

NAME: .....

SCHOOL:.....

DATE: .....

## WAVES I

### INSTRUCTIONS TO CANDIDATES

*Answer ALL questions in this paper in the spaces provided.*

- i. Here is some information about ultrasound.

Human ears can detect sounds with frequencies in the range 20 Hz to 20 000 Hz. Frequencies above this range are called ultrasound.

Short bursts of ultrasound waves can be used to measure the depth of the sea. The waves are produced by a crystal vibrating at a very high frequency.

- (a) Which of the following frequencies could be ultrasound?

Circle the correct answer.

15 Hz

250 Hz

15 000 Hz

25 000 Hz

(1)

- (b) Why can humans not hear ultrasound?

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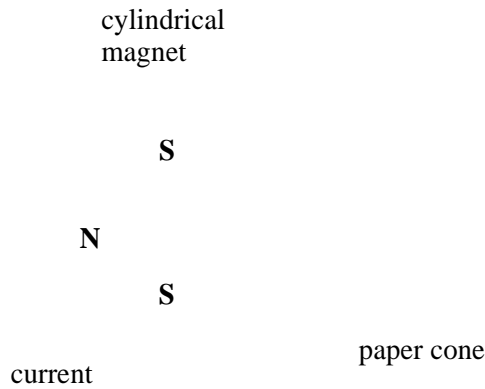
- (c) The crystal vibrates at a very high frequency.  
Which is the best description of the frequency of vibration?

  - A The distance the crystal vibrates in a second.
  - B The number of vibrations of the crystal in a second.
  - C The time it takes for the crystal to complete one vibration.

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

(1)  
(Total 3 marks)

2. The diagram shows a moving coil loudspeaker.



- (a) (i) When the current is in the direction shown in the diagram, the paper cone moves to the right.

Describe the movement of the paper cone when the direction of the current is reversed.

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(1)

- (ii) Explain why the paper cone moves when a current passes in the coil.

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(2)

- (b) An alternating current passes in the coil.

Describe the movement of the paper cone.

.....  
.....

(1)

- (c) The loudspeaker is used to produce a sound that has a frequency of 800 Hz.  
The wavelength of the sound as it leaves the loudspeaker is 0.40 m.  
Calculate the speed of the sound in air.

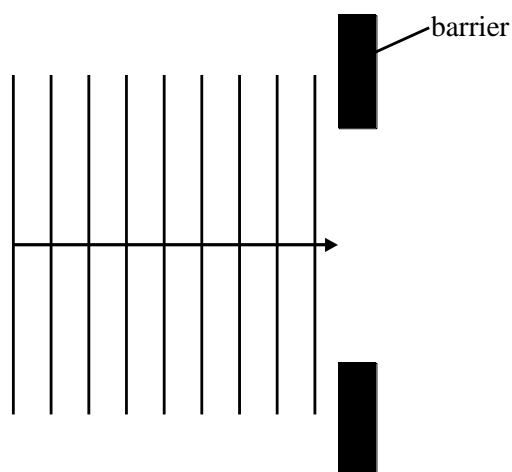
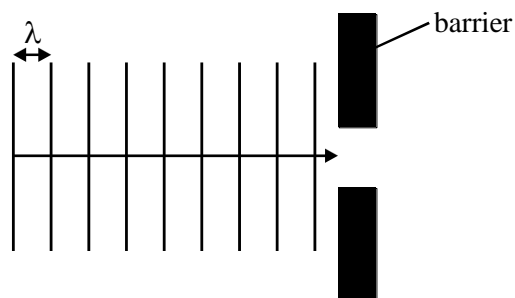
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(3)

(Total 7 marks)

3. Sound waves are diffracted when they pass through a gap in a barrier.

(a) (i) Complete the diagrams below to show how the effect of diffraction depends on the size of the gap.



(5)

(ii) What other factor affects the diffraction that occurs when a wave passes through a gap?

.....

(1)

- (b) When a person speaks into a loudhailer, the sound is first amplified before passing out through a cone.

A typical frequency of sound used for speech is 1000 Hz. The speed of sound in air is 330 m/s.

