AQA GCSE Physics | 8463

SPECIFICATION POINT 4.6.2.6

Visible light (physics only)

Past-paper questions

Tier	**Higher**
Question groups	**37**
Available paper years	**2005–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.6.2.6 Visible light (physics only)

Question 01

June 2005 | 3451 | Original Q10 | Legacy

10 (a) Information transmitted through an optical fibre communications system is sent as a digital signal.

(i) Name **one** type of electromagnetic wave, other than visible light, used to carry information through an optical fibre.

.....

(1 mark)

(ii) What is a digital signal?

.....

.....

(1 mark)

(b) Information can be sent as an analogue signal. The signals weaken with distance and need to be amplified.
Explain why this causes the quality of the signal to deteriorate.

.....

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(3 marks)

(c) Microwaves are used to send information within mobile phone networks.

Explain how microwaves could be harmful to living cells.

.....

.....

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.....

(2 marks)

7

4.6.2.6 Visible light (physics only)

Question 02

June 2005 | 3462 | Original Q8 | Legacy

8 (a) Information transmitted through an optical fibre communications system is sent as a digital signal.

(i) Name **one** type of electromagnetic wave, other than visible light, used to carry information through an optical fibre.

.....

(1 mark)

(ii) What is a digital signal?

.....

.....

(1 mark)

(b) Information can be sent as an analogue signal. The signals weaken with distance and need to be amplified.
Explain why this causes the quality of the signal to deteriorate.

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(3 marks)

(c) Microwaves are used to send information within mobile phone networks.

Explain how microwaves could be harmful to living cells.

.....

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.....

(2 marks)

7

4.6.2.6 Visible light (physics only)

Question 03

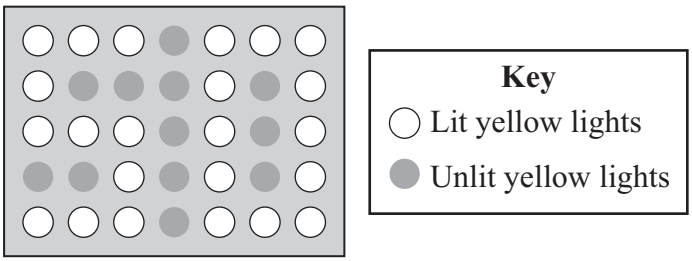
November 2006 | PHY1B | Original Q3 | Legacy

QUESTION THREE

Vehicles on motorways often travel at high speeds. It is important that clear warning signs are used.

Tests were carried out to find the most suitable colour for the lights in the warning sign.

The drawing shows a sign which has yellow lights.



3A Suggest why yellow light is used for the sign.

1 It has a higher frequency than all other colours.

2 It has a longer wavelength than all other colours.

3 It is easier to see than all other colours.

4 It travels faster than all other colours.

3B What determines the colour of the light from the display?

1 its brightness

2 its frequency

3 its power

4 its speed in a vacuum

4.6.2.6 Visible light (physics only)

Question 03 · continued

3C The wavelength of red light is 700 nm and the wavelength of violet light is 300 nm.

What is the likely value of the wavelength of the yellow light from the sign?

1 350 nm

2 450 nm

3 600 nm

4 750 nm

3D The warning sign is switched on by sending a radio signal. The frequency of the signal is 2 000 000 hertz and its wavelength is 150 metres.

Calculate the wave speed of the signal in metres/second.

wave speed = **frequency** × **wavelength**

1 13 333 m/s

2 1 333 333 m/s

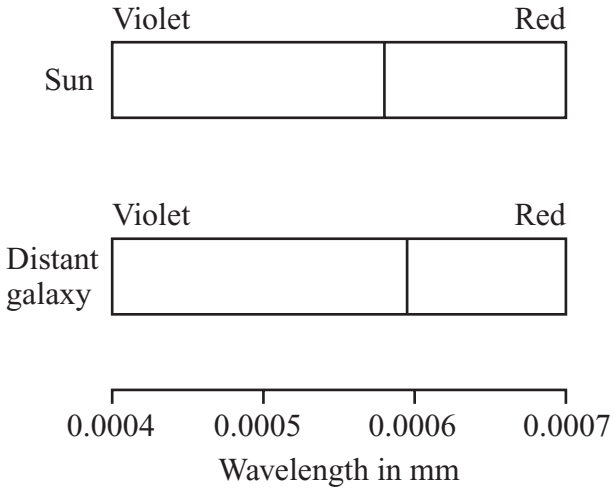
3 300 000 000 m/s

4 3 000 000 000 m/s

4.6.2.6 Visible light (physics only)

Question 04

3 The visible part of the electromagnetic spectrum from a star includes a dark line. This line is at a specific wavelength. The diagram shows the position of the dark line in the spectrum from the Sun and in the spectrum from a distant galaxy.



(a) Explain how the spectrum 'shift' of the dark line supports the theory that the Universe began from a very small point.

.....

.....

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(3 marks)

Question 3 continues on the next page

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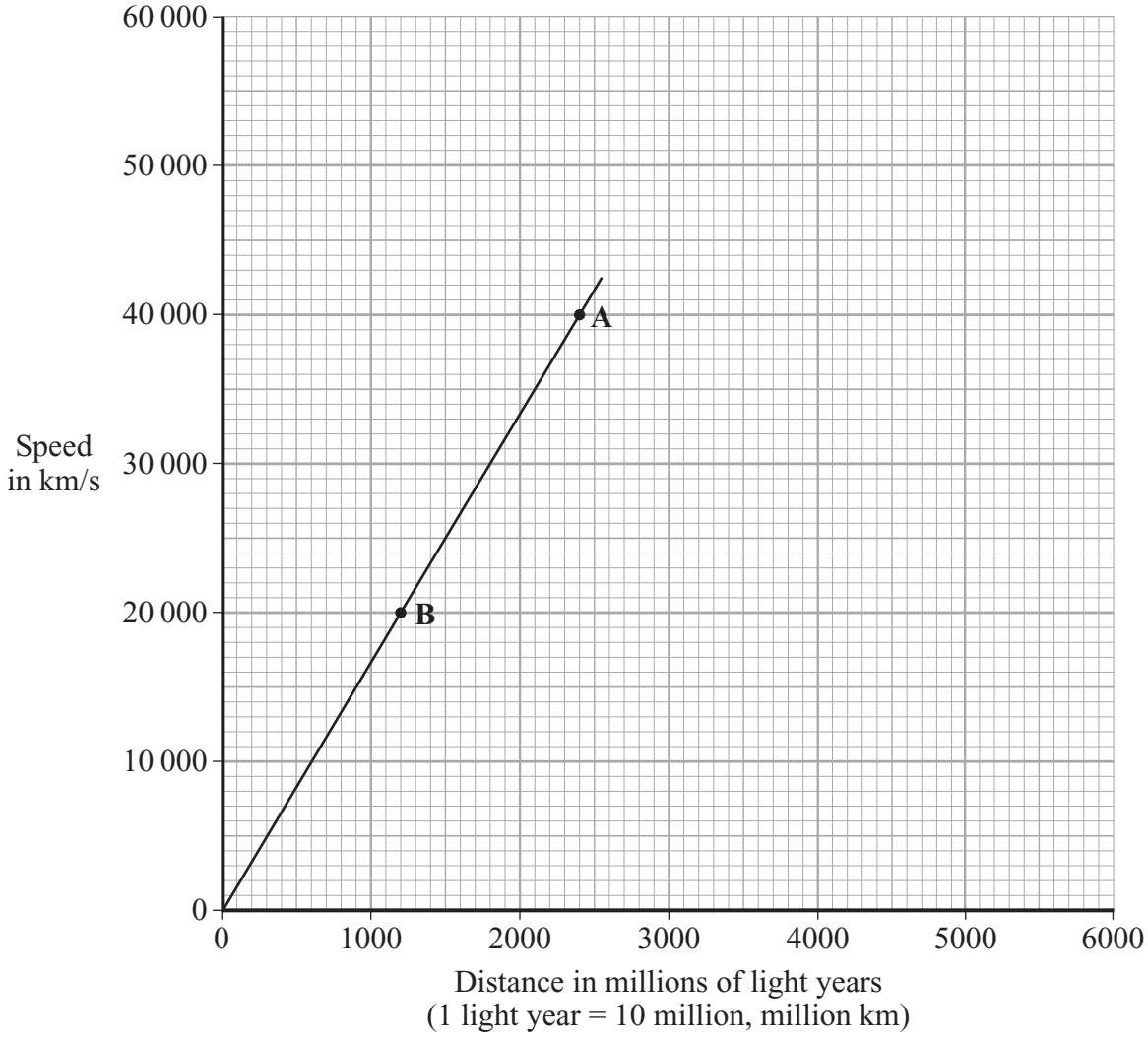
(b) From data collected, a graph can be drawn that links the speed of a galaxy with the distance of the galaxy from the Earth.



(i) How does the visible light spectrum from galaxy **A** look different from the visible light spectrum from galaxy **B**?

.....

.....

(1 mark)

4.6.2.6 Visible light (physics only)

Question 04 · continued

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(ii) A third galaxy, **C**, seems to be travelling away from the Earth at about 60 000 km/s.

Estimate how far galaxy **C** might be from the Earth, showing how you use the graph to do this.

.....

.....

Distance between galaxy **C** and the Earth = ... million light years

(2 marks)

(c) Astronomers use telescopes to observe distant galaxies. Since 1990 the Hubble optical telescope has been in orbit around the Earth.

Explain why an optical telescope in space allows astronomers to see further and more clearly than an optical telescope on Earth.

.....

