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

Monday 9 June 2008 – Morning

Time: 2 hours

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
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Total	

Materials required for examination
Calculator

Items included with question papers
Nil

Worked 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.
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 24 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.

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Turn over

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(1)

Leave blank

1. (a) What is the astronomical significance of one day? Put a cross (☒) in the correct box.

the time taken for the Earth to orbit the Sun ☒

the time taken for the Moon to orbit the Earth ☒

the time taken for the Earth to rotate once ☒

(1)

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

the time taken for the Earth to orbit the Sun ☒ the sidereal period

the time taken for the Moon to orbit the Earth ☒

the time taken for the Earth to rotate once ☒

(1)

(c) Which way does the Earth rotate? Put a cross (☒) in the correct box.

from East to West ☒

from North to South ☒

from West to East ☒

(1)

(d) By how many minutes is a sidereal day shorter than a solar day?

four minutes

(1)

(Total 4 marks)

Q1

(2)

Leave blank

2. (a) Which region of the electromagnetic spectrum:

(i) lies between infra-red and radio waves? Put a cross (☒) in the correct box.

microwaves ☒ ultra-violet ☒ X-rays ☒

(ii) has the longest wavelength? Put a cross (☒) in the correct box.

radio waves ☒ ultra-violet ☒ visible light ☒

(2)

(b) From which part of the Sun are X-rays emitted? Put a cross (☒) in the correct box.

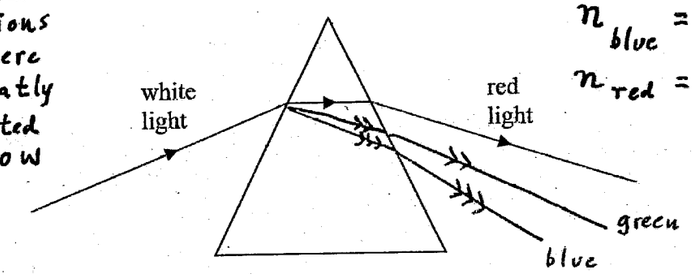
chromosphere ☒ corona ☒ photosphere ☒

(1)

(c) The diagram shows the path taken by white light entering a glass prism. The path taken by red light leaving the prism is shown.

The angular separations shown here are greatly exaggerated - see below

Typicall, $n_{blue} = 1.54$ $n_{red} = 1.52$



On the diagram show the path taken by violet light as it passes through the prism.

(2)

(Total 5 marks)

Q2

2.(b) JF²:
Because it is extremely hot ~ 2×10^6 K

(c) The angular separation of the blue and red components within the prism is ~ (only) 2° (sic)

(3)

Leave blank

3. (a) A group of students observed the sky on a clear night and described what they saw. For each of the descriptions (i) to (iii), put a cross (☒) in the correct box.

(i) It moved from east to west and I saw green and red flashing lights.

Aircraft ☒ Earth satellite ☒ Meteor ☒ Planet ☒

(ii) Out of the corner of my eye, I saw a bright streak of light lasting for about one second.

Aircraft ☒ Earth satellite ☒ Meteor ☒ Planet ☒

(iii) A constellation looking like the letter 'W'.

Orion ☒ Cassiopeia ☒ Taurus ☒ Ursa Major ☒

(3)

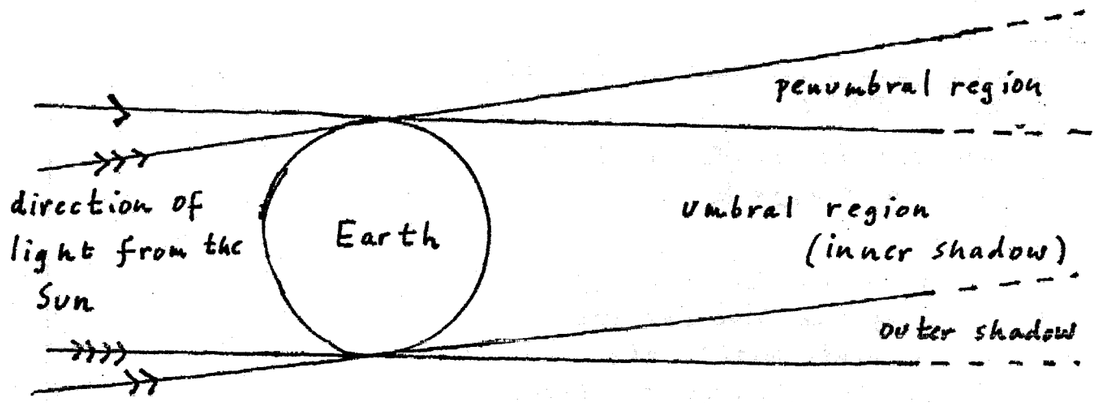
artificial

(b) On another occasion the students observed an Earth satellite. During the observation its light faded within a few seconds. Explain why the light from a satellite fades in this way.

