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

Astronomy

Paper 2: Telescopic Astronomy

Total Marks

Monday 8 June 2020 – Afternoon

Time: 1 hour 45 minutes plus your additional time allowance

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 – 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.

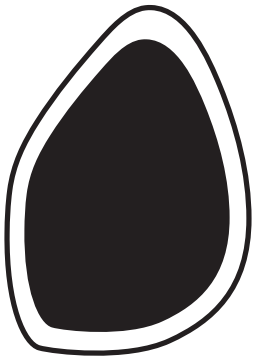
Answer ALL questions. Write your answers in the spaces provided.

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 small telescope to make some sketches of astronomical objects.

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

(i) A dark patch on the surface of the Sun, with a darker centre. (1 mark)



☐ A solar cycle

☐ B solar flare

☐ C solar wind

☐ D sunspot

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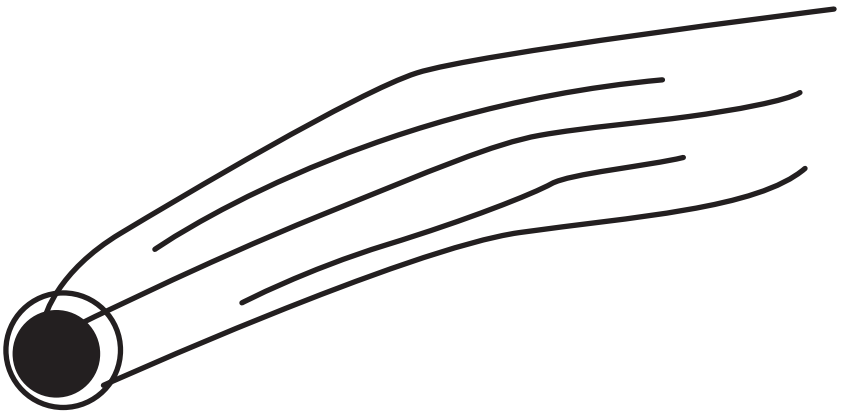
1 continued.

(ii) A fuzzy patch of light with a tail, visible in the sky for several weeks. (1 mark)



☐ A asteroid

☐ B comet

☐ C meteor

☐ D planet

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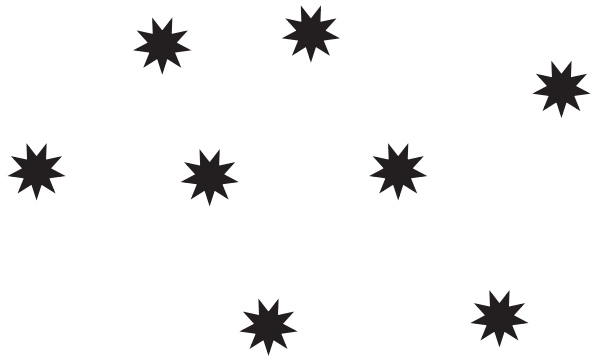
1 continued.

(iii) A small group of several bright stars. (1 mark)



☐ A binary star

☐ B constellation

☐ C globular cluster

☐ D open cluster

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1 continued.

(b) A student writes a description of how some astronomical objects appear when viewed through a small telescope.

Identify each object from its description.

(i) ‘A planet with bright rings around it.’ (1 mark)

☐ A Mars

☐ B Mercury

☐ C Neptune

☐ D Saturn

(ii) ‘A star with a fuzzy ring of material around it.’ (1 mark)

☐ A black hole

☐ B double star

☐ C globular cluster

☐ D planetary nebula

(continued on the next page)

1 continued.

(c) Sketch the appearance of a crater on the Moon, when viewed through a pair of binoculars.
(1 mark)

(TOTAL FOR QUESTION 1 = 6 MARKS)

2 (a) Identify each of the following planets from the description provided.

(i) The smallest planet in the Solar System. (1 mark)

☐ A Jupiter

☐ B Mercury

☐ C Uranus

☐ D Venus

(ii) The planet with the highest average surface temperature. (1 mark)

☐ A Jupiter

☐ B Mercury

☐ C Uranus

☐ D Venus

(continued on the next page)

2 continued.

(iii) The first planet to be discovered with a telescope. (1 mark)

☐ A Jupiter

☐ B Mercury

☐ C Uranus

☐ D Venus

(iv) The first planet to have some of its satellites discovered with a telescope. (1 mark)

☐ A Jupiter

☐ B Mercury

☐ C Uranus

☐ D Venus

(continued on the next page)

2 continued.