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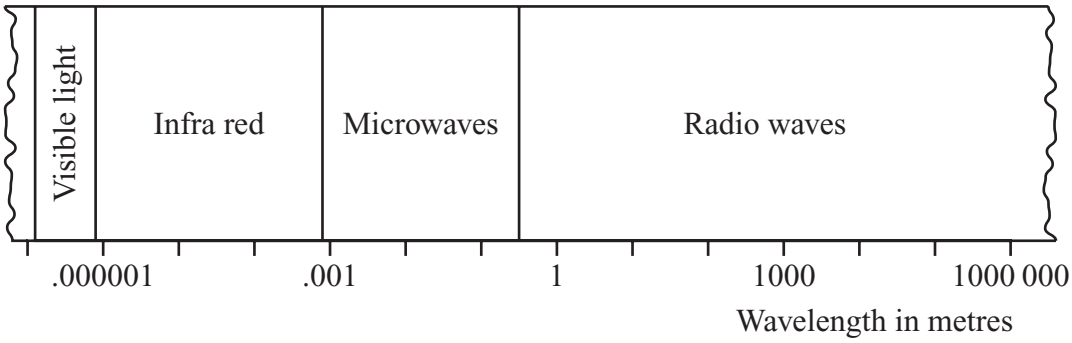
(2 marks)

8

4.6.2.6 Visible light (physics only)

Question 05

5 (a) The diagram represents part of the electromagnetic spectrum.



(i) Visible light travels through air at 300 000 000 m/s.

Why can we assume that radio waves travel through air at the same speed as light?

.....

(1 mark)

(ii) A radio station broadcasts at a frequency of 200 kHz.

Use the following equation to calculate the wavelength of the waves broadcast by this radio station. Show clearly how you work out your answer.

wave speed = frequency × wavelength

.....

.....

Wavelength = ... m

(2 marks)

(iii) Draw a vertical line on the diagram above to show the position of this radio wave in the electromagnetic spectrum.

(1 mark)

(b) Many radio stations now broadcast digital signals instead of *analogue* signals.

(i) What is an *analogue* signal?

.....

(1 mark)

4.6.2.6 Visible light (physics only)

Question 05 · continued

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(ii) Give **one** reason why a radio station would broadcast digital signals instead of analogue signals.

.....

.....

(1 mark)

(c) A student thinks that because energy cannot be destroyed it is not possible to waste energy. So he leaves his radio, TV and computer on all the time, even when there is no one in the house.

Explain why he is wrong about not being able to waste energy.

.....

.....

.....

.....

(2 marks)

8

4.6.2.6 Visible light (physics only)

Question 06

June 2007 | PHY1B | Original Q7 | Legacy

QUESTION SEVEN

This question is about the transmission of light by optical fibres.

7A Optical fibres can bend light around corners without loss of signal.

This is because . . .

1 absorption of the signal occurs in the optical fibre.

2 following signals push the signals around the corners.

3 reflection of the signal occurs inside the optical fibre.

4 light signals are digital signals.

7B Infra red and visible light are used to send signals along optical fibres.

Compared with other electromagnetic radiations, infra red and visible light . . .

1 have similar frequencies and wavelengths.

2 have very high frequencies and very high wavelengths.

3 have very low frequencies and very low wavelengths.

4 travel at different speeds.

7C Communication by electromagnetic radiation may be by analogue signals.

Which row of the table correctly describes the characteristics of these analogue signals?

	Speed	Signal type
1	constant	continuously varying
2	constant	only on or off
3	varies	continuously varying
4	varies	only on or off

4.6.2.6 Visible light (physics only)

wave speed (metre/second, m/s)	=	frequency (hertz, Hz)	×	wavelength (metre, m)

7D An infra red wave has a wavelength of 0.001 m and a wave speed of 300 000 000 m/s.

The frequency of this wave is:

1 3 Hz

2 30 Hz

3 30 000 Hz

4 300 000 000 000 Hz

Turn over for the next question

4.6.2.6 Visible light (physics only)

Question 07

November 2007 | PHY1B | Original Q2 | Legacy

QUESTION TWO

The table gives typical frequencies for different types of electromagnetic radiation.

Match the names of the types of electromagnetic radiation, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

A infra red radiation

B ultraviolet radiation

C visible light

D X-rays

Type of electromagnetic radiation	Typical frequency in Hz
1	100 000 billion
2	1 000 000 billion
3	10 000 000 billion
4	100 000 000 billion

4.6.2.6 Visible light (physics only)

Question 08

January 2008 | PHY1H | Original Q5 | Legacy

5 (a) The wavelengths of four different types of electromagnetic wave, including visible light waves, are given in the table.

Type of wave	Wavelength
Visible light	0.0005 mm
A	1.1 km
B	100 mm
C	0.18 mm

Which of the waves, **A**, **B** or **C**, is an infra red wave? .....

(1 mark)

(b) A TV station broadcasts at 500 000 kHz. The waves travel through the air at 300 000 000 m/s.

Use the equation in the box to calculate the wavelength of the waves broadcast by this station.

wave speed = frequency × wavelength

Show clearly how you work out your answer.

.....

.....

Wavelength = ... m

(2 marks)

(c) What happens when a metal aerial absorbs radio waves?

.....

.....

.....

.....

(2 marks)

4.6.2.6 Visible light (physics only)

Question 08 · continued

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(d) Stars emit all types of electromagnetic waves. Telescopes that monitor X-rays are mounted on satellites in space.

Why would an X-ray telescope based on Earth not be able to detect X-rays emitted from distant stars?

.....

.....

(1 mark)

6

Turn over for the next question

4.6.2.6 Visible light (physics only)

Question 09

March 2008 | PHY1BP | Original Q2 | Legacy

QUESTION TWO

The electromagnetic spectrum is continuous but the wavelengths within it can be grouped into types.

Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A gamma rays

B radio waves

C ultraviolet waves

D visible light

The type of electromagnetic radiation which can be used to send signals along optical fibres is . . . **1** . . . .

The type of electromagnetic radiation which has the highest frequency is . . . **2** . . . .

The type of radiation that has the longest wavelength is . . . **3** . . . .

The type of electromagnetic radiation used in sunbeds for tanning is . . . **4** . . . .

4.6.2.6 Visible light (physics only)

Question 10

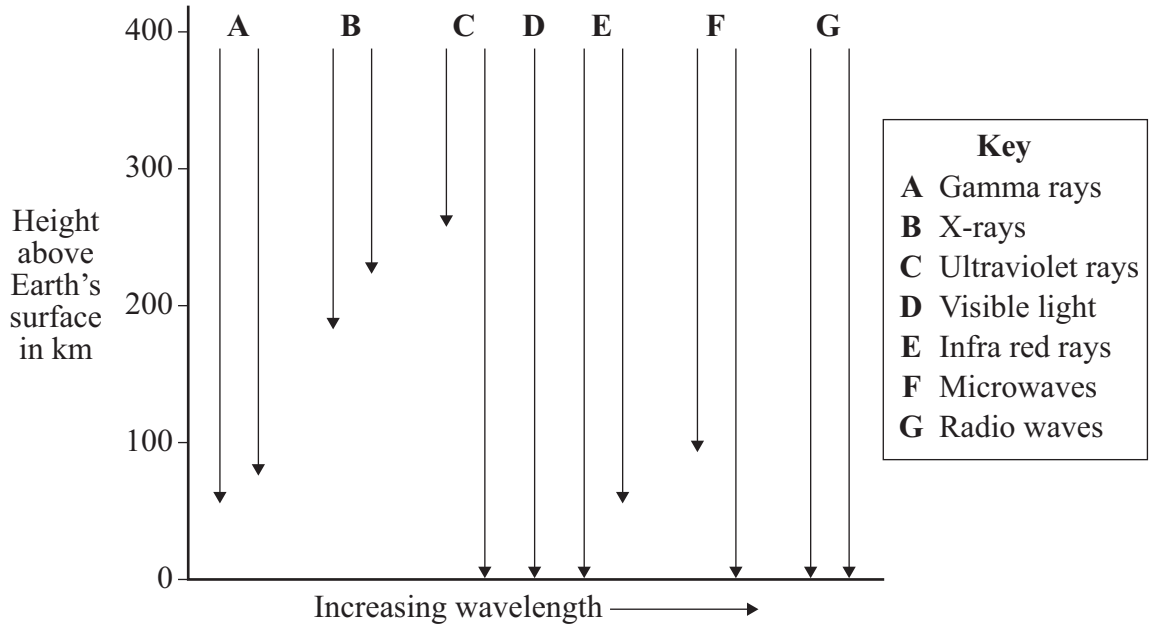
March 2008 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

All forms of electromagnetic radiation from space are used by scientists to explore the Universe.

The diagram shows how far electromagnetic waves can penetrate the Earth's atmosphere.

Where two arrows are shown for a type of electromagnetic radiation, longer and shorter waves penetrate the atmosphere to different depths.



9A Which one of the following statements is true?

1 Gamma radiation penetrates the atmosphere further than all other types of electromagnetic radiation.

2 All frequencies of microwaves reach Earth's surface.

3 No frequencies of radio waves reach Earth's surface.

4 Higher frequencies of ultraviolet radiation are completely absorbed by the atmosphere.

9B What would be the minimum height above the Earth for a satellite carrying a telescope designed to detect gamma rays and X-rays of all wavelengths?

1 50 km

2 70 km

3 180 km

4 230 km

4.6.2.6 Visible light (physics only)

9C Which one of the following correctly describes the data on the diagram?

1 The absorption of electromagnetic radiation by the atmosphere is directly proportional to wavelength.

2 The absorption of electromagnetic radiation by the atmosphere is inversely proportional to wavelength.

3 The shorter the wavelength of electromagnetic radiation, the greater the absorption by the atmosphere.

4 Absorption of electromagnetic radiation does **not** depend only on wavelength.

9D Electromagnetic radiation from distant galaxies is very weak and is therefore very difficult to detect.

The Spitzer space telescope uses liquid helium to keep its scientific instruments at a very low temperature.

Which type of weak electromagnetic radiation would best be detected by instruments kept at this very low temperature?

1 gamma rays

2 X-rays

3 infra red rays

4 ultraviolet rays

END OF TEST

4.6.2.6 Visible light (physics only)

Question 11

June 2008 | PHY1BP | Original Q5 | Legacy

QUESTION FIVE

The table gives information about some telescopes.

