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
The diagram shows a wave.

(a) Which arrow shows the amplitude of the wave?

Tick one box.

A  B  C  D

(b) Which arrow shows the wavelength of the wave?

Tick one box.

A  B  C  D

(c) It takes 0.5 seconds for a wave in the diagram to travel from point P to point Q.

Calculate the frequency of the waves shown in the diagram.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Frequency = ____________________ Hz

(d) What type of wave is sound?

Tick one box.

Electromagnetic
Longitudinal
Transverse
Two students carried out an experiment to determine the speed of sound.

This is the method used.

1. Student A stands 100 m away from Student B.
2. Student A bangs two blocks of wood together making a loud sound.
3. Student B starts a stopclock when he sees the blocks of wood bang together.
4. Student B stops the stopclock when he hears the sound and records the time.
5. The students repeat steps 2–4 several times.

The students calculated the speed of sound from their results.

(e) Suggest the most likely source of error in the experiment.

___________________________________________________________________
___________________________________________________________________

(1)

(f) The speed of sound calculated was lower than the true speed of sound in air.

Suggest one improvement to the students' method that would give a more accurate value for the speed of sound.

___________________________________________________________________
___________________________________________________________________

(1)

(g) A student compares the properties of visible light waves and radio waves.

Which two properties are the same for both visible light waves and radio waves?

Tick two boxes.

- Both are transverse waves
- Both can travel through a vacuum
- Both have the same amplitude
- Both have the same frequency
- Both have the same wavelength

(Total 9 marks)
Diagram 1 shows four of the seven types of wave in the electromagnetic spectrum.

<table>
<thead>
<tr>
<th>J</th>
<th>K</th>
<th>L</th>
<th>Visible light</th>
<th>Infrared</th>
<th>Microwaves</th>
<th>Radio waves</th>
</tr>
</thead>
</table>

(a) The **four** types of electromagnetic wave named in **Diagram 1** above are used for communication.

(i) Which type of electromagnetic wave is used when a traffic signal communicates with a car driver?

(ii) Which type of electromagnetic wave is used to communicate with a satellite in space?

(b) Gamma rays are part of the electromagnetic spectrum.

Which letter, J, K or L, shows the position of gamma rays in the electromagnetic spectrum?

Draw a ring around the correct answer.
Diagram 2 shows an infrared wave.

(i) Which one of the arrows, labelled A, B or C, shows the wavelength of the wave?

Write the correct answer, A, B or C, in the box.

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

The wavelength of infrared waves is shorter than the wavelength of radio waves.

(1)
Mobile phone networks send signals using microwaves. Some people think the energy a person’s head absorbs when using a mobile phone may be harmful to health.

(i) Scientists have compared the health of people who use mobile phones with the health of people who do not use mobile phones.

Which one of the following statements gives a reason why scientists have done this?

Tick (✓) one box.

- To find out if using a mobile phone is harmful to health. 
- To find out if mobile phones give out radiation. 
- To find out why some people are healthy.

(ii) The table gives the specific absorption rate (SAR) value for two different mobile phones.

The SAR value is a measure of the maximum energy a person’s head absorbs when a mobile phone is used.

<table>
<thead>
<tr>
<th>Mobile Phone</th>
<th>SAR value in W/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>0.28</td>
</tr>
<tr>
<td>Y</td>
<td>1.35</td>
</tr>
</tbody>
</table>

A parent buys mobile phone X for her daughter.

Using the information in the table, suggest why buying mobile phone X was the best choice.

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(2) (Total 8 marks)
A microphone and a cathode ray oscilloscope (CRO) can be used to show the pattern of a sound wave.

Four sound wave patterns, A, B, C and D, are shown. They are all drawn to the same scale.

(a) Which one of the patterns has the smallest amplitude? __________________________

(b) Which one of the patterns has the lowest frequency? __________________________

(Total 2 marks)

The table shows the electromagnetic spectrum. Three types of wave have been missed out.

<table>
<thead>
<tr>
<th>Gamma rays</th>
<th>Ultraviolet rays</th>
<th>Visible light</th>
<th>Microwaves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shortest wavelength</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(i) Use words from the box to complete the table.

infra red rays  radio waves  X-rays

(2)
(ii) Which one of the following gives a use of gamma rays?

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

- to communicate with satellites
- to see objects
- to kill cancer cells

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

All electromagnetic waves move ________ from one place to another.

- energy
- gases
- particles

(Total 4 marks)

5

A note was played on an electric keyboard.

The frequency of the note was 440 Hz.

(a) (i) What does a frequency of 440 Hz mean?

__________________________________________________________________________

__________________________________________________________________________

(ii) The sound waves produced by the keyboard travel at a speed of 340 m / s.

Calculate the wavelength of the note.

Give your answer to three significant figures.

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

Wavelength = ____________________ metres

(3)
(b) **Figure 1** shows a microphone connected to a cathode ray oscilloscope (CRO) being used to detect the note produced by the keyboard.

![Figure 1](image1)

**Figure 2** shows the trace produced by the sound wave on the CRO.

![Figure 2](image2)

A second note, of different wavelength, was played on the keyboard.

**Figure 3** shows the trace produced by the sound wave of the second note on the CRO.

![Figure 3](image3)

The settings on the CRO were unchanged.
What two conclusions should be made about the second sound wave produced by the keyboard compared with the first sound wave?

Give a reason for each conclusion.

Conclusion 1 ________________________________________________________________
___________________________________________________________________
Reason _________________________________________________________________ 
___________________________________________________________________

Conclusion 2 ________________________________________________________________
___________________________________________________________________
Reason _________________________________________________________________ 
___________________________________________________________________

(4)
(Total 8 marks)
Some TV signals are transmitted to a satellite in space and back to Earth. A satellite dish is fixed to a house. The satellite dish receives the TV signal. Microwaves are used for satellite TV transmission.

(a) Why are microwaves used, rather than radio waves, to transmit TV signals to and from satellites in space?

___________________________________________________________________
___________________________________________________________________
(1)
(b) The shape of the satellite dish allows microwaves to be focused at the receiver. The diagram shows how microwave A is reflected by the satellite dish.

Microwave A

Satellite dish

Microwave B

(i) Complete the diagram to show how microwave B is reflected by the satellite dish.

(ii) Draw on the diagram where the receiver should be placed.

For the receiver, use this symbol: ☐

Waves may be longitudinal or transverse.

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

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(Total 3 marks)
(b) Radio waves are electromagnetic waves.

Describe how radio waves are different from sound waves.

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(4)
(Total 7 marks)

The diagram shows a ripple tank.

Lamp

Motor

Water

White card
(a) The motor makes a noise when it is turned on.

Describe the differences between the properties of the sound waves produced by the motor and the water waves in the ripple tank.

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___________________________________________________________________
(4)

(b) The period of the sound waves produced by the motor is 8.3 milliseconds.

Calculate the frequency of the sound waves.

Use the Physics Equations Sheet.

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___________________________________________________________________

Frequency = ____________________ Hz

(3)
(c) Explain how a student could make appropriate measurements and use them to determine the wavelength of the waves in the ripple tank.
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)