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

Astronomy

PAPER 1: Naked-eye Astronomy

Total Marks

Time: 1 hour 45 minutes

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

Surname					
Other names					
Centre Number					
Candidate Number					

Pearson

YOU MUST HAVE

Calculator, ruler

YOU WILL BE GIVEN

Formulae and Data Booklet

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 Look at Figure 1 for Question 1(a) in the Diagram Booklet. It shows sketches of the brightest stars in four different constellations.

The sketches are labelled A, B, C and D.

(a) (i) Which ONE of the sketches in Figure 1 shows the brightest stars in Orion?
(1 mark)

- ☐ **A Sketch A**
- ☐ **B Sketch B**
- ☐ **C Sketch C**
- ☐ **D Sketch D**

(continued on the next page)

1 continued.

(ii) Which ONE of the sketches in Figure 1 shows the brightest stars in Cassiopeia?
(1 mark)

☐ A Sketch A

☐ B Sketch B

☐ C Sketch C

☐ D Sketch D

(iii) Which ONE of the sketches in Figure 1 shows the brightest stars in Cygnus?
(1 mark)

☐ A Sketch A

☐ B Sketch B

☐ C Sketch C

☐ D Sketch D

(continued on the next page)

1 continued.

(b) Pinhole projection can be used to observe the Sun safely.

(i) Describe the pinhole projection method.

You may include a clearly labelled diagram in your answer.
(2 marks)

(continued on the next page)

1 continued.

(ii) Describe the appearance of the Milky Way when observed with the naked eye from Earth. (1 mark)

(continued on the next page)

1 continued.

(iii) Give ONE reason why the pinhole projection method may NOT be suitable when observing the Milky Way.
(1 mark)

_____

_____

_____

(Total for Question 1 = 7 marks)

2 (a) Look at Figure 2 for Question 2(a) in the Diagram Booklet. It shows part of a cross-section of the Earth and its major internal divisions.

(i) Which ONE of the internal divisions in Figure 2 has the highest average temperature? (1 mark)

☐ A crust

☐ B inner core

☐ C mantle

☐ D outer core

(ii) Which ONE of the following lists all the internal divisions in Figure 2 that are entirely solid? (1 mark)

☐ A crust

☐ B crust and inner core

☐ C crust, mantle, inner core and outer core

☐ D inner core and outer core

(continued on the next page)

2 continued.

(iii) Which ONE of the following lists all the internal divisions in Figure 2 that are made of mainly iron and nickel?
(1 mark)

☐ A inner core

☐ B mantle and inner core

☐ C mantle, inner core and outer core

☐ D inner core and outer core

(iv) The Earth's inner core is thought to have a mean diameter of 2400 km.

Name the dwarf planet whose diameter is closest to that of the Earth's inner core.

Use information from the Formulae and Data Booklet.
(1 mark)

_____

_____

(continued on the next page)

2 continued.

(b) The Earth's shape can be described as an oblate spheroid.

Draw an 'oblate spheroid'.
(2 marks)

(continued on the next page)

2 continued.

(c) (i) Which ONE of the following is the line of latitude on which the Sun will NOT rise above the horizon on the 21 December?
(1 mark)

☐ A Antarctic Circle

☐ B Arctic Circle

☐ C Tropic of Cancer

☐ D Tropic of Capricorn

(ii) Which ONE of the following is the line of latitude on which the Sun is seen to pass directly overhead on the 21 December?
(1 mark)

☐ A Antarctic Circle

☐ B Arctic Circle

☐ C Tropic of Cancer

☐ D Tropic of Capricorn

(Total for Question 2 = 8 marks)

3 Look at Figure 3 for Question 3(a) in the Diagram Booklet. It shows the orbits of Venus, Earth and Mars around the Sun.

(a) (i) Label on Figure 3 the position of Mars when it is seen to be in opposition for an observer on Earth.

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

(ii) Label on Figure 3 the position of Venus when it is seen to be in superior conjunction for an observer on Earth.

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

(iii) Label on Figure 3 the TWO possible positions of Venus when it is seen to be at greatest elongation for an observer on Earth.

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

(continued on the next page)

3 continued.

