

Please check the examination details below before entering your candidate information

Candidate surname					
Other names					
Centre Number					
Candidate Number					

Pearson Edexcel

Level 1/Level 2 GCSE (9-1)

Monday 10 June 2019

Afternoon (Time: 1 hour 45 minutes plus your additional time allowance)

Paper Reference 1AS0/02

Astronomy

Paper 2: Telescopic Astronomy

YOU MUST HAVE: Formulae and Data Sheet (enclosed) Calculator, ruler Diagram Booklet (enclosed)	Total Marks
---	--------------------

INSTRUCTIONS

- **Use BLACK ink, ball-point pen or your usual method.**
- **FILL IN THE BOXES** at the top of the previous page with your name, centre number and candidate number.
- **Answer ALL questions.**
- **Answer the questions in the spaces provided.**
– there may be more space than you need.
- **Calculators may be used.**
- **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.**

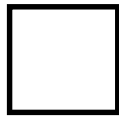
ANSWER ALL QUESTIONS.

WRITE YOUR ANSWERS IN THE SPACES PROVIDED.

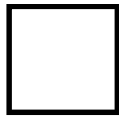
**SOME QUESTIONS MUST BE ANSWERED WITH A
CROSS IN A BOX ☐ .**

**IF YOU CHANGE YOUR MIND ABOUT AN ANSWER,
PUT A LINE THROUGH THE BOX ☒ AND THEN
MARK YOUR NEW ANSWER WITH A CROSS ☐ .**

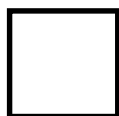
- 1 A student used binoculars to make some sketches of objects in the night sky.**
- (a) Identify each of the objects from the student's sketches shown in the diagram booklet.**
- (i) A circular shape on the surface of the Moon with rays around it. (1 mark)**



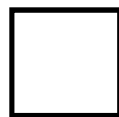
A crater



B mare



C rille



D ring

1 (a)(ii)

Four small points of light in a line, close to the planet Jupiter. (1 mark)

☐

A comets

☐

B galaxies

☐

C meteors

☐

D moons

1 (a)(iii)

A sphere of very densely packed stars. (1 mark)

☐

A comet

☐

B double star system

☐

C globular cluster

☐

D planetary nebula

- 1 (b) A student writes a description of some objects in the night sky when viewed through a small telescope.**

Identify each object from its description.

- (i) A long curved structure on the surface of the Moon. (1 mark)**

☐

A crater

☐

B mare

☐

C rille

☐

D ring

1 (b)(ii)

A very bright flashing light, which crossed the field of view in a few seconds. (1 mark)

☐

A aeroplane

☐

B comet

☐

C meteor

☐

D planet

1 (b)(iii)

A group of millions of stars, arranged in a spiral pattern. (1 mark)

☐

A aurora

☐

B cluster

☐

C galaxy

☐

D supernova

- 1 (c) Sketch the appearance of a sunspot as seen through a powerful telescope on the diagram in the diagram booklet. (2 marks)**

(TOTAL FOR QUESTION 1 = 8 MARKS)

2 (a) Which of the following is NOT a possible theory for the origin of the Moon? (1 mark)

☐

A capture

☐

B co-accretion

☐

C geocentric

☐

D Giant Impact

2 (b) Figure 1 in the diagram booklet shows the internal divisions of the Moon.

(i) What is the name of Region X? (1 mark)

☐

A crust

☐

B inner core

☐

C mantle

☐

D outer core

2 (b)(ii)

What is the name of Region Y? (1 mark)

☐

A crust

☐

B inner core

☐

C mantle

☐

D outer core

- 2 (c) Only one side of the Moon is ever visible from Earth.**

Explain how astronomers have observed the other side of the Moon. (2 marks)

2 (d) State TWO differences between the appearance of the Moon's near side and far side. (2 marks)

1 _____

2 _____

(TOTAL FOR QUESTION 2 = 7 MARKS)

- 3 (a)** Figure 2 in the diagram booklet shows the Sun's interior.

