Write your name here

Surname	Other names

Pearson Edexcel GCSE

Centre Number	Candidate Number

Astronomy

Unit 1: Understanding the Universe

Wednesday 6 June 2018 – Morning
Time: 2 hours

Paper Reference
5AS01/01

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this 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.*

Information

- The total mark for this paper is 120.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care on these questions with your spelling, punctuation and grammar, as well as the clarity of expression.*

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.

Turn over ▶

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Pearson

Answer ALL questions.

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 Figure 1 shows a group of seven bright stars that is often visible in the night sky.

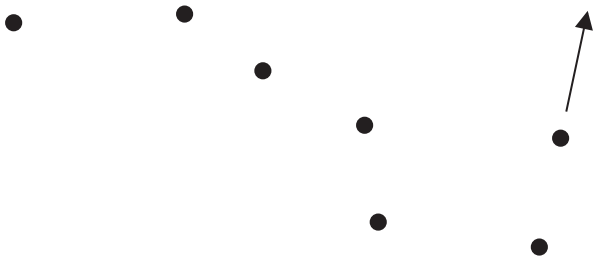


Figure 1

(a) This group of stars is known as:

(1)

☒ **A** Orion's Belt

☒ **B** The Plough

☒ **C** The Seven Sisters

☒ **D** The Summer Triangle

(b) Which constellation contains this group of stars?

(1)

☒ **A** Cassiopeia

☒ **B** Cygnus

☒ **C** Orion

☒ **D** Ursa Major

(c) The arrow in Figure 1 points towards a star called:

(1)

☒ **A** Aldebaran

☒ **B** Arcturus

☒ **C** Polaris

☒ **D** Sirius

(Total for Question 1 = 3 marks)

2 Identify each of the following astronomical objects from its description.

(a) A bright streak of light across the sky, lasting about one second.

(1)

☒ **A** aurora

☒ **B** meteor

☒ **C** nebula

☒ **D** variable star

(b) A dark shadow spreading across the face of the full Moon, eventually turning the whole disc a coppery-red colour.

(1)

☒ **A** lunar eclipse

☒ **B** partial eclipse

☒ **C** solar eclipse

☒ **D** transit

(c) A moving curtain of coloured light in the sky.

(1)

☒ **A** aurora

☒ **B** meteor

☒ **C** nebula

☒ **D** variable star

(d) A star that clearly appears to be two points of light close together, when viewed with the naked eye.

(1)

☒ **A** binary star

☒ **B** circumpolar star

☒ **C** double star

☒ **D** variable star

(e) A point of light that moves across the sky in a few minutes, disappearing before it reaches the horizon.

(1)

☒ **A** asteroid

☒ **B** planet

☒ **C** satellite

☒ **D** variable star

(Total for Question 2 = 5 marks)

3 Which of the following planets in the Solar System:

(a) is the smallest?

(1)

☒ **A** Jupiter

☒ **B** Mercury

☒ **C** Saturn

☒ **D** Venus

(b) has the largest moon?

(1)

☒ **A** Jupiter

☒ **B** Mercury

☒ **C** Saturn

☒ **D** Venus

(c) has no atmosphere?

(1)

☒ **A** Jupiter

☒ **B** Mercury

☒ **C** Saturn

☒ **D** Venus

(d) has the highest average surface temperature?

(1)

☒ **A** Jupiter

☒ **B** Mercury

☒ **C** Saturn

☒ **D** Venus

(Total for Question 3 = 4 marks)

4 Figure 2 shows the relative positions of the Sun (**S**), Moon (**M**) and Earth (**E**) during a full Moon.

Not to scale

Figure 2

In the diagrams below, draw the position of the Moon (**M**) during each of the following events.

The Sun (**S**) and the Earth (**E**) have already been drawn for you.