(b) Name the TWO planets which CANNOT reach opposition for an observer on the Earth.
(2 marks)

1 _____

_____

2 _____

_____

(c) Name the planet that can be seen to transit in front of the Sun when observed from Venus.
(1 mark)

_____

_____

(continued on the next page)

3 continued.

(d) Calculate the MINIMUM possible distance between Venus and Mars.

Use information from the Formulae and Data Booklet.

Give your answer in astronomical units (AU).
(1 mark)

Minimum distance = _____ AU

(Total for Question 3 = 7 marks)

4 (a) (i) Explain why time zones are used on the Earth.
(2 marks)

(ii) The Earth's surface is divided into twenty-four time zones.

Show that each time zone is, on average, fifteen degrees of longitude wide.
(1 mark)

(continued on the next page)

4 continued.

(iii) An aircraft flies in a straight line from Mogadishu, which has a longitude of 45°E to Jakarta which has a longitude of 107°E.

It takes the shortest route possible.

Calculate the smallest number of time zones that the aircraft could pass through on this journey.
(2 marks)

Smallest number of time zones = _____

(continued on the next page)

4 continued.

(b) Look at Figure 4 for Question 4(b) in the Diagram Booklet. It shows a sundial located in the Earth's southern hemisphere.

It is correctly sited and aligned.

(i) Draw an arrow to show how the sundial can be used to determine the direction of north on Figure 4.
(1 mark)

(ii) Label Figure 4 to show how the sundial can be used to determine the latitude at which this sundial is being used.
(1 mark)

(iii) Ruhee uses a sundial to determine Greenwich Mean Time (GMT).

She records the following data:

Time on her sundial = 11 am

Equation of Time = –12 minutes

Longitude of the sundial = 8^{o} West

(continued on the next page)

4 continued.

Calculate the Greenwich Mean Time (GMT) at the time of her observations.
(2 marks)

GMT = _____ h:min

(Total for Question 4 = 9 marks)

5 **Look at Figure 5 for Question 5(a) in the Diagram Booklet. It is a diagram of the Moon's orbit around the Earth.**

Four positions in the Moon's orbit are labelled A, B, C and D.

Look at Table 1 for Question 5(a) in the Diagram Booklet. It shows details of three positions (A, B and C) in the Moon's orbit.

(a) (i) **Using Figure 5, complete Table 1 to determine the Moon's phase when seen from Earth and the time at which the Moon will cross the observer's meridian.**
(4 marks)

(continued on the next page)

5 continued.

(ii) Which ONE of the following positions of the Moon in Figure 5 will cause a neap tide to occur on Earth?
(1 mark)

☐ A position A only

☐ B position B only

☐ C position A and position B

☐ D position C and position D

(b) Look at Figure 6 for Question 5(b) in the Diagram Booklet. It shows the Earth when viewed from above the North Pole. The directions of the Moon and Sun are also shown.

Label on Figure 6 TWO positions on the Earth's equator where a low tide is most likely to occur.

Use the labels L1 and L2.
(2 marks)

(continued on the next page)

5 continued.

(c) Look at Figure 7 for Question 5(c) in the Diagram Booklet. The first picture in Figure 7 shows a sketch of the Moon's phase when observed from a latitude of 60° N.

On the same night, the Moon is also observed from the equator and from a latitude of 60° S.

Draw on Figure 7 how the Moon would appear on the same night when observed from the equator and from a latitude of 60° S.
(2 marks)

(Total for Question 5 = 9 marks)

6 (a) A model of the Universe which has the Earth at its centre is called:
(1 mark)

☐ A circumpolar

☐ B geocentric

☐ C heliocentric

☐ D synodic

(b) Look at Figure 8 for Question 6(b) in the Diagram Booklet. It shows a cross-section of the celestial sphere and an astronomer.

Point X on Figure 8 is located directly above the astronomer.

The astronomer measures the angle between the North celestial pole and X as 32^{o}.

(i) Name the bright star which is located very close to the North celestial pole.
(1 mark)

_____

_____

(continued on the next page)

6 continued.

(ii) Name the point **X** in Figure 8, which is located directly above the astronomer.
(1 mark)

_____

_____

(iii) A star located on the celestial equator is culminating.

Draw the position of this star on Figure 8.

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

(continued on the next page)

6 continued.