Name of telescope	Arecibo	COBE	Spitzer	Keck	Hopkins
Type of radiation detected	radio waves	microwaves	infra red	visible light	ultraviolet
Location of telescope	on the Earth's surface	in space	in space	high on the Earth's surface	in space

5A Why is the Keck telescope located high on the Earth's surface?

1 so that astronomers are not disturbed

2 it is cheaper to build in this location

3 to be closer to the stars it is observing

4 to be above clouds and dust in the Earth's atmosphere

5B The Hopkins telescope is located in space . . .

1 so that the astronomers are not exposed to ultraviolet radiation.

2 because not all ultraviolet radiation penetrates the Earth's atmosphere.

3 to be closer to the stars it is observing.

4 because there is not enough land on the Earth to build telescopes.

5C Which of the telescopes in the table might provide evidence of the red-shift of light from distant galaxies?

1 COBE

2 Spitzer

3 Keck

4 Hopkins

5D The longer the wavelength of the radiation being absorbed, the larger the telescope needs to be.

Which telescope is the largest?

1 Arecibo

2 Spitzer

3 Keck

4 Hopkins

Turn over for the next question

4.6.2.6 Visible light (physics only)

Question 12

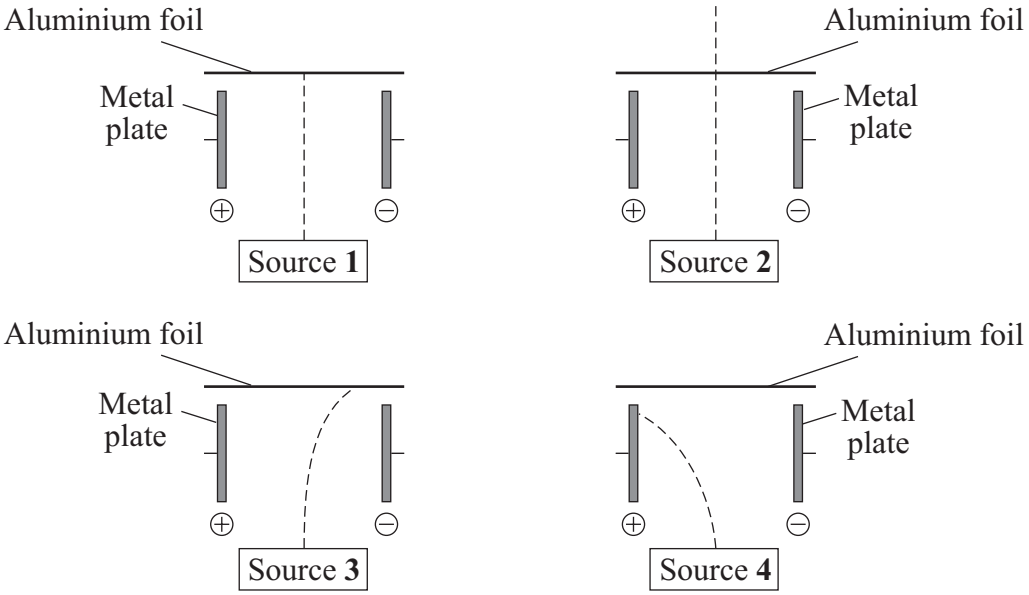
November 2008 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

Radiation from four sources, **1**, **2**, **3** and **4**, is directed into an electric field between two metal plates.

There is a sheet of aluminium foil after the gap between the metal plates.

Light waves are not deflected in electric fields.



In each diagram, the dashed line (----------) shows the path of the radiation.

Match the types of radiation, **A**, **B**, **C** and **D**, with the sources **1–4**.

A alpha radiation

B beta radiation

C gamma radiation

D visible light

4.6.2.6 Visible light (physics only)

Question 13

November 2008 | PHY1BP | Original Q6 | Legacy

QUESTION SIX

The tables show the types of radiation observed by different telescopes, and the types of radiation emitted by different parts of the universe.

Name of telescope	Type of radiation
Arecibo	Radio
COBE	Microwave
Hess	Gamma
Hopkins	Ultraviolet
Keck	Visible light
Spitzer	Infra red
XMM Newton	X-rays

Origin of radiation in universe	Main radiation emitted
Pulsars	Radio
Neutron stars	X-rays
Nebulae	Infra red
Stars	Visible light
Gamma ray bursts	Gamma
Big bang	Microwaves

6A Which telescope could be used to hunt for neutron stars in galaxies?

1 Arecibo

2 Spitzer

3 Hopkins

4 XMM Newton

6B Which telescope could be used to analyse the radiation of the universe left over from the 'big bang'?

1 COBE

2 Spitzer

3 Keck

4 Hopkins

4.6.2.6 Visible light (physics only)

6C Which one of the following emits the longest wavelength radiation?

1 Gamma ray bursts

2 Neutron stars

3 Pulsars

4 Stars

6D Which one of the following emits radiation with the highest frequency?

1 Nebulae

2 Neutron stars

3 Pulsars

4 Stars

Turn over for the next question

4.6.2.6 Visible light (physics only)

Question 14

November 2008 | PHY1BP | Original Q8 | Legacy

QUESTION EIGHT

This question is about two space telescopes.

The Hubble space telescope orbits the Earth at a distance of 569 km and detects visible light.

The James Webb space telescope is planned to be launched some time after 2013 and will orbit at about 1.5 million kilometres from the Earth and will detect infra red frequencies (rays).

8A The main advantage of the Hubble telescope being so far from Earth is the improvement in image quality.

This improvement is because . . .

1 there is little atmosphere to distort the data being received.

2 there is no light pollution from cities.

3 there is no gravity to distort the mirror in the telescope.

4 there is no need for access for service or repairs to the mirror in the telescope.

8B The James Webb space telescope should be able to receive data from distant galaxies billions of light years away from the Earth. It is shielded from the Sun to keep it at a temperature of –225°C and will contain a large mirror.

The reason that it is designed to detect infra red frequencies is that . . .

1 all the radiation emitted by the galaxies is in the infra red region of the spectrum.

2 infra red radiation can be detected in the dark.

3 much of the radiation we receive from galaxies is at infra red frequencies due to a significant red-shift.

4 we receive only infra red radiation from the galaxies.

8C The major reason for keeping the mirror so cold is to . . .

1 avoid the need to carry extra fuel to heat it.

2 keep it rigid.

3 minimise the infra red radiation from it which would confuse the data being collected.

4 stop it from melting.

4.6.2.6 Visible light (physics only)

Question 14 · continued

8D There are also radio telescopes on Earth.
The longer the wavelength of the radiation being absorbed, the larger a telescope needs to be.

Which row in the table gives the correct order of size for the telescopes?

	Smallest ← → **Largest**		
1	James Webb telescope	Hubble telescope	Radio telescope
2	Radio telescope	James Webb telescope	Hubble telescope
3	Hubble telescope	James Webb telescope	Radio telescope
4	Hubble telescope	Radio telescope	James Webb telescope

Turn over for the next question

4.6.2.6 Visible light (physics only)

Question 15

March 2009 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

Ultraviolet radiation is next to X-rays in the electromagnetic spectrum. Ultraviolet radiation consists of three regions: UVA, UVB, and UVC, as shown in the table.

	UVA	UVB	UVC	X-rays	

9A The UVA region of the spectrum has wavelengths between 315 and 400 nm. The visible light region of the spectrum extends to wavelengths of 700 nm.

In what wavelength region will violet light be found?

1 nanometre, 1 nm = 0.000 000 001 metre

1 360 – 400 nm

2 400 – 430 nm

3 620 – 700 nm

4 700 – 760 nm

9B Different types of electromagnetic radiation will penetrate materials to different depths. UVA will penetrate the top and middle layers of human skin. UVB will penetrate the top layer only.

This is surprising because gamma rays . . .

1 penetrate less than X-rays and have a lower frequency than X-rays.

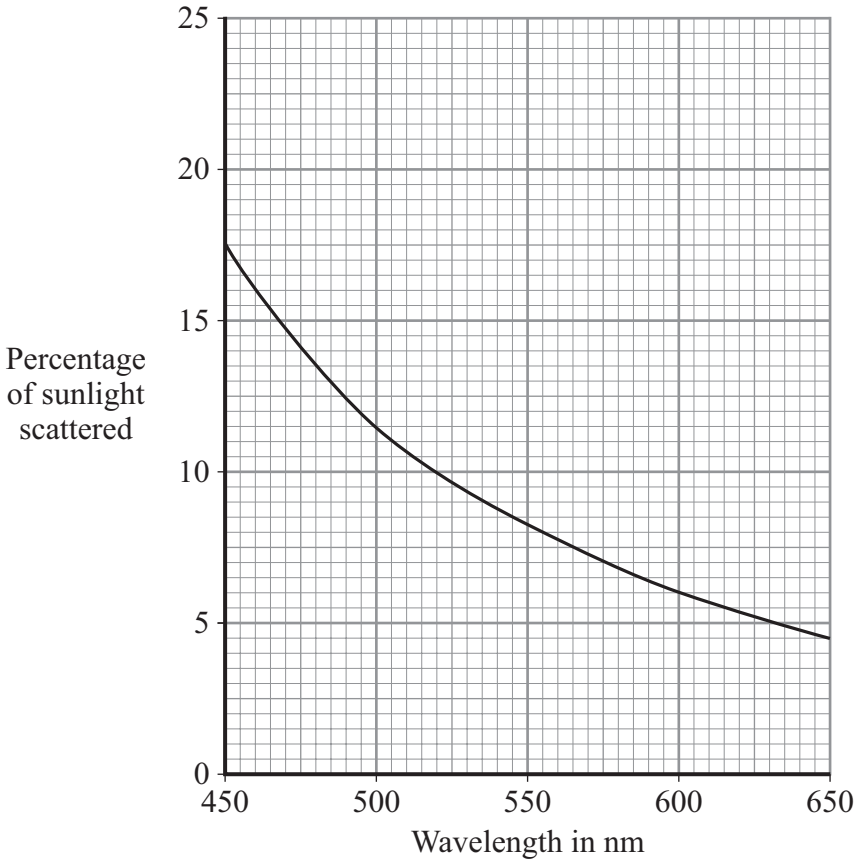
2 penetrate less than X-rays and have a higher frequency than X-rays.