(a) new Moon

(1)

(b) lunar eclipse

(1)

(c) first or last quarter Moon

(1)

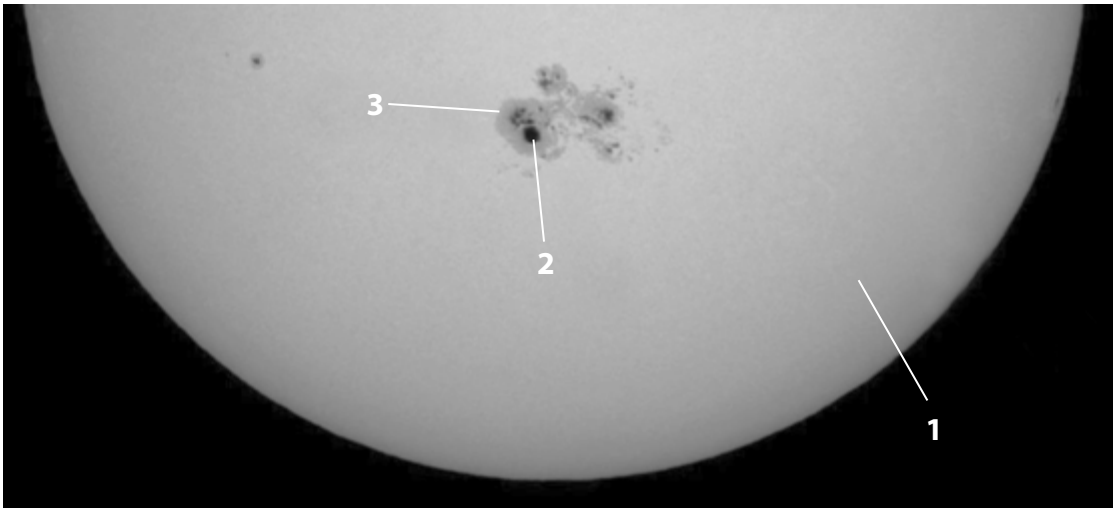
(d) crescent Moon

(1)

(Total for Question 4 = 4 marks)

5 Figure 3 shows the Sun, with a number of sunspots visible.

Identify each of the labelled features **1**, **2** and **3**.



Source © NASA

Figure 3

(a) The bright circular disc of the Sun (**1**).

(1)

☒ **A** Chromosphere

☒ **B** Corona

☒ **C** Magnetosphere

☒ **D** Photosphere

(b) The dark central area of a sunspot (**2**).

(1)

☒ **A** Filament

☒ **B** Flare

☒ **C** Penumbra

☒ **D** Umbra

(c) The grey outer area of a sunspot (**3**).

(1)

☒ **A** Filament

☒ **B** Flare

☒ **C** Penumbra

☒ **D** Umbra

(Total for Question 5 = 3 marks)

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6 Figure 4 shows a photograph of the full Moon.
The photograph was taken from a location close to the Earth's equator.

Source © NASA

Figure 4

(a) Label the position of each of the following features by writing the appropriate letter clearly in the correct place on Figure 4.

(i) The crater Tycho – use the letter **T**

(1)

(ii) The Sea of Crises – use the letter **C**

(1)

(iii) The Ocean of Storms – use the letter **S**

(1)

(iv) The Apennine Mountains – use the letter **A**

(1)

(b) Each of the following diagrams shows a cross-section through a feature on the surface of the Moon (not to scale).

Choose the word that correctly identifies each feature.

(i)

(1)

- ☒ **A** Crater
- ☒ **B** Mare
- ☒ **C** Rille
- ☒ **D** Terra

(ii)

(1)

- ☒ **A** Crater
- ☒ **B** Mare
- ☒ **C** Rille
- ☒ **D** Terra

(iii)

(1)

- ☒ **A** Crater
- ☒ **B** Mare
- ☒ **C** Rille
- ☒ **D** Terra

(Total for Question 6 = 7 marks)

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7 Identify each of the following astronomical objects from its description.

(a) (i) A white dwarf star surrounded by a shell of material that is expanding at great speed.

(1)

- ☒ **A** emission nebula
- ☒ **B** globular cluster
- ☒ **C** planetary nebula
- ☒ **D** supernova remnant

(ii) A cloud of hydrogen gas collapsing under its own gravity.

(1)

- ☒ **A** emission nebula
- ☒ **B** globular cluster
- ☒ **C** planetary nebula
- ☒ **D** supernova remnant

(iii) An area where new stars are starting to form.

(1)

- ☒ **A** emission nebula
- ☒ **B** globular cluster
- ☒ **C** planetary nebula
- ☒ **D** supernova remnant

(b) (i) A star that has collapsed until it is only about 20 km in diameter.

