Paper Reference(s) 1AS0/02
Pearson Edexcel Level 1/Level 2 GCSE (9–1)

Astronomy

Paper 2: Telescopic 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

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.

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 student used a telescope to make sketches of some astronomical objects.

(a) Identify each of the following objects from the student's sketches.

(i) Look at the sketch for Question 1(a)(i) in the Diagram Booklet. It shows a bright patch of light with a tail, visible in the sky for several weeks.
(1 mark)

☐ **A asteroid**

☐ **B comet**

☐ **C galaxy**

☐ **D planet**

(continued on the next page)

1 continued.

(ii) Look at the sketch for Question 1(a)(ii) in the Diagram Booklet. It shows a spiral-shaped fuzzy patch of light.
(1 mark)

☐ A asteroid

☐ B comet

☐ C galaxy

☐ D planet

(continued on the next page)

1 continued.

(b) Identify each of the following astronomical objects from its description and photograph.

(i) Look at Figure 1 for Question 1(b)(i) in the Diagram Booklet. It shows the thin layers of gas stretching outwards from the Sun, only visible during a total solar eclipse.
(1 mark)

☐ A aurora

☐ B corona

☐ C nebula

☐ D photosphere

(continued on the next page)

1 continued.

(ii) Look at Figure 2 for Question 1(b)(ii) in the Diagram Booklet. It shows the glowing 'curtain' of coloured light in the night sky. (1 mark)

☐ A aurora

☐ B corona

☐ C nebula

☐ D photosphere

(iii) Look at Figure 3 for Question 1(b)(iii) in the Diagram Booklet. It shows a sphere of expanding gas surrounding a star. (1 mark)

☐ A aurora

☐ B corona

☐ C nebula

☐ D photosphere

(continued on the next page)

1 continued.

(c) Draw the appearance of the planet Saturn, when viewed through a telescope with an aperture of 25 cm.
(2 marks)

(Total for Question 1 = 7 marks)

2 (a) (i) **Which ONE of the following types of star is most likely to be the youngest?**
(1 mark)

- ☐ A main sequence
- ☐ B neutron star
- ☐ C red giant
- ☐ D white dwarf

(ii) **Which ONE of the following types of star is the smallest in size?**
(1 mark)

- ☐ A main sequence
- ☐ B neutron star
- ☐ C red giant
- ☐ D white dwarf

(continued on the next page)

2 continued.

(b) (i) Which ONE of the following are Small Solar System Objects (SSSO)?
(1 mark)

☐ A asteroids

☐ B dwarf planets

☐ C exoplanets

☐ D moons

(continued on the next page)

2 continued.

(ii) The orbit of an object in the Solar System is observed for several months.

The orbit is found to be at an angle of 60° to the ecliptic.

The object is most likely to be:
(1 mark)

☐ A a comet

☐ B a planet

☐ C the Moon

☐ D the Sun

(continued on the next page)

2 continued.

(c) A star's position on the Hertzsprung–Russell Diagram is determined by its:
(1 mark)

☐ A absolute magnitude and spectral class

☐ B apparent magnitude and size

☐ C colour and temperature

☐ D temperature and spectral class

(d) Edwin Hubble's observations of distant galaxies showed that the Universe:
(1 mark)

☐ A began with a Big Bang

☐ B is contracting

☐ C is expanding

☐ D will end with a Big Crunch

(continued on the next page)

2 continued.

(e) The Search for Extra-Terrestrial Intelligence (SETI) detects:
(1 mark)

☐ **A gamma rays**

☐ **B infrared radiation**

☐ **C radio waves**

☐ **D X-rays**

(Total for Question 2 = 7 marks)

3 Before 1609 most astronomers assumed that the Sun and the planets orbited the Earth.

(a) A theory where the Sun and the planets orbit the Earth is called:
(1 mark)

☐ A elliptical

☐ B geocentric

☐ C heliocentric

☐ D terrestrial

(continued on the next page)

3 continued.