(b) The list below shows four series of stages in the life of a star.

(i) Which is the correct series for a star with a mass similar to the Sun's? (1 mark)

☐ A main sequence – neutron star – red giant

☐ B main sequence – red giant – supernova

☐ C main sequence – red giant – white dwarf

☐ D main sequence – white dwarf – black hole

(ii) Which is the correct series for a star with a mass twenty times that of the Sun? (1 mark)

☐ A main sequence – neutron star – red giant

☐ B main sequence – red giant – supernova

☐ C main sequence – red giant – white dwarf

☐ D main sequence – white dwarf – black hole

(TOTAL FOR QUESTION 2 = 6 MARKS)

3 Look at Figure 1 for Question 3(a) and 3(b) in the Diagram Booklet. It shows a telescope.

(a) This telescope is a: (1 mark)

☐ A Cassegrain reflector

☐ B Galilean refractor

☐ C Keplerian refractor

☐ D Newtonian reflector

(continued on the next page)

3 continued.

(b) Identify each of the following parts of the telescope.

(i) The part labelled X in Figure 1 is the: (1 mark)

☐ A eyepiece lens

☐ B finder scope

☐ C objective mirror

☐ D secondary mirror

(ii) The part labelled Y in Figure 1 is the: (1 mark)

☐ A eyepiece lens

☐ B finder scope

☐ C objective mirror

☐ D secondary mirror

(continued on the next page)

3 continued.

(c) Owen wishes to use this telescope to observe the planet Jupiter.

Look at Figure 2 for Question 3(c) in the Diagram Booklet. He wants to obtain a view similar to the one shown.

The telescope in Figure 1 has an aperture of 25 cm and a focal length of 200 cm.

Explain WHY Owen has chosen to use:

(i) a telescope with an aperture of 25 cm
(2 marks)

(continued on the next page)

3 continued.

(ii) a telescope with a focal length of 200 cm
(2 marks)

(continued on the next page)

3 continued.

(iii) Owen has a range of eyepieces available for the telescope in Figure 1.

Suggest a suitable focal length for the eyepiece in order to obtain the view in Figure 2 and give a reason for your answer. (2 marks)

Focal length = _____ mm

_____

_____

_____

(TOTAL FOR QUESTION 3 = 9 MARKS)

4 **In 1609 the astronomer Galileo Galilei made drawings of the planet Venus, using a small telescope. Look at Figure 3 for Question 4(a) in the Diagram Booklet. These drawings are shown.**

The drawings show how Venus appears to change its appearance, for an observer on the Earth.

(a) The drawings in Figure 3 help to prove that Venus cannot be orbiting the Earth.
Explain how they do this.

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

(continued on the next page)

4 continued.

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4 continued.

(b) Ancient Babylonian descriptions of Venus from around 4000 BCE sometimes refer to it as having 'horns'.

It has been suggested that this may mean that some ancient Babylonian astronomers were able to see the changing shape of Venus.

Look at Figure 4 for Question 4(b) in the Diagram Booklet. It contains some data about the visibility of the planet Venus.

Evaluate the suggestion that ancient astronomers were able to observe the changing shape of Venus.

Use the data in Figure 4. (3 marks)

(continued on the next page)

4 continued.

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4 continued.

(c) Look at Figure 5 for Question 4(c) in the Diagram Booklet. It shows the transit of Venus that took place in June 2004.

Observing a transit of Venus involves looking at the Sun's disc.

Explain how the photograph in Figure 5 could have been taken SAFELY.

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

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4 continued.

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4 continued.

(d) Alice and Bob decide to observe a transit of Venus.

Look at Figure 6 for Question 4(d) in the Diagram Booklet. Alice (A) observes from the North Pole and Bob (B) observes from the South Pole, as shown.

By comparing their measurements of the transit, they find that the distance between the Earth and the Sun is 12 000 times the diameter of the Earth.

(i) Calculate the distance between the Earth and the Sun.

Use the results of Alice and Bob's observations.

Use data from the Formulae and Data Booklet.

Give your answer in kilometres. (2 marks)

Distance = _____ km

(continued on the next page)

4 continued.

(ii) In 1761 observations of a transit of Venus were also used to measure the distance between the Earth and the Sun.

One observer was in Newfoundland (Latitude = 60° N) and the other was at the Cape of Good Hope (Latitude = 34° S).