(1)

- ☒ **A** Cepheid variable star
- ☒ **B** main sequence star
- ☒ **C** neutron star
- ☒ **D** red giant star

(ii) A star that has just started to run out of hydrogen 'fuel'.

(1)

- ☒ **A** Cepheid variable star
- ☒ **B** main sequence star
- ☒ **C** neutron star
- ☒ **D** red giant star

(iii) A star whose radiation is received on Earth as rapid pulses of radio waves.

(1)

- ☒ **A** Cepheid variable star
- ☒ **B** main sequence star
- ☒ **C** neutron star
- ☒ **D** red giant star

(Total for Question 7 = 6 marks)

8 Table 1 contains information about some of the bright stars in the constellation of Sagittarius.

Star	Right Ascension (h:min)	Declination (°)
Kaus Australis	18:24	–34° 23′
Nunki	18:55	–26° 18′
Ascella	19:02	–29° 53′
Kaus Media	18:21	–29° 50′
Kaus Borealis	18:28	–25° 25′
Al Baldah	19:10	–21° 01′
Alnasl	18:06	–30° 25′

Table 1

Figure 5 shows part of a star map, in the area of the constellation Sagittarius. The positions of three stars in this constellation have already been plotted, using data from Table 1.

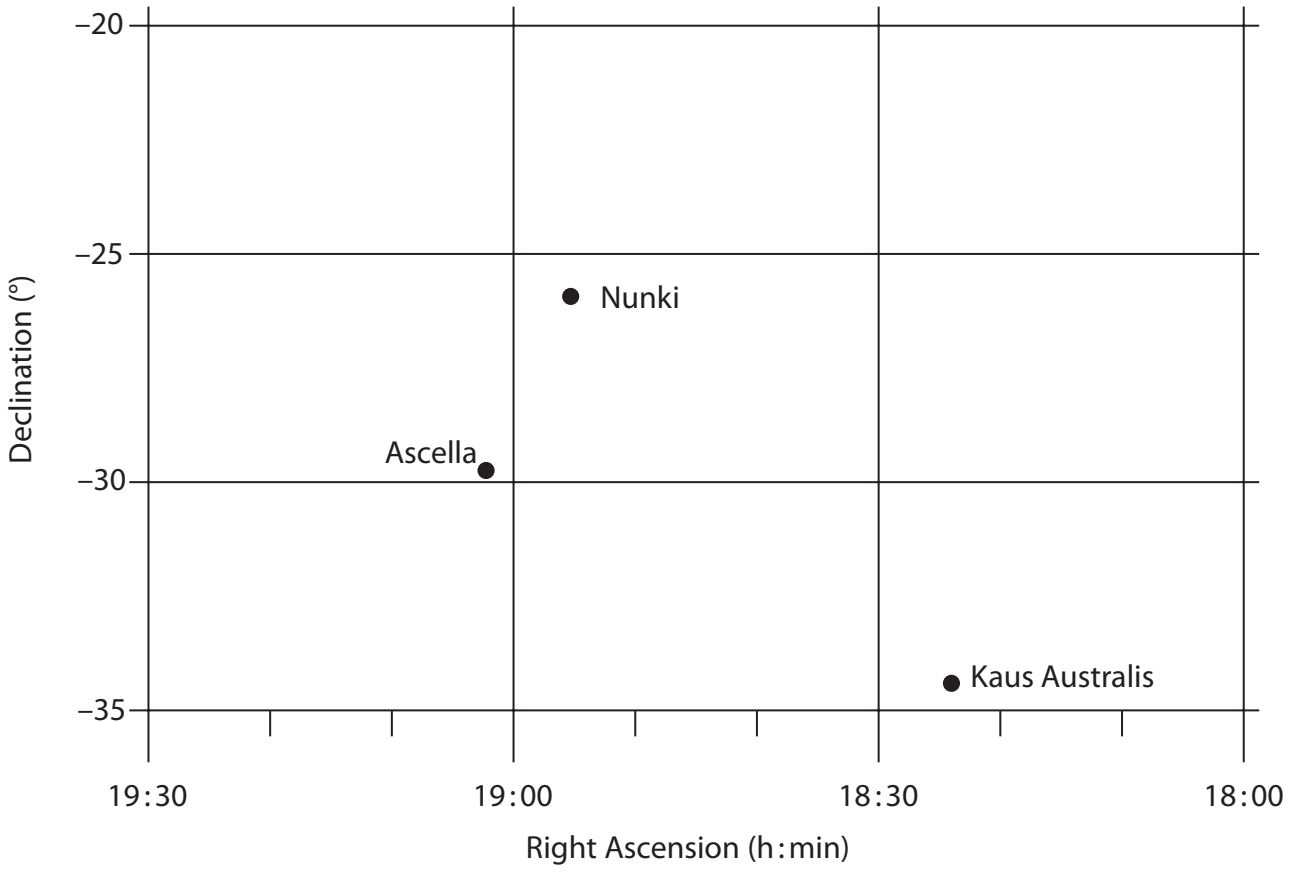

Figure 5

(a) Plot the positions of the four remaining stars in the constellation of Sagittarius on the star map shown in Figure 5.

Use the data in Table 1.

