Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						1	6	2	7	/	0	1	Signature	

Paper Reference(s)

1627/01

Edexcel GCSE

Astronomy

Paper 01

Friday 18 June 2010 – Morning

Time: 2 hours

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
Total	

Materials required for examination
Calculator

Items included with question papers
Nil

Suggested answers

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname and initial(s) and your signature.
Answer ALL questions in the spaces provided in this book. Do not use pencil. Use blue or black ink.
Show all stages in any calculations and state the units. Calculators may be used.
Include diagrams in your answers where these are helpful.
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 (☒).

Information for Candidates

The marks for the various parts of questions are shown in round brackets: e.g. **(2)**.
There are 20 questions in this question paper. The total mark for this paper is 120.
There are 32 pages in this question paper. Any blank pages are indicated.

Advice to Candidates

This symbol shows where the quality of your written answer will also be assessed.

Printer's Log. No.
N36497A
W850/R1627/57570 6/5/4/2/

N 3 6 4 9 7 A 0 1 3 2

Turn over

edexcel
advancing learning, changing lives

BLANK PAGE

Leave blank

1. Figure 1 shows a well-known group of stars.

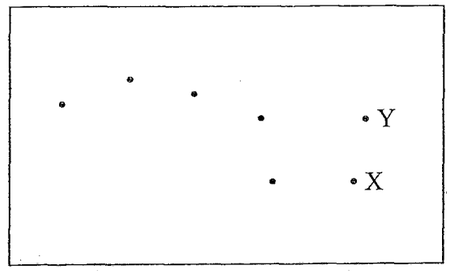


Figure 1

(a) What is a common name of this group of stars? Put a cross (☒) in the correct box.

Cassiopeia ☐
Orion ☐
The Plough ☒
The Summer Triangle ☐

(1)

(b) What is the name of the star that X and Y point to? Put a cross (☒) in the correct box.

Betelgeuse ☐
Polaris ☒
Rigel ☐
Sirius ☐

(1)

(c) In which direction would you be facing if you were observing this pattern of stars? Put a cross (☒) in the correct box.

North ☒
South ☐
East ☐
West ☐

(1)

(d) In which constellation is this group of stars located?

Ursa Major or The Great Bear

(1) Q1

(Total 4 marks)

Leave blank

2. (a) Which of these is the **largest** in size? Put a cross (☒) in the correct box.

The Earth ☐

Jupiter ☐

The Sun ☒

Venus ☐

(1)

(b) Which of these is **closest** to the Earth? Put a cross (☒) in the correct box.

The Moon ☒

Mars ☐

The Sun ☐

Venus ☐

(1)

(c) What is the phase of the Moon during a **lunar** eclipse? Put a cross (☒) in the correct box.

crescent ☐

full ☒

gibbous ☐

new ☐

(1)

(d) For approximately how long does a total **solar** eclipse last? Put a cross (☒) in the correct box.

4 seconds ☐

4 minutes ☒

4 hours ☐

4 weeks ☐

(1)

Leave blank

(e) Which part of the Sun can easily be seen during a total **solar** eclipse? Put a cross (☒) in the correct box.

chromosphere ☐

core ☐

corona ☒

photosphere ☐

(1)

Q2

(Total 5 marks)

Leave blank

3. Four regions of the electromagnetic spectrum are listed below.

infra-red

radio waves

ultra-violet

X-rays

Which region:

(i) is emitted in regular bursts by pulsars?

Radio waves

(ii) was used on the Magellan mission to map the surface of Venus?

Radio waves

(iii) is emitted by the Sun's very hot corona?

X-rays

(iv) led to the discovery of quasars?

Radio waves

(v) is emitted from accretion discs surrounding black holes?

X-rays

Q3

(Total 5 marks)

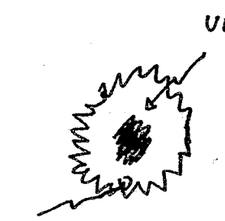
Leave blank

4. (a) What are sunspots?

cooler (and hence darker) regions on the photosphere; regions of strong magnetic fields

The photosphere : 6000k ; sunspots around 4000k (1)

(b) In the space below, sketch and label a typical sunspot.



(i) Extremely dark area (the umbra)

(ii) Pattern of prouds, which seems to emanate from this region.

(iii) less dark surrounding area (the penumbra)

(iv) the "background" pattern on which the sunspot is located is the solar granulation (likened the appearance of simmering porridge)

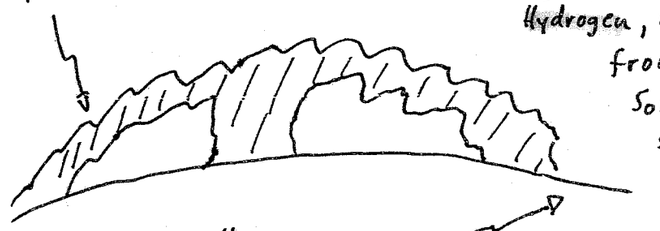
(2)

(c) Describe briefly **one** safe method for observing the Sun.