State the name of the internal divisions labelled W, X, Y and Z. (2 marks)

W _____

X _____

Y _____

Z _____

- 3 (b)** Which of the following is a correct list of the Sun's features, in order from hottest to coldest?
(1 mark)

☐

A chromosphere, photosphere, corona, sunspot

☐

B corona, chromosphere, photosphere, sunspot

☐

C corona, photosphere, chromosphere, sunspot

☐

D photosphere, corona, sunspot, chromosphere

3 (c) Which of the following is located furthest from the Sun's surface? (1 mark)

☐

A chromosphere

☐

B corona

☐

C heliosphere

☐

D penumbra

3 (d) Which of the following summarises the proton-proton cycle? (1 mark)

☐

A 1 hydrogen nucleus produces 1 helium nucleus

☐

B 1 hydrogen nucleus produces 4 helium nuclei

☐

C 4 hydrogen nuclei produce 4 helium nuclei

☐

D 4 hydrogen nuclei produce 1 helium nucleus

- 3 (e) Describe a safe method of observing the Sun when using a telescope.**

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

- 3 (f) Calculate the ratio of the Sun's mean diameter to Jupiter's mean diameter.**

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

☐

A 0.98

☐

B 9.8

☐

C 98

☐

D 980

(TOTAL FOR QUESTION 3 = 8 MARKS)

- 4 (a) A group of astronomers wish to take high resolution images of Mars.**

Figure 3 in the diagram booklet compares three types of space probe that could be used for this mission.

- (i) Analyse the data in Figure 3 in order to explain which is the most suitable space probe for this mission. (2 marks)**

4 (a)(ii)

Calculate the minimum distance between Earth and Mars.

Give your answer in km.

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

distance = _____ km

4 (a)(iii)

The distance travelled by the orbiter space probe is much larger than the fly-by space probe.

State TWO reasons for this difference.

Complete the diagram in the diagram booklet to illustrate your reasons. (2 marks)

1

2

4 (b)(i)

The closest distance between Venus and the Earth is less than the closest distance between the Earth and Mars.

State TWO reasons why there are no future plans to send a manned mission to Venus. (2 marks)

1 _____

2 _____

(ii) State a reason why Venus is sometimes referred to as Earth's 'twin' planet. (1 mark)

(TOTAL FOR QUESTION 4 = 9 MARKS)

turn over >

5 Figure 4 in the diagram booklet shows a simplified Hertzsprung-Russell diagram.

(a) Complete the labels on the horizontal axis by filling in the missing spectral types. (1 mark)

(b) Label Figure 4 with the positions of:

(i) the Sun. Use the label S. (1 mark)

(ii) a blue giant star. Use the label BG. (1 mark)

(iii) a supergiant star. Use the label SG. (1 mark)

(c) Label Figure 4 with the positions of a star that has its gravitational collapse balanced by:

(i) radiation pressure. Use the label RP. (1 mark)

(ii) electron pressure. Use the label EP. (1 mark)

- 5 (d) State why neutron stars are NOT plotted on the Hertzsprung-Russell diagram. (1 mark)

- 5 (e) By studying the mass of the Sun astronomers predict that it will eventually become a planetary nebula.**

Explain this prediction. (2 marks)

(TOTAL FOR QUESTION 5 = 9 MARKS)

- 6 (a) There is observational evidence for both the Big Bang theory and the Steady State theory.**

Complete Figure 5 in the diagram booklet.

Use a tick (✓) to indicate that the observational evidence supports the theory or a cross (x) to indicate that it proves the theory wrong.

(3 marks)

6 (b) Figure 6 in the diagram booklet illustrates two possible evolutionary paths of the Universe.

Label Figure 6 with the positions of:

- (i) the Big Bang. Use the label B. (1 mark)**
- (ii) the Big Crunch. Use the label C. (1 mark)**

(c) The existence of Dark Energy has been proposed.

Complete Figure 6 to show the future evolutionary path of the universe due to Dark Energy. (2 marks)

- 6 (d) The Andromeda galaxy is approximately 0.78 Mpc from Earth.**

Calculate the time in years it takes for the light from this galaxy to reach Earth.

Use the Formulae and Data Sheet. (2 marks)

time taken = _____ years

(TOTAL FOR QUESTION 6 = 9 MARKS)

7 Study Figure 7 and 8 in the diagram booklet.

Astronomers think liquid water is a requirement for lifeforms to exist.

Liquid water is below the surface of Enceladus.

It may also be under the surface of Europa, a moon of Jupiter.

(a) Name the planet that Enceladus orbits. (1 mark)

- 7 (b) Astronomers are proposing to send a space probe to one of these moons to search for the evidence of lifeforms.**

Compare the advantages and disadvantages of sending a lander rather than an orbiter. (3 marks)

- 7 (c) The energy requirements for sending a space probe to Europa or Enceladus are much greater than those required to orbit the Earth.