3 penetrate more than X-rays and have a shorter wavelength than X-rays.

4 penetrate more than X-rays and have a longer wavelength than X-rays.

Question 15 · continued

9C The scattering of sunlight by the atmosphere causes the daylight colour of the sky to be blue. The graph shows how the scattering of sunlight changes with the wavelength.



What percentage of direct sunlight reaches the Earth **unscattered** at a wavelength of 500 nm?

1 11.5%

2 37.5%

3 62.5%

4 88.5%

9D How much scattering would you expect from ultraviolet rays?

1 less scattering than from visible light because ultraviolet rays have a lower frequency than visible light.

2 less scattering than from visible light because ultraviolet rays travel more slowly than visible light.

3 more scattering than from visible light because ultraviolet rays have a shorter wavelength than visible light.

4 the same scattering as from visible light because they both travel at the same speed.

END OF TEST

4.6.2.6 Visible light (physics only)

Question 16

June 2009 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

Electromagnetic radiation can be grouped into types. Each type has a different range of wavelengths.

Match types of radiation, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

A microwaves

B X-rays

C visible light

D radio waves

gamma rays	Shortest wavelength
... **1** ...	
ultraviolet rays	
... **2** ...	
infra red rays	
... **3** ...	
... **4** ...	Longest wavelength

4.6.2.6 Visible light (physics only)

Question 17

June 2009 | PHY1BP | Original Q7 | Legacy

QUESTION SEVEN

Some types of electromagnetic radiation from space are absorbed by the Earth's atmosphere.

	Short wavelength radio	Short wavelength microwaves	Infra red	Visible light	Ultraviolet	X-rays	Gamma rays
Percentage absorbed by atmosphere	0	95	96	5	98	100	100

Different objects or events in the universe emit different types of electromagnetic radiation.

	Gamma ray bursts	Nebulae	Pulsars	Stars	Universe background radiation
Radiation emitted	gamma rays	infra red	radio	all types	short wavelength microwaves

The planets and moons of the solar system reflect light from the Sun.

7A Early civilisations observed the sky with the naked eye.

Which objects did they see?

1 moons, nebulae and pulsars

2 gamma ray bursts, moons and planets

3 nebulae and pulsars

4 moons, planets and stars

7B Telescopes that could detect electromagnetic waves of the lowest frequency were built in the 20th century. These telescopes are on the surface of the Earth.

From the information in the tables, which of the following, which could not have been observed before, could then be easily observed from the Earth's surface?

1 pulsars

2 gamma ray bursts

3 nebulae

4 stars

4.6.2.6 Visible light (physics only)

Question 17 · continued

7C In 1989, the background radiation from the universe was mapped from a telescope in space.

Why was this **not** done with telescopes based on Earth?

1 Because only 2% of ultraviolet radiation penetrates Earth's atmosphere.

2 Because only 4% of infra red radiation penetrates Earth's atmosphere.

3 Because only 5% of short wavelength microwave radiation penetrates Earth's atmosphere.

4 Because only 95% of visible radiation penetrates Earth's atmosphere.

7D The first table suggests that, with the exception of . . .

1 radio, the percentage of radiation absorbed by the atmosphere, increases with increasing wavelength.

2 radio, the percentage of radiation absorbed by the atmosphere, decreases with increasing wavelength.

3 visible light, the percentage of radiation absorbed by the atmosphere, increases with increasing wavelength.

4 visible light, the percentage of radiation absorbed by the atmosphere, decreases with increasing wavelength.

4.6.2.6 Visible light (physics only)

Question 18

June 2009 | PHY1H | Original Q1 | Legacy

1 (a) The table lists the names of seven telescopes. Each one of the telescopes is designed to detect a different one of the seven types of electromagnetic wave.
The table is incomplete.

Name of telescope	Type of wave detected
HESS	Gamma
XMM Newton	X-ray
FUSE	Ultraviolet
William Herschel	Visible light
Spitzer	
SPT	Microwave
Lovell	Radio

1 (a) (i) Which **one** of the telescopes is designed to detect the type of wave with the shortest wavelength?

.....

(1 mark)

1 (a) (ii) What type of wave is the Spitzer telescope designed to detect?

.....

(1 mark)

1 (b) The William Herschel telescope is on the Earth's surface. Another telescope, the Hubble telescope, which also detects visible light, orbits the Earth.

How is the image produced by the Hubble telescope better than the image produced by the William Herschel telescope?

.....

Give a reason for your answer.

.....

.....

(2 marks)

4.6.2.6 Visible light (physics only)

Question 18 · continued

for mark

1 (c) Some types of electromagnetic wave are absorbed by water.
The SPT telescope is located in the Antarctic, which is a dry environment.

Explain why it is better to have this type of telescope in a dry environment rather than in a wet, humid environment.

.....

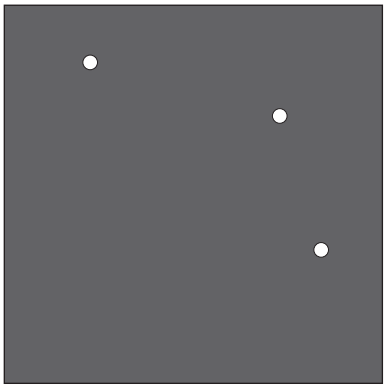
.....

.....

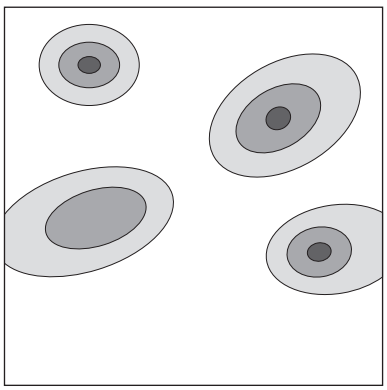
.....

(2 marks)

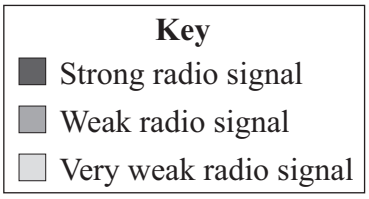
1 (d) The pictures represent the images produced using a visible light telescope and a radio telescope. Both images are of the same part of the sky. The shading on the radio telescope image represents the strength of the radio signals.



Visible light image



Radio telescope image



Suggest what extra information can be gained from the radio telescope image compared with the visible light image.

.....

.....

(1 mark)

7

4.6.2.6 Visible light (physics only)

Question 19

November 2009 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

Visible light from space can be gathered and focused by optical telescopes.

9A Optical telescopes used to observe objects in space are limited because they can only be used . . .

1 as ground-based telescopes.

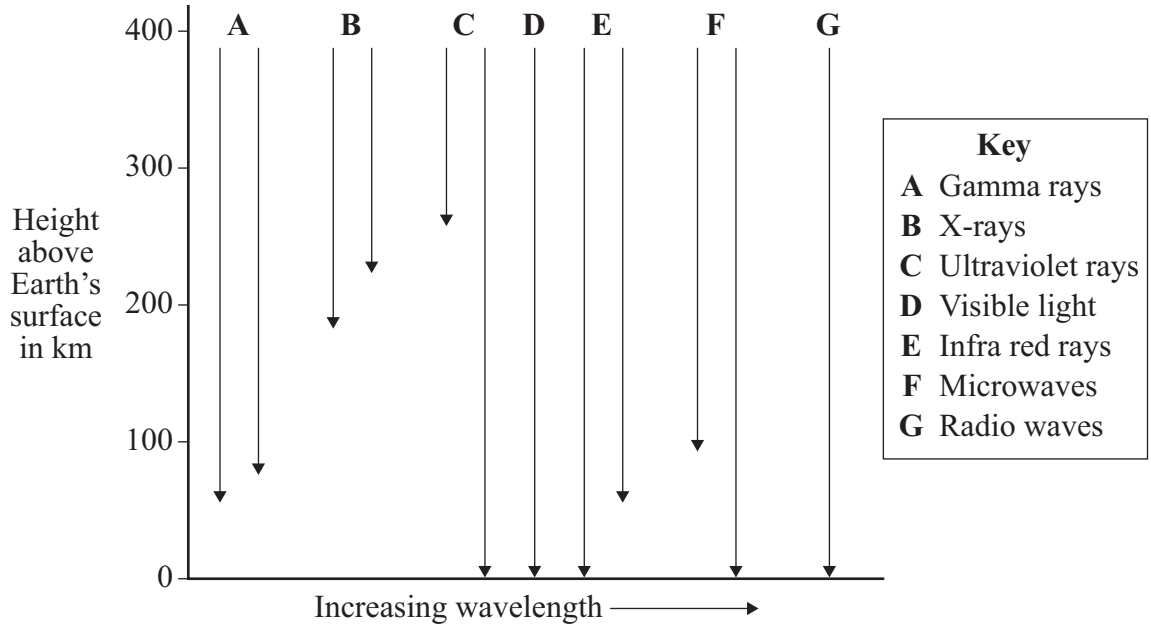
2 at night.

3 to observe a small region of the electromagnetic spectrum.

4 to observe one region of the sky.

The diagram shows how far electromagnetic waves can penetrate the Earth's atmosphere.

Where two arrows are shown for a type of electromagnetic radiation, longer and shorter waves penetrate the atmosphere to different depths.



9B Radio telescopes are sited on the ground.

This is because radio waves . . .

1 are emitted by many stars.

2 can penetrate the atmosphere.

3 have a shorter wavelength than microwaves.

4 have more energy than infra red waves.