Artificial Earth satellites shine as a result ..... Of light reflected from the Sun (as does the ..... Moon). The light fades when the satellite ..... enters the shadow cast by the Earth. ..... The distinction between umbra and penumbra is important.

(2) Q3

(Total 5 marks)



Note that the umbral region converges to a point, which is about 200 R_E in length.

The satellite fades as it enters the penumbra; it then disappears from view on entry to the umbra.

(4)

Leave blank

4. (a) (i) What is the approximate distance from the Earth to the Moon? Put a cross (☒) in the correct box.

13 000 km ☒ 250 000 km ☒ 380 000 km ☒

(ii) What is the approximate distance from the Earth to the Sun? Put a cross (☒) in the correct box.

93 million km ☒ 150 million km ☒ 380 million km ☒

(2)

(b) State the shape of the Earth's orbit around the Sun.

Elliptical

(1)

(c) State what is meant by one Astronomical Unit.

The mean distance of the Earth from the Sun.

Q4

(Total 5 marks)

JF2:

4. (c)

Perihelion = 1.47×10^{11} m

Aphelion = 1.52×10^{11} m

The difference = 0.05×10^{11} m

The eccentricity = $\frac{\text{the difference}}{\text{the mean value}}$

$= \frac{0.05 \times 10^{11}\ m}{1.49 \times 10^{11}\ m}$

$= \frac{0.05}{1.49}$

$= 0.03$

It would be difficult to distinguish the orbit of the Earth from a circle, if drawn to scale.

Mars and Pluto have orbits which are much more eccentric.

5

Leave blank

5. Five moons are listed:

Phobos, a moon of Mars

Io, a moon of Jupiter

Titan, a moon of Saturn

Miranda, a moon of Uranus

Triton, a moon of Neptune.

From the list, name the moon described in each statement below.

(i) The surface is covered in ridges, faults and cliffs; the moon appears to have broken apart and re-formed.

Miranda

(ii) It is one of the coldest moons in the Solar System with a surface temperature of –235 °C. Geysers erupt from its surface.

Triton

(iii) The surface is orange/red in colour and contains a large number of active volcanoes.

Io

(iv) The dense atmosphere contains methane and nitrogen and the moon was studied by the Huygens space probe in 2005.

Titan

(Total 4 marks)

Q5

6

Leave blank

6. The image shows the Earth rising above the Moon's surface. Clouds in the Earth's atmosphere are clearly visible.

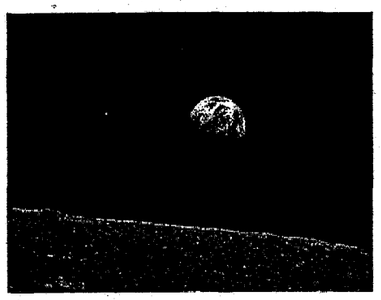


Image courtesy of NASA

The Earth shown here is partly in the shadow cast by the Moon

(a) Describe **two** drawbacks of the Earth's atmosphere to astronomers.

① Filters out a lot of electromagnetic radiation; ② refracts the light; ③ pollutes the skies; ④ clouds are a problem for optical telescopes, and ⑤ reduces the apparent brightnesses of the stars.

(2)

(b) Describe **two** features of planet Earth that distinguish it from the other planets in the Solar System.

① The prescence of water; ② forests; ③ oxygen-rich atmosphere, and ④ the closeness and relatively large mass of the Moon combine to produce profoundly important ocean and sea tides.

(2)

(c) In the image the Earth's phase is gibbous. Viewed from Earth, what was the Moon's phase on the same day?

or hunch-backed

brecent

(1)

(Total 5 marks)

Q6

Leave blank

7. (a) State what is meant by the Moon's **shadow terminator**.

The boundary between the daylit and night hemispheres

(1)

(b) Features on the Moon's surface are illuminated differently according to the lunar phase. What phase of the Moon is ideal to observe large rayed-craters such as Tycho or Copernicus?

Full Moon

(1)

(c) Explain why the same side of the Moon always faces the Earth.

The rotation of the Moon is said to be "captured" or "synchronous". It is thought that, early in its history, the Moon was rotating more quickly, but was not solid, but had not cooled sufficiently, after its formation. The powerful tides in its globe, formed by the Earth, try to keep a bulge, turned Earthward.

