

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	Silver Level
Booklet	Question Paper 1

Time Allowed: 60 minutes

Score: /59

Percentage: /100

Grade Boundaries:

Q1. A baby monitor has a sensor unit that transmits an image of the baby and the noises the baby makes to a monitor unit.

The monitor unit then displays an image of the baby and emits the noises the baby makes.

- (a) Compare the properties of the waves that transmit images and noises from the monitor unit.

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(4)

- (b) The sensor unit can detect infrared and visible light.

Suggest **one** advantage of being able to detect infrared.

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(1)

- (c) Write down the equation that links frequency, wave speed and wavelength.

Equation

(1)

- (d) The signals for the monitor unit are transmitted as electromagnetic waves with a wavelength of 0.125 m.

Wave speed of electromagnetic waves = 3×10^8 m / s

Calculate the frequency of the signal.

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Frequency = Hz

(3)
(Total 9 marks)

Q2.Waves may be longitudinal or transverse.

- (a) Describe the differences between longitudinal waves and transverse waves.

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(3)

- (b) Radio waves are electromagnetic waves.

Describe how radio waves are different from sound waves.

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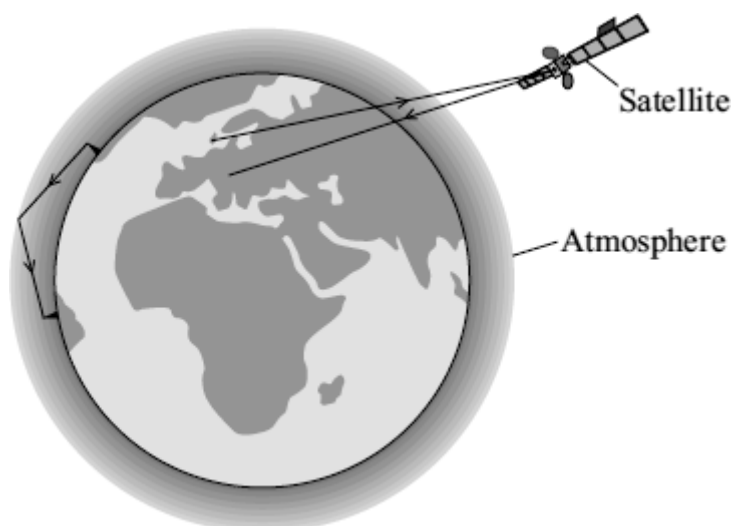
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(4)
(Total 7 marks)

- Q3.** (a) Electromagnetic waves have many uses. The diagram shows two ways of sending information using electromagnetic waves.



- (i) What type of wave is used to send information to and from satellites?

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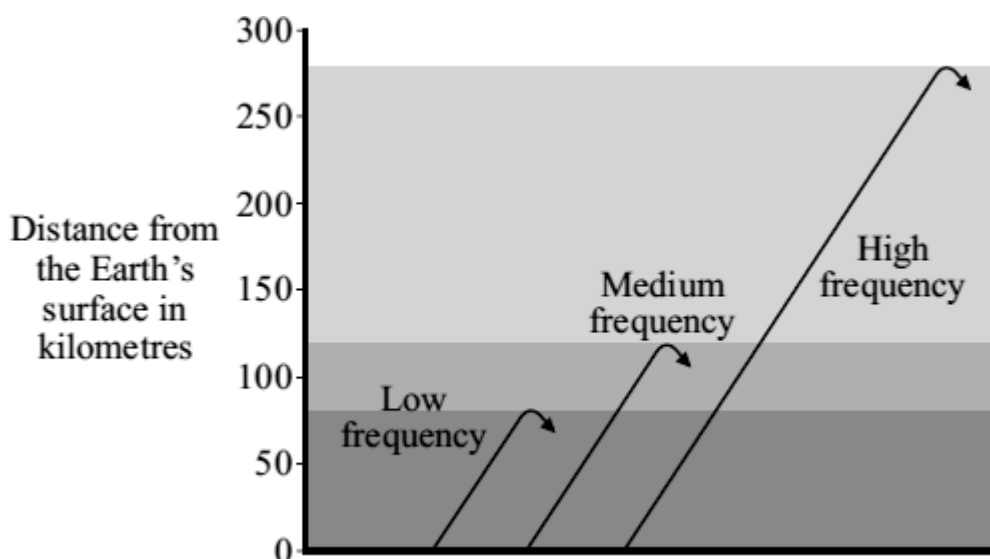
(1)

- (ii) What property of this type of wave makes it suitable for satellite communications?

