

Electromagnetic Waves

Question Paper 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Physics
Exam Board	AQA
Topic	6.6 Waves
Sub-Topic	Electromagnetic Waves
Difficulty Level	Gold Level
Booklet	Question Paper 1

Time Allowed: 60 minutes

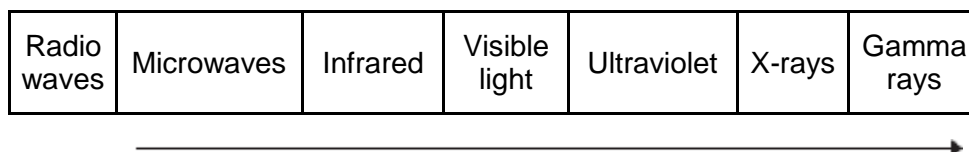
Score: /60

Percentage: /100

Grade Boundaries:

Q1. Different parts of the electromagnetic spectrum have different uses.

(a) The diagram shows the electromagnetic spectrum.



(i) Use the correct answers from the box to complete the sentence.

amplitude	frequency	speed	wavelength
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The arrow in the diagram is in the direction of increasing
and decreasing

(2)

(ii) Draw a ring around the correct answer to complete the sentence.

The range of wavelengths for waves in the electromagnetic

spectrum is approximately

10^{-15} to 10^4
10^{-4} to 10^4
10^4 to 10^{15}

metres.

(1)

(b) The wavelength of a radio wave is 1500 m.
The speed of radio waves is 3.0×10^8 m / s.

Calculate the frequency of the radio wave.

Give the unit.

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.....

.....
Frequency =

(3)

- (c) (i) State **one** hazard of exposure to infrared radiation.

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(1)

- (ii) State **one** hazard of exposure to ultraviolet radiation.

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(1)

- (d) X-rays are used in hospitals for computed tomography (CT) scans.

- (i) State **one** other medical use for X-rays.

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(1)

- (ii) State a property of X-rays that makes them suitable for your answer in part (d)(i).

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(1)

- (iii) The scientific unit of measurement used to measure the dose received from radiations, such as X-rays or background radiation, is the millisievert (mSv).

The table shows the X-ray dose resulting from CT scans of various parts of the body.

The table also shows the time it would take to get the same dose from background radiation.

Part of the body	X-ray dose in mSv	Time it would take to get the same dose from background radiation
Abdomen	9.0	3 years
Sinuses	0.5	2 months
Spine	4.0	16 months

A student suggests that the X-ray dose and the time it would take to get the same dose from background radiation are directly proportional.

Use calculations to test this suggestion and state your conclusion.

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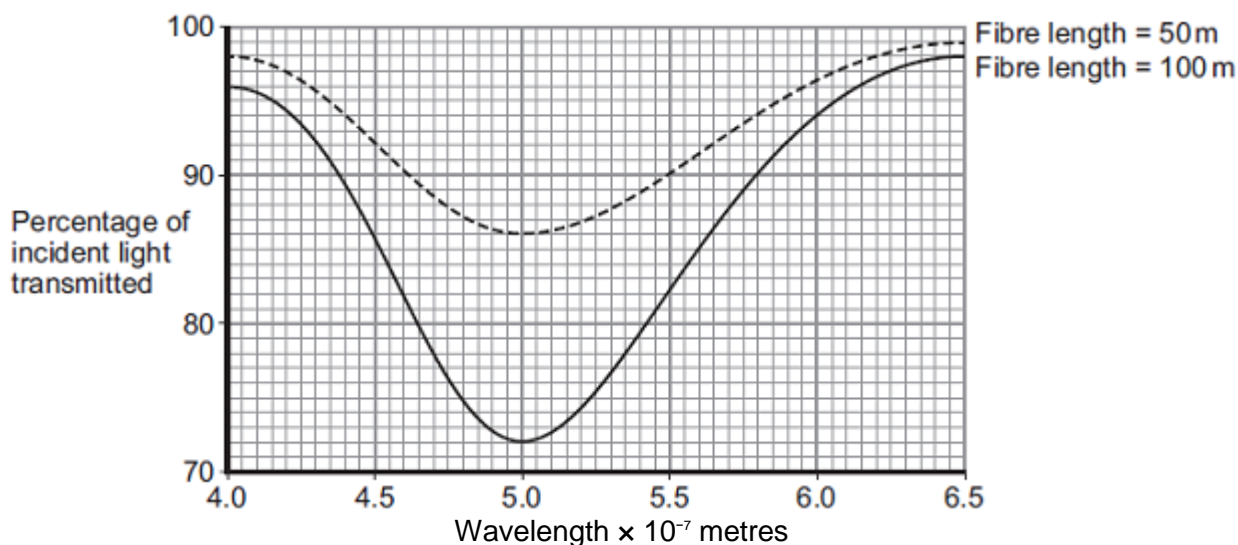
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(3)
(Total 13 marks)