This slowed the rotation of the Moon (think of the effect of brake shoes on a bicycle wheel), so that eventually, relative to the Earth, the Moon ceased rotating. The Moon now keeps the same "face" facing the Earth.

N.B. However, the same face is not turned permanently towards the Sun: every part of the Lunar surface has regular day and night. A lunar "day" is almost as long as two Earth weeks.

(d) Give **one** reason why it is possible to observe slightly more than 50% of the Moon's surface over a period of time.

Libration in longitude. The Moon seems to rock very slightly from side to side. (It is too slow to be observed over a short time interval, but it does occur).

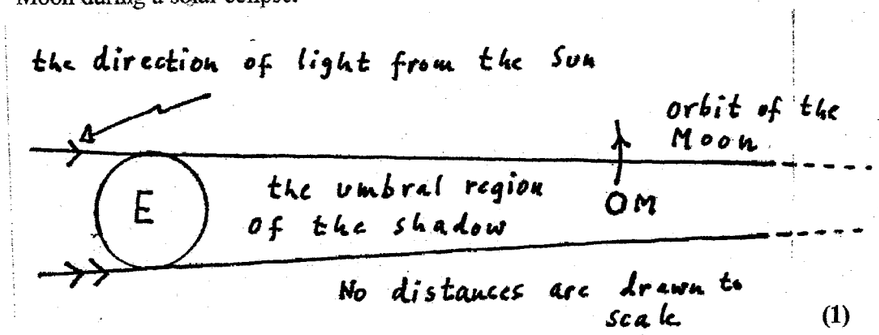
(1)

(Total 5 marks)

Q7

Leave blank

8. (a) Draw a labelled diagram to show the relative positions of the Earth, the Sun and the Moon during a solar eclipse.



No distances are drawn to scale

(1)

(b) During a **total** solar eclipse

(i) Which part of the Sun is visible?

the corona (meaning "crown")

(ii) Explain why this part of the Sun can only be observed at this time.

Although the corona is hot ($\sim 2\times10^6$ K), it is so tenuous that its brightness is much less than that of the solar surface ($\sim 6\times10^3$ K). When the photosphere is obscured, the corona is rendered visible.

(c) (i) Draw the appearance of the Sun during an **annular** eclipse.

"annular" (not "annual") from "annulus," meaning "ring".

an extremely thin (relatively speaking) ring of the Solar disc is visible for a short time

(ii) Explain briefly why an **annular** eclipse occurs.

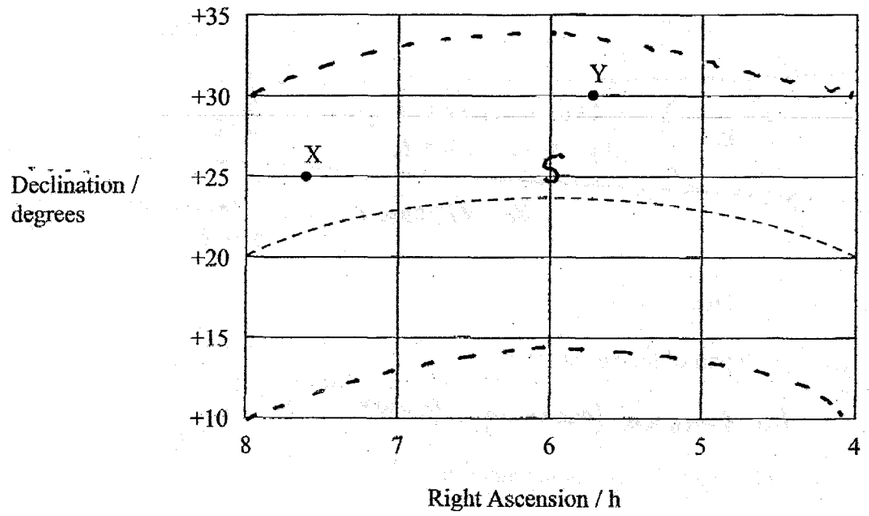
When the Sun - Moon - Earth alignment occurs to coincide with the apogee of the Moon, the angle which it subtends at the Earth is at its smallest. Remember that the orbit of the Moon around the Earth is highly elliptical

(Total 7 marks)

Q8

Leave blank

9. The diagram represents part of the celestial sphere. The dashed line shows the ecliptic and two stars, X and Y, have been plotted.