(b) In 1609 Galileo Galilei made observations of the night sky using a small telescope. His observations were evidence that the Sun and the planets did NOT orbit the Earth.

(i) Look at Figure 4 for Question 3(b)(i) in the Diagram Booklet. Galileo made drawings of four moons orbiting the planet Jupiter, as shown in Figure 4.

Explain how Galileo used the drawings in Figure 4 as evidence that the Sun and planets did NOT orbit the Earth.
(2 marks)

(continued on the next page)

3 continued.

(ii) Look at Figure 5 for Question 3(b)(ii) in the Diagram Booklet. Galileo made drawings of the changing appearance of the planet Venus, as shown in Figure 5.

Explain how Galileo used the drawings in Figure 5 as evidence that the Sun and planets did NOT orbit the Earth.
(2 marks)

(continued on the next page)

3 continued.

(iii) Look at Figure 6 for Question 3(b)(iii) in the Diagram Booklet. Galileo made drawings of the appearance of the Moon's disc, as shown in Figure 6.

Explain how Galileo used the drawing in Figure 6 as evidence that the Sun and planets did NOT orbit the Earth.
(2 marks)

(continued on the next page)

3 continued.

(c) Four hundred years after Galileo, twenty-first century astronomers use telescopes to produce much higher quality images of Jupiter, Venus and the Moon.

Look at Table 1 for Question 3(c) in the Diagram Booklet. It shows some information about these telescopes.

Analyse the data in Table 1 in order to explain how the images from twenty-first century telescopes are better than those obtained by Galileo in 1609. (2 marks)

(Total for Question 3 = 9 marks)

4 (a) Astronomers have identified a number of planets orbiting a nearby star.

This star is very similar to our Sun.

Look at Table 2 for Question 4(a) in the Diagram Booklet. It shows some information about these planets.

Identify, using the information in Table 2, which planet is:

(i) most likely to support life.
(1 mark)

☐ A Planet A

☐ B Planet B

☐ C Planet C

☐ D Planet D

(continued on the next page)

4 continued.

(ii) most similar to Jupiter.
(1 mark)

☐ A Planet A

☐ B Planet B

☐ C Planet C

☐ D Planet D

(iii) orbiting the star in the shortest time.
(1 mark)

☐ A Planet A

☐ B Planet B

☐ C Planet C

☐ D Planet D

(continued on the next page)

4 continued.

(iv) orbiting the star with a period of 18·5 years. (1 mark)

☐ A Planet A

☐ B Planet B

☐ C Planet C

☐ D Planet D

(continued on the next page)

4 continued.

(b) One method for finding planets orbiting other stars is to take very careful measurements of the star's brightness as the planet transits the star.

Look at Figure 7 for Question 4(b) in the Diagram Booklet. It shows a set of measurements taken in this way.

(i) Explain the shape of the graph in Figure 7.

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

(continued on the next page)

4 continued.

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_____

(ii) The planet is known to be travelling at 140 000 km per hour in its orbit.

Evaluate the information in Figure 7 in order to estimate the diameter of the planet.
(3 marks)

Diameter of planet = _____

(continued on the next page)

4 continued.

(c) Describe a DIFFERENT method that astronomers use to find planets orbiting other stars.

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

(Total for Question 4 = 11 marks)

5 (a) Look at Figure 8 for Question 5(a) in the Diagram Booklet. It shows the first picture ever taken of the far side of the Moon.

It was taken by the Luna 3 probe in 1959.

(i) The Luna 3 probe was an example of:
(1 mark)

☐ A a fly-by probe

☐ B an impactor

☐ C a lander

☐ D an orbiter

(ii) Which ONE of the following statements about the far side of the Moon is correct?
(1 mark)

☐ A it has more craters than the near side

☐ B it has more mare than the near side

☐ C it has no craters

☐ D it is colder than the near side

(continued on the next page)

5 continued.