(iv) Calculate the altitude of the North celestial pole from this location.
(1 mark)

Altitude = _____°

(continued on the next page)

6 continued.

(v) State the astronomer's latitude.
(1 mark)

_____

_____

(vi) State the declination of point **X**.
(1 mark)

_____

_____

(c) Look at Figure 9 for Question 6(c) in the Diagram Booklet. It shows a cross-section of the celestial sphere and a second astronomer at a different location.

A circumpolar star is shown at its lower transit, crossing the astronomer's meridian.

The North celestial pole has an altitude of 68°.

The star has a declination of +70°.

(continued on the next page)

6 continued.

(i) Draw the position of the star during its upper transit on Figure 9.

Use the label U.
(1 mark)

(ii) Calculate the altitude of the star above the astronomer's northern horizon during its upper transit.
(2 marks)

Altitude = _____ °

(continued on the next page)

6 continued.

(d) An astronomer incorrectly describes an observation of 'the constellation of the Plough'.

State a correct version of the astronomer's statement.
(1 mark)

(Total for Question 6 = 11 marks)

7 (a) Light pollution can be a problem for astronomers.

(i) State ONE source of light pollution.
(1 mark)

(ii) State ONE effect that light pollution has on observations of objects in the night sky.
(1 mark)

(iii) Astronomers in ancient times did not have to overcome the problems associated with light pollution.

Give ONE reason for this.
(1 mark)

(continued on the next page)

7 continued.

(b) An astronomer makes observations of the night sky with the aid of a star chart.

He then decides to replace the star chart with a planisphere.

(i) Give TWO observational ADVANTAGES of using a planisphere instead of a star chart.
(2 marks)

1 _____

_____

_____

2 _____

_____

_____

(continued on the next page)

7 continued.

(ii) Give ONE observational DISADVANTAGE of using a planisphere instead of a star chart.
(1 mark)

_____

_____

_____

(continued on the next page)

7 continued.

(c) Look at Figure 10 for Question 7(c) in the Diagram Booklet.

An astronomy student observes five objects in the night sky.

She tries to use her observations to identify each object.

Her observational record is shown in Figure 10.

Evaluate the suitability of her suggested objects in Figure 10.

Where necessary, suggest alternative objects that could fit her observations.
(6 marks)

(continued on the next page)

7 continued.

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7 continued.

(Total for Question 7 = 12 marks)

8 Look at Figure 11 for Question 8(a) in the Diagram Booklet. It shows a simplified sketch made by an astronomer observing the apparent path taken by a star during the night.

The position of the star is shown when the astronomer's local mean time was 01:30.

(a) (i) State the right ascension of the star.
(1 mark)

Right ascension = _____ hours

(ii) Draw the position of the star two hours earlier on Figure 11.

Use the label S.
(1 mark)

(iii) State the number of hours that the star spends above the astronomer's horizon during this night's observation.
(1 mark)

_____

_____

(continued on the next page)

8 continued.

(iv) Which ONE of the following is the astronomer's local mean time when the star was culminating?
(1 mark)

☐ A 02:00

☐ B 02:30

☐ C 03:00

☐ D 03:30

(v) Which ONE of the following is the star's hour angle at 01:30 local mean time?
(1 mark)

☐ A 01:00

☐ B 03:00

☐ C 04:00

☐ D 23:00

(continued on the next page)

8 continued.

(vi) Which ONE of the following is the local sidereal time at 01:30 local mean time? (1 mark)

☐ A 01:00

☐ B 03:00

☐ C 04:00

☐ D 23:00

(continued on the next page)

8 continued.

(b) The apparent motion of the Sun can be used to help find positions on the surface of the Earth.

Alice and Bob make observations of sunrise times and day lengths from two different locations.

Alice makes her observations from London.

Bob makes his observations from another European city.

Look at Table 2 for Question 8(b) in the Diagram Booklet. It shows their results.

(i) Analyse Table 2 in order to determine the location of Bob.

Include in your answer whether he is:

- north or south of London
- east or west of London.

(3 marks)

_____

_____

(continued on the next page)

8 continued.

(continued on the next page)

8 continued.

(ii) Suggest a practical problem with using the apparent motion of the Sun to determine your latitude.
(2 marks)

(Total for Question 8 = 11 marks)

9 The following is an extract from an astronomy newsletter.

‘A “blue moon” is the name given to the second of two full moons which have occurred in the same calendar month. A blue moon occurred on the 31st January 2018.