(3)

(b) Explain why Sagittarius is called a **zodiacal** constellation.

Use the data from Table 1.

(2)

(c) (i) State the best month to observe the constellation of Sagittarius in the night sky.

(1)

(ii) Explain your answer.

(2)

(Total for Question 8 = 8 marks)

9 Helen took the star trail photograph, shown in Figure 6, from her back garden.

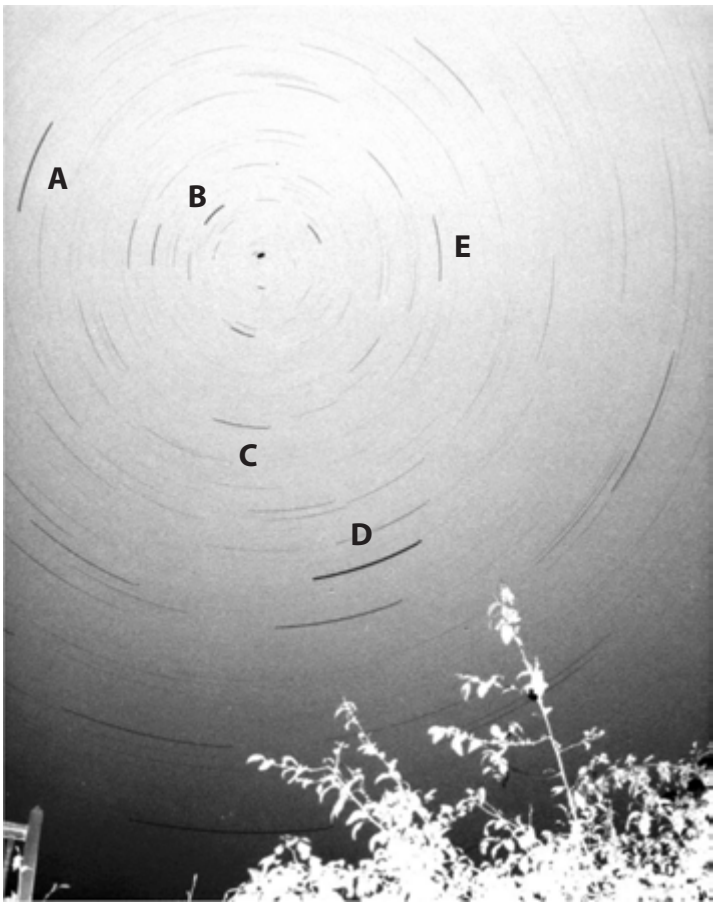

Figure 6

She measured the angle that several of the clearest star trails made around the Pole Star and recorded her results in Table 2 below.

Star trail	Angle (°)
A	22
B	28
C	25
D	22
E	27

Table 2

(a) The exposure time for the photograph in Figure 6 was 1 hour and 40 minutes.

Calculate a value for the Earth's rotation period.
Use the information given in Table 2.

Show clearly the steps in your calculation.

(3)

(b) Explain **two** ways that Helen could improve the accuracy of her value for the Earth's rotation period.

(4)

1

2

(c) Explain why the Pole Star appears as a small curve in the photograph shown in Figure 6, rather than as a point.

(2)

(Total for Question 9 = 9 marks)

10 The piece of text below is from an article that suggests an astronomical explanation for the description of the Star of Bethlehem in the Bible.