(b) In 1969 the Apollo 11 mission allowed astronauts to visit the surface of the Moon.

The rocket launching the mission from Earth was over two thousand times more powerful than the one launching it from the Moon.

(i) Explain why the launch from the Earth required a much more powerful rocket than the launch from the Moon.
(2 marks)

_____

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_____

(continued on the next page)

5 continued.

_____

_____

Look at Figure 9 for Question 5(b) in the Diagram Booklet. It shows the Earth and the Moon, with the Apollo 11 launch and landing sites labelled.

(ii) Explain why the Apollo 11 mission did not travel in a straight line between its launch and landing sites.
(1 mark)

_____

_____

_____

(iii) Draw the path taken by the Apollo 11 mission on Figure 9.
(3 marks)

(continued on the next page)

5 continued.

(c) The Apollo missions provided astronomers with new information about the Moon.

State TWO pieces of new information about the Moon provided by the Apollo missions.
(2 marks)

1 _____

_____

2 _____

_____

(Total for Question 5 = 10 marks)

6 (a) Look at Figure 10 for Question 6(a) in the Diagram Booklet. It shows an image of the planet Jupiter.

Jupiter is 1300 times larger than the Earth.

Its mass is only 318 times as much as the Earth's.

Explain why Jupiter does NOT have a mass 1300 times as much as the Earth's.
(2 marks)

(continued on the next page)

6 continued.

(b) Europa is one of the moons of Jupiter.

Look at Figure 11 for Question 6(b) in the Diagram Booklet. It is an image of Europa orbiting Jupiter, taken by the Voyager 1 probe.

(i) Explain the cause of the dark circle labelled 'X' in Figure 11.
(2 marks)

(continued on the next page)

6 continued.

(ii) Jupiter's Great Red Spot is also labelled in Figure 11.

The Great Red Spot is a large, reddish-coloured spot, first observed in 1878.

State TWO OTHER physical properties of the Great Red Spot.
(2 marks)

1 _____

_____

2 _____

_____

(iii) Explain why the Great Red Spot was NOT observed until 1878.
(2 marks)

_____

_____

_____

(continued on the next page)

6 continued.

(c) **Some astronomers have suggested that, since the formation of the Solar System, Jupiter has changed its position amongst the other planets.**

Give TWO pieces of evidence for this suggestion. (2 marks)

1

2

(Total for Question 6 = 10 marks)

7 (a) A student makes a scale model of the Solar System.

He places the models of the Earth and the Sun 1 cm apart.

(i) Calculate the distance from the model of the Sun to the point where the model of Neptune should be placed.

Use information from the Formulae and Data Booklet.

Give your answer in cm.
(1 mark)

Distance from model of Sun =

_____ cm

(continued on the next page)

7 continued.

(ii) The most distant objects in the Oort Cloud are thought to orbit approximately 0·8 l.y. from the Sun.

Calculate the distance from the model of the Sun to the point where the model of an Oort Cloud object should be placed.

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

Distance from model of Sun =

_____

(continued on the next page)

7 continued.

(b) In 1772 the German astronomer Johann Bode noticed a similarity between the radii of the orbits of the planets in the Solar System and a simple sequence of numbers.

He started with this sequence of numbers (which are doubling each time):

0 3 6 12 24 48 96

192 384 …

He then added four to each number and divided the result by ten to give:

0·4 0·7 1·0 1·6 2·8 5·2

10 19·6 38·8 …

He noticed that these numbers were very similar to the radii of the orbits of the planets when measured in AU.

(continued on the next page)

7 continued.

Look at Table 3 for Question 7(b) in the Diagram Booklet. The data for this comparison are summarised in Table 3.

(i) Complete Table 3 by filling in the missing NAME and NUMBERS.

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

(ii) It has been suggested that Bode's number pattern matches the actual radii of the orbits of the planets.