A total lunar eclipse also occurred on this date. This lunar eclipse would have looked especially impressive because it was a “supermoon” as the Moon was near its perigee on 31st January 2018.’

(a) (i) Determine the date in January 2018 on which the first full moon of the month occurred. (1 mark)

_____

_____

(continued on the next page)

9 continued.

(ii) Explain why a supermoon can look more impressive than other full moons.
(2 marks)

(continued on the next page)

9 continued.

(iii) Analyse this extract in order to determine the orbital positions of the Earth, Moon and Sun at the time of the blue moon.

You may include a clearly labelled diagram in your answer.
(3 marks)

(continued on the next page)

9 continued.

(continued on the next page)

9 continued.

(b) An astronomer sketched the Moon from the same location on two dates.

One date was near the summer solstice and the other was near the winter solstice.

He noted that the Moon had the same phase on both dates.

Look at Figure 12 for Question 9(b) in the Diagram Booklet. It shows the astronomer's sketches.

Explain the Moon's differing appearance when observed on these two dates.

You may include a clearly labelled diagram in your answer.
(2 marks)

(continued on the next page)

9 continued.

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9 continued.

(c) Patrick wants to observe the following three features on the surface of the Moon:

- Sea of Tranquility
- the crater Tycho
- Apennine mountain range.

Look at Figure 13 for Question 9(c) in the Diagram Booklet. It shows a lunar phase calendar for the month in which Patrick is planning to observe.

Design an observational programme that will allow Patrick to make the best possible observations of each of his three chosen features.

Use information from Figure 13.

(continued on the next page)

9 continued.

Your observational programme should include:

- **possible days of the month when each of his three chosen features will be best placed for observation**

- **reasons why you selected each of these days of the month.**

(6 marks)

(continued on the next page)

9 continued.

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9 continued.

(Total for Question 9 = 14 marks)

10 Uranus has twenty-seven known moons.

Look at Table 3 for Question 10 in the Diagram Booklet. It shows data for some of these moons.

(a) (i) Look at Figure 14 for Question 10(a)(i) in the Diagram Booklet.

Using the data in Table 3, plot a graph on Figure 14 of T^2 on the vertical axis against r^3 on the horizontal axis for the moons that are shown.

Draw a line of best fit for your data points. (3 marks)

(continued on the next page)

10 continued.

(ii) Another moon of Uranus has a mean orbital radius of $1{\cdot}6 \times 10^5$ km.

Calculate the orbital period of this moon.

Use the graph in Figure 14.

Give your answer in days.
(3 marks)

Orbital period = _____ days

(continued on the next page)

10 continued.

(b) Astronomers can use Kepler's Third Law to calculate the orbital period of moons around planets in the Solar System.

Kepler's Third Law can be written in the form:

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

(i) State how this constant can be determined from the graph drawn in Figure 14.
(1 mark)

_____

_____

_____

(continued on the next page)

10 continued.

(ii) For the moons of Uranus, this constant is equal to $0{\cdot}91 \times 10^{-15}$ day^2/km^3.

However, this constant CANNOT be used to calculate the orbital periods of the moons orbiting Saturn.

Explain this statement.
(2 marks)

(continued on the next page)

10 continued.

(iii) An astronomer wishes to calculate the constant used in Kepler's Third Law for the planet Saturn.

Show that the ratio of the mass of Saturn to the mass of Uranus is approximately 6·3.

Use information from the Formulae and Data Booklet.
(1 mark)

_____

_____

(continued on the next page)

10 continued.

(iv) Calculate the constant used in Kepler's Third Law for Saturn.

Use the constant for the moons of Uranus, equal to $0{\cdot}91 \times 10^{-15}$ day^2/km^3.

Use the ratio of the mass of Saturn to the mass of Uranus which is equal to 6·3.

Give your answer in $\times 10^{-15}$ $days^2/km^3$.
(2 marks)

Constant for Saturn =

_____ $\times 10^{-15}$ $days^2/km^3$

(Total for Question 10 = 12 marks)

TOTAL FOR PAPER = 100 MARKS
END OF PAPER