(a) On the diagram:

(i) plot the position of the Sun on June 21 (use S);

(ii) indicate the zodiacal band.

(3)

(b) From what latitude could an observer see star X directly overhead?

For X to be seen overhead, the latitude of the observer must be equal to the declination of X. That is, + 25° N. .....

(1)

(c) Explain why star Y is not circumpolar when observed from Penzance in Cornwall (latitude 50 °N).

For an observer at a latitude of + 50°N, Y is not circumpolar, because its declination does not exceed 40°. ....

(2) Q9

(Total 6 marks)

9(b) continued.
The declination (the angular distance above / below the celestial equator) of Polaris is + 90°. Therefore only at the North Pole would an observer see Polaris at the zenith.

Leave blank

10. Galileo Galilei (pictured below) made many important discoveries that developed the heliocentric theory.

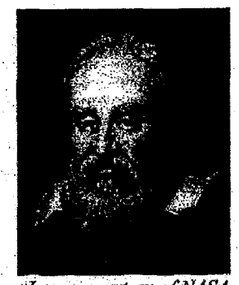


Image courtesy of NASA

(a) What is meant by the **heliocentric theory**?

The theory according to which the Sun lies in the centre of the Solar System.

(1)

(b) Which one of the following astronomers suggested the heliocentric theory before Galileo. Put a cross (☒) in the correct box.

Copernicus ☒ Kepler ☒ Newton ☒

(1)

(c) State **two** of Galileo's discoveries that gave evidence for the heliocentric theory.

1. The phases (apparent changes in shape) of Venus.
2. The Jovian satellites (the moons of Jupiter)

(2)

(d) Galileo also discovered that Saturn had an unusual appearance, that was later shown to be a system of rings. State **two** key facts about Saturn's rings.

1. The rings have gaps between them.
2. Every constituent particle obeys Kepler's Laws of planetary motion.
3. The thickness very much less than the diameter.

(2)

(e) State **one** further astronomical discovery made by Galileo.

① Observed the mountains and craters of the Moon. .....

② Resolved the "Milky Way" into individual stars .....

(1) Q10

(Total 7 marks)

(11)

Leave blank

11. The image shows the planet Jupiter following impacts of fragments of Comet Shoemaker-Levy in 1994.

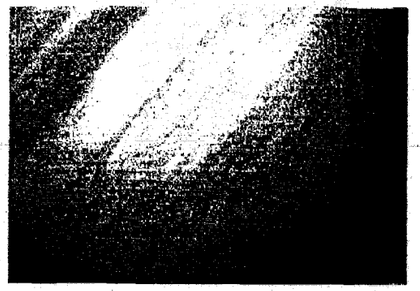


Image courtesy of NASA

(a) Explain why Jupiter was the most likely planet for such a collision.

The large gravitational pull of Jupiter, determined by its mass and radius, would enable it to perturb the orbit of a much less massive comet.

(2)

(b) State **three** further pieces of evidence to show that serious collisions between objects in the Solar System have occurred.

(1) The Lunar surface has many craters on it.

(2) Also, the origin of the Moon.

(3) The unusual nature of other planetary moons. That is, their surface appearances.

(4) Distribution and nature of the asteroids.

(3)

(12)

Leave blank

(c) At its furthest distance a comet is 20 AU from the Sun. At its closest distance it is 2 AU from the Sun.

(i) What is the name of the furthest point on its orbit?

The aphelion .....

(ii) How many times greater will the force of gravity on the comet be when it is 2 AU from the Sun compared to when it is 20 AU from the Sun? Put a cross (☒) in the correct box.

1 ☐ 10 ☐ 100 ☒ 1000 ☐

(2)

(Total 7 marks)

Q11

JF^2 : 11. (c) (ii)

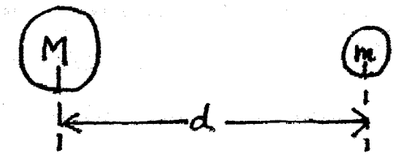
The gravitational force between two bodies is

(a) proportional to the product of their masses, (distance of separation, d, constant) and

(b) inversely proportional to the square of their separation, (the masses being constant).

That is $\vec{F} \propto \frac{M\,m}{d^2}$

∴ increasing the distance ten-fold decreases the force $(10)^2 = 100$-fold



Leave blank

12. The Sun is a main sequence star.

(i) Describe how the Sun became a main sequence star.

A gas cloud undergoes gravitational collapse into a protostar. This leads to a temperature rise and pressure increase in the centre of the star. The processes of the nuclear fusion of Hydrogen nuclei begin. Much of the mass of the protostar star is lost in the form of a "stellar wind".

