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# GCSE PHYSICS

Topic Paper: 6.1 Waves in air, fluids and solids (longitudinal and transverse waves)

Part 1

Time allowed: 40 minutes

## Materials

For this paper you must have:

- the Periodic Table/Data Sheet, provided as an insert (enclosed)
- a ruler with millimetre measurements
- a calculator, which you are expected to use where appropriate.

## Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

## Information

- The Periodic Table/Data Sheet is provided as in insert.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering questions you need to make sure that your answer:
  - is clear, logical, sensibly structured
  - fully meets the requirements of the question
  - shows that each separate point or step supports the overall answer.



**34 Marks**



**Q1.** All radio waves travel at 300 000 000 m/s in air.

(i) Give the equation that links the frequency, speed and wavelength of a wave.

..... (1)

(ii) Calculate the wavelength, in metres, of a radio wave which is broadcast at a frequency of 909 kHz. Show clearly how you work out your answer.

.....  
.....  
.....

Wavelength = ..... metres (2)  
**(Total 3 marks)**

**Q2.** (i) Use the words frequency, wavelength and wave speed to write an equation which shows the relationship between them.

..... (1)

(ii) Calculate the speed of a sound wave with a frequency of 250 Hz and a wavelength of 1.3 m.

Show how you get to your answer and give the unit.

.....  
.....

Speed = ..... (2)  
**(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.

.....  
.....

(1)

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

Calculate the wavelength of the microwaves.

Use the correct equation from the Physics Equations Sheet.

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

.....  
.....  
.....

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 <sup>3</sup> of semen
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.** Galaxies emit all types of electromagnetic wave.

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

.....

(1)

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

.....  
 .....

(1)

- (b) Electromagnetic waves travel through space at a speed of  $3.0 \times 10^8$  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)



(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.

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

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

.....  
.....

(1)

(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)

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

.....  
.....

(1)

**(Total 9 marks)**

**Q5.** (a) Microwaves are one type of electromagnetic wave.

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

.....

(1)

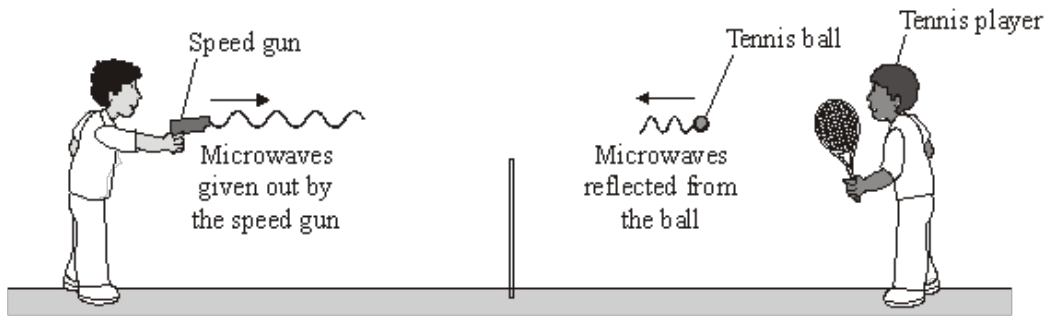
(ii) What do all types of electromagnetic wave transfer from one place to another?

.....

(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.

Use the equation in the box to calculate the wavelength of the microwaves emitted from the speed gun.

$\text{wave speed} = \text{frequency} \times \text{wavelength}$
---

Show clearly how you work out your answer.

.....  
 .....

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?

.....  
 .....

(1)

- (iii) Some of the microwaves transmitted by the speed gun are reflected from the moving ball back towards the speed gun.

Describe how the wavelength and frequency of the microwaves change as they are reflected from the moving ball.

.....  
 .....  
 .....  
 .....

(2)

(Total 7 marks)



- Q6.** (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
<b>A</b>	1.1 km
<b>B</b>	100 mm
<b>C</b>	0.18 mm

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

(1)

- (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.

$\text{wave speed} = \text{frequency} \times \text{wavelength}$
---

Show clearly how you work out your answer.

.....  
 .....

Wavelength = ..... m

(2)

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

.....  
 .....  
 .....  
 .....

(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?

.....  
 .....

(1)

**(Total 6 marks)**