Write your name here

Surname	Other names

Pearson Edexcel GCSE

Centre Number | | | | | |

Candidate Number | | | | |

Astronomy

Unit 1: Understanding the Universe

Friday 20 May 2016 – Afternoon
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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P 4 6 3 3 2 R A 0 1 3 2

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 part of a well-known constellation of stars in the night sky.

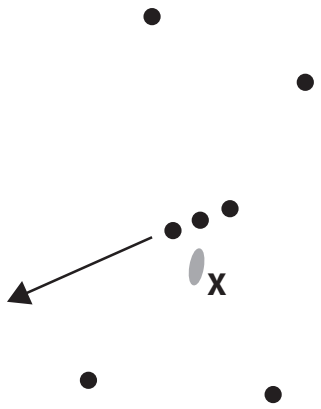

Figure 1

(a) The name of this constellation is:

(1)

☒ **A** Cygnus

☒ **B** Orion

☒ **C** Pegasus

☒ **D** Ursa Major

(b) The arrow in Figure 1 is pointing towards a bright star called:

(1)

☒ **A** Aldebaran

☒ **B** Fomalhaut

☒ **C** Rigel

☒ **D** Sirius

(c) The **X** on Figure 1 marks a fuzzy patch of light which is a:

(1)

☒ **A** Comet

☒ **B** Double star

☒ **C** Galaxy

☒ **D** Nebula

(Total for Question 1 = 3 marks)

2 (a) The planet Uranus was discovered by:

(1)

- ☒ **A** William Herschel
- ☒ **B** Johannes Kepler
- ☒ **C** Isaac Newton
- ☒ **D** Clyde Tombaugh

(b) A star that regularly changes its brightness is called a:

(1)

- ☒ **A** Double star
- ☒ **B** Dwarf star
- ☒ **C** Supernova
- ☒ **D** Variable star

(c) The region around a star where planets may be able to support life is called the:

(1)

- ☒ **A** Asteroid Belt
- ☒ **B** Goldilocks Zone
- ☒ **C** Kuiper Belt
- ☒ **D** Magnetosphere

(d) The Sun crosses the Celestial Equator on the:

(1)

- ☒ **A** 1st January
- ☒ **B** 21st March
- ☒ **C** 21st June
- ☒ **D** 21st December

(e) Which of the following do **NOT** orbit the Sun?

(1)

- ☒ **A** Centaurs
- ☒ **B** Comets
- ☒ **C** Exoplanets
- ☒ **D** Trans-Neptunian Objects

(Total for Question 2 = 5 marks)

3 The Polish astronomer, Nicolaus Copernicus was one of the first to propose a theory of the Solar System where the Sun, rather than the Earth, was at the centre.

(a) What name do astronomers give to any theory that places the Sun at the centre of the Solar System?

(1)

.....

(b) In what other way did Copernicus' theory improve on earlier theories of the Solar System?

(1)

.....

.....

(c) Copernicus' theory was further supported by the discoveries of the astronomer Galileo Galilei. Name **two** of these discoveries.

(2)

1 .....

2 .....

(Total for Question 3 = 4 marks)

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4 Describe how each of the following would appear in the night sky to someone observing by naked eye.

(a) The aurora borealis

(1)

(b) An artificial satellite

(1)

(c) A fireball

(1)

(d) A star with an apparent magnitude of +5

(1)

(Total for Question 4 = 4 marks)

5 Identify which planet is being described in each of the following statements.

(a) The planet that orbits the Sun in the shortest time

(1)

- ☒ **A** Jupiter
- ☒ **B** Mars
- ☒ **C** Mercury
- ☒ **D** Venus

(b) The gas giant planet that orbits nearest to the Kuiper Belt

(1)

- ☒ **A** Jupiter
- ☒ **B** Neptune
- ☒ **C** Saturn
- ☒ **D** Uranus

(c) The planet that passes closest to Earth

(1)

- ☒ **A** Mars
- ☒ **B** Mercury
- ☒ **C** Moon
- ☒ **D** Venus

(d) The largest inferior planet

(1)

- ☒ **A** Earth
- ☒ **B** Mars
- ☒ **C** Mercury
- ☒ **D** Venus

(Total for Question 5 = 4 marks)

6 (a) Each of the following statements is a description of a feature found on the surface of the Moon. Identify which feature is being described.