(ii) Describe how the Sun will evolve after the main sequence.

The star remains in its main sequence phase until most of the Hydrogen has been converted to Helium. This leads to a fall in the temperature of the core, reducing the pressure, leading to a pressure reduction and the star begins to collapse, with the loss of gravitational potential energy.

Q12

(Total 7 marks)

JF2 12.(ii) continued

During this collapse is still burning in the shell surrounding the core. The effect of this is dramatic: The source of energy is moving away from the centre, increasing the pressure in the outer regions of the star. This causes the star to swell, reducing the density in the outer parts of the star, with a decrease in the surface temperature. After such an expansion, a red giant is formed.

Leave blank

13. (a) State what is meant by the **radiant** of a meteor shower.

The point in the sky from which the meteors of any particular shower appear to radiate.

(1)

(b) State why an observer on the Moon could never see a meteor "trail"

There is no atmosphere, so no ion trail can ever be observed.

(c) Explain clearly the difference between a meteoroid and a meteorite.

A meteoroid is in orbit around the Sun. Only when it intersects the atmosphere of the Earth, and lands on the surface, does it become a meteorite.

(2)

Q13

(Total 5 marks)

13.(b) continued.

JF2 : to be read only by the heroes and heroines

Most meteors are about the size of a grain of rice, at a height of several tens of kilometres, and can never be visible.

The streak of light which is observed in the sky is an ion trail. Consider a meteor of mass 0·001 kg, travelling at 20000 m s^{-1}, just before it strikes the surface of the Earth.

" K.E. $= \frac{1}{2} m v^2$ "

$= 0 \cdot 5 \times (10^{-3}\,\text{kg}) \times (2 \times 10^{4}\,\text{m s}^{-1})^2$

$= 2 \times 10^{5}\,\text{J}$

This is the same as the K.E. of a car of mass 1000 kg, travelling at 50 m.p.h. (20 m s^{-1}) !

15

Leave blank

14. (a) Explain why it is dangerous to observe the Sun directly.

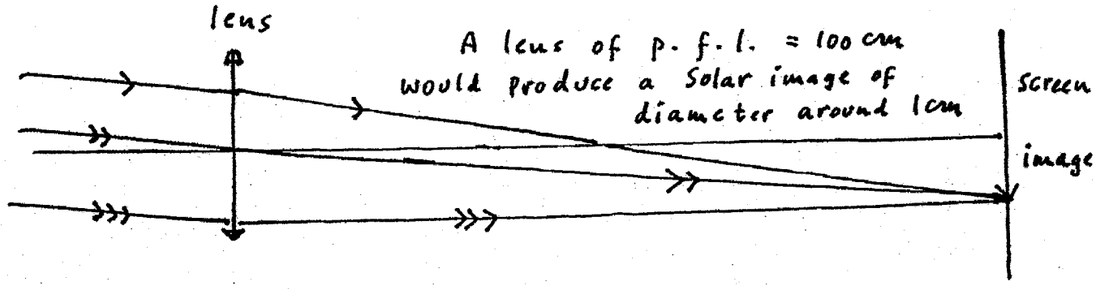
Both the light and considerable heat would damage the retina. .....

.....

(1)

(b) With the aid of a diagram, describe **one** method of safely observing the Sun.

Use a convex lens of long principal focal length, (say) the objective of a refracting telescope, to focus the real image of the Sun onto a screen.



.....

.....

(2)

(c) Describe how the Sun's energy is produced

The overall reaction involves four protons fusing, to form a single Helium nucleus. The mass difference between four protons and one Helium nucleus is 4.37×10^{-29} kg.

Using "$\Delta E = \Delta m . c^2$"

$= 4.37 \times 10^{-29}\ kg \times (3 \times 10^8\ m\ s^{-1})^2$

$= 3.9 \times 10^{-12}$ J each fusion of four protons.

(3)

(d) Which part of the Sun has the lowest temperature? Put a cross (☒) in the correct box.

core ☐ corona ☐ photosphere ☒ radiation zone ☐

(1)

(Total 7 marks)

Q14

16

Leave blank

15. (a) Two stars, α and β, have apparent magnitudes of –0.2 and +2.8 respectively.

By how many times does star α appear brighter than star β?

$\Delta m = 3.0 \quad \therefore \quad \Delta B = 15.6 \ (= (2.51)^3)$ .....

(2)

(b) A galaxy has an apparent magnitude of +14.5 and is 10 Mpc away from the Earth. Calculate the galaxy's absolute magnitude.