> *'The Bible's description of the Star of Bethlehem involves an unusually bright star that rose in the east and moved steadily westwards during the night.*
>
> *One explanation that has been proposed is that this 'star' was actually a conjunction of the planet Jupiter with the star Regulus (α Leo).*
>
> *It has also been suggested that the planet Jupiter was going through a retrograde loop at the same time.'*

(a) The star Regulus can be referred to as 'α Leo'.

State the astronomical significance of the Greek letter 'α' (alpha) in this description.

(1)

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(b) Explain why a conjunction of Jupiter and Regulus would appear as a very bright object in the sky.

(2)

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(c) Explain why Jupiter performing a retrograde loop would make this conjunction even more noticeable.

(2)

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(Total for Question 10 = 5 marks)

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***11** One astronomer has estimated that there may be around 16 000 other intelligent civilisations in the Milky Way galaxy.

Some other astronomers think this estimate is much too high, others think it is too low.

Describe how astronomers make an estimate of this number.

Explain why it is difficult to make an accurate estimate.

(6)

(Total for Question 11 = 6 marks)

12 Tom is observing from a location in Finland that has a latitude of 80°N.

For each of the following astronomical objects, choose the correct description of its apparent motion over a 24-hour period.

(a) A star with a declination of +80°.

(1)

☒ **A** circumpolar

☒ **B** never above the horizon

☒ **C** rises and sets, passing through his zenith

☒ **D** rises and sets, without passing through his zenith

(b) The Sun on the 21st March.

(1)

☒ **A** circumpolar

☒ **B** never above the horizon

☒ **C** rises and sets, passing through his zenith

☒ **D** rises and sets, without passing through his zenith

(c) The Pole Star.

(1)

☒ **A** circumpolar

☒ **B** never above the horizon

☒ **C** rises and sets, passing through his zenith

☒ **D** rises and sets, without passing through his zenith

(d) A star with a declination of 0°.

(1)

☒ **A** circumpolar

☒ **B** never above the horizon

☒ **C** rises and sets, passing through his zenith

☒ **D** rises and sets, without passing through his zenith

(e) A star with a declination of –19°.

(1)

☒ **A** circumpolar

☒ **B** never above the horizon

☒ **C** rises and sets, passing through his zenith

☒ **D** rises and sets, without passing through his zenith

(Total for Question 12 = 5 marks)

13 Figure 7 shows a model of the Solar System proposed by the Danish astronomer Tycho Brahe in the late 16th century. In this model, the Sun and Moon orbit the Earth. The planets orbit the Sun.