(i) A long narrow channel

(1)

- ☒ **A** Mare
- ☒ **B** Rille
- ☒ **C** Terra
- ☒ **D** Wrinkle Ridge

(ii) A highland area

(1)

- ☒ **A** Mare
- ☒ **B** Rille
- ☒ **C** Terra
- ☒ **D** Wrinkle Ridge

(iii) A smooth dark plain

(1)

- ☒ **A** Mare
- ☒ **B** Rille
- ☒ **C** Terra
- ☒ **D** Wrinkle Ridge

(b) Describe **two** ways in which the far side of the Moon appears different to the side facing the Earth.

(1)

1 .....

2 .....

(Total for Question 6 = 4 marks)

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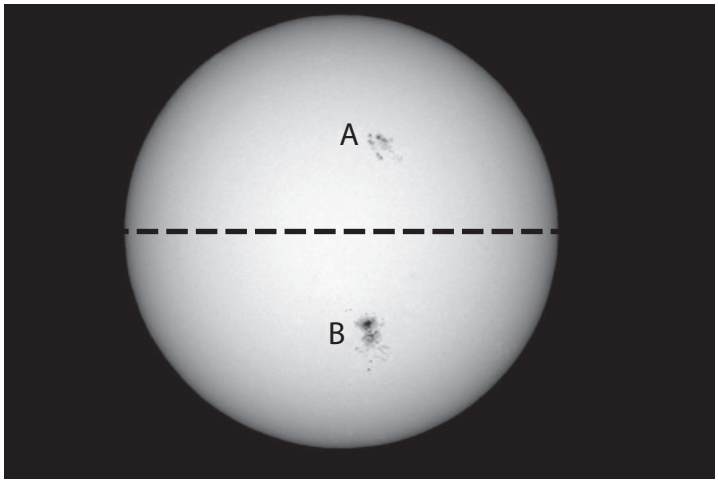
7 Figure 2 shows two large sunspot groups on the surface of the Sun, labelled A and B. The dotted line indicates the position of the solar equator.



(Source: © NASA)

Figure 2

(a) (i) Give the approximate temperature of a typical sunspot in kelvin.

(1)

.....

(ii) Draw arrows on Figure 2 to show how the two sunspot groups A and B will appear to move over the next few days.

(2)

*(b) Describe a method for using a telescope to observe sunspots safely. Use a clearly labelled diagram as part of your answer.

(3)

.....

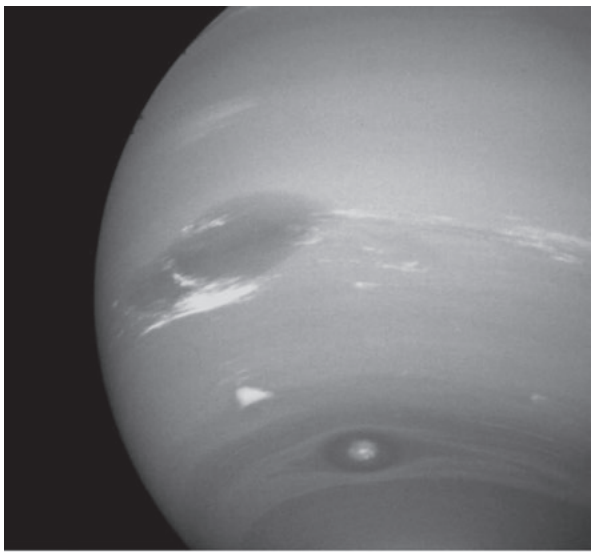
.....

.....

.....

(Total for Question 7 = 6 marks)

8 Figure 3 shows an image of the planet Neptune.



(Source: © NASA)

Figure 3

(a) Describe the discovery of the planet Neptune.

(2)

(b) Describe Neptune's satellite system.