Use the formula $M = m + 5 - 5 \lg d$ where d is the distance in parsecs.

Using "$M = m + 5 - 5 \log_{10} d$" (I hate this formula!)

$M = 14.5 + 5 - 5 \log_{10} d$

Note that $\log_{10} 10000000 = 7$

$\therefore \quad M = 19.5 - 35$

$\therefore \quad M = -15.5$

.....

(3)

(Total 5 marks)

Q15

16. (a) Describe how astronomers obtain the spectrum of a star.

See 2.(c) on this Paper. The light from the star is refracted through a telescope and is then dispersed through a prism, resulting in a spectrum. The faintness of the light means that it will have to be amplified. .....

(3)

(b) The spectrum of a star contains absorption lines. Describe the appearance of absorption lines.

Dark lines, the positions of which indicate the elements | compounds, against the spectrum background. .....

(1)

(c) State **two** facts about a star that astronomers can deduce by analysing its spectrum.

1. Composition.
2. Rotational period: one limb receding and the other approaching. .....
3. Radial velocity.
4. Splitting of the lines.

(2)

(Total 6 marks)

Q16

Leave blank

17. In 1990, the surface of Venus was mapped using radar reflection.

(a) Which region of the electromagnetic spectrum was used?

Radio waves : λ between 1 cm and 100 m ..... (1)

(b) Name the space mission that mapped Venus.

Magellan. (Named after the famous explorer) ..... (1)

(c) Why was it not possible for astronomers to describe the surface of Venus before this mission?

The atmosphere of Venus is not transparent to the optical region of the E-M spectrum ∴ light could not reach the Earth from below the cloud layer. .... (1)

(d) At one point in its orbit, waves emitted from the space probe returned 0.0018 seconds later. Calculate the height of the probe above the surface of Venus at this time.

Use the formula speed = distance / time

The speed of light is 300 000 km/s

The time required for the pulse to reach the surface of Venus = 0·0009 s. .....

∴ the height of the probe = velocity of the pulse × time = $3 \times 10^8 \text{ m s}^{-1} \times 0{\cdot}0009 \text{ s}$ = $2{\cdot}7 \times 10^5$ m .... (3)

Q17

15 (b) continued. Definitely JF² [A totally unrealistic question)

10 Mpc is one million times greater than 10 pc, which is the criterion for Absolute Magnitude. At only 10pc, the galaxy would be one million times closer = 10^6 times closer.

∴ its brightness would become 10^{12} times greater.

We have to calculate what magnitude difference, Δm, would be required to produce a brightness difference of 10^{12}. That is, to which power would 2·51 have to be raised to give 10^{12} ?

So, $10^{12} = (2{\cdot}51)^{\Delta m}$ ——— ①

Leave blank

18. The Milky Way is a faint band of stars stretching across the sky.

(a) Explain why the Milky Way appears like this.

Light from the Milky Way emanates from the centre of the Galaxy, where the stars are too close to be resolved separately with the unaided eye. The observer is receiving light along the plane of the Galaxy. (2)

(b) State **one** factor that can make it difficult to observe the Milky Way on a clear night.

Mainly light pollution. Sometimes the Moon. (1)

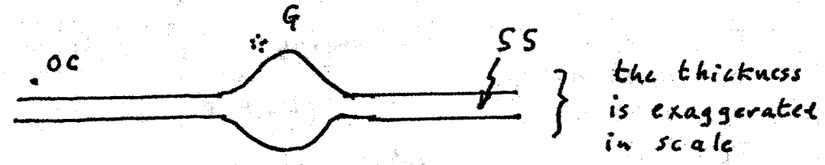
(c) Sketch a side view ot our galaxy. Indicate the position of:

(i) the Solar System (use **SS**)

(ii) a typical open cluster (use **OC**)

(iii) a typical globular cluster (use **G**)

The best-known open cluster is the Pleiades (the "seven sisters"), in Taurus



About 120 globular clusters are known, all of which are at great distances from the Galactic plane. In Britain, the only one visible with the naked eye is M13, in Hercules. It is far from bright.

13 (b) continued — JF² — yet again.

Using the theory of logarithms, and taking logarithms to both sides of ①:

$\log_{10} 10^{12} = \Delta m \cdot \log_{10} 2{\cdot}51$

$\therefore \quad \Delta m = \dfrac{\log_{10} 10^{12}}{\log_{10} 2{\cdot}51}$

$= \dfrac{12}{0{\cdot}40}$

$= 30$

∴ The galaxy at 10 pc would be 30 magnitudes brighter.