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(1)

- (b) Different frequency radio waves travel different distances through the atmosphere before being reflected.



Use the information in the diagram to describe the connection between the frequency of a radio wave and the distance the radio wave travels through the atmosphere before it is reflected.

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(1)

- (c) Electromagnetic waves travel at a speed of 300 000 000 m/s.

A radio station transmits waves with a wavelength of 20 metres.

Calculate the frequency, in kilohertz (kHz), of these waves.

Show clearly how you work out your answer.

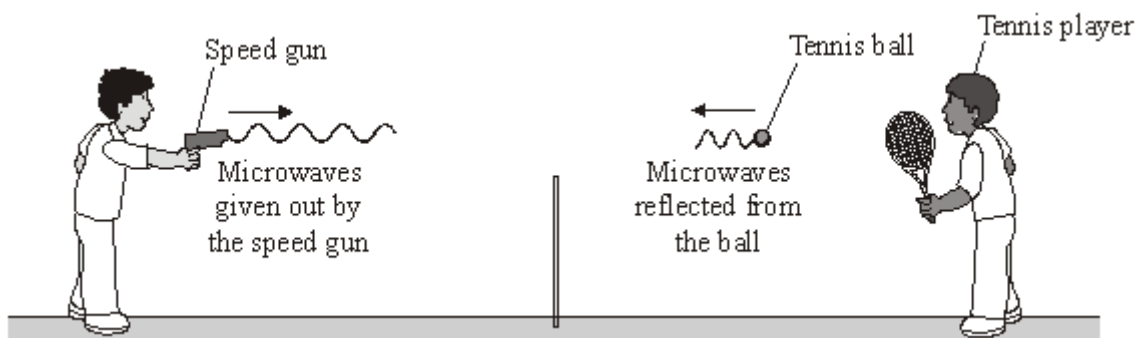
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Frequency = kHz

(2)

(Total 5 marks)

- Q4. (a) The picture shows a speed gun being used to measure how fast a tennis player hits the ball.



Some of the microwaves from the speed gun are absorbed by the ball and some are reflected by the ball.

- (i) Complete the following sentence by choosing **one** of the phrases from the box.

longer than	the same as	shorter than
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The wavelength of the microwaves reflected from the ball are

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

(1)

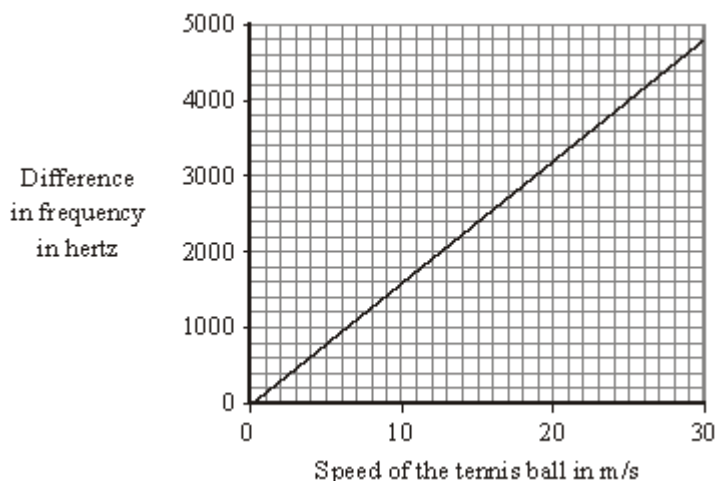
- (ii) Complete the following sentence by drawing a ring around the correct line in the box.

When the ball absorbs microwaves, its temperature will

decrease slightly
not change
increase slightly

(1)

- (b) The microwaves reflected from the ball have a higher frequency than the microwaves from the speed gun.
The graph shows how the difference between the two frequencies depends on the speed of the ball.



- (i) Describe the pattern that links the difference between the two frequencies and the speed of the ball.

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(1)

- (ii) The speed gun measures the difference between the two frequencies as 3200 Hz.

Use the graph to find the speed of the tennis ball.
Show clearly on the graph how you obtain your answer.

Speed of the tennis ball = m/s

(2)

- (iii) Which **one** of the following gives the reason why the data has been shown as a line graph and **not** as a bar chart?

Put a tick (✓) in the box next to your choice.