Using (say) a telescope, project the (real) image of the Sun onto a white screen. The greater the principal focal length of the objective, the greater the size of the image. (1)

(d) Draw a sketch of a typical solar prominence.

prominence: a mass of glowing gas, mainly Hydrogen, rising from the Solar surface



(1)

Q4

(Total 5 marks)

Leave blank

5. (a) Who discovered the principal satellites of Jupiter? Put a cross (☒) in the correct box.

Galileo Galilei ☒
Johannes Kepler ☐
Isaac Newton ☐
Tycho Brahe ☐

(1)

(b) What was discovered by William Herschel in 1781? Put a cross (☒) in the correct box.

Halley's Comet ☐
Uranus ☒
Neptune ☐
Saturn's Rings ☐

(1)

(c) Which of these planets has the hottest surface? Put a cross (☒) in the correct box.

Earth ☐
Jupiter ☐
Mars ☐
Venus ☒

(1)

(d) Where do most long period comets originate? Put a cross (☒) in the correct box.

Asteroid Belt ☐
Kuiper Belt ☐
Oort Cloud ☒
Zodiacal Band ☐

(1) Q5

(Total 4 marks)

Leave blank

6. (a) State **one** difference between the orbit of Pluto and the orbit of Neptune.

① The orbit of Pluto is the more elliptical. (see footnote)
② The plane of the orbit of Pluto is the more inclined to the Ecliptic **(1)**

(b) State **two** reasons why Pluto has recently been regarded by astronomers as a new type of object in the Solar System.

1. The smallness of Pluto
2. Many similar objects were discovered beyond Neptune
3. Much lower density and different composition than Mercury, Venus, Earth and Mars.

(2)

(c) Outline briefly the discovery of Pluto.

(i) "Irregularities" in the movement of Neptune prompted the search.
(ii) Clyde Tombaugh initiated a photographic search, using a "blink microscope".
(iii) The planet was discovered in 1930.

(3) Q6

(Total 6 marks)

⑥ (c) JF²

Percival Lowell, around 1916, has suspicions about a planet beyond Neptune.
Lowell was an expert mathematician and his predicted position was close to Tombaugh's sighting of Pluto, fourteen years after Lowell's death.

The orbit of Pluto is tilted at an angle of 17° to the Ecliptic. Between 1979 and 1999, Neptune, not Pluto, was the outermost planet.

Leave blank

7. A group of students were observing a gibbous Moon with binoculars.

(a) The students noticed that the Moon had large, dark grey areas and lighter areas on its surface.

(i) What is the general name for the large, dark grey areas?

sea | seas | mare | maria

(ii) How do astronomers think that these features were formed?

Large, excavated basins

Lava - filled

volcanic activity

(3)

(b) The students also observed some craters near the Moon's terminator.

(i) What is the terminator?

The dividing line between the Lunar day and night

(ii) Explain why it is useful to observe craters that are located near the Moon's terminator.

- Shadows of objects on the lunar surface are enhanced.
- This is due to the low angle of the Sun over the Lunar horizon.
- Considerable contrast between "day" and "night".

Q7

(Total 6 marks)

Leave blank

8. (a) In which month does the Summer Solstice occur? Put a cross (☒) in the correct box.

May ☐

June ☒

July ☐

August ☐

(1)

(b) What is the astronomical significance of an equinox? Put a cross (☒) in the correct box.

The Sun lies on the celestial equator. ☒

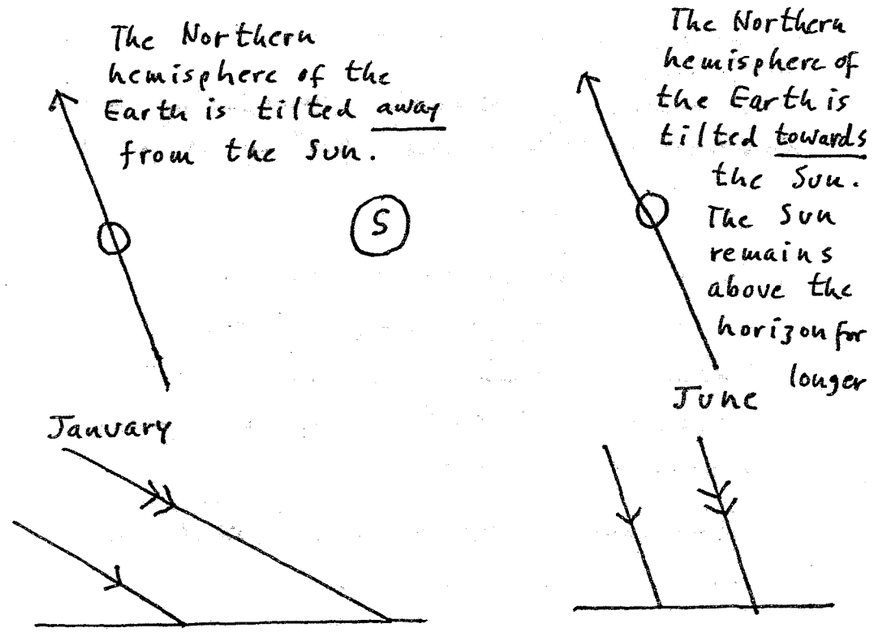
The Moon lies on the celestial equator. ☐