∴ M = +14·5 − 30

= −15·5

Leave blank

19. (a) Describe some of the evidence for the existence of planetary systems orbiting stars other than the Sun.

(1) The detection of planets due to their effects on the motion of the "parent" stars.
(2) 1995 saw the first direct evidence of a body of planetary mass orbiting a Main Sequence star: minute oscillations in the wavelength of spectral lines from the star (51 Pegasi, with a period of 4·2 days). ...
(3) Transit of the exoplanet, causing the star to "dim". (3)

(b) The table gives data for two planets orbiting a star.

planet	radius of orbit / AU	orbital period / days
A	0.42	40
B	1.68	

Calculate the orbital period of planet B.

Use the formula $(T_1 / T_2)^2 = (r_1 / r_2)^3$

T_1 = 40 days
r_1 = 0·42 A.U.
r_2 = 1·68 A.U.
T_2 = ?

Rearranging: $T_2^2 = \frac{T_1^2 \times r_2^3}{r_1^3}$ (planet B)

Using KIII:

$\frac{T_1^2}{r_1^3} = \frac{T_2^2}{r_2^3}$

Substituting:

$T_2^2 = \frac{(40\text{ days})^2 \times (1{\cdot}68\text{ A.U.})^3}{(0{\cdot}42\text{ A.U.})^3}$

$\therefore T_2^2 = \frac{1600\text{ days}^2 \times 4{\cdot}71\text{ A.U.}^3}{0{\cdot}076\text{ A.U.}^3}$

$= \frac{7500\text{ days}^2}{0{\cdot}076}$

$\approx 100000\text{ days}^2$

$\therefore T \approx \left[100000\text{ days}^2\right]^{\frac{1}{2}}$

≈ 312 days

The Mark Scheme gives 320 days. The discrepancy arises from the accuracy of my slide-rule where three decimal places are concerned.

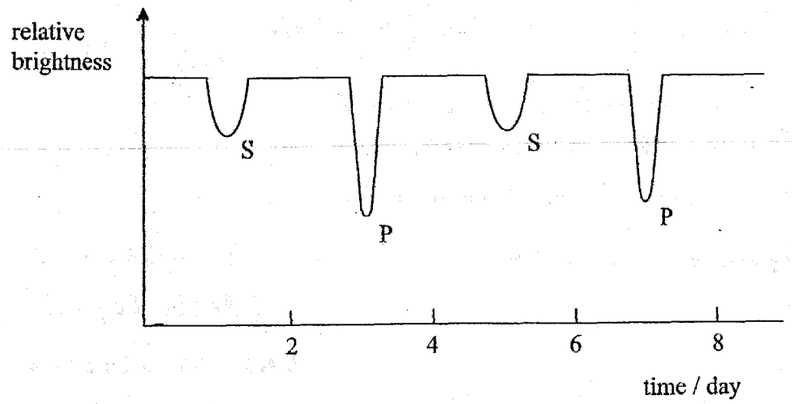
(3)

Q19

(Total 6 marks)

Leave blank

20. (a) The diagram shows the light curve for an eclipsing binary star.



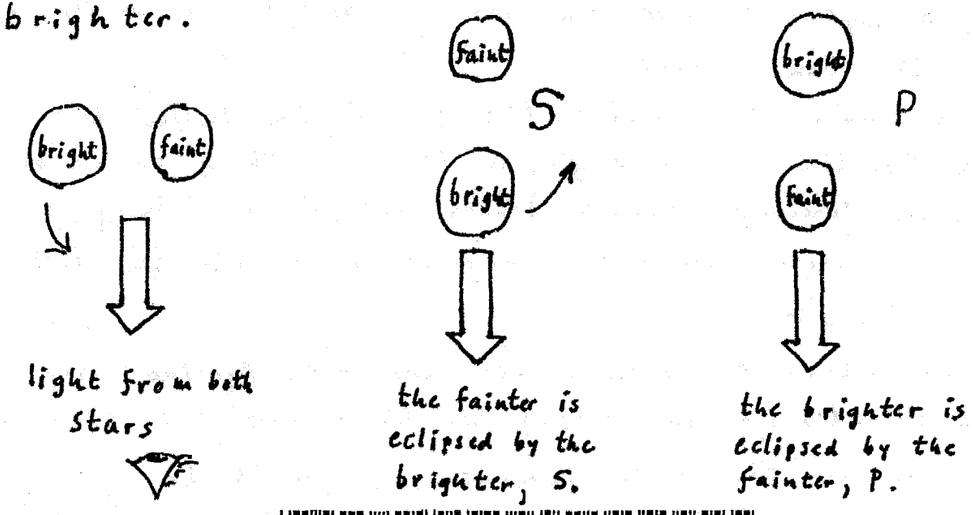
(i) Determine the orbital period of the binary star.