4.6.2.6 Visible light (physics only)

Question 19 · continued

9C The types of radiation collected by four telescopes, **M**, **N**, **P** and **Q**, are given in the table.

Telescope	Radiation collected
M	infra red waves
N	gamma rays
P	X-rays
Q	microwaves

Which telescopes could be operated from an aircraft flying at an altitude of 12 km?

1 **M** and **N**

2 **N** and **P**

3 **P** and **Q**

4 **Q** and **M**

9D What is the minimum height above the Earth for a satellite to be able to use telescope **P**?

1 50 km

2 70 km

3 180 km

4 250 km

END OF TEST

4.6.2.6 Visible light (physics only)

Question 20

March 2010 | PHY1BP | Original Q7 | Legacy

QUESTION SEVEN

Some of the world's best telescopes are placed on the tops of mountains. These telescopes detect infra red and visible light waves from distant stars and galaxies.

Some space telescopes detect X-rays from these galaxies. These telescopes are placed above the Earth's atmosphere.

7A The Hubble Space Telescope (HST) has been in orbit around the Earth since 1990. The HST is an optical telescope.

What is the advantage of placing the HST in orbit around the Earth?

1 Light, gathered by the HST, has not been distorted by the atmosphere.

2 Once the HST goes into orbit, it costs nothing to run.

3 The HST can observe the whole sky in one orbit.

4 The HST picks up clearer pictures because it is nearer to space.

7B A ground-based telescope could not detect X-rays from space because . . .

1 there are no X-rays in space.

2 the Earth's atmosphere absorbs X-rays.

3 X-rays are harmful to people.

4 X-rays are digital signals.

7C The longer the wavelength of the radiation being received, the larger the diameter of the receiving dish of the telescope needs to be.

The telescopes with the largest dishes are those detecting . . .

1 gamma rays.

2 radio waves.

3 visible light.

4 X-rays.

4.6.2.6 Visible light (physics only)

Question 20 · continued

7D Images of distant galaxies produced by the Hubble telescope provide evidence to support the idea that the universe . . .

1 has a definite edge.

2 is contracting.

3 is expanding.

4 is neither expanding nor contracting.

Turn over for the next question

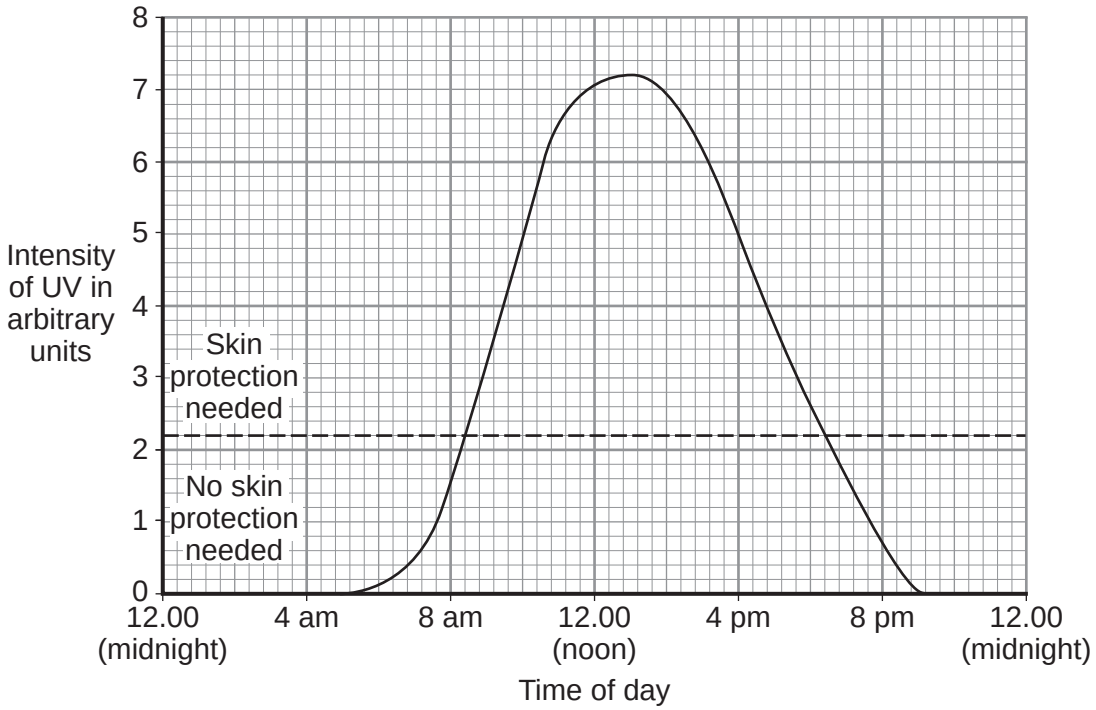
4.6.2.6 Visible light (physics only)

Question 21

June 2010 | PHY1BP | Original Q3 | Legacy

QUESTION THREE

The graph shows how the intensity of ultraviolet (UV) radiation changes during a typical day in June in the UK.



3A The intensity of UV radiation reaches a maximum at . . .

1 9.30 am

2 12.00 noon

3 1.00 pm

4 5.00 pm

4.6.2.6 Visible light (physics only)

Question 21 · continued

3B The dashed line (– – – –) on the graph shows the intensity above which you should protect your skin from UV radiation by using sunscreen cream.

For approximately how long is the intensity of UV radiation high enough to suggest that protection is needed?

1 0 hours

2 7 hours

3 10 hours

4 16 hours

3C For a typical day in December in the UK, how would you expect the graph to be different?

	Peak	Area under the graph
1	higher	the same
2	lower	the same
3	higher	bigger
4	lower	smaller

3D UV radiation travels as an electromagnetic wave.

Which row in the table below correctly shows the speed and frequency of UV compared with the speed and frequency of visible light?

	Speed of UV compared with visible light	Frequency of UV compared with visible light
1	slower	lower
2	same	higher
3	faster	higher
4	same	lower

4.6.2.6 Visible light (physics only)

Question 22

June 2010 | PHY1H | Original Q4 | Legacy

4 (a) Microwaves and visible light are two types of electromagnetic wave. Both can be used for communications.

4 (a) (i) Give **two** properties that are common to both visible light and microwaves.

1 .....

.....

2 .....

.....

(2 marks)

4 (a) (ii) Name **two** more types of electromagnetic wave that can be used for communications.

..... and .....

(1 mark)

4 (b) Wi-Fi is a system that joins computers to the internet without using wires. Microwaves, with a wavelength of 12.5 cm, are used to link a computer to a device called a router. Microwaves travel through the air at 300 000 000 m/s.

Use the equation in the box to calculate the frequency of the microwaves used to link the computer to the router.

wave speed = frequency × wavelength

Show clearly how you work out your answer and give the unit.

.....

.....

.....

Frequency = ...

(3 marks)

4.6.2.6 Visible light (physics only)

Question 22 · continued

4 (c) Wi-Fi is used widely in schools. However, not everyone thinks that this is a good idea.

A politician commented on the increasing use of Wi-Fi. He said: 'I believe that these systems may be harmful to children.'

However, one group of scientists said that there is no reason why Wi-Fi should not be used in schools. These scientists also suggested that there is a need for further research.

4 (c) (i) Suggest what the politician could have done to persuade people that what he said was not just an opinion.

.....

.....

(1 mark)

4 (c) (ii) Why did the group of scientists suggest that there is a need for further research?

.....

.....

(1 mark)

8

4.6.2.6 Visible light (physics only)

Question 23

November 2010 | PHY1BP | Original Q5 | Legacy

QUESTION FIVE

Fluorescers are substances that are used to make objects look brighter. Fluorescers absorb ultraviolet radiation and re-emit it as visible light. This makes the object glow when exposed to ultraviolet radiation.

- Laundry detergents contain fluorescers to make 'white look even whiter'.
- Dental compounds contain fluorescers to make teeth look brighter.
- Since 1950, fluorescers have been added to white paper to brighten it.

5A A white shirt has been washed in detergent containing a fluorescer.

The white shirt will . . .

1 be much cleaner.

2 glow in the dark.

3 look cleaner.

4 stay cleaner for longer.

5B A dentist paints someone's teeth with enamel containing a fluorescer.

The enamel absorbs ultraviolet radiation from sunlight and then emits light with . . .

1 a higher frequency and a longer wavelength.

2 a higher frequency and a shorter wavelength.

3 a lower frequency and a longer wavelength.

4 a lower frequency and a shorter wavelength.

5C A document is dated 1805. The document glows when it is viewed in ultraviolet light.

The document is likely to . . .

1 be a forgery.

2 have been printed before 1805.

3 have a dull surface.

4 have a shiny surface.

4.6.2.6 Visible light (physics only)

Question 23 · continued

5D The ultraviolet radiation used to view the document has a wavelength of 0.000 000 1 metres.

wave speed (metre/second, m/s)	=	frequency (hertz, Hz)	×	wavelength (metre, m)

Speed of electromagnetic waves = 300 000 000 m/s

What is the frequency of ultraviolet radiation of wavelength 0.000 000 1 metres?

1 30 Hz

2 3 000 000 Hz

3 3 000 000 000 Hz

4 3 000 000 000 000 000 Hz

Turn over for the next question

4.6.2.6 Visible light (physics only)

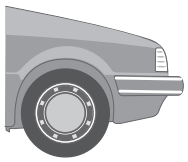
Question 24

March 2011 | PHY1AP | Original Q2 | Legacy

QUESTION TWO

This question is about controlling some forms of radiation.

1



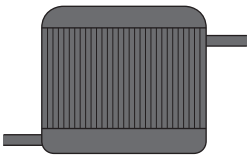
Car headlight has a shiny coating inside

2



Camera is matt black inside

3



Car radiator is painted matt black

4



Soil is covered with black plastic

Match statements, **A**, **B**, **C** and **D**, with diagrams **1**–**4**.