The Sun is furthest from the celestial equator. ☐

The Moon is furthest from the celestial equator. ☐

(1)

(c) Explain with the aid of a diagram why it is generally warmer in the northern hemisphere during July rather than during January.



During winter, the radiant flux from the sun is spread over a larger area. Hence, the heating effect is reduced.

Q8

Leave blank

9. Figures 2 and 3 show two galaxies.

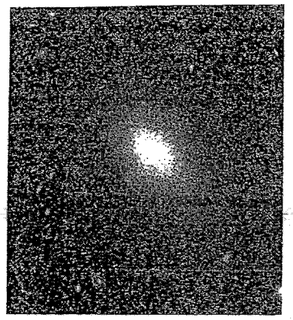
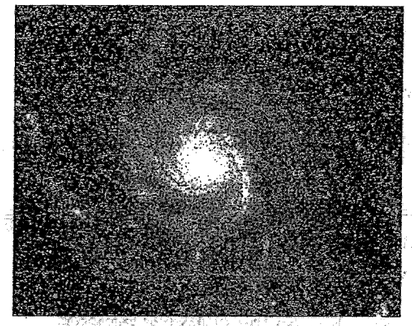


Figure 2



(*Source: NASA*)

Figure 3

(a) State the **type** of galaxy in:

(i) Figure 2.. Elliptical, E .....

(ii) Figure 3.. Spiral: S | Sa | Sb | Sc .....

(2)

(b) Both galaxies are members of our Local Group. What is meant by the Local Group?

The group of galaxies, numbering around one hundred, of which our Galaxy is a member.

(c) State **two** ways in which quasars differ from typical galaxies

1 Quasars have particularly high red-shifts, indicating immense distances.

2. Quasars emit radio waves and huge amounts of X-rays.

(2)

Q9

(Total 5 marks)

3. They appear "point-like", that is, are not extended sources.

4. Quasars are intensely luminous, that is, they emit huge amounts of energy every second.

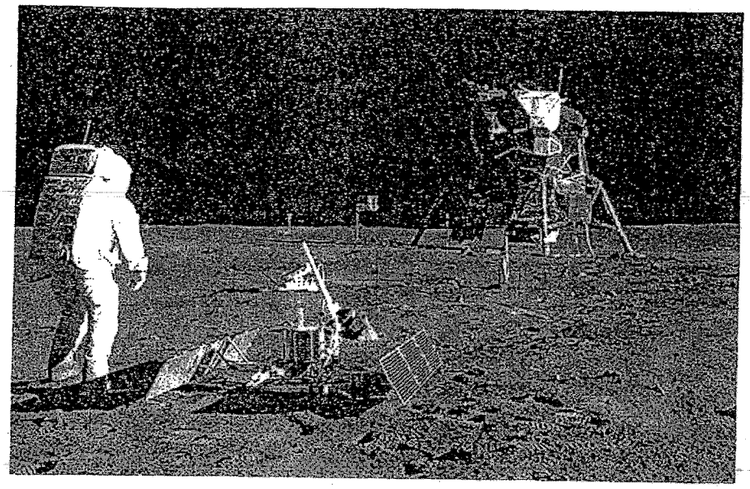
$P_{quasar} \gg P_{Sun}$ [$\sim 10^{26}$ W (10^{26} J s^{-1})]

BLANK PAGE

Turn over for Question 10

Leave blank

10. Figure 4 shows an astronaut on the surface of the Moon with an instrument from the Scientific Experiments Package.



(*Source: NASA*)

Figure 4

(a) What was the name of the space programme to land men on the Moon?

The Apollo

(1)

(b) Explain briefly why the sky on the Moon appears black.

- There is no atmosphere to scatter the light from the Sun.
- I have several times read about references to the glare from the surrounding Lunar rocks, especially when the Sun is high in the Lunar sky.