Frequency and speed are both categoric variables.

☐

Frequency and speed are both continuous variables.

☐

Speed is a continuous variable and frequency is a categoric variable.

☐

(1)
(Total 6 marks)

Q5. (a) Some scientists think that there is a link between using a mobile phone and some types of illness. Other scientists disagree. They say that the evidence is limited and unreliable.

(i) Suggest what scientists could do to show a link between using a mobile phone and illness.

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(1)

(ii) How could scientists improve the reliability of the evidence?

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(1)

(iii) Complete the following passage by drawing a ring around the word in the box that is correct.

There has been little or no experimental research into the health of children who use mobile phones.

This is partly because of the	<div>economic</div> <div>environmental</div> <div>ethical</div>	issues involved in using
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children in scientific research.

(1)

- (b) Before being sold, new mobile phones must be tested and given a SAR value. The SAR value is a measure of the energy absorbed by the head while a mobile phone is being used.

The table gives the SAR value for three mobile phones made by different companies.

To be sold in the UK, a mobile phone must have a SAR value lower than 2.0 W/kg.

Mobile phone	SAR value in W/kg
J	0.18
K	0.86
L	1.40

- (i) All companies use the same test to measure a SAR value.

Why is using the same test important?

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(1)

- (ii) Would the companies that make the mobile phones, **J**, **K** and **L**, be correct to claim that these three phones are totally safe to use?

Answer yes or no.

Give a reason for your answer.

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(1)

- (c) Devices designed to protect a mobile phone user from microwave radiation are now available.

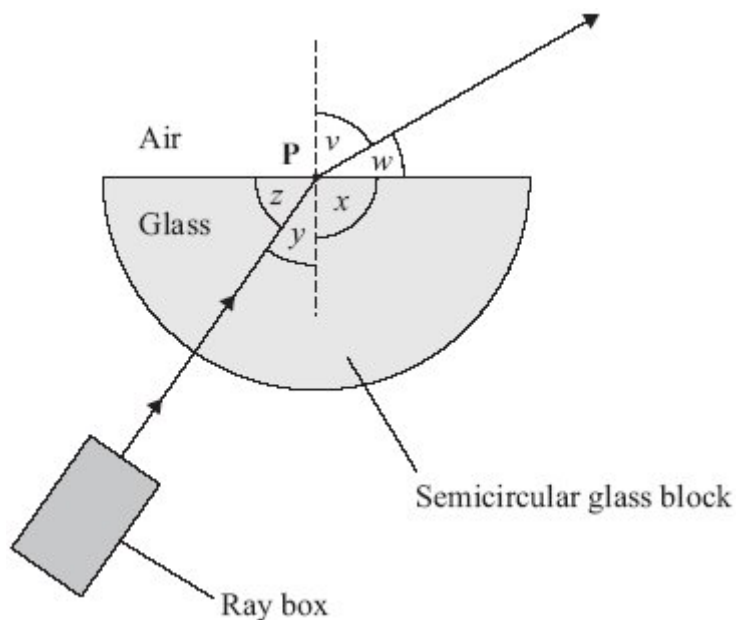
Why is it important that these devices are tested by scientists who are **not** working for the company that makes the devices?

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(1)

(Total 6 marks)

- Q6.** A student uses a ray box and a semicircular glass block to investigate refraction.



- (a) What is the vertical dashed line called?

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(1)

- (b) Which angle, v , w , x , y or z , is the angle of refraction?

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(1)

- (c) Why has refraction taken place?

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(1)

- (d) In an investigation, a student always aims the light from the ray box at point **P**. She moves the ray box to give different values of angle v . She records angle y for each of these values. The table shows her results.

Angle v measured in degrees	Angle y measured in degrees
30	19
40	25
50	31
60	35
70	39
80	41

The student studies the data and comes to the following conclusion.

Angle y is directly proportional to angle v .

Her friend says that this conclusion is **not** correct.

- (i) Use data from the table to explain why the conclusion is **not** correct.

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(2)

- (ii) Write a correct conclusion for the experiment.

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(1)

- (iii) Why is your conclusion only valid when angle v is between 30° and 80° ?

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(1)

(Total 7 marks)

Q7. After a person is injured a doctor will sometimes ask for a photograph to be taken of the patient's bone structure, e.g. in the case of a suspected broken arm.

- (i) Which type of electromagnetic radiation would be used to take the photograph?