(2)

(Total for Question 8 = 4 marks)

9 Figure 4 shows an image of the transit of Venus that took place in June 2004.

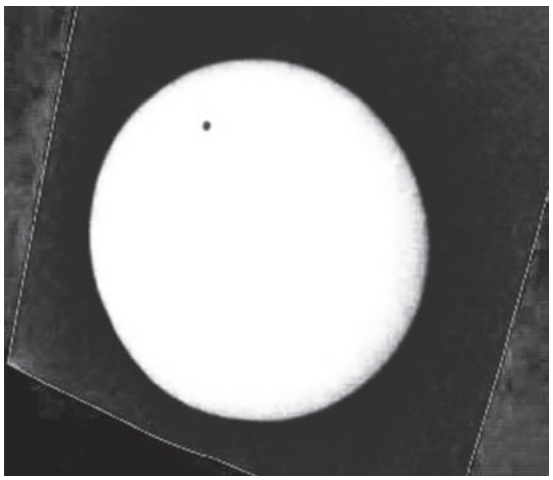


Figure 4

(a) (i) The only other planet in the Solar System that can be seen to transit the Sun by an observer on Earth is:

(1)

☒ **A** Jupiter

☒ **B** Mars

☒ **C** Mercury

☒ **D** Saturn

(ii) Venus can only be seen to transit when it is at: **(1)**

☒ **A** Elongation

☒ **B** Conjunction

☒ **C** Occultation

☒ **D** Opposition

(b) In the space below, using the letters **E**, **S** and **V**, show the positions of the Earth, Sun and Venus during a transit.

(1)

(c) The first record of anyone observing a transit of Venus was not made until 1639. Explain why astronomers were not able to make detailed observations of transits of Venus before this time.

(2)

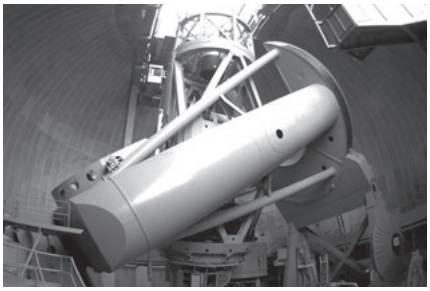
(d) Although Venus orbits the Sun once every 225 days, transits of Venus are extremely rare. Explain why they are so rare.

(2)

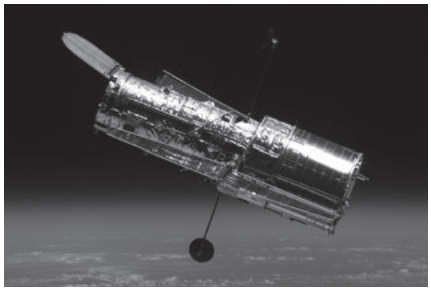
(Total for Question 9 = 7 marks)

10 Figure 5 shows two large reflecting telescopes currently used by professional astronomers.

The Hale Telescope



The Hubble Space Telescope



(Source: © NASA)

Figure 5

The table below gives some information about each telescope.

	The Hale Telescope	**The Hubble Space Telescope**
Diameter of main mirror	5m	2.5m
Location	California, USA	Orbiting Earth

(a) Give **two** reasons why the world's largest telescopes are reflectors rather than refractors.

(2)

1 .....

.....

2 .....

.....

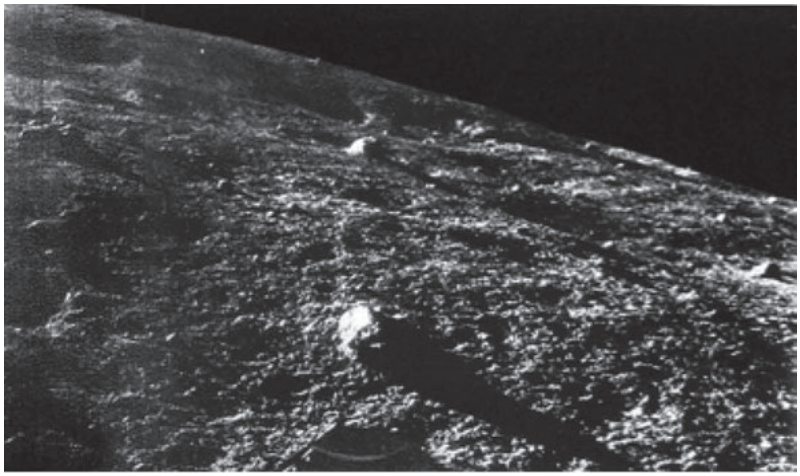
*(b) A group of astronomers wish to study some extremely faint galaxies. They decide that the Hale Telescope will give them the best images.

Discuss their decision, giving reasons which support it and reasons which do not. Your answer should include information from the table wherever possible.

(6)

(Total for Question 10 = 8 marks)

11 Figure 6 shows the surface of the Moon. It was taken by the Soviet Union's Luna 9 probe, which was the first unmanned probe to land safely on the surface of the Moon.