Leave blank

(c) One of the scientific instruments left on the Moon was a special mirror. This allowed a laser light from Earth to be reflected back.

If a laser light sent from Earth to the Moon returned in 2.56 s, calculate the distance from the Earth to the Moon in km.

Use the formula: speed = distance / time. The speed of light is 3.0×10^5 km/s.

The outward journey of the light pulse takes 1·28 s to reach the Lunar surface.
∴ the distance of the Moon from the Earth
= velocity of light × time for the journey
= 3.0×10^5 km s^{-1} × 1·28 s
= 3.84×10^5 km

(2)

(d) State **two** other scientific purposes of this space programme.

① Collection and the return of rock samples.
② Deploy scientific experiments on the Lunar surface.
③ Studies of the Solar Wind. ④ Investigating Moonquakes.

(2)

(e) Explain the energy requirements involved in launching a spacecraft.

The combustion of sufficient fuel to provide the spacecraft with enough kinetic energy to reach the "escape velocity". As the spacecraft "coasts" towards the Moon, it loses kinetic energy and acquires gravitational potential energy.

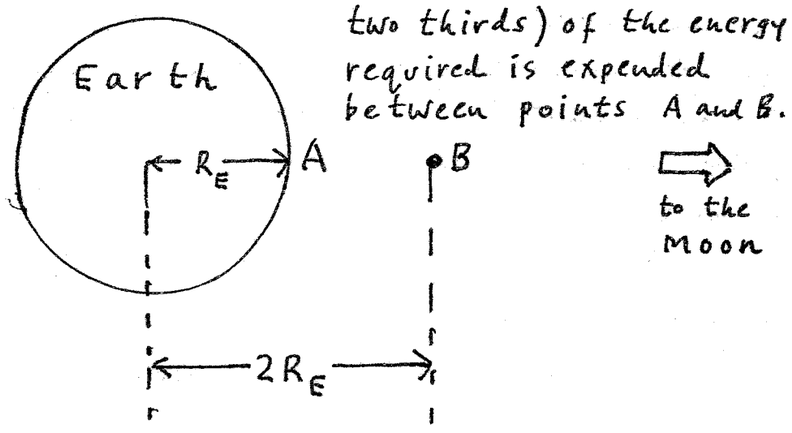
(2)

Q10

(Total 9 marks)

IMPORTANT

Nearly two-thirds (yes, two thirds) of the energy required is expended between points A and B.



Leave blank

11. (a) Describe the nature and location of the Van Allen Belts.

These are zones around the Earth in which charged particles are trapped in the magnetic field of the Earth. The outer zone consists mainly of electrons; the inner zone of protons.

(b) The Van Allen Belts are influenced by the solar wind.

(i) What is the solar wind?

A flow of charged particles streaming from the Sun.

(ii) From which part of the Sun does the solar wind originate?

The solar atmosphere, the corona

(2)

(c) The solar wind is also responsible for aurorae. Describe the nature and location of aurorae.

Glows in the upper atmosphere of the Earth, due to the interaction of charged particles with the magnetic field of the Earth. Aurora Borealis in the Northern hemisphere; Aurora Australis in the Southern hemisphere.

Q11

(Total 6 marks)

JF[2] : Diffuse luminous forms over large areas of the sky have been observed since ancient times in Northern regions between 15° and 30° from the magnetic. Triangulation measurements of the heights of aurorae show that most occur between 80 km and 160 km, with a few as high as 1000 km.

Auroral emissions result when low-energy electrons precipitate out of the inner radiation zone, then collide with, and excite and ionize atmospheric gases.

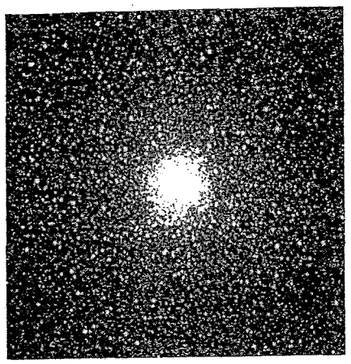
BLANK PAGE

Turn over for Question 12

(b)

12. ~~(a)~~ Figure 5 shows a globular cluster.

Bound by gravity into a spherical shape.



(*Source: NASA*)

Figure 5

(i) State **two** facts about the stars in a globular cluster.

1 Huge, regular systems of stars.

2 can contain up to 10^6 stars

3. Many of the stars are red, because the clusters are old.

(ii) Where are globular clusters located?

They are distributed spherically about the Galaxy, have little gas or dust and (usually) contain no hot stars. Their properties imply great age, and provide a tool for probing the structure and history of our Galaxy.