Alice and Bob's observations give a more accurate value for the distance between the Earth and the Sun than the observations made in 1761.

Explain why Alice and Bob's observations give a more accurate result. (2 marks)

(continued on the next page)

4 continued.

(TOTAL FOR QUESTION 4 = 11 MARKS)

5 In 1929 Edwin Hubble discovered that the light from many galaxies is red-shifted.

(a) (i) Light that has been red-shifted will appear to have a: (1 mark)

☐ A greater brightness

☐ B higher frequency

☐ C higher speed

☐ D longer wavelength

(ii) This red-shift was explained by the theory 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)

5 continued.

(b) Look at Figure 7 for Question 5(b) in the Diagram Booklet. It shows the Hooker '100-inch' telescope at the Mount Wilson Observatory in the United States, which Edwin Hubble used to make this discovery.

Look at Figure 8 for Question 5(b) in the Diagram Booklet. It shows some information about this telescope.

Explain why astronomers using earlier telescopes were not able to discover the red-shift of light from other galaxies.

Use the data in Figure 8. (3 marks)

(continued on the next page)

5 continued.

(c) **Later observations found some galaxies whose light is blue-shifted.**

These included the Andromeda and Triangulum galaxies.

Explain why the light from these galaxies is blue-shifted. (2 marks)

(continued on the next page)

5 continued.

(d) Look at Figure 9 for Question 5(d) in the Diagram Booklet. It shows, the Mount Wilson Observatory was built near the top of an isolated mountain.

Since the observatory was built, the city of Los Angeles has expanded.

It is now quite close to the observatory.

State TWO ways in which light pollution from Los Angeles could affect the images from the optical telescopes at the Mount Wilson Observatory. (2 marks)

1 _____

_____

_____

2 _____

_____

_____

(TOTAL FOR QUESTION 5 = 9 MARKS)

6 Look at Figure 10 for Question 6(a) and 6(b) in the Diagram Booklet. It shows the Lovell radio telescope at the Jodrell Bank Observatory.

It has a large metal dish with a diameter of 76 m.

(a) State the reason why the dish in a radio telescope must be made from metal. (1 mark)

(b) Explain why the dish in this radio telescope needs to have a much larger diameter than the mirrors in the largest optical telescopes. (3 marks)

(continued on the next page)

6 continued.

(c) Look at Figure 11 for Question 6(c) in the Diagram Booklet. It shows two of the radio dishes at the Mullard Radio Astronomy Observatory near Cambridge.

This telescope has three dishes, spread out over 1600 m.

Each dish has a diameter of 18 m.

(i) Explain why this radio telescope is made up of several smaller dishes, rather than a single large dish. (3 marks)

(continued on the next page)

6 continued.

(continued on the next page)

6 continued.

(ii) State TWO ways that the resolution of this telescope could be increased. (2 marks)

1 _____

_____

_____

2 _____

_____

_____

(TOTAL FOR QUESTION 6 = 9 MARKS)

7 (a) Identify each of the following stages in the life of a star from the description provided.

(i) Where the inward pull of gravity is balanced by outward radiation pressure. (1 mark)

☐ A black hole

☐ B main sequence star

☐ C neutron star

☐ D white dwarf star

(ii) Where the inward pull of gravity is balanced by outward electron pressure. (1 mark)

☐ A black hole

☐ B main sequence star

☐ C neutron star

☐ D white dwarf star

(continued on the next page)

7 continued.

(iii) Where the inward pull of gravity is balanced by outward neutron pressure. (1 mark)

☐ A black hole

☐ B main sequence star

☐ C neutron star

☐ D white dwarf star

(continued on the next page)

7 continued.

(b) An astronomer wishes to identify a white dwarf star from a group of five stars.

Look at Figure 12 for Question 7(b) in the Diagram Booklet. It gives some information about these five stars.

Evaluate which of these five stars is most likely to be a white dwarf star. (6 marks)

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7 continued.

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7 continued.

(c) An astronomer wishes to find the distance to the star Procyon B, a nearby white dwarf star.

One method for measuring the distance of nearby stars is called 'heliocentric parallax'.

This method involves observing a nearby star against the background of more distant stars.

Look at Figure 13 for Question 7(c) in the Diagram Booklet. It shows the Sun and a nearby star.

(i) Complete Figure 13 to show the parallax angle of the nearby star, for an observer on the Earth.