Q2. Different wavelengths of light can be used to transmit information along optical fibres.

The graph below shows how the percentage of incident light transmitted through a fibre varies with the wavelength of light and the length of the fibre.



Compare the percentages of incident light transmitted through the two different fibres over the range of wavelengths shown.

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(Total 3 marks)

Q3.(a) Electromagnetic waves form a continuous spectrum with a range of wavelengths.

What is the approximate range of wavelengths of electromagnetic waves?

Tick (✓) **one** box.

10^{-15} metres to 10^4 metres

☐

10^{-4} metres to 10^{15} metres

☐

10^{-6} metres to 10^6 metres

☐

(1)

(b) Infrared waves and microwaves are used for communications.

(i) Give **one** example of infrared waves being used for communication.

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(1)

(ii) A mobile phone network uses microwaves to transmit signals through the air. The microwaves have a frequency of 1.8×10^9 Hz and travel at a speed of 3.0×10^8 m/s.

Calculate the wavelength of the microwaves.

Give your answer to **two** significant figures.

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Wavelength = m

(3)

(c) Some scientists suggest there is a possible link between using a mobile phone and male fertility.

The results of their study are given in the table.

Mobile phone use in hours per day	Sperm count in millions of sperm cells per cm^3 of semen
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0	86
less than 2	69
2 – 4	59
more than 4	50

The results show a negative correlation: the more hours a mobile phone is used each day, the lower the sperm count. However, the results do **not** necessarily mean using a mobile phone causes the reduced sperm count.

Suggest **one** reason why.

.....

(1)
 (Total 6 marks)

Q4.(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?

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(1)

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

Calculate the wavelength of the waves broadcast by this station.

Show clearly how you work out your answer.

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Wavelength = m

(2)

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

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(2)

- (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?

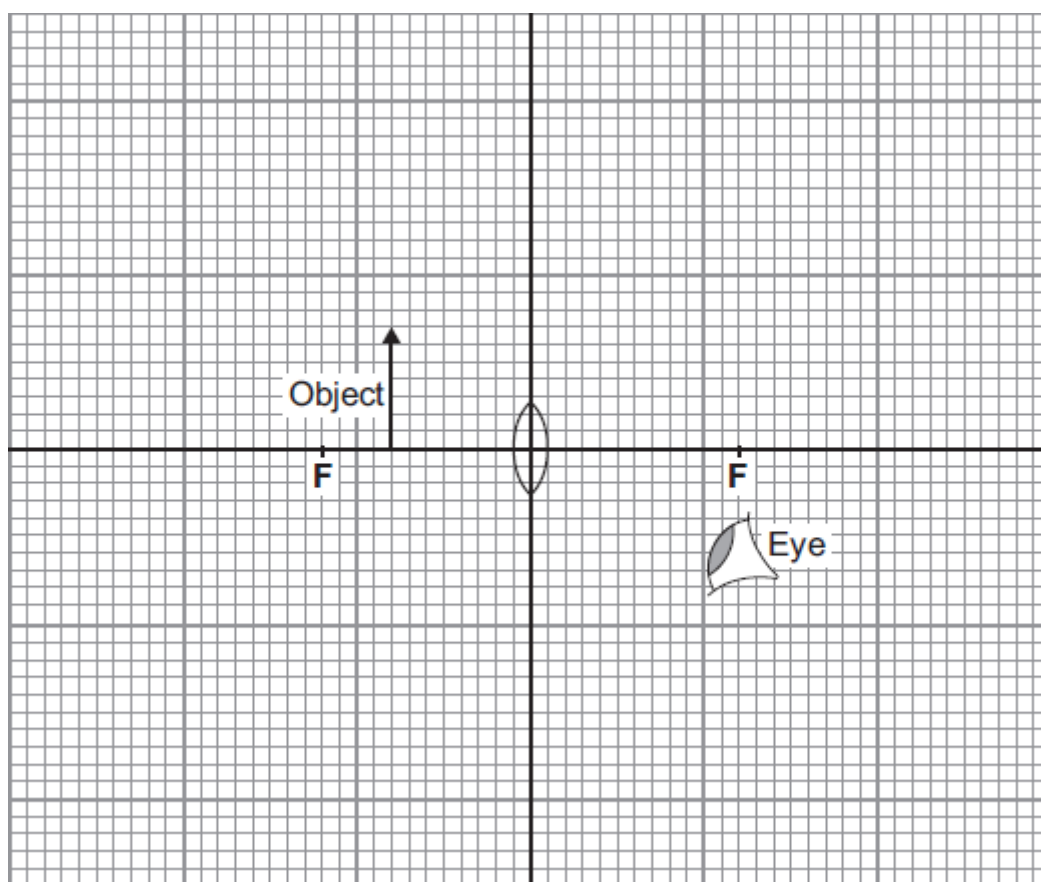
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(1)