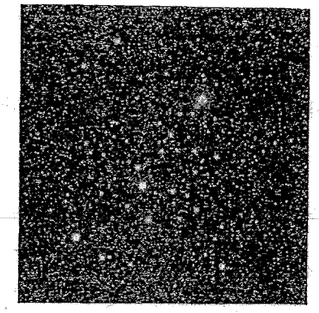
All are distant — few are within 7000 pc of the Sun. Only just over one hundred have been found in the entire Galaxy. From Britain, the only naked-eye one is M13 in Hercules. Even so, it is far from bright. These clusters lie around →

(3)

Leave blank

(a)

~~(b)~~ Figure 6 shows an open cluster.



(*Source: NASA*)

Figure 6

(i) State **two** facts about the stars in an open cluster.

1. Lots of gas / dust present.

2. Typically consist of a few hundred stars.

3. Often contain very hot stars

4. Such stars are in irregularly-shaped groups

(ii) Where are open clusters located?

close to the plane of the Galaxy and the spiral arms

(3)

Q12

(Total 6 marks)

Leave blank

the edges of the Milky Way (main) Galaxy.

Near the centres of the clusters, the stars are closely packed. In these regions, the distances between stars are only light-days or light-weeks. (If our Sun were a member of a globular cluster, the night sky would be superb: there would be many stars bright enough to cast shadows; there would be no true darkness at all).

(12) (a) (i) continued.

These clusters contain barely enough mass, to be bound long-term by gravity, and will eventually disperse.

"interior" is a better word, I think.

Leave blank

13. (a) Name the **two inferior** planets.

Mercury and Venus

(1)

(b) On Figure 7, show one position of an inferior planet when it is at **greatest elongation**. Use a cross (X).

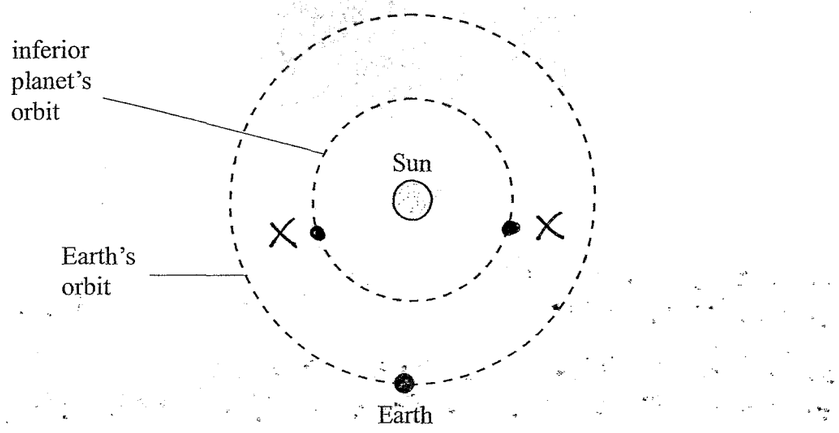


Figure 7

(2)

(c) On some occasions, an inferior planet can be seen crossing the disc of the Sun. What is the name of such an event?

A transit

(1)

"exterior" is a better word, I think.

(d) When a **superior** planet is at opposition, it is 4.7 AU from Earth. How far is the planet from Earth when it is at conjunction?

6·7 A.U.

(2) **Q13**

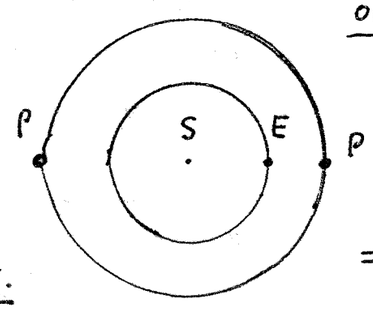
(Total 6 marks)

Conjunction

E–P is now

= 4·7 A.U. + diameter of the orbit of the Earth

= 4·7 A.U. + 2 A.U. = 6·7 A.U.



opposition

E → P

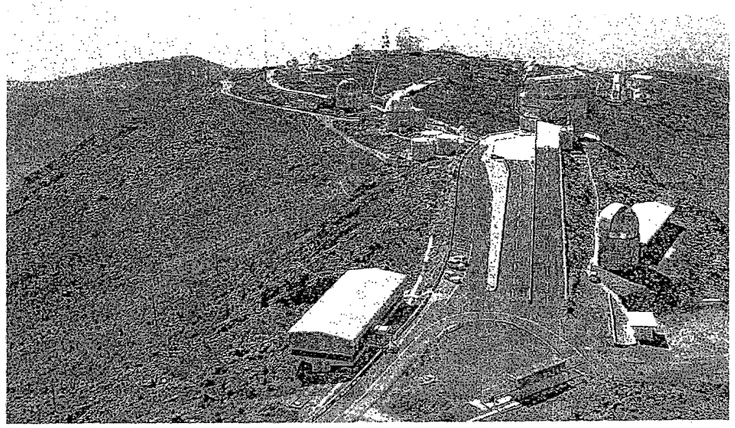
= 4·7 A.U.

