 = 14 marks)

9 (a) Describe ONE similarity and ONE difference between the design of an equatorial sundial and a horizontal sundial.
(2 marks)

Similarity

Difference

(continued on the next page)

9 continued.

(b) Look at Figure 5 for Question 9(b) in the Diagram Booklet. It shows the annual variation of the Equation of Time.

(i) State the date nearest to the vernal equinox when the local Mean Solar Time is equal to the local Apparent Solar Time.
(1 mark)

(continued on the next page)

9(b) continued.

(ii) Explain why Figure 5 suggests that a sundial reading would differ greatly from local Mean Solar Time in November.
(2 marks)

(continued on the next page)

9 continued.

(c) A correctly aligned sundial is used to produce the following results.

Date = 15 December

Sundial reading = 14:00

Longitude of sundial = 2·5°E

Greenwich Mean Time (GMT) = 13:42

The accuracy of the sundial is defined as:

accuracy of sundial =
corrected sundial reading – GMT

Calculate the accuracy of the sundial.

Use information from Figure 5.

Give your answer to the nearest minute.
(4 marks)

Answer space continues on the next page.

9(c) continued.

Accuracy = _____ min

(continued on the next page) Turn over

9 continued.

(d) Two causes of the annual variation of the Equation of Time are the Earth's elliptical orbit around the Sun and the Earth's axial tilt to the ecliptic.

Look at Figure 6 for Question 9(d) in the Diagram Booklet. It shows how these two causes contribute to the annual variation of the Equation of Time.

(i) Analyse Figure 6 in order to explain why the Equation of Time can have a value of zero on some dates.
(2 marks)

Answer space continues on the next page.

9(d)(i) continued.

_____

_____

(continued on the next page)

9(d) continued.

(ii) Analyse Figure 6 in order to determine which of these two causes gives the greater contribution to the annual variation of the Equation of Time. (2 marks)

(Total for Question 9 = 13 marks)

10 An astronomer in the northern hemisphere observes and records the altitude of star **A** between 20:00 and 06:00

Look at Table 4 for Question 10 in the Diagram Booklet. It shows the altitude of star **A** above the astronomer's horizon between 20:00 and 06:00 during the observation.

The data in Table 4 are shown as a graph in Figure 7.

(a) Look at Figure 7 for Question 10 in the Diagram Booklet. Complete the graph in Figure 7 using the data in Table 4.

You should:

- add an appropriate scale on the vertical axis
- plot the remaining points
- draw a line of best fit.

(3 marks)

(continued on the next page)

10 continued.

(b) State the time at which star **A** culminated.
(1 mark)

Time = _____ : _____

(c) State the hour angle of star **A** at 02:00
(1 mark)

Hour Angle = _____ h _____min

(continued on the next page)

10 continued.

(d) In which direction was the astronomer looking at 03:00 to observe star **A**?

Use data from Figure 7.

(1 mark)

☐ A north-east

☐ B south-east

☐ C south-west

☐ D north-west

(continued on the next page)

10 continued.

(e) Explain why star A's altitude changed over the course of the observation. (2 marks)

(continued on the next page)

10 continued.

(f) Explain why star A is not circumpolar.

Use data from Figure 7.
(2 marks)

(continued on the next page)

10 continued.

(g) The astronomer was located at a latitude of 26°N

Calculate the declination of star A.
(2 marks)

Use the equation:

altitude of the star at culmination = observer's latitude + (90 − declination of the star)

Answer space continues on the next page.

10(g) continued.

Declination = _____ °

(continued on the next page)

10 continued.

(h) Star **B** has a declination that is 10 degrees further from the north celestial pole than star **A**.

Look again at the Figure 7 for Question 10 in the Diagram Booklet.
Sketch on Figure 7 a line or curve to show how the altitude of star **B** changes between 20:00 and 06:00
(2 marks)

(Total for Question 10 = 14 marks)

TOTAL FOR PAPER = 100 MARKS
END OF PAPER