Label the angle 'P'. (2 marks)

(ii) The astronomer measures the parallax angle of the star Procyon B to be 0·25″.

Calculate the distance of Procyon B in light years. (3 marks)

(continued on the next page)

7 continued.

Distance = _____ l.y.

(TOTAL FOR QUESTION 7 = 14 MARKS)

8 Look at Figure 14 for Question 8(a) in the Diagram Booklet. A galaxy is a group of billions of stars, as shown.

Each star is orbiting the core of the galaxy.

Two groups of astronomers investigate the connection between the speed of a star and its distance from the centre of the galaxy.

The first group suggests that stars near the edge of the galaxy should be travelling much more slowly than those near the core.

Their suggestion is shown by the curve labelled '**Theory**' in Figure 15.

(a) Explain this suggestion, using the idea of gravity. (2 marks)

(continued on the next page)

8 continued.

(b) A second group of astronomers measures the speed of some stars at different distances from the core of the galaxy.

They use 21 cm radio waves for these observations.

(i) Explain why they used 21 cm radio waves for these observations. (2 marks)

(continued on the next page)

8 continued.

Their results are shown by the curve labelled **'Observation'** in Figure 15.

(ii) Describe the connection between **Speed of star** and **Distance from core** shown by the **'Observation'** curve in Figure 15. (2 marks)

(continued on the next page)

8 continued.

(c) Analyse the data in Figure 15 to explain the difference between the 'Theory' and 'Observation' curves. (4 marks)

(continued on the next page)

8 continued.

(d) An astronomer is studying a spectral line with a wavelength of 400·0 nm.

He uses observations of the spectra from two galaxies, A and B.

Look at Figure 16 for Question 8(d) in the Diagram Booklet. His measurements are shown.

When viewed from Earth, galaxies A and B are directly opposite each other in the sky.

Calculate the wavelength that this spectral line will appear to have in the spectrum of galaxy B, when observed by an astronomer in galaxy A. (3 marks)

(continued on the next page)

8 continued.

Wavelength = _____ nm

(TOTAL FOR QUESTION 8 = 13 MARKS)

9 Wahida used a small pair of binoculars to estimate the magnitudes of some of the brightest stars in the constellation of Orion.
Look at Figure 17 for Question 9 in the Diagram Booklet. The view from her observing location is shown.

Look at Figure 18 for Question 9 in the Diagram Booklet. Her observations are recorded.

(a) Analyse the information in Figures 17 and 18 in order to comment on Wahida's observational method. (3 marks)

(continued on the next page)

9 continued.

(b) Evaluate ways to improve Wahida's observations in order to obtain more accurate estimates of the stars' magnitudes. (6 marks)

(continued on the next page)

9 continued.

(continued on the next page)

9 continued.

(c) Wahida discovers that the constellation of Orion contains an emission nebula.

Describe what is meant by an emission nebula.
(2 marks)

(TOTAL FOR QUESTION 9 = 11 MARKS)

10 (a) In the seventeenth century, the Dutch astronomer Christiaan Huygens made observations to compare the brightness of the star Sirius with the brightness of the Sun.

(i) State TWO practical difficulties in carrying out this comparison. (2 marks)

1 _____

_____

_____

2 _____

_____

_____

(continued on the next page)

10 continued.

(ii) Huygens estimated that the Sun is approximately 400 million times brighter than the star Sirius.

He concluded that Sirius must therefore be 20 000 times further away from the Earth than the Sun.

Explain how he came to this conclusion.
(2 marks)

(continued on the next page)

10 continued.

(iii) State ONE assumption that Huygens made about the Sun and the star Sirius. (1 mark)

_____

_____

_____

(continued on the next page)

10 continued.

(iv) Calculate the distance from the Earth to the star Sirius.

Use Huygen's estimate that Sirius is 20 000 times further from the Earth than the Sun.

Use information from the Formulae and Data Booklet.

Give your answer in kilometres (km).
(2 marks)

Distance = _____ km

(continued on the next page)

10 continued.

(b) The star Sirius has an absolute magnitude of 1·42.

(i) Explain the DIFFERENCE between absolute magnitude and apparent magnitude.

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

(continued on the next page)

10 continued.

(ii) The star Sirius is actually 2·64 pc from the Earth.

Calculate its apparent magnitude. (3 marks)

Use the equation:

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

Apparent magnitude = _____

(TOTAL FOR QUESTION 10 = 12 MARKS)

TOTAL FOR PAPER = 100 MARKS

END