BLANK PAGE

Turn over for Question 14

Leave blank

14. Figure 8 shows a number of telescope domes at the European Southern Observatory's La Silla site in Chile. The observatory hosts some of the world's largest telescopes.



(*Source: ESO/H Zodet*)

Figure 8

(a) State **two** advantages to astronomers of locating an observatory on top of a high mountain compared with locating one at sea level.

1. Clearer air
2. Less turbulent air
3. Reduced chemical / light pollution
4. Above the "weather"
5. Infra-red studies possible

Not that water vapour absorbs IR radiation

(2)

(b) How much more light does a 10 metre telescope collect compared with a 5 metre telescope?

Area $= \pi r^2 = \pi \left(\frac{d}{2}\right)^2 = \frac{\pi d^2}{4}$ = 4 times more

(1)

(c) State **two** further advantages to astronomers of using a 10 metre telescope compared with a 5 metre telescope.

1 Twice the resolving power (ability to reveal detail)

2 Brighter image

(2)

(c) Assuming that 10 m and 5 m refer to apertures and not principal focal lengths.

Leave blank

(d) NASA is planning to launch the James Webb Space Telescope into an orbit around the Earth in 2013. State two major **disadvantages** of an observatory in space.

1 .. Maintenance is much more difficult and expensive.

2 .. Damage caused by striking meteoroids

(2)

(e) The James Webb Space Telescope will be an infra-red telescope.
Why will it be necessary to cool the telescope?

The telescope would otherwise be emitting its own infra-red radiation.

(1)

Q14

(Total 8 marks)

Leave blank

15. (a) How many times is the gravitational field strength of the Earth greater than that of the Moon? Put a cross (☒) in the correct box.

2 ☐ G.F.S. Earth = 9·8 N kg⁻¹

3 ☐

5 ☐ G.F.S. Moon = 1·6 N kg⁻¹

6 ☒

(1)

(b) When a short period comet is at perihelion, it is 1.5 AU from the Sun. When the comet is at aphelion, it is 7.5 AU from the Sun. How many times greater is the Sun's pull of gravity on the comet when it is at perihelion compared with aphelion?

25 Five times closer at perihelion ∴ the gravitational force is twenty-five times greater (The inverse-square law)

(2)

(c) In 1994, Comet Shoemaker-Levy broke into several fragments which then collided with a planet.

(i) Name the planet. Jupiter

(ii) What property of this planet made it the most likely candidate for such an impact?

The gravitational field stength makes it most likely to perturb a comet.

(2) Q15

(Total 5 marks)

BLANK PAGE

Turn over for Question 16

Leave blank

16. Figure 9 shows three stars in a particular constellation.

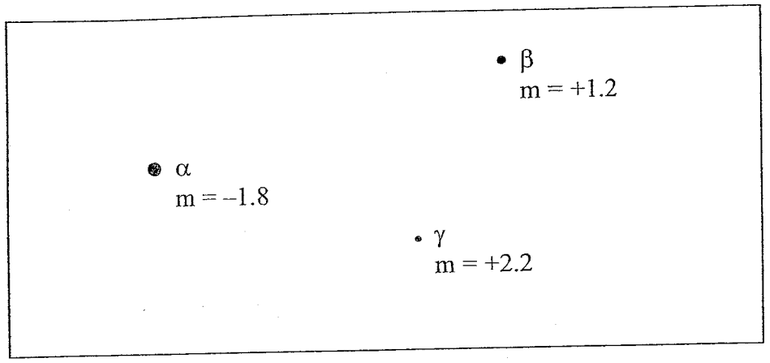


Figure 9

(a) What is the significance of the letters α, β and γ?

Relative brightness.
In decreasing brightness: α, β, γ

(1)

(b) How many times brighter than star γ is:

(i) star β? 2.5

(ii) star α? $(2.5)^4 = 40$

(2)

Leave blank

(c) Stars α and γ have the same absolute magnitude.

(i) Explain the meaning of the term **absolute magnitude**.

The apparent magnitude a star would have, were it observed from a distance of 10 pc.

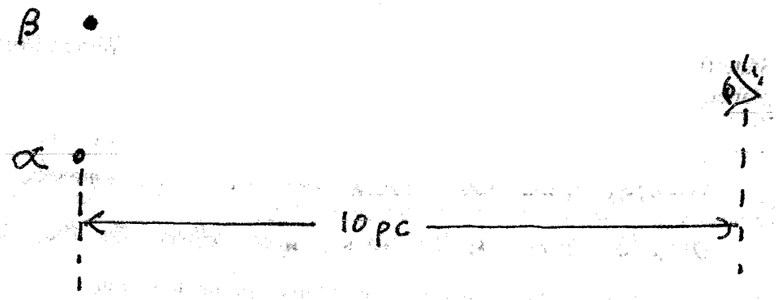
(ii) State which of the two stars is closer to Earth.

