P6
WAVES
TEST 2

GCSE
PHYSICS
AQA - COMBINED SCIENCE

Materials
For this paper you must have:
• Ruler
• Pencil, Rubber, Protractor and Compass
• Scientific calculator, which you are expected to use when appropriate

Instructions
• Answer all questions
• Answer questions in the space provided
• All working must be shown
• Do all rough work in this book. Cross out any rough work you don’t want to be marked

Information
• The marks for the questions are shown in brackets
Infrared and microwaves are two types of electromagnetic radiation.

The diagram below shows the positions of the two types of radiation within part of the electromagnetic spectrum.

(a) Name one type of electromagnetic radiation which has more energy than infrared.

___________________________________________________________________

(b) Use the correct answer from the box to complete each sentence.

Each answer may be used once, more than once or not at all.

<table>
<thead>
<tr>
<th>greater than</th>
<th>less than</th>
<th>the same as</th>
</tr>
</thead>
</table>

The wavelength of infrared is ____________ the wavelength of microwaves.

The frequency of microwaves is ____________ the frequency of infrared.

The speed of microwaves in a vacuum is ____________ the speed of infrared in a vacuum.

(Total 4 marks)

Figure 1 shows an X-ray of an arm with a broken bone.

Figure 1

(a) Complete the following sentence.

X-rays are part of the ____________ spectrum.

(1)
(b) **Figure 2** shows how the intensity of the X-rays changes as they pass through soft tissue and reach a detector.

![Figure 2](image)

(i) Use **Figure 2** to determine the intensity of X-rays reaching the detector for a 3 cm thickness of soft tissue.

Intensity of X-rays = ________ arbitrary units

(ii) Describe how the thickness of soft tissue affects the intensity of the X-rays.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

(2)
(iii) The data in Figure 2 are shown as a line graph and not as a bar chart. Choose the reason why.

Tick (✔) one box.

Both variables are categoric

Both variables are continuous

One variable is continuous and one is categoric

(c) What happens to X-rays when they enter a bone?

___________________________________________________________________

___________________________________________________________________

(1)

d) How are images formed electronically in a modern X-ray machine?

Tick (✔) one box.

With a charge-coupled device (CCD)

With an oscilloscope

With photographic film
Radiographers who take X-ray photographs may be exposed to X-rays.

(i) X-rays can increase the risk of the radiographer getting cancer.

Why can X-rays increase the risk of getting cancer?

Tick (√) one box.

- X-rays travel at the speed of light
- X-rays can travel through a vacuum
- X-rays are ionising

(ii) What should the radiographer do to reduce the risk from X-rays?

______________________________________________________________
______________________________________________________________

(Total 9 marks)

The diagram shows a longitudinal wave being produced in a stretched spring.

(i) Use the bold words from the diagram to complete the following sentence. Put only one word in each space.

A longitudinal wave is one in which the ___________________ causing the wave is parallel to the ___________________ of energy transfer.

(ii) Name the type of energy that is transferred by longitudinal waves.

______________________________________________________________

(Total marks)
The diagram shows water waves made by a wave machine in a swimming pool.

Every second, two waves go past a person standing in the swimming pool.

The waves have a wavelength of 0.8 metres.

Calculate the speed of the water waves.

Write down the equation you use, and then show clearly how you work out your answer.

Give the correct unit in your answer.

Wave speed = ______________________________

(3)
(c) The graph shows how the speed of deep ocean waves depends on the wavelength of the waves.

What can you conclude from the graph?

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)
(Total 8 marks)
Figure 1 shows a set of tuning forks.

A tuning fork has a handle and two prongs. It is made from metal.

When the prongs are struck on a hard object, the tuning fork makes a sound wave with a single frequency. The frequency depends on the length of the prongs.

(a) Use the correct answer from the box to complete each sentence.

<table>
<thead>
<tr>
<th>direction</th>
<th>loudness</th>
<th>pitch</th>
<th>speed</th>
</tr>
</thead>
</table>

The frequency of a sound wave determines its ____________ .

The amplitude of a sound wave determines its ____________ .

(b) Each tuning fork has its frequency engraved on it. A student measured the length of the prongs for each tuning fork.

Some of her data is shown in the table.

<table>
<thead>
<tr>
<th>Frequency in hertz</th>
<th>Length of prongs in cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>320</td>
<td>9.5</td>
</tr>
<tr>
<td>384</td>
<td>8.7</td>
</tr>
<tr>
<td>480</td>
<td>7.8</td>
</tr>
<tr>
<td>512</td>
<td>7.5</td>
</tr>
</tbody>
</table>

(i) Describe the pattern shown in the table.

________________________________________________________________________
________________________________________________________________________
(ii) **Figure 2** shows a full-size drawing of a tuning fork.

![Tuning Fork Diagram](image)

Measure and record the length of the prongs.

Length of prongs = _______________ cm

(1)

Use the data in the table above to estimate the frequency of the tuning fork in **Figure 2**.

Explain your answer.