Evaluate this statement using the data in Table 3.
(6 marks)

_____

_____

_____

_____

(continued on the next page)

7 continued.

(Total for Question 7 = 12 marks)

8 **Look at Figure 12 for Question 8 in the Diagram Booklet. It is an X-ray image of the night sky. The image was taken using the eROSITA X-ray telescope, on board a satellite orbiting the Earth.**

Light areas indicate bright X-ray sources and darker areas indicate weaker X-ray sources.

(a) Explain why the image in Figure 12 needed to be taken from a satellite.
(2 marks)

(continued on the next page)

8 continued.

(b) The very bright X-ray source called Cygnus X-1 is labelled in Figure 12.

Cygnus X-1 is believed to be a binary star system containing a black hole.

(i) State the physical property of a black hole that makes it impossible for it to emit X-rays.
(1 mark)

_____

_____

(continued on the next page)

8 continued.

(ii) Explain how the Cygnus X-1 system is such a bright emitter of X-rays.

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

(continued on the next page)

8 continued.

(c) (i) State the part of the Milky Way galaxy that is most likely to be the brightest X-ray source.
(1 mark)

(ii) Explain your answer to (c)(i).
(2 marks)

(continued on the next page)

8 continued.

(d) Cygnus X-1 and the Milky Way galaxy are sources of X-rays.

State TWO OTHER astronomical sources of X-rays.
(2 marks)

1 _____

_____

2 _____

_____

(Total for Question 8 = 11 marks)

9 A student used observations of sunspots to measure the length of the Solar Cycle.

She used a reflecting telescope with a solar filter.

Look at Figure 13 for Question 9(a) in the Diagram Booklet. She used a mobile phone camera to record the view through the eyepiece, as shown in Figure 13.

Look at Table 4 for Question 9(a) in the Diagram Booklet. Details of her telescope are shown in Table 4.

(a) Analyse the information in Figure 13 and Table 4 in order to comment on the suitability of her observing equipment.
(3 marks)

(continued on the next page)

9 continued.

_____

_____

(continued on the next page)

9 continued.

Look at Table 5 for Question 9(b) in the Diagram Booklet. Her observations are summarised in Table 5.

(b) Evaluate ways to improve her observations in order to obtain a more accurate estimate of the length of the Solar Cycle.
(6 marks)

(continued on the next page)

9 continued.

(continued on the next page)

9 continued.

(c) While completing her observations, she noticed that groups of sunspots change their appearance.

Describe how a group of sunspots changes its appearance over a period of one month.
(2 marks)

(Total for Question 9 = 11 marks)

10 (a) The Sun has an apparent magnitude of approximately −27

The bright star Canopus has an apparent magnitude of approximately −1

The Sun appears approximately 20 billion times brighter than Canopus.

(i) Explain why the apparent magnitude of the Sun is only 27 times that of Canopus, even though it appears 20 billion times brighter. (2 marks)

(continued on the next page)

10 continued.

(ii) Show that the Sun has an absolute magnitude of approximately +4·5

Assume that the Sun has an apparent magnitude of −27

Use information from the Formulae and Data Booklet

Use the equation:

$$M = m + 5 - 5 \log d$$

(4 marks)

(continued on the next page)

10 continued.

(iii) **Explain why the Sun's apparent magnitude is so much brighter than its absolute magnitude. (2 marks)**

(continued on the next page)

10 continued.

(b) Stars A and B appear to be the same brightness for an observer on the Earth.

Star A is three magnitudes brighter than Star B.

(i) State which one of these two stars is further from the Earth.
(1 mark)

_____

_____

(continued on the next page)

10 continued.

(ii) Star A is 60 pc from the Earth.

Calculate the distance of Star B from the Earth.

Give your answer in parsecs (pc).
(3 marks)

Distance of Star B = _____ pc

(Total for Question 10 = 12 marks)

TOTAL FOR PAPER = 100 MARKS
END OF PAPER