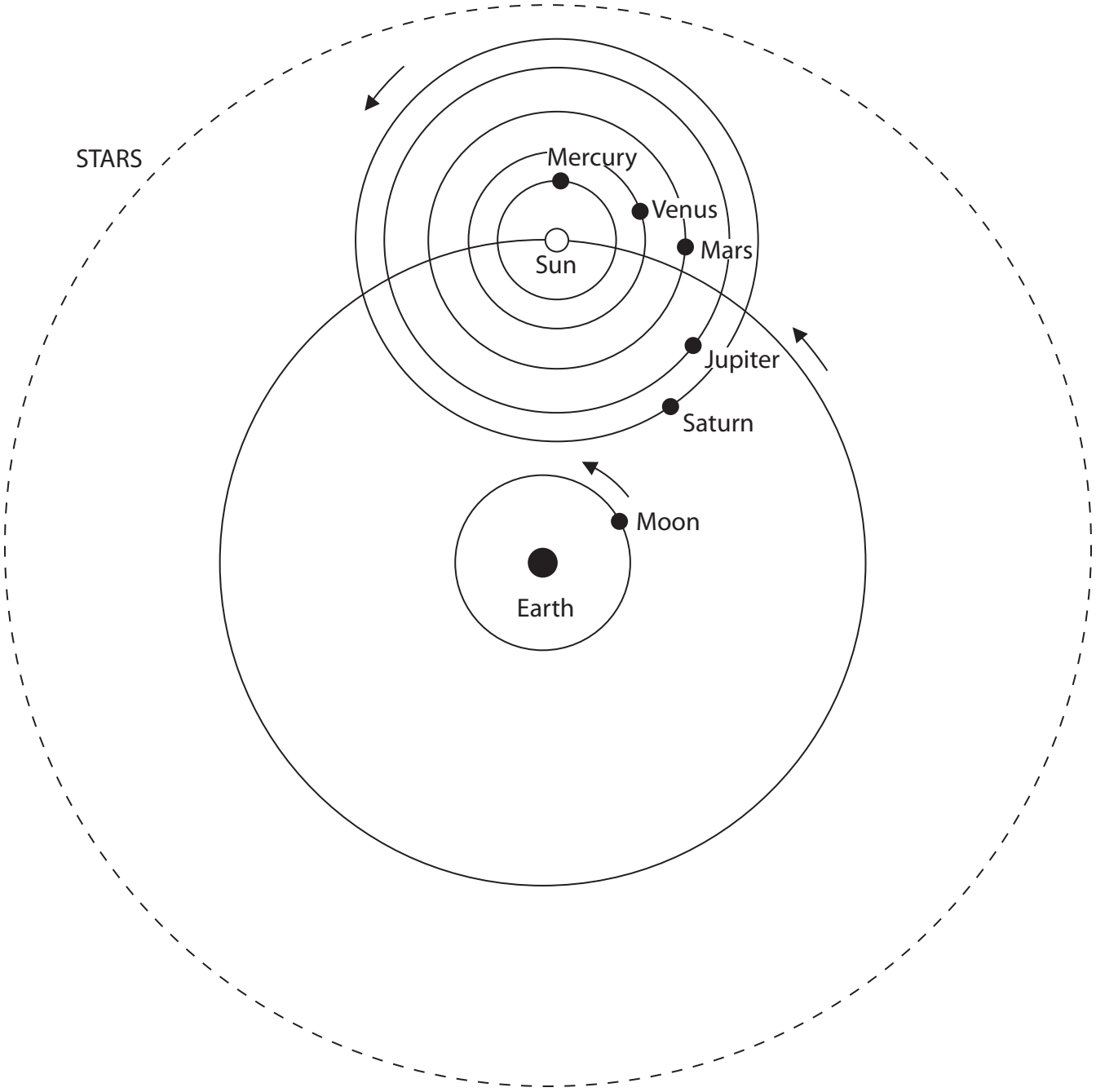

Figure 7

(a) State **one** way that this model was different to earlier ancient models of the Solar System.

(1)

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(b) In this model, an observer on the Earth would see the stars rise in the east and set in the west every 24 hours.

Describe how each of the following appears to move relative to the stars.

(i) The Sun

(1)

.....

(ii) The Moon

(1)

.....

(iii) Mars

(1)

.....

(c) State **one** feature of this model that is also in the model proposed by Nicolaus Copernicus.

(1)

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.....

(d) Explain why Tycho Brahe did not include the planets Uranus or Neptune in his model.

(1)

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.....

(Total for Question 13 = 6 marks)

14 A lesser-known comet has been orbiting the Sun for many thousands of years in a highly elliptical orbit with an orbital period of more than 50 years.

There are recorded observations of the comet being visible from Earth in the years 1560, 1830 and 2010. Astronomers suspect that some of the dates when it was visible from Earth were not recorded.

(a) Calculate a value for the orbital period of the comet.
Use the **incomplete** set of dates given above.

(2)

(b) Figure 8 shows the orbits of some of the planets in the Solar System with their orbital periods.