A is designed to increase the rate at which infra red radiation is absorbed

B is designed to increase the rate at which infra red radiation is emitted

C is designed to improve the ability to reflect visible light

D is designed to prevent the reflection of visible light

4.6.2.6 Visible light (physics only)

Question 25

March 2011 | PHY1BP | Original Q7 | Legacy

QUESTION SEVEN

In 2009, the European Space Agency launched two space telescopes: the Herschel and the Planck.

Also in 2009, the US space shuttle Atlantis was launched. Atlantis carried seven astronauts to service the Hubble space telescope.

The table gives information about the three space telescopes.

	Hubble	Herschel	Planck
Distance from Earth	560 km	1.5 million km	1.5 million km
Radiation detected	Visible light, ultraviolet	Infra red	Microwaves
Cost of 2009 launch	£1 billion (for servicing)	Total for the 2 telescopes - £1.7 billion	
Objects observed	Distant stars and galaxies	Early development of galaxies	Radiation left over from the 'Big Bang'

7A The Hubble and Herschel telescopes both contain mirrors. The diameter of the mirror in the Herschel telescope is 50 % larger than the diameter of the main mirror in the Hubble telescope.

This means that the . . .

1 Herschel mirror is capable of collecting more energy each second than the Hubble mirror.

2 cost of the Herschel telescope is higher than the cost of the Hubble servicing mission.

3 Herschel telescope is much lighter than the Hubble telescope.

4 orbit of the Herschel telescope is much larger than the orbit of the Hubble telescope.

7B The larger the diameter of a telescope mirror, the longer the wavelength of radiation it can detect.

The order of increasing diameters for the space telescopes in the table is . . .

1 Herschel; Hubble; Planck.

2 Hubble; Herschel; Planck.

3 Planck; Herschel; Hubble.

4 Planck; Hubble; Herschel.

7C The table refers to radiation left over from the ‘Big Bang’.

What is the ‘Big Bang’?

1 a theory that the light from distant galaxies shows a red-shift

2 an observation that the universe is expanding

3 a theory that the universe began from a very small initial point

4 evidence that distant galaxies are moving away from the Earth

7D A survey showed that a lot of people living in the UK think that the money spent on the launches in 2009 would have been better spent on feeding starving people in the developing world.

The people in the survey are concerned about . . .

1 political and scientific issues.

2 political and environmental issues.

3 economic and environmental issues.

4 economic and ethical issues.

4.6.2.6 Visible light (physics only)

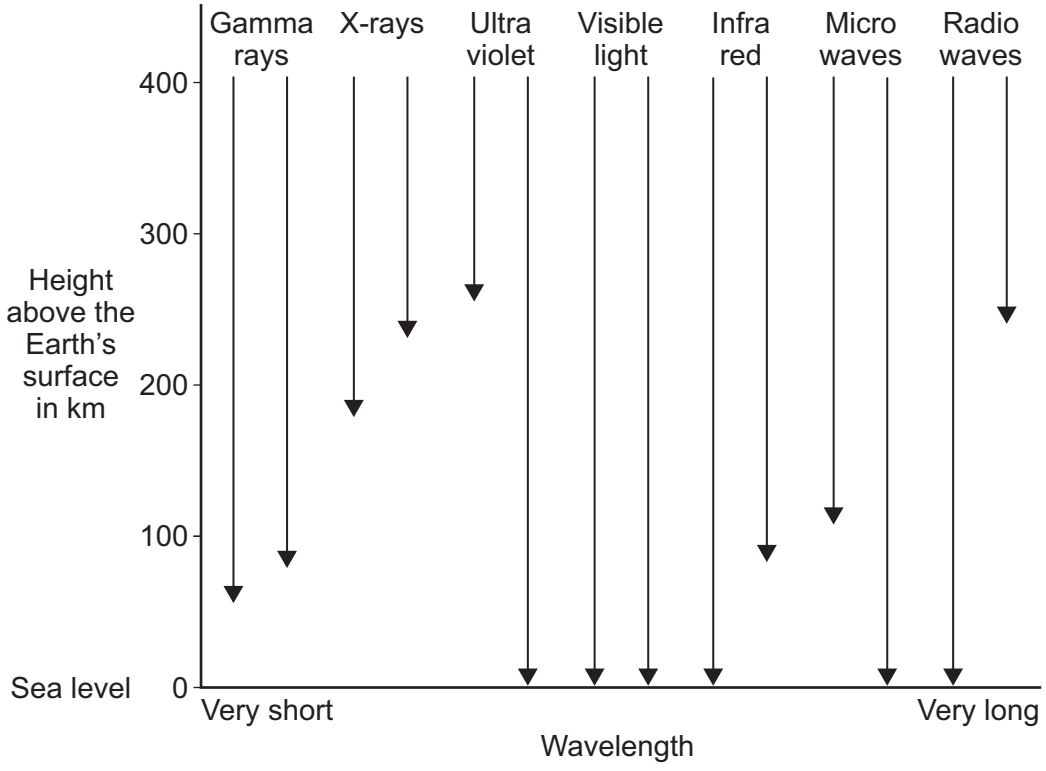
Question 26

June 2011 | PHY1BP | Original Q4 | Legacy

QUESTION FOUR

Telescopes can be based on the Earth's surface or put into orbit in space.

The diagram shows how far electromagnetic waves penetrate the Earth's atmosphere. For some types of electromagnetic radiation, longer and shorter waves penetrate the atmosphere to different depths.



4A Telescopes on Earth detect **all** wavelengths of . . .

1 radio waves only.

2 visible light only.

3 radio waves and visible light.

4 visible light and X-rays.

4B Which of the following statements about the use of telescopes in space is true?

1 The atmosphere distorts the image produced by the telescope.

2 The telescopes are affected by light pollution from the Earth.

3 The telescopes can detect electromagnetic waves that cannot reach the Earth's surface.

4 The telescopes are easy to repair and maintain.

4.6.2.6 Visible light (physics only)

Question 26 · continued

The table gives information about some space telescopes. Each telescope detects a different type of electromagnetic radiation.

Telescope	Wavelength detected in nanometres
INTEGRAL	less than 0.01
Chandra	0.01 – 20
FUSE	20 – 400
Hubble	400 – 700
Spitzer	1000 – 1 000 000

4C The Hubble telescope detects visible light.

Which telescope detects infra red radiation?

1 Chandra

2 FUSE

3 INTEGRAL

4 Spitzer

4D Which telescope detects X-rays?

1 Chandra

2 FUSE

3 INTEGRAL

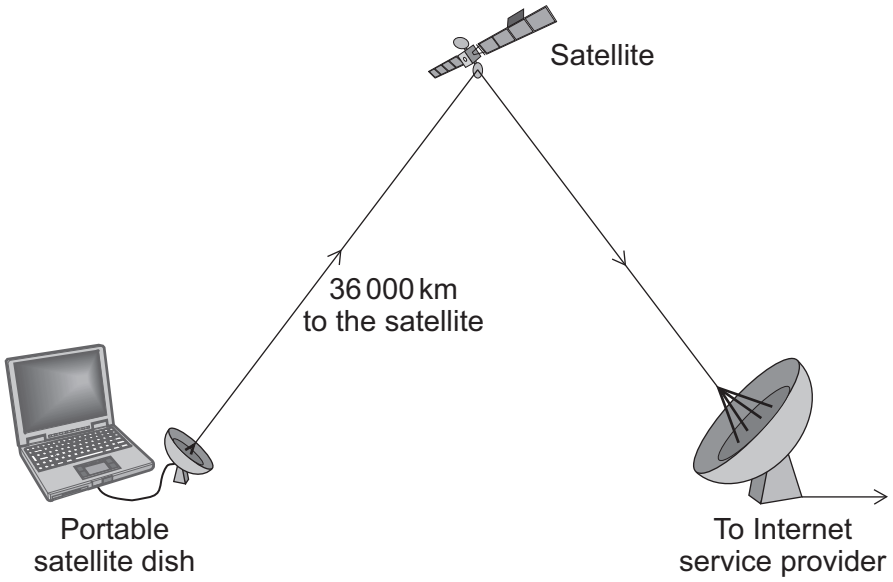
4 Spitzer

4.6.2.6 Visible light (physics only)

Question 27

June 2011 | PHY1H | Original Q3 | Legacy

3 (a) The diagram shows a computer connected to the Internet using a satellite link.



3 (a) (i) Name the type of electromagnetic wave used to send information to and from the satellite.

.....

(1 mark)

3 (a) (ii) The information is sent to and from the satellite using a *digital signal*.

Describe a *digital signal*.

You may draw a diagram to help you answer.

.....

.....

(1 mark)

4.6.2.6 Visible light (physics only)

Question 27 · continued

3 (a) (iii) Give **one** advantage of sending information as a digital signal rather than as an analogue signal.

.....

.....

(1 mark)

3 (b) Electromagnetic waves travel at a speed of 300 000 000 m/s.
The waves travelling to and from the satellite have a wavelength of 15 cm.

Use the equation in the box to calculate the frequency of these waves.

wave speed = frequency × wavelength

Show clearly how you work out your answer and give the unit.

.....

.....

Frequency = ...

(3 marks)

3 (c) In 2009, parts of the African country Kenya, were linked to the Internet by a super-fast optical fibre. Before that, all Internet connections had to be made via a satellite link.

3 (c) (i) Complete the following sentence.

Signals can be sent along an optical fibre using either visible light or

..... .

(1 mark)

3 (c) (ii) Suggest a reason why signals sent through the optical fibre arrive faster than signals sent via a satellite link.

.....

.....

(1 mark)

8

4.6.2.6 Visible light (physics only)

Question 28

November 2011 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

The frequencies of the waves in the electromagnetic spectrum can be grouped into types.

Match types, **A**, **B**, **C** and **D**, with the descriptions **1**–**4** in the table.

A gamma rays

B infra red rays

C radio waves

D ultraviolet rays

1	They have a higher frequency than X-rays.
2	They have a lower frequency than microwaves.
3	They have a lower frequency than visible light but a higher frequency than microwaves.
4	They have a lower frequency than X-rays but a higher frequency than visible light.