α

(iii) Explain your answer.

(4) Q16

(Total 7 marks)

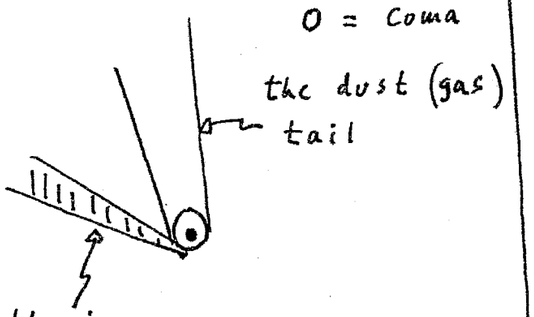


At 10pc, the stars would be equally bright.
(There is no need to consider the inverse-square law)
∴ N.B. The stars have the same luminosity.

∴ For α now to be brighter, it must be closer to the Earth.

Leave blank

17. (a) Draw a labelled diagram to show the structure of a comet including its two tails.



The ion tail is seen due to the gaseous ions from the comet emitting light, while travelling directly away from the Sun, under the influence of the Solar wind.

The dust tail is due to light reflected and scattered from small dust particles, that were ejected from the comet.

(b) State **two** ways in which the orbit of a long period comet is different from that of a planet.

1. Much more eccentric.
2. Much greater orbital period than any planet.
3. Orbits can be prograde or retrograde
4. Orbits are not confined close to the Ecliptic

(2)

(c) State the ways in which the two tails of a comet are made visible.

1 Glowing / excitation from within

2 Reflexion of sunlight

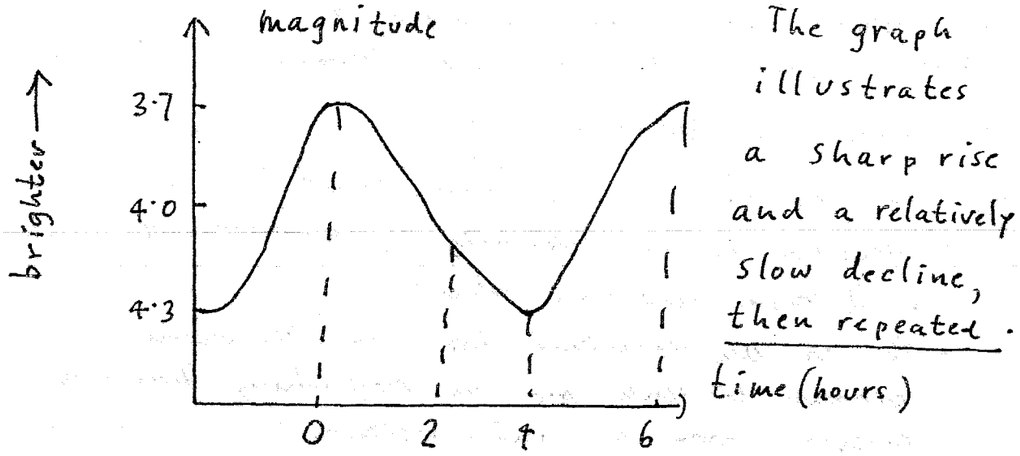
(2)

Q17

(Total 7 marks)

Leave blank

18. (a) (i) Sketch the light curve of a Cepheid variable.



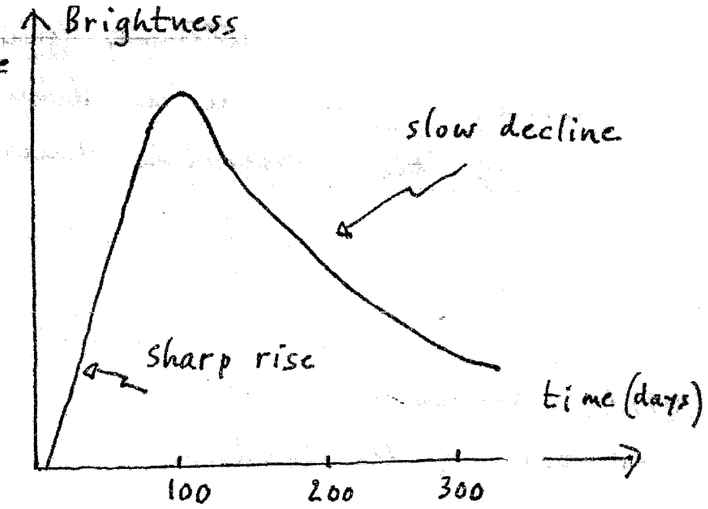
The graph illustrates a sharp rise and a relatively slow decline, then repeated.