(Source: © Russian Federal Space Agency)

Figure 6

(a) Why were the first probes to land on the Moon unmanned?

(1)

.....

(b) For a manned spacecraft to land safely on the surface of the Moon, it is important that it is not travelling too quickly when it lands.

(i) Give **one** feature of the Moon that means a spacecraft is likely to reach its surface travelling more **slowly** than on the Earth.

(1)

.....

(ii) Give **one** feature of the Moon that means a spacecraft is likely to reach its surface travelling more **quickly** than on the Earth.

(1)

.....

(c) (i) State the name of the first space mission to land a human being safely on the surface of the Moon.

(1)

.....

(ii) State **two** scientific measurements this mission made on the Moon.

(2)

1 .....

2 .....

(d) Explain why the sky appears black, rather than blue, during daytime on the Moon.

(2)

.....

.....

(Total for Question 11 = 8 marks)

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12 Figure 7 shows a clock and a sundial on a church wall in the UK.

Figure 7

The clock is showing a time of 09:10 GMT while the shadow on the sundial indicates a time of 9 am.

(a) (i) State the Apparent Solar Time when this photograph was taken.

(1)

.....

(ii) If the Equation of Time on the day when this photograph was taken was –2 minutes, calculate the Mean Solar Time at this location.

Use the equation:

Equation of Time = Apparent Solar Time – Mean Solar Time

(2)

.....

.....

.....

(iii) Hence show that the longitude of the location where the photograph was taken is 2°W.

(2)

.....

.....

(b) Figure 8 shows how the length of the shadow on the sundial changes during a day in June. Add a second curve to Figure 8 to show how the shadow length varies during a day in March.

(2)

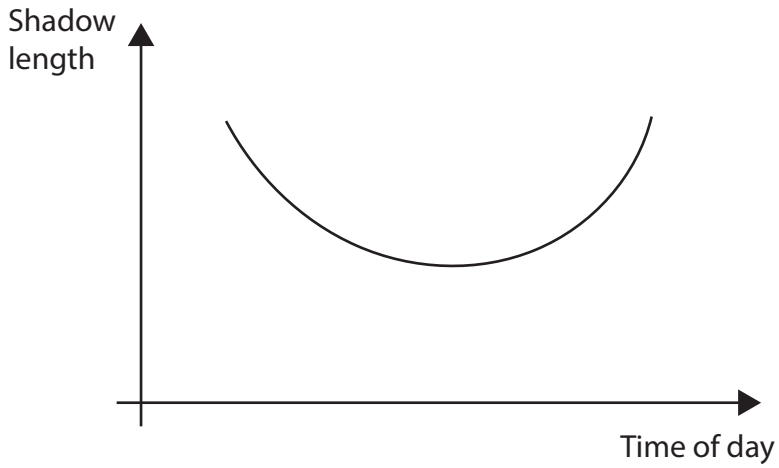

Figure 8

(Total for Question 12 = 7 marks)

13 Long-period comets, like Comet Hyakutake shown in Figure 9, can take many thousands of years to complete one orbit of the Sun. They are thought to originate in the Oort Cloud.

(Source: © NASA)

Figure 9

(a) (i) Draw a labelled diagram to show the position of the **Sun** and the **Oort Cloud**. Include the **orbit** of a long-period comet.

Your diagram need not be to scale.

(2)

(ii) Mark the position of the comet when it is at perihelion on your diagram. Use the letter **P**.

(1)

(iii) Describe how an object in the Oort Cloud could become a long-period comet.

(1)

.....

.....

(b) How many times bigger is the gravitational pull on a comet when it is 5 AU from the Sun than when it is 50 AU from the Sun?

(2)

.....

.....

(c) Comet Crommelin orbits at an average distance of 9 AU from the Sun. Calculate the time it takes to complete one orbit. Give your answer in years.

Use the relationship: $T^2 = r^3$

(2)

.....

.....

.....

.....

.....

(Total for Question 13 = 8 marks)

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14 (a) Explain what is meant by the term **circumpolar**.

(1)

.....

.....

(b) Two astronomers, Alice and Bob, decide to observe some objects in the sky. Alice observes from London (latitude = 52°N) and Bob observes from a city in Brazil (latitude = 16°S). They decide to observe the following objects:

- the Pole Star
- the Sun at midday on June 21st
- the star Sirius, with a declination of –16°
- the stars in Orion's Belt, with a declination of 0°.