(Total 6 marks)

- Q5.** (a) The diagram shows a converging lens being used as a magnifying glass.

- (i) On the diagram, use a ruler to draw two rays from the top of the object which show how and where the image is formed. Represent the image by an arrow drawn at the correct position.



(3)

- (ii) Use the equation in the box to calculate the magnification produced by the lens.

$\text{magnification} = \frac{\text{image height}}{\text{object height}}$

Show clearly how you work out your answer.

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Magnification =

(2)

- (b) A camera also uses a converging lens to form an image.

Describe how the image formed by the lens in a camera is different from the image formed by a lens used as a magnifying glass.

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(2)
(Total 7 marks)

Q6. Radio waves and microwaves are two types of electromagnetic wave.

Both waves:

- can be used for communications
- travel at the same speed through air.

(a) Give **two** more properties that are the same for both radio waves and microwaves.

1

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2

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(2)

(b) Some satellites are used to transmit television programmes. Signals are sent to, and transmitted from, the satellites using microwaves.

What is the property of microwaves that allows them to be used for satellite communications?

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(1)

(c) Electromagnetic waves travel at a speed of 3.0×10^8 m/s.

A radio station transmits waves with a wavelength of 2.5×10^2 m.

Calculate the frequency of the radio waves.

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

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.....

Frequency =

(3)
(Total 6 marks)

Q7. (a) Microwaves and visible light are two types of electromagnetic wave. Both can be used for communications.

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

1
.....
2
.....

(2)

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

..... and

(1)

(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.

Calculate the frequency of the microwaves used to link the computer to the router.

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

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Frequency =

(3)

- (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 WiFi. 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.

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

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(1)