Approximates to the light curve for δ Cephei

(ii) Explain briefly the cause of this variability.

Results from a large amplitude pulsation of the star — an instability in the envelope of the star. Expansion and contraction (4)

(b) Sketch the light curve of a supernova.



The light curve varies for one supernova to another. However, all share a sharp rise followed by a slow decline on regular basis.

(2)

18

Leave blank

19. (a) What is meant by the term **red shift**?

A receding light source causes a particular spectral line to shift towards the red part of the spectrum. (1)

(b) Explain why red shift is important in cosmology.

- The extent of the "red shift" is a measure of the velocity of recession of a distant celestial object.
- It is an essential tool in Astronomy, because evidence for an expanding Universe emerges from its interpretation.
- Understanding of the large-scale nature of the Universe is aided.

(c) What is meant by the term **dark matter**?

Although it cannot be seen, its presence is inferred from the gravitational force which it exerts. (1)

(d) Explain why dark matter is important in cosmology.

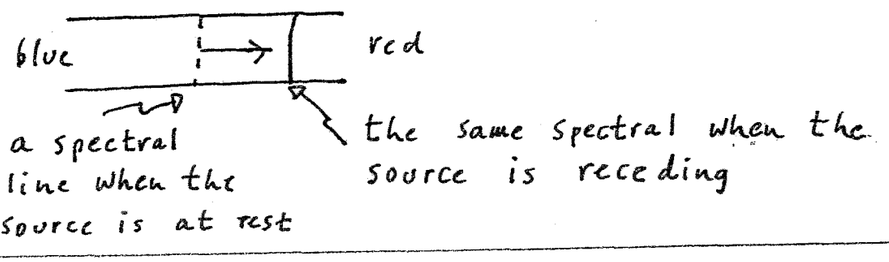
- There is evidence that its importance lies in determining the ultimate fate of the
- Universe. It helps us to deduce the total mass of the observable Universe.

(2)

Q19

(Total 7 marks)

(19) (a) continued



Leave blank

20. Figure 10 shows an observer's view of the sky looking south. The observer's meridian is shown.

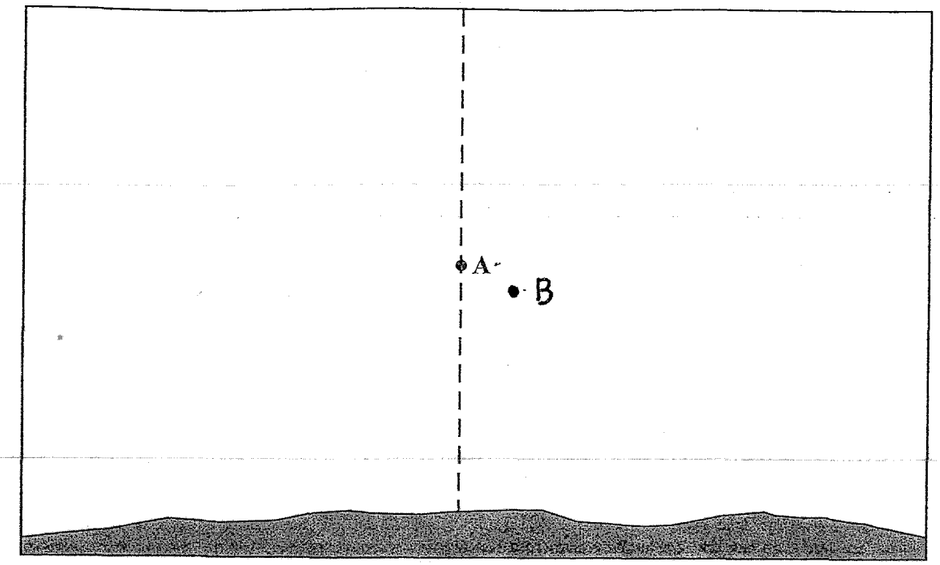


Figure 10

(a) By how many degrees does the Earth spin in one hour?

15

(1)

(b) At 19:00 GMT on December 15th, star **A** is crossing the observer's meridian. Indicate on Figure 10 the position of this star one hour later. Use the letter **B**.

(2)

(c) On Figure 10, indicate the position of star **A** at 19:00 GMT one month later. Use the letter **C**.

(2)

(d) The longitude of the observer is 3° East. At what time GMT would an observer at a longitude of 1° West observe **A** crossing his or her meridian on December 15th?

(2)

Q20

(Total 7 marks)

TOTAL FOR PAPER: 120 MARKS

END

BLANK PAGE