The table below summarises the results of their observations.

Complete the table by writing **one** of the following letters in each box:

C – Circumpolar

N – Not visible

R – Rises and sets without passing through the zenith

Z – Rises and sets and passes through the zenith.

(Two boxes have been filled in for you.)

(3)

	Viewed from **London** (Latitude: 52°N)	Viewed from **Brazil** (Latitude: 16°S)
Pole Star	C	.....
Sun at midday on June 21st	.....	.....
Sirius (Declination:–16°)	.....	.....
Orion's Belt (Declination: 0°)	R	.....

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(c) Explain the astronomical significance of the Tropic of Capricorn.

(2)

.....

.....

.....

(Total for Question 14 = 6 marks)

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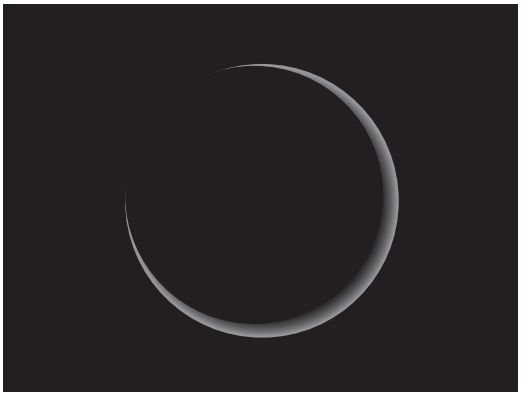
15 Figure 10 shows an annular eclipse of the Sun, which occurs when the Moon is slightly further from the Earth.



(Source: © NASA)

Figure 10

(a) (i) At which phase of the Moon do solar eclipses occur?

(1)

.....

(ii) Which part of the Sun is still visible during the annular eclipse shown in Figure 10?

(1)

.....

(b) (i) State the shape of the Moon's orbit round the Earth.

(1)

.....

(ii) Explain, with the aid of a clearly labelled diagram, why the Sun is not completely covered by the Moon in the annular eclipse shown in Figure 10.

(2)

.....

.....

.....

(Total for Question 15 = 5 marks)

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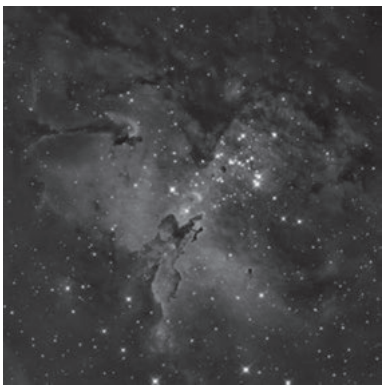
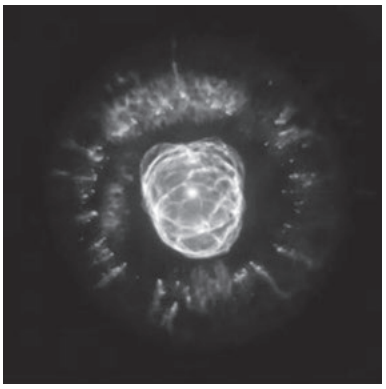
16 (a) Figure 11 shows four stages in the evolution of a star.

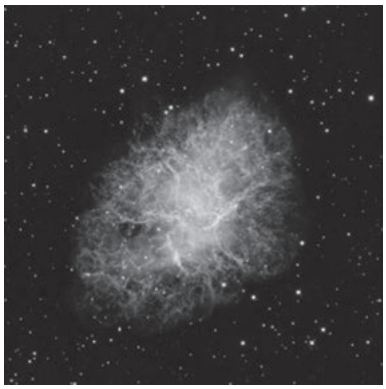


The Eagle Nebula
– an area of star formation



The Eskimo Nebula
– a planetary nebula

The Horsehead Nebula
– an absorption nebula



The Crab Nebula
– a supernova remnant

(Source: © NASA)

Figure 11

(i) Name the **two** nebulae that are expanding.

(1)

..... and .....

(ii) Name the nebula that is most likely to contain heavy elements such as iron.

(1)

.....

(iii) Name **two** nebulae that occur before the Main Sequence.

(1)

..... and .....

(b) (i) In the space below, draw a Hubble Tuning Fork diagram, showing clearly the location of barred spiral, elliptical and spiral galaxies.