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

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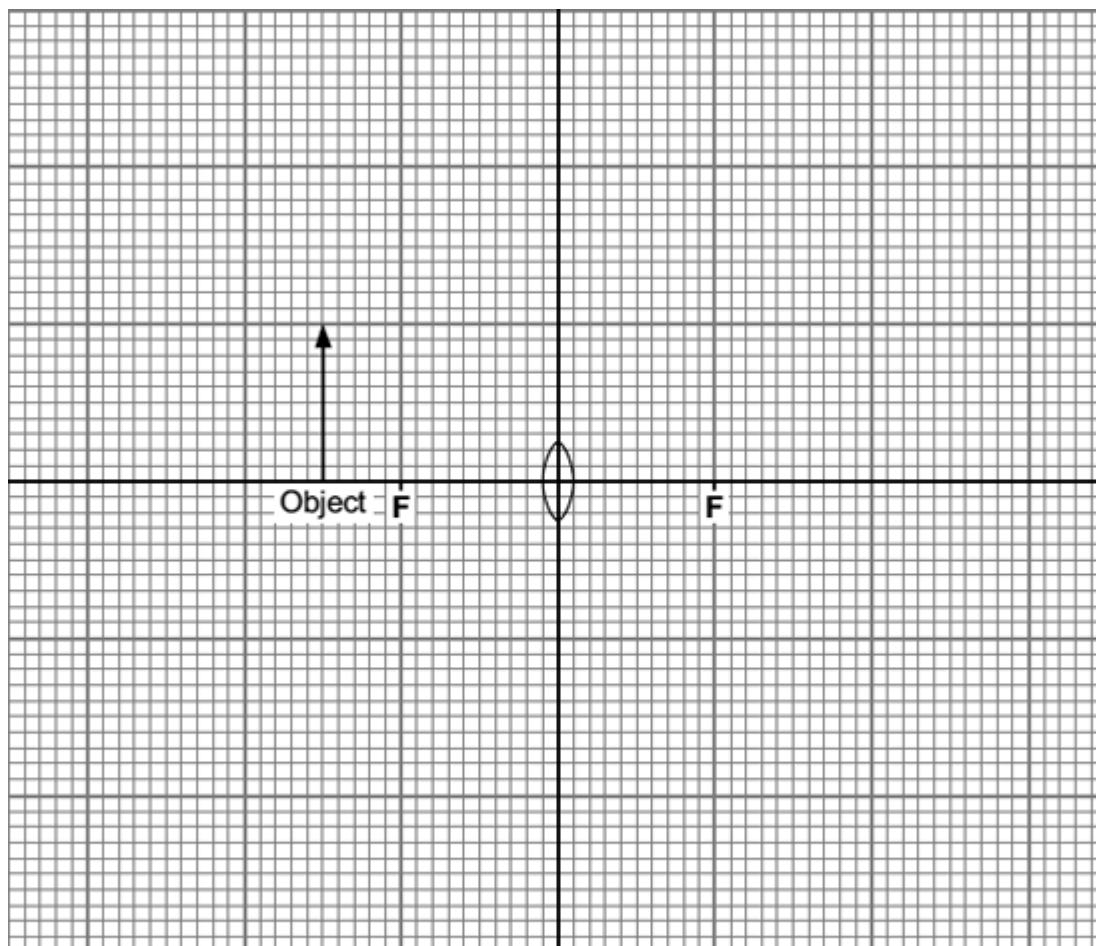
(1)

(Total 8 marks)

- Q8.** A student investigated how the nature of the image depends on the position of the object in front of a large converging lens.

The diagram shows one position for the object.

- (a) Use a ruler to complete a ray diagram to show how the image of the object is formed.



Key: F = principal focus

(4)

- (b) Describe the nature of this image relative to the object.

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(2)

(Total 6 marks)

Q9. (a) Microwaves are one type of electromagnetic wave.

(i) Which type of electromagnetic wave has a lower frequency than microwaves?

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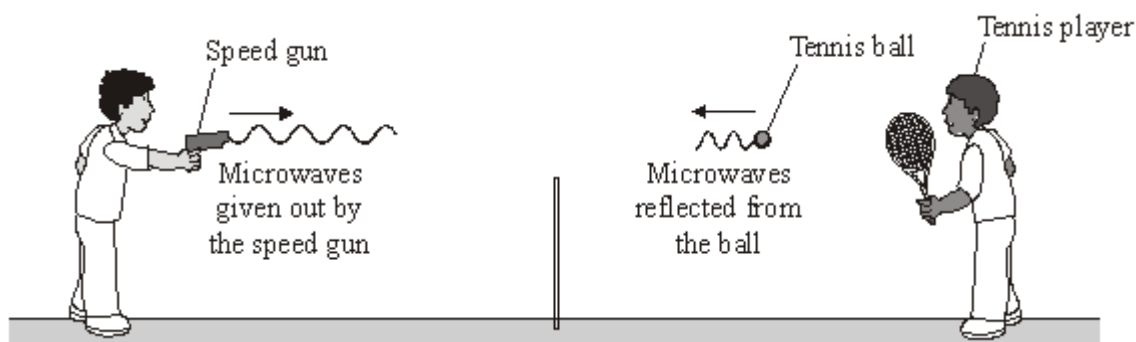
(1)

(ii) What do all types of electromagnetic wave transfer from one place to another?

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(1)

(b) The picture shows a tennis coach using a speed gun to measure how fast the player serves the ball.



(i) The microwaves transmitted by the speed gun have a frequency of 24 000 000 000 Hz and travel through the air at 300 000 000 m/s.

Calculate the wavelength of the microwaves emitted from the speed gun.

Show clearly how you work out your answer.

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Wavelength = m

(2)

- (ii) Some of the microwaves transmitted by the speed gun are absorbed by the ball.

What effect will the absorbed microwaves have on the ball?

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(1)
(Total 5 marks)