4.6.2.6 Visible light (physics only)

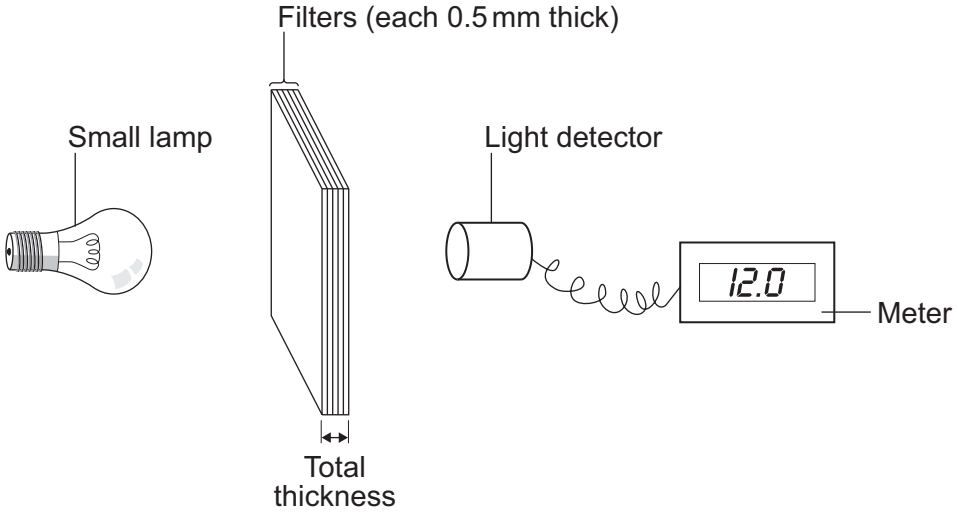
Question 29

November 2011 | PHY1BP | Original Q6 | Legacy

QUESTION SIX

Different numbers of coloured filters were placed between a small lamp and a light detector. Each filter was 0.5 mm thick.

The meter showed the intensity of the light reaching the detector.



The graph shows how the light intensity changes as the thickness of the filters changes.



4.6.2.6 Visible light (physics only)

Question 29 · continued

6A Which is the best description of the pattern shown by the graph considering all the coloured filters?

1 The light intensity transmitted is directly proportional to the total thickness of the filters.

2 The light intensity transmitted is inversely proportional to the total thickness of the filters.

3 As the total thickness of the filters increases, the light intensity transmitted increases.

4 As the total thickness of the filters increases, the light intensity transmitted decreases.

6B What is the light intensity reading when 14 blue filters are used?

1 4.5 units

2 6.2 units

3 6.5 units

4 6.6 units

6C How many green filters would be needed to reduce the initial light intensity by 50 %?

1 three

2 five

3 six

4 seven

6D Which types of electromagnetic radiation are used to send signals along optical fibres?

1 infra red rays and ultraviolet rays

2 infra red rays and visible light

3 infra red rays, ultraviolet rays and visible light

4 visible light and ultraviolet rays

4.6.2.6 Visible light (physics only)

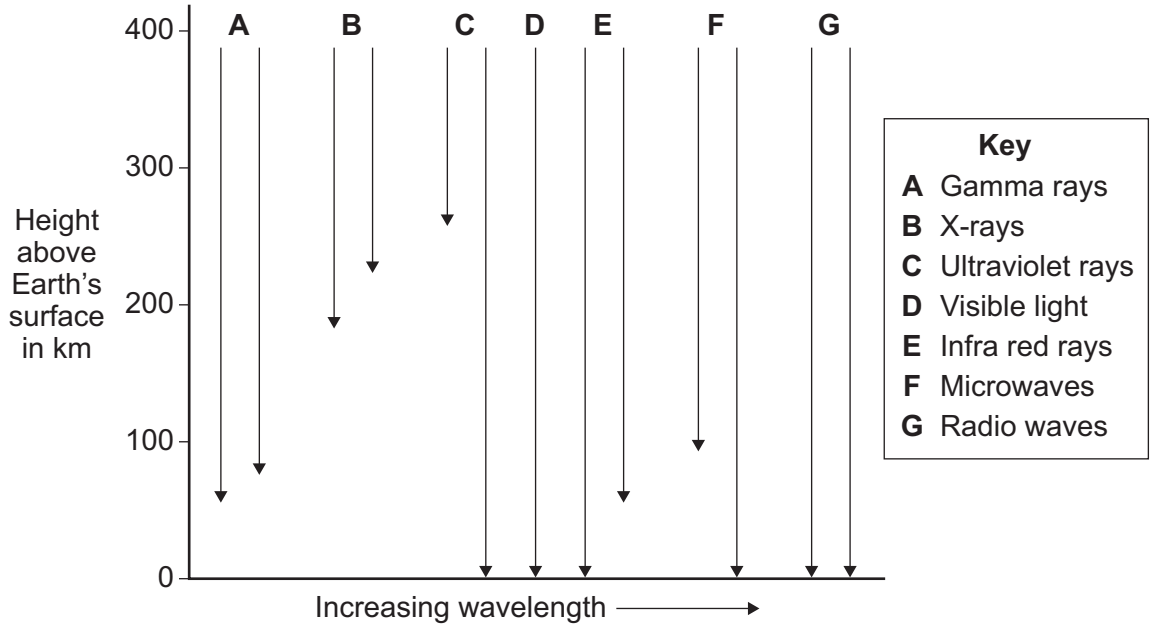
Question 30

November 2011 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

The diagram shows how far electromagnetic waves can penetrate the Earth's atmosphere.

Where two arrows are shown for a particular type of electromagnetic radiation, longer and shorter waves penetrate the atmosphere to different depths.



9A Which one of the following statements is true?

1 Gamma rays penetrate the atmosphere further than all other types of electromagnetic radiation.

2 All frequencies of ultraviolet radiation reach the Earth's surface.

3 No frequencies of radio waves reach the Earth's surface.

4 Higher frequencies of microwaves are completely absorbed by the atmosphere.

9B What would be the minimum height above the Earth for a satellite carrying telescopes designed to detect gamma rays, X-rays and ultraviolet radiation of all wavelengths?

1 50 km

2 70 km

3 180 km

4 260 km

4.6.2.6 Visible light (physics only)

Question 30 · continued

9C Optical telescopes used to observe objects in space are limited because they can be used only . . .

1 as ground-based telescopes.

2 at night.

3 to observe a small region of the electromagnetic spectrum.

4 to observe one region of the sky.

9D Electromagnetic radiation from distant galaxies is very weak and is therefore very difficult to detect.

Some space telescopes use liquid helium to keep scientific instruments at a very low temperature.

Which type of weak electromagnetic radiation would best be detected by instruments kept at a very low temperature?

1 gamma rays

2 X-rays

3 infra red rays

4 ultraviolet rays

END OF TEST

4.6.2.6 Visible light (physics only)

Question 31

January 2013 | PH1HP | Original Q5 | Legacy

5 Galaxies emit all types of electromagnetic wave.

5 (a) (i) Which type of electromagnetic wave has the shortest wavelength?

.....

(1 mark)

5 (a) (ii) State **one** difference between an ultraviolet wave and a visible light wave.

.....

.....

(1 mark)

5 (b) Electromagnetic waves travel through space at a speed of 3.0×10^8 m/s.

The radio waves emitted from a distant galaxy have a wavelength of 25 metres.

Calculate the frequency of the radio waves emitted from the galaxy and give the unit.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Frequency = ...

(3 marks)

5 (c) Scientists use a radio telescope to measure the wavelength of the radio waves emitted from the galaxy in part **(b)** as the waves reach the Earth. The scientists measure the wavelength as 25.2 metres. The effect causing this observed increase in wavelength is called red-shift.

5 (c) (i) The waves emitted from most galaxies show red-shift.

What does red-shift tell scientists about the direction most galaxies are moving?

.....

.....

(1 mark)

4.6.2.6 Visible light (physics only)

Question 31 · continued

5 (c) (ii) The size of the red-shift is **not** the same for all galaxies.

What information can scientists find out about a galaxy when they measure the size of the red-shift the galaxy produces?

.....

.....

.....

.....

(2 marks)

5 (c) (iii) What does the observation of red-shift suggest is happening to the Universe?

.....

.....

(1 mark)

9

4.6.2.6 Visible light (physics only)

Question 32

June 2016 | PH2HP | Original Q6 | Legacy

6 (a) Brown dwarf stars are thought to have been formed in the same way as other stars.
They are too small for nuclear fusion reactions to take place in them.
Brown dwarf stars emit infrared radiation but are not hot enough to emit visible light.

6 (a) (i) Describe how a star is formed.

[2 marks]

6 (a) (ii) Describe the process of nuclear fusion.

[1 mark]

6 (a) (iii) Scientists predicted that brown dwarf stars existed before the first one was discovered in 1995.

Suggest **one** reason why scientists are now able to observe and identify brown dwarf stars.

[1 mark]

4.6.2.6 Visible light (physics only)

Question 32 · continued

6 (b) In the 18th century some scientists suggested a theory about how the planets formed in the Solar System. The theory was that after the Sun formed, there were cool discs of matter rotating around the Sun. These cool discs of matter formed the planets. The scientists thought this must have happened around other stars too.

6 (b) (i) Thinking about this theory, what would the scientists have predicted to have been formed in other parts of the Universe?

[1 mark]

6 (b) (ii) Since the 1980s scientists studying young stars have shown the stars to be surrounded by cool discs of rotating matter.

What was the importance of these observations to the theory the scientists suggested in the 18th century?

[1 mark]

6 (c) The Earth contains elements heavier than iron.

Why is the presence of elements heavier than iron in the Earth evidence that the Solar System was formed from material produced after a massive star exploded?

[1 mark]

7

4.6.2.6 Visible light (physics only)

Question 33

June 2019 | 8463/1H | Original Q1

0 1 Light bulbs are labelled with a power input.

0 1 . 1 What does power input mean?