______________________________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________

Estimated frequency = _______________ Hz

(3)

(c) Ultrasound waves are used in hospitals.

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

<table>
<thead>
<tr>
<th>electronic</th>
<th>hydraulic</th>
<th>radioactive</th>
</tr>
</thead>
</table>

Ultrasound waves can be produced by ______________________ systems.

(1)
(ii) The frequency of an ultrasound wave used in a hospital is $2 \times 10^6$ Hz.

It is **not** possible to produce ultrasound waves of this frequency using a tuning fork.

Explain why.

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

(2)

(d) **Figure 3** shows a tuning fork and a microphone. The microphone is connected to an oscilloscope.

![Figure 3](https://www.examqa.com/s/oscilloscope-tuning-fork.jpg)
When the tuning fork is struck and then placed in front of the microphone, a trace appears on the oscilloscope screen.

**Figure 4** shows part of the trace on the screen.

![Figure 4](image)

Each horizontal division in **Figure 4** represents a time of 0.0005 s.

What is the frequency of the tuning fork?

__________________________________________

__________________________________________

__________________________________________

Frequency = ___________________ Hz

(3)

(Total 13 marks)
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.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

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

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

(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 = \(3 \times 10^8\) m/s

Calculate the frequency of the signal.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Frequency = __________________ Hz

6

Infrared and microwaves are two types of electromagnetic radiation.

(a) State one example of the use of each type of radiation for communication.

Infrared: ______________________

Microwaves: ___________________

(2)

(b) Some of the properties of infrared and microwaves are the same.

State two of these properties.

1. _________________________________________________________________
___________________________________________________________________
___________________________________________________________________

2. _________________________________________________________________
___________________________________________________________________

(2)
Bats use the reflection of high pitched sound waves to determine the position of objects. The image below shows a bat and an insect flying in front of the bat.

(a) What determines the pitch of a sound wave?

Tick (✔) one box.

<table>
<thead>
<tr>
<th>Tick (✔)</th>
</tr>
</thead>
<tbody>
<tr>
<td>amplitude</td>
</tr>
<tr>
<td>frequency</td>
</tr>
<tr>
<td>speed</td>
</tr>
</tbody>
</table>

(b) State the name given to reflected sound waves.

___________________________________________________________________

(1)

(c) The bat emits a sound wave with a frequency of 25.0 kHz and a wavelength of 0.0136 metres.

Calculate the speed of this sound wave.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Speed = ____________ m/s

(2)
Some students did an investigation to study the behaviour of waves.

The figure below shows a ripple tank that they used to model the behaviour of waves.

(a) Complete the wave fronts on the figure above.

Show how the wave is refracted as it passes from the shallow region into the deep region.

(b) Explain what happens to the waves as they pass into the deep region.
(c) The waves generated on the surface of the water are transverse waves. Describe the differences between longitudinal waves and transverse waves. You may include labelled diagrams to help your answer.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(3)

(d) Some students investigate the properties of the waves generated in the figure above. Student A says ‘the waves move water from one end of the tank to the other’. Student B says ‘that’s wrong. Only the waves move, not the water’. Suggest what the students could do to decide which of them is correct.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)
(e) Another student uses a ripple tank where all the water is the same depth.

She measures the wavelength of each wave as 0.34 m.

The period of each wave is 0.42 s.

Calculate the speed of the wave.

Use the correct equation from the Physics Equation Sheet.

Give the unit.

Give your answer to three significant figures.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Speed = ______________

Unit = _____________

(5)

(Total 13 marks)

Different parts of the electromagnetic spectrum have different uses.

(a) The diagram shows the electromagnetic spectrum.

<table>
<thead>
<tr>
<th>Radio waves</th>
<th>Microwaves</th>
<th>Infrared</th>
<th>Visible light</th>
<th>Ultraviolet</th>
<th>X-rays</th>
<th>Gamma rays</th>
</tr>
</thead>
</table>

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

<table>
<thead>
<tr>
<th>amplitude</th>
<th>frequency</th>
<th>speed</th>
<th>wavelength</th>
</tr>
</thead>
</table>

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

\[10^{-15} \text{ to } 10^{-4}\]
\[10^{-4} \text{ to } 10^{4}\]
\[10^{4} \text{ to } 10^{15}\]

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

Calculate the frequency of the radio wave.

Give the unit.

Frequency = ____________________

(3)

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

___________________________________________________________________

(1)

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

___________________________________________________________________

(1)

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

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

___________________________________________________________________

___________________________________________________________________

(1)

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

___________________________________________________________________

___________________________________________________________________

(1)
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.

<table>
<thead>
<tr>
<th>Part of the body</th>
<th>X-ray dose in mSv</th>
<th>Time it would take to get the same dose from background radiation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdomen</td>
<td>9.0</td>
<td>3 years</td>
</tr>
<tr>
<td>Sinuses</td>
<td>0.5</td>
<td>2 months</td>
</tr>
<tr>
<td>Spine</td>
<td>4.0</td>
<td>16 months</td>
</tr>
</tbody>
</table>

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.

(3) (Total 13 marks)