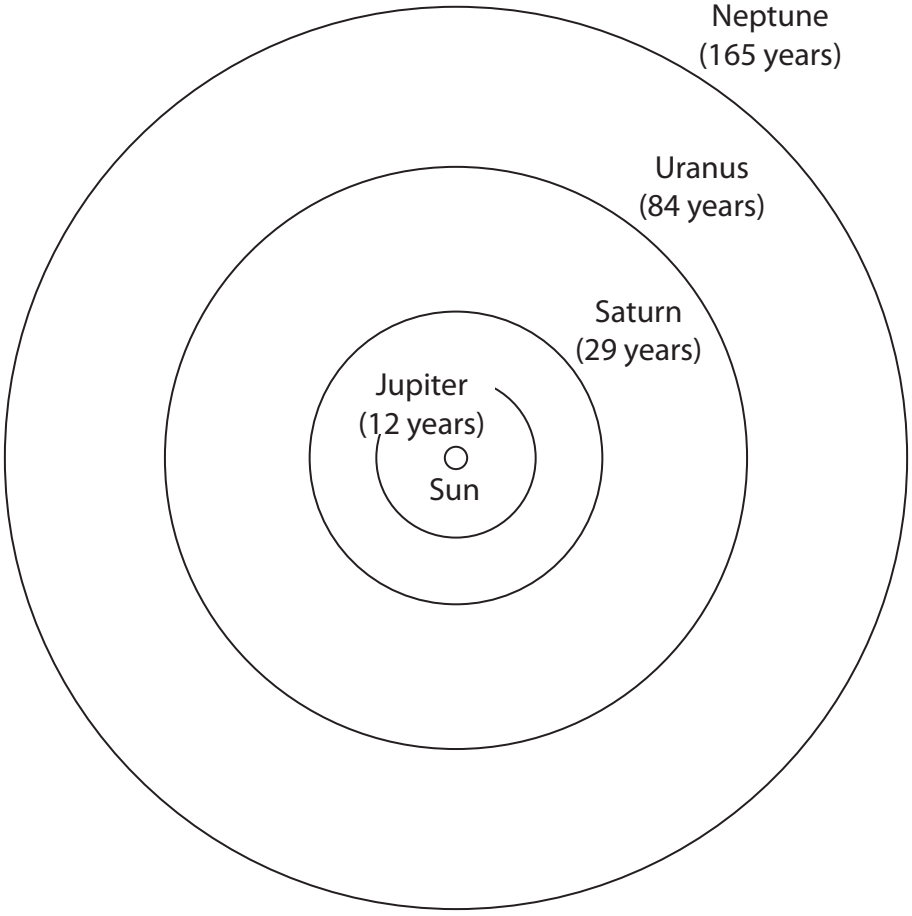

Figure 8

Draw a possible orbit for the comet on Figure 8.

(3)

(c) An astronomer uses a telescope to observe the comet.

She waits until the comet is passing closest to the Earth.

(i) Explain why this is the best time to observe the comet.

(2)

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(ii) Sketch the possible appearance of the comet when viewed through a telescope.

Label any parts of the comet that could be visible.

(2)

(Total for Question 14 = 9 marks)

15 Figure 9 shows a map of part of southern Egypt, including the town of Syene.

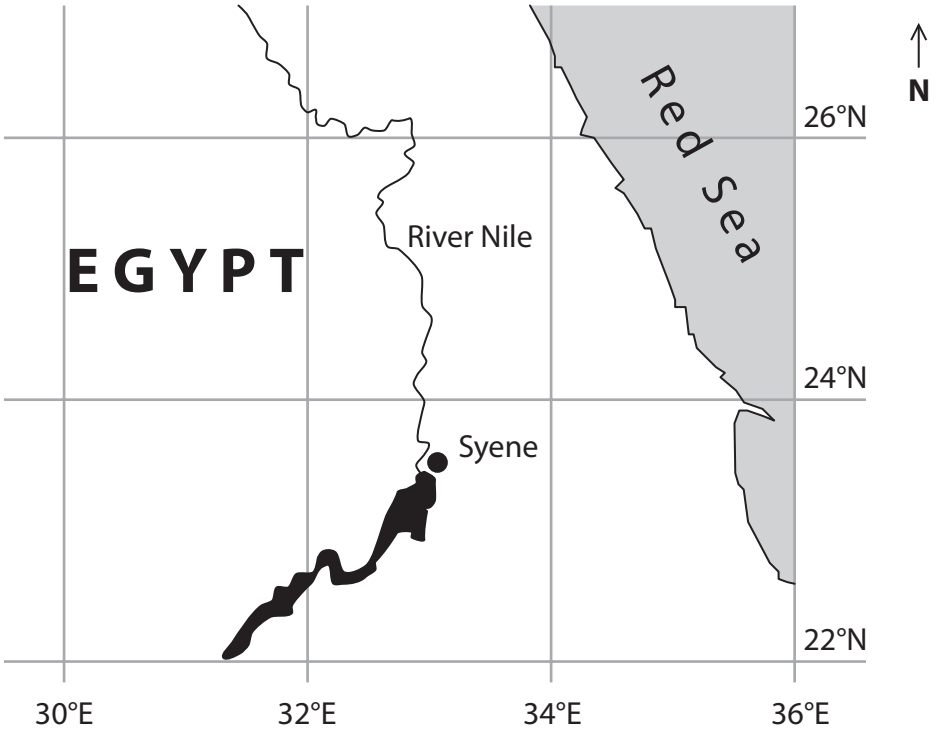

Figure 9

In 240 BCE, the astronomer Eratosthenes read about the Sun being directly overhead at midday on 21st June in the town of Syene.