[1 mark]

Tick (✓) **one** box.

- The charge transferred each second by the bulb. ☐
- The current through the bulb. ☐
- The energy transferred each second to the bulb. ☐
- The potential difference across the bulb. ☐

0 1 . 2 Write down the equation which links current, potential difference and power.

[1 mark]

_____

0 1 . 3 A light bulb has a power input of 40 W

The mains potential difference is 230 V

Calculate the current in the light bulb.

[3 marks]

_____

_____

_____

Current = _____ A

4.6.2.6 Visible light (physics only)

Question 33 · continued

Table 1 shows information about three different light bulbs.

Table 1

Light bulb	Total power input in watts	Useful power output in watts	Efficiency
P	6.0	5.4	0.90
Q	40	2.0	0.05
R	9.0	**X**	0.30

0 1 . 4 Write down the equation which links efficiency, total power input and useful power output.

[1 mark]

0 1 . 5 Calculate the value of **X** in **Table 1**.

[3 marks]

X = _____ W

0 1 . 6 In addition to power input, light bulbs should also be labelled with the rate at which they emit visible light.

Suggest why.

[2 marks]

11

4.6.2.6 Visible light (physics only)

Question 34

November 2021 | 8463/2H | Original Q3

0 3 A main sequence star in a distant galaxy is the same size and mass as the Sun.

0 3 . 1 Explain why the star is stable while it is in the main sequence stage of its life cycle.

[2 marks]

0 3 . 2 Describe what will happen to the star between the main sequence stage and the end of the star's life cycle.

You should include the names of the stages in the life cycle of the star.

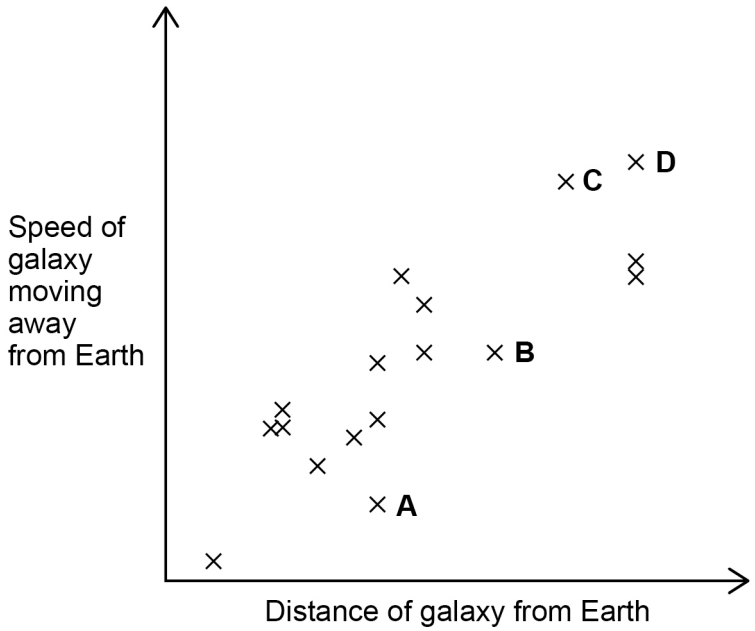
[3 marks]

4.6.2.6 Visible light (physics only)

Question 34 · continued

0 3 . 3 **Figure 5** shows how the speed of galaxies moving away from Earth varies with the distance of the galaxies from Earth.

Figure 5



Which galaxy would show the smallest observed change in the wavelength of visible light?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

Reason _____

_____

7

4.6.2.6 Visible light (physics only)

Question 35

November 2021 | 8463/2H | Original Q5

0 5 Ultraviolet is a type of electromagnetic wave.

0 5 . 1 Give **one** use of ultraviolet.

[1 mark]

_____

0 5 . 2 An ultraviolet wave has a wavelength of 300 nanometres.

Which of the following is equal to 300 nanometres?

[1 mark]

Tick (✓) **one** box.

3×10^{7} m ☐

3×10^{-7} m ☐

3×10^{9} m ☐

3×10^{-9} m ☐

0 5 . 3 The speed of ultraviolet waves is 3×10^{8} m/s.

Calculate the frequency of the ultraviolet wave.

Use your answer to Question **05.2**

[3 marks]

_____

_____

_____

_____

_____

Frequency = _____ Hz

4.6.2.6 Visible light (physics only)

Question 35 · continued

0 5 . 4 **Table 1** gives the wavelength of an ultraviolet wave and three other electromagnetic waves.

Table 1

	Ultraviolet	Wave E	Wave F	Wave G
Wavelength in nanometres	300	0.1	600	100 000

Draw **one** line from each wave to the name of the wave.

[1 mark]

Wave	Name
Wave E	Infrared
Wave F	Visible light
Wave G	X-rays

0 5 . 5 Electromagnetic waves are transverse.

Some other types of wave are longitudinal.

Describe the difference between transverse and longitudinal waves.

[2 marks]

8

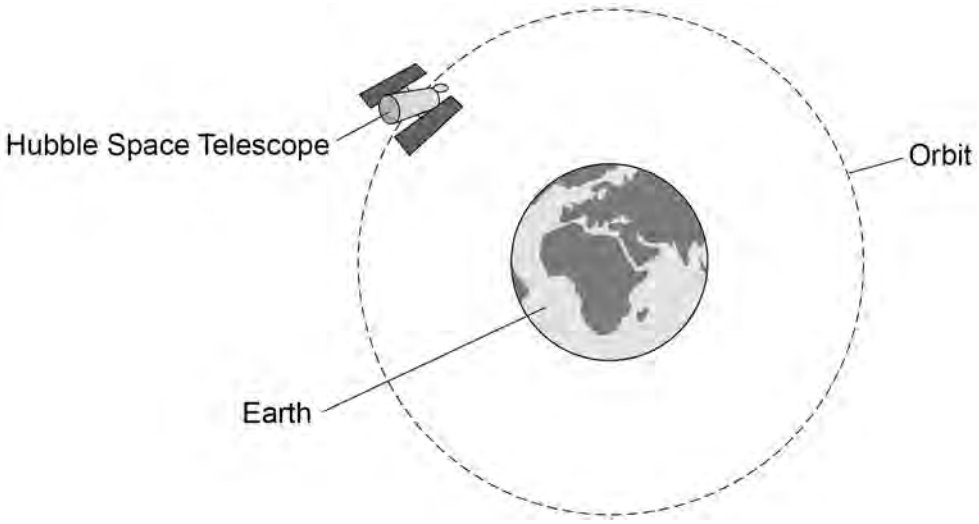
4.6.2.6 Visible light (physics only)

Question 36

June 2023 | 8463/2H | Original Q6

0 6 **Figure 15** shows the Hubble Space Telescope orbiting the Earth.

Figure 15



0 6 . 1 What name is given to objects that orbit a planet?

[1 mark]

Question 6 continues on the next page

4.6.2.6 Visible light (physics only)

Question 36 · continued

0 6 . 2 A space telescope uses microwaves to communicate with the Earth.

A microwave has a wavelength of 12.5 cm.

The speed of microwaves through space is 3.0×10^8 m/s.

Calculate the frequency of the microwave.

Use the Physics Equations Sheet.

Give your answer in standard form.

[5 marks]

Frequency (in standard form) = _____ Hz

0 6 . 3 Explain the effect of the Earth's gravitational force on the motion of the Hubble Space Telescope.

[3 marks]

4.6.2.6 Visible light (physics only)

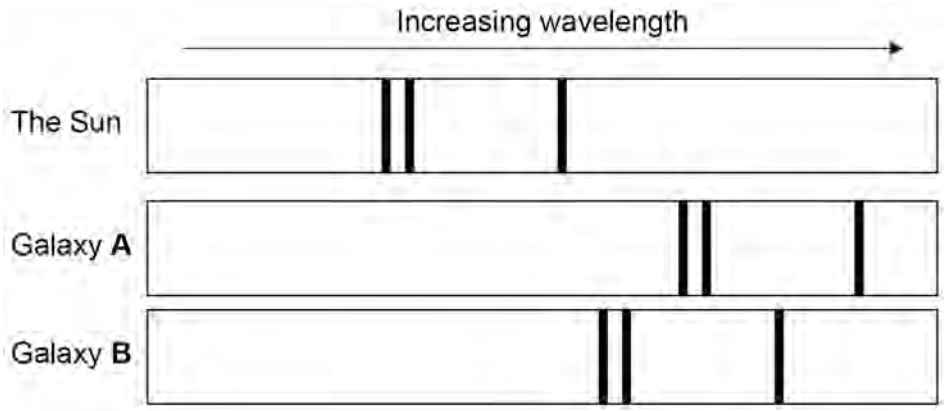
Question 36 · continued

0 6 . 4 The Hubble Space Telescope can detect visible light from distant galaxies.

The visible light spectra from stars and galaxies include dark lines at specific wavelengths.

Figure 16 shows the visible light spectra from the Sun and two galaxies.

Figure 16



Explain what conclusions can be made about galaxies **A** and **B**.

[3 marks]

12

4.6.2.6 Visible light (physics only)

Question 37

June 2025 | 8463/2H | Original Q1

0 1 In a thunderstorm, lightning produces visible light waves and sound waves.

0 1 . 1 Describe the similarities and differences between visible light waves and sound waves.

[6 marks]

4.6.2.6 Visible light (physics only)

Question 37 · continued

Use the Physics Equations Sheet to answer questions **01.2** and **01.3**.

0 1 . 2 Which equation links distance (*s*), speed (*v*) and time (*t*)?

[1 mark]

Tick (✓) **one** box.

speed = distance × time ☐

speed = $\frac{\text{distance}}{\text{time}}$ ☐

speed = $\frac{\text{time}}{\text{distance}}$ ☐

0 1 . 3 Lightning strikes the ground 13 200 m from a student.

The speed of sound in air is 330 m/s.

Calculate the time taken for the sound created by the lightning strike to reach the student.

[3 marks]

Time = _____ s

10