Four days .....

(ii) With the aid of a diagram, explain how dips P and S occur.

There are two components, one considerably brighter than the other, completing one revolution around their common centre of gravity.

The angle from which the system is viewed is such that the fainter star passes regularly in front of the brighter. There is a small secondary minimum, when the fainter is eclipsed by the brighter.



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(b) State the difference between a **binary** star and an **optical double** star.

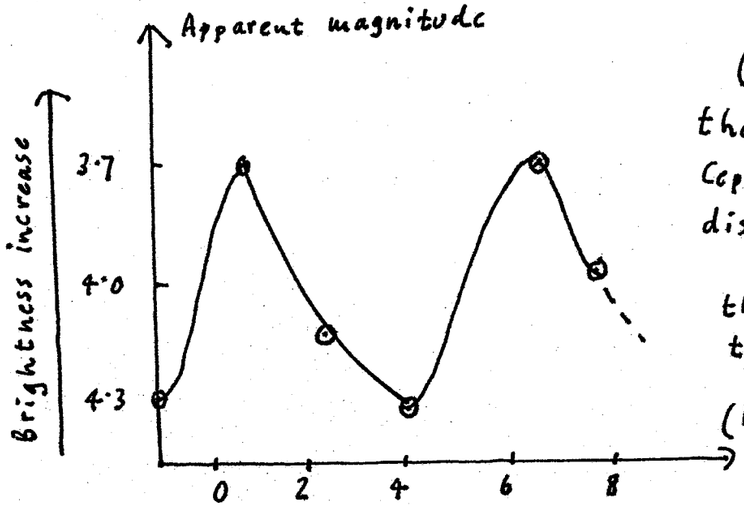
Binary: a system comprising two components, physically associated (in a "gravitational embrace"). .....

Double: Can be optical, due to a line-of-sight effect. .....

(2)

(c) (i) Sketch the light curve for a Cepheid variable.

JF2



δ Cephei (Delta Cephei), the prototypical Cepheid variable star, discovered in 1784. The magnitude range for this star is from 4·4 to about 3·7. Its period is 5·3 days and is totally regular.

(ii) Explain how the light curve of a Cepheid variable can be used to determine its distance.

Cepheids are giant stars, and are common in the Galaxy. What makes them so important is that their periods are linked with their luminosities. That is, a Cepheid with a period of 5·3 days will have the same luminosity as another Cepheid with the same period.

The longer the period, the greater the luminosity: thus, Eta Aquilae, in the Eagle, a Cepheid with a period of 7·2 days, is more luminous (powerful) than Delta Cephei. Once we know the luminosity and the apparent magnitude, the distance can be calculated.

To return to Delta Cephei and Eta Aquilae: the apparent magnitudes (brightnesses) are the same, but since Eta Aquilae is the more luminous, it must be the more remote. Cepheids act as →

(4)

(Total = 10)

our "standard candles", and have been of immense value, because they have been seen in other galaxies, as well as our own. They are old stars, usually of spectral types F and G, and they are pulsating, so that they swell and shrink regularly. A better-known example is Polaris, the North pole star.

The period-luminosity relationship was discovered in 1908, by Harvard astronomer, Henrietta Swan Leavitt. Her observational work, which established her as a Titan in the field, was based on Cepheids in the Magellanic Clouds, which are really part of our Galaxy. Cepheids were vital in the critical rôle of enabling astronomers to deduce the size of the Milky Way, and distances of galaxies beyond our own. In 1924, Edwin Powell Hubble used them to calculate the distance to the Andromeda galaxy (M31), showing clearly that it lay beyond the Milky Way. Cepheids have played a key part in measurements of the expansion of the Universe, using Edwin Hubble's Law. That is

$$v \propto d \quad \text{or} \quad "v = H_0 d"$$

Where v is the velocity of recession of the galaxy, d is its distance and H_0 is the Hubble Parameter.

Cepheids are one type of intrinsically variable star. Such stars physically deform to produce variability. In the case of Cepheids, it is through pulsation.

Apparent and Absolute magnitudes of the star are related using the Distance Modulus Expression:

I dislike expresions "pulled out of the hat"

$$M = m + 5 - 5 \log_{10} d$$

The derivation of this is based on the Inverse-