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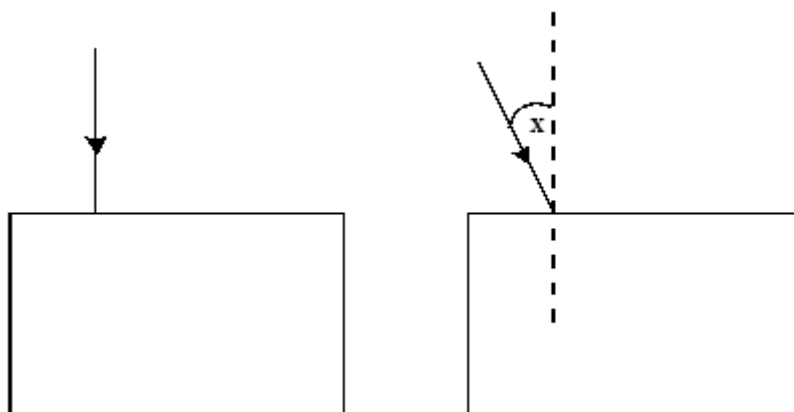
(1)

- (ii) Describe the properties of this radiation which enable it to be used to photograph bone structure.

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(2)
(Total 3 marks)

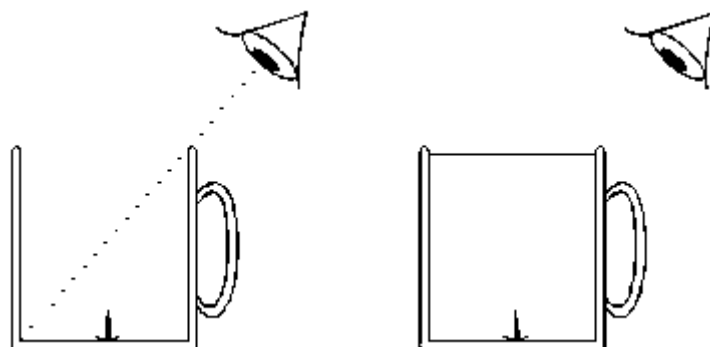
- Q8.** (a) The diagrams show rays of light. Each ray strikes a surface of a glass block.



- (i) On the diagram draw the path of each ray through the glass block and out into the air again.
- (ii) Label another angle on the diagram which is equal to the angle marked **X**. Label this angle **Y**.

(4)

- (b) The diagrams show two beakers. Both beakers have a drawing pin inside as shown.



The first beaker is empty. The eye cannot see the drawing pin.

The second beaker is full of water and the eye can see the drawing pin.

Explain how the eye is able to see the drawing pin in the second beaker. You may add to the diagram if it helps your answer.

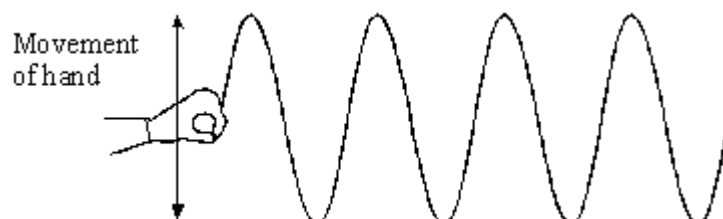
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(3)
(Total 7 marks)

Q9. The diagram shows a wave travelling along a rope.



(a) On the diagram:

- (i) show the wavelength and label it **W**;
- (ii) show the amplitude and label it **A**.

(2)

(b) The wavelength of the wave is 0.1 m. Its frequency is 2 Hz.

Calculate the speed of the wave. Show clearly how you work out your answer and give the unit.

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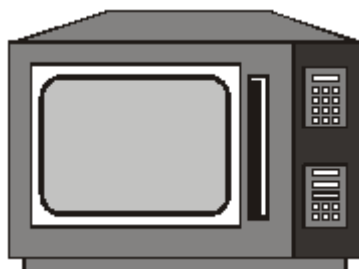
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Speed of wave

(3)

(Total 5 marks)

Q10. Microwave ovens can be used to heat many types of food.



(i) Describe, in as much detail as you can, how microwaves heat food.

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(2)

- (ii) Microwaves have a frequency of 10 000 million Hz. Their wavelength is 0.03 m.

Calculate the speed of microwaves.

Show clearly how you work out your answer.

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Speed of microwaves..... m/s

(2)

(Total 4 marks)