State a reason for this. (1 mark)

7 (d) Comets are made of water ice. Figure 9 in the diagram booklet gives some data about the two moons Enceladus and Europa and the nucleus of the comet 67P.

(i) It is possible for water to exist as a liquid below the surface of Enceladus and Europa.

Analyse the data in Figure 9 in order to explain this statement. (2 marks)

7 (d)(ii)

Liquid water is not thought to exist in the nucleus of the comet 67P.

Analyse the data in Figure 9 in order to explain this statement. (2 marks)

(e) Name the equation used to estimate the number of civilisations in our galaxy. (1 mark)

7 (f) Figure 10 in the diagram booklet shows Phoebe, one of the moons of Saturn.

It has a much smaller mass than Europa.

Explain why Europa is spherical but Phoebe has an irregular shape. (2 marks)

(TOTAL FOR QUESTION 7 = 12 MARKS)

- 8 Figure 11 in the diagram booklet shows a sketch of a binary star system made by an astronomer using a small telescope.**

The two stars in the binary system are just resolved and labelled A and B.

- (a)(i) Define the term ‘binary star system’. (1 mark)**

- (ii) Define the term ‘field of view’ of a telescope. (1 mark)**

8 (a)(iii)

The angular separation of stars A and B is 2 seconds of arc (2").

Estimate the field of view of this telescope.

Take suitable measurements from Figure 11 and give your answer in minutes of arc. (3 marks)

field of view = _____ minutes of arc

8 (a)(iv)

Figure 12 shows some data about this telescope.

FIGURE 12

Diameter of objective (cm)	20
Focal length of objective (m)	1.50
Magnification	50 ×

Calculate the focal length of the eyepiece that produces this magnification.

Give your answer in mm. (2 marks)

focal length = _____ mm

turn over >

8 (b) The stars A and B are observed with a naked-eye.

Describe TWO ways in which their appearance differs from that shown in Figure 11. (2 marks)

1

2

8 (c) Another method of observing these stars is with a radio telescope.

(i) Explain why radio telescopes need very large apertures to maintain a useful resolution.

(2 marks)

(ii) State another method that radio astronomers use to improve resolution. (1 mark)

(TOTAL FOR QUESTION 8 = 12 MARKS)

turn over >

- 9 An astronomer wants to compare the stellar densities inside and outside the plane of the Milky Way.**

She takes two photographs shown in the diagram booklet.

Details of her images are shown in Figure 13 in the diagram booklet.

- (a)(i) State the type of object that could have caused the faint dotted line that is visible in photograph A. (1 mark)**

9 (a)(ii)

Analyse the information in Figure 13 to determine a value for the ratio of the number of stars in photograph A to the number of stars in photograph B. (2 marks)

ratio = _____

9 (a)(iii)

Evaluate ways of improving the accuracy of these measurements based on the observational procedures that were used. (6 marks)

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

9 (b)(i)

Describe the observational evidence that the Milky Way galaxy is classified as spiral rather than elliptical. (2 marks)

(ii) State how astronomers determined the structure of the Milky Way galaxy. (1 mark)

(TOTAL FOR QUESTION 9 = 12 MARKS)

turn over >

- 10 (a)** Figure 14 in the diagram booklet shows the light curve of a Cepheid variable star.
- (i)** Determine the period of the Cepheid variable star in Figure 14. (1 mark)

Period = _____ days

Figure 15 in the diagram booklet shows the period-luminosity relationship for Cepheid variables.

- (ii)** Determine the absolute magnitude of the Cepheid variable star in Figure 14. (1 mark)

10 (a)(iii)

The Cepheid variable star shown in Figure 14 has an average apparent magnitude of +1.0.

Calculate the distance to this star in parsecs.

(3 marks)

distance = _____pc

10 (b)(i)

Name ONE OTHER method that astronomers use to measure stellar distances. (1 mark)

(ii) Describe this method. (2 marks)

- 10 (c) Delta Cephei, a star that can be seen with the naked-eye, is a Cepheid variable star in the circumpolar constellation of Cepheus.**

Design an observational procedure to determine the distance to this star.

Your design should include the following:

- the observations that should be made**
 - how you could process and analyse these observations to find the distance to the star.**
- (6 marks)**

TOTAL FOR PAPER = 100 MARKS