- (i) Show that sound with a frequency of 1000 Hz has a wavelength of 0.33 m in air.

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.....

(2)

- (ii) The diameter of the loudhailer cone is 0.30 m.  
Explain whether it is suitable for a person speaking to a crowd of people.

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

(2)

- (iii) When listening to music, the ear needs to detect frequencies over a wide range. A typical frequency of a high-pitched sound is 4000 Hz. Explain why the loudhailer is not suitable for use by a female singer who is singing to an audience.

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.....  
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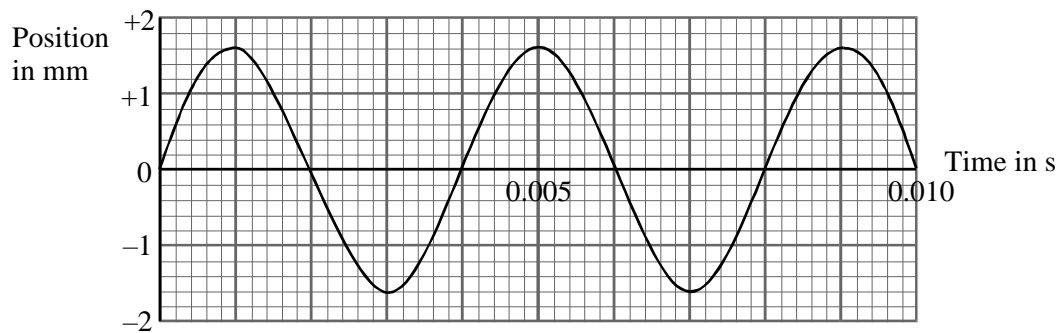
(2)

(Total 12 marks)

4. The diagram shows how two different waves are involved when listening to a radio.  
radio wave

sound wave

- (a) Complete the sentences that compare the radio wave and the sound wave.
- (i) The frequency of the radio wave is ..... than the frequency of the sound wave. (1)
  - (ii) The radio wave is transverse; the sound wave is ..... (1)
- (b) The graph shows how the position of the loudspeaker cone changes when it is reproducing a sound of frequency 250 Hz.



- (i) Which word best describes the movement of the loudspeaker cone?  
Circle the word of your choice.  
amplification                      gyration                      rotation  
vibration (1)
- (ii) Use the graph to write down the amplitude of the wave motion.  
..... mm (2)
- (iii) Use the graph to write down the time taken to complete one cycle of the wave motion.  
..... s (1)



- (c) The amplitude and frequency of the movement of the loudspeaker cone are both reduced.
- (i) Sketch on the grid in part (b) a graph that shows the loudspeaker cone moving with reduced amplitude and frequency. (2)
- (ii) Give two ways in which the sound changes when the loudspeaker cone moves with reduced amplitude and frequency.
- 1 .....
- 2 ..... (2)
- (Total 10 marks)

5. The table gives information about some waves used for radio broadcasting.

	Modulation	Range	Amount of information carried	Frequency
long wave	amplitude	hundreds of km	low	200 kHz
medium wave	amplitude	50 km	medium	1 MHz
VHF	frequency	50 km	high	100 MHz

Use the information in the table to answer the questions below.

- (a) (i) Which wave has the highest frequency?  
 ..... (1)
- (ii) Which wave is used to broadcast weather information to ships?  
 .....
- Why is this wave used?  
 .....  
 .....
- (2)

(iii) Which wave is used for high-quality music broadcasts?

.....

Why is this wave used?

.....  
.....

(2)

(iv) Noise affects the amplitude of a wave but not its frequency.

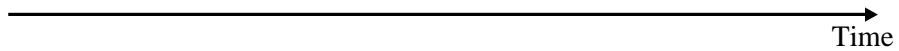
Which two waves are most affected by noise?

..... and .....

(1)

(b) The diagram shows a radio wave that is not carrying a signal.

Displacement

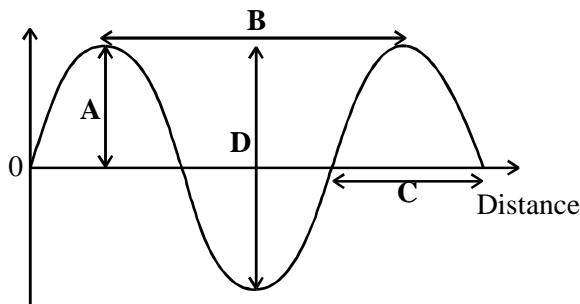


Draw a similar diagram, on the axes below, to show an amplitude modulated radio wave.



(2)  
(Total 8 marks)

6. (a) The diagram shows part of a wave.



(i) Which letter (A, B, C or D) shows the wavelength of the wave?

.....

(1)

(ii) Which letter (A, B, C or D) shows the amplitude of the wave?

.....

(1)

(b) Circle the correct unit for the frequency of a wave.

m/s                      km/s                      Hz                      W

(1)

(c) The diagram shows a wave on a pond.

When the wave reaches the cork, the cork bobs up and down but does not move nearer to the side of the pond.

(i) Explain why the cork only bobs up and down.

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(2)

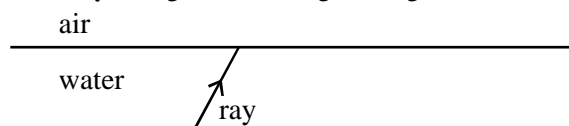
(ii) What does the wave transfer to the side of the pond?

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(1)

(Total 6 marks)

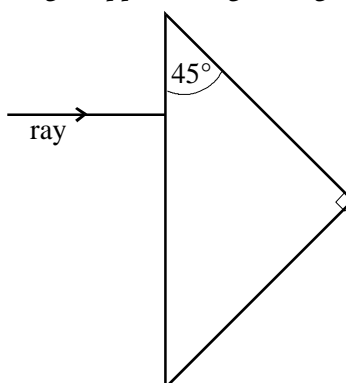
7. (a) The diagram shows a ray of light travelling through water, towards the surface.



Complete the diagram, showing the ray leaving the water.

(2)

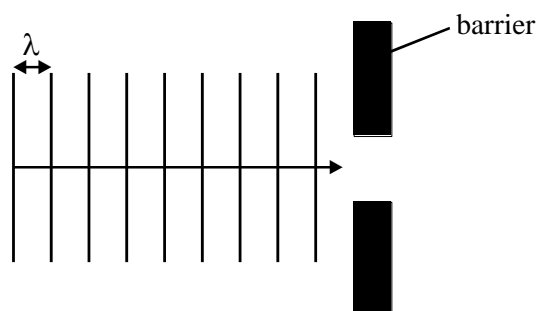
- (b) The diagram shows a ray of light approaching a  $45^\circ$  glass prism.



Complete the diagram, showing the path of the ray through the prism.

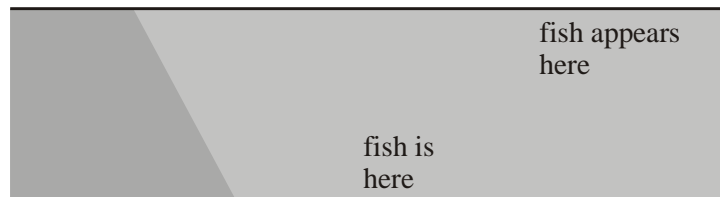
(3)

- (c) Water waves are diffracted when they pass through a gap in a barrier. Complete the diagram below to show this effect.



(3)  
(Total 8 marks)

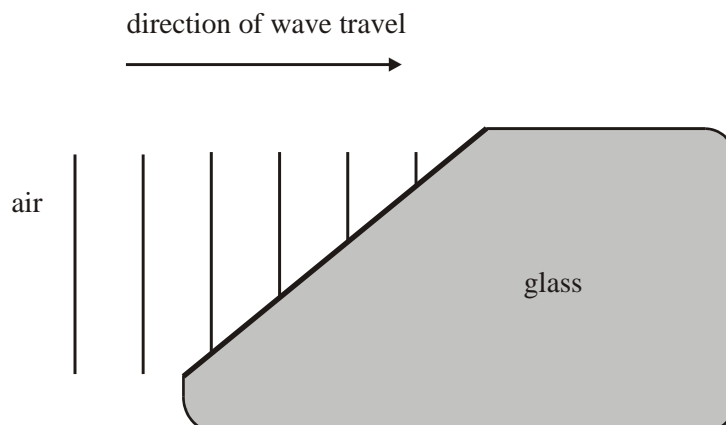
8. (a) The diagram shows a ray of light from a fish in a river as it passes from the water into the air and enters the eye of the person on the bank.



- (i) What name is given to the bending of the ray of light as it passes from the water into the air?  
..... (1)

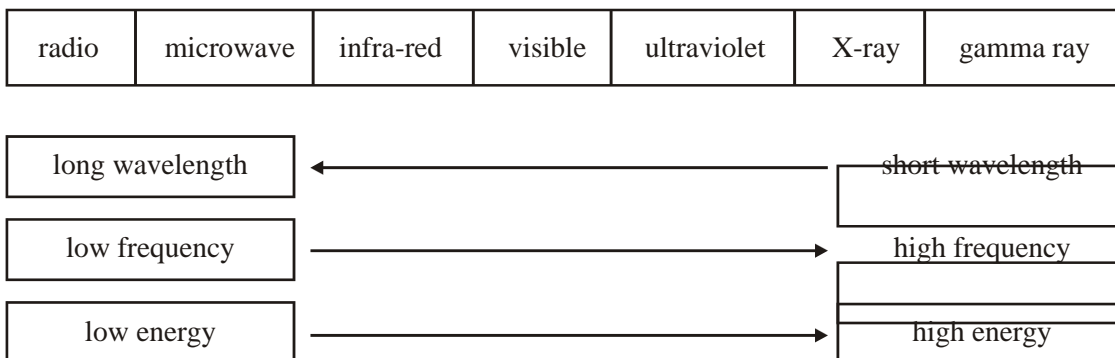
- (ii) Use the diagram to explain why the fish appears to be above the place where it actually is.  
.....  
..... (2)

- (b) The diagram shows wavefronts of light arriving at the boundary between air and glass. Complete the diagram to show the wavefronts inside the glass.



(2)  
(Total 5 marks)

9. (a) The diagram shows the various parts of the electromagnetic spectrum.



(i) Describe the relationship shown between the energy carried by an electromagnetic wave and its frequency.

.....  
 .....

(1)

(ii) Explain why waves with high energy are more dangerous to humans than those with low energy.

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

(2)

(iii) Describe the relationship shown between the wavelength and frequency of the waves.

.....  
 .....

(1)

(b) Ultrasounds are also waves.

State two differences between ultrasound waves and radio waves.

1 .....

2 .....

(2)

(Total 6 marks)

10. (a) Chris is just about to send a transverse wave along the stretched spring.

Draw two arrows on the diagram to show the directions in which she has to move her hand.

(2)

(b) Give one example of a longitudinal wave.

.....

(1)

(c) The diagram shows a wave.

(i) The amplitude of this wave is ..... cm.

(1)

(ii) The wavelength of this wave is ..... cm.

(2)

(iii) In 7 seconds, 14 complete waves pass the point P.

Calculate the frequency of this wave.

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(3)

(Total 9 marks)

- ii. (a) Outside a shop is a security light. This switches on at night when it detects body heat. Which type of electromagnetic wave does the security light detect?

.....

(1)

- (b) The diagram represents a light wave.

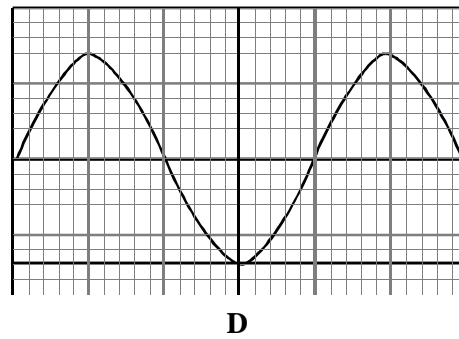