(3)

(ii) Indicate clearly the position of the Milky Way galaxy on your diagram. Use the letter **M**.

(1)

(iii) Indicate clearly the position of an E7 galaxy on your diagram. Use the label **E7**.

(1)

(Total for Question 16 = 8 marks)

17 Cygnus X–1 is a binary star system where one star is thought to be a black hole.
An artist's impression of the system is shown in Figure 12.

(Source: © NASA)

Figure 12

(a) Explain what is meant by a **binary star system**.

(2)

(b) (i) Explain why electromagnetic waves cannot escape from a black hole.

(2)

(ii) Explain how astronomers are able to detect the presence of black holes, even though they do not give out any electromagnetic waves.

(2)

(c) Cygnus X–1 was discovered using early X-ray telescopes. Explain why X-ray telescopes cannot be sited on the Earth's surface.

(1)

.....

(d) The Cygnus X–1 system has an absolute magnitude of –6.5 whereas the Sun has an absolute magnitude of only +4.5. How many times greater is the luminosity of Cygnus X–1 than that of the Sun?

(2)

.....

.....

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.....

(Total for Question 17 = 9 marks)

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18 One method for finding planets orbiting other stars is to take very careful measurements of the star's brightness as the planet passes in front of it. Figure 13 shows a set of measurements taken in this way.

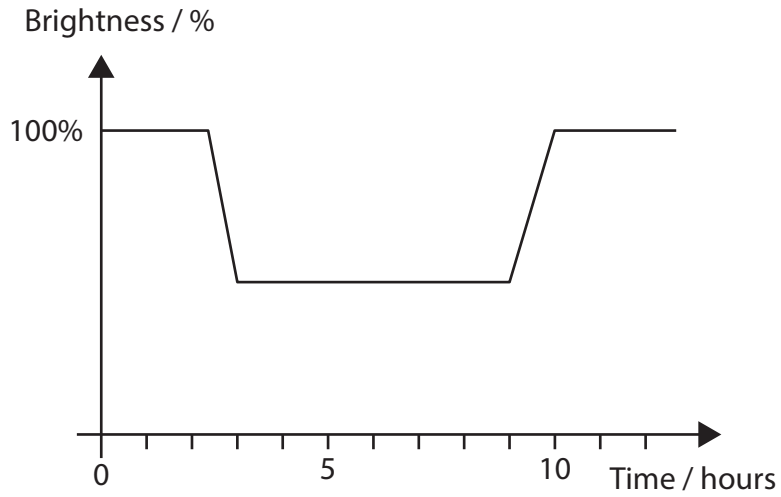

Figure 13

(a) Explain the shape of the curve.

(1)

(b) The planet is known to be travelling at about 150 000 km per hour as it orbits the star. Use this value and information from Figure 13 to estimate the size of the planet. Show the steps in your calculation clearly.

(2)

(c) Describe a **different** method astronomers also use to find planets orbiting other stars.

(2)

(Total for Question 18 = 5 marks)

19 After the expansion of the Universe had been discovered, two main theories were proposed to explain this expansion – the Steady State and the Big Bang theories.

The Steady State theory said that the Universe had always been expanding.

(a) Describe how the Big Bang theory explained the expansion of the Universe.

(2)

(b) Explain how the discovery of the Cosmic Microwave Background radiation in 1965 helped to support the Big Bang theory.

(2)

***(c)** Explain how the discovery of Quasi-Stellar Objects (Quasars) provided strong support for the Big Bang theory instead of the Steady State theory.

(3)

(Total for Question 19 = 7 marks)

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20 Figure 14 shows the Andromeda galaxy, which is around 1000 kpc from our Milky Way galaxy.

(Source: © Bradford Robotic Telescope)

Figure 14

(a) This galaxy is part of our Local Group. Explain what is meant by the term **Local Group**.

(2)

(b) (i) The Andromeda galaxy has an absolute magnitude of –21.5. Use this information to calculate its apparent magnitude.

Use the equation:

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

(3)

(ii) What would be the apparent magnitude of the Andromeda galaxy if it were moved 10 times closer, i.e. to a distance of 100 kpc?

(2)

.....

.....

.....

(iii) Describe how the Andromeda galaxy would appear to a naked-eye observer on the Earth if it was only 100 kpc away.

(1)

.....

.....

.....

(Total for Question 20 = 8 marks)

TOTAL FOR PAPER = 120 MARKS

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