(a) Explain why the Sun being directly overhead in Syene would have been a notable event in Egypt.

Use information from Figure 9.

(2)

*(b) Describe how you would measure the altitude of the Sun above the horizon.

State clearly the equipment you would use.

State clearly how your measurement would be taken safely.

You may include a clearly-labelled diagram in your answer.

(3)

(c) Two groups of students, one in Southampton and another in Edinburgh, decide to take measurements of the Sun's position to estimate the circumference of the Earth.

Edinburgh is 680 km due north of Southampton.

Students in Southampton measured the altitude of the Sun at midday as 48°.
On the same day, students in Edinburgh measured the Sun's altitude at midday as 42°.

Calculate a value for the circumference of the Earth, using the students' measurements.

Show your working clearly.

(3)

(Total for Question 15 = 8 marks)

16 (a) State **two** reasons why clocks and sundials in the same location do not always show the same time.

(2)

1 .....

.....

2 .....

.....

*(b) Explain why a sidereal day is not the same length as a solar day.

You may include a clearly-labelled diagram in your answer.

(4)

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(Total for Question 16 = 6 marks)

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17 Table 3 contains some information about four stars: A, B, C and D.

	Apparent Magnitude (m)	Absolute Magnitude (M)	Spectral Class
Star A	+4.0	+10	M2
Star B	–1.3	–6	M3
Star C	0.0	+4	F9
Star D	+0.1	–8	B6

Table 3

(a) Which of these stars is most like the Sun?

(1)

☒ **A** star A

☒ **B** star B

☒ **C** star C

☒ **D** star D

(b) Which of these stars is most likely to be a red giant star?

(1)

☒ **A** star A

☒ **B** star B

☒ **C** star C

☒ **D** star D

(c) Which of these stars is most likely to be a red dwarf star?

(1)

☒ **A** star A

☒ **B** star B

☒ **C** star C

☒ **D** star D

(d) Which of these stars has the highest surface temperature?

(1)

☒ **A** star A

☒ **B** star B

☒ **C** star C

☒ **D** star D

(e) Which of these stars is the furthest from the Earth?

(1)

☒ **A** star A

☒ **B** star B

☒ **C** star C

☒ **D** star D

(Total for Question 17 = 5 marks)

18 Figure 10 shows photographs of the nearby Andromeda galaxy (M31) and the more distant Virgo A galaxy (M87).

Andromeda (M31)

Virgo A (M87)

Sources © NASA

Figure 10

The Andromeda galaxy is 0.8 million parsecs (0.8 Mpc) from the Earth and is moving towards us at 120 km/s.

The Virgo A galaxy is 16.4 million parsecs (16.4 Mpc) from the Earth and is moving away from us at 1307 km/s.

(a) Explain why the Andromeda galaxy is moving towards us.

(2)

(b) Explain why the Virgo A galaxy is moving away from us.

(2)

(c) Describe how astronomers measure the speed that a distant galaxy is moving away from us.

(3)

(Total for Question 18 = 7 marks)

19 (a) A star has an apparent magnitude of +1.16 and is 100 parsecs away.

Calculate the absolute magnitude of the star.

Use the equation:

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

Show your working clearly.

(3)

(b) Two stars (A and B) appear to be the same brightness when viewed from Earth.

Star A has an absolute magnitude of +1.0 and is four times closer to Earth than Star B.

Calculate the absolute magnitude of Star B.

Show your working clearly.

(3)

(Total for Question 19 = 6 marks)

20 Following the discovery of evidence for the expansion of our universe, two theories were proposed to explain this expansion – the Steady State and Big Bang theories.

(a) Describe, in detail, **two** pieces of observational evidence that support the Big Bang theory.

(4)

1 .....

.....

.....

2 .....

.....

.....

*(b) The Big Bang theory makes a number of predictions for the future evolution of our universe.

Describe, in detail, one of these predictions giving evidence.

(4)

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(Total for Question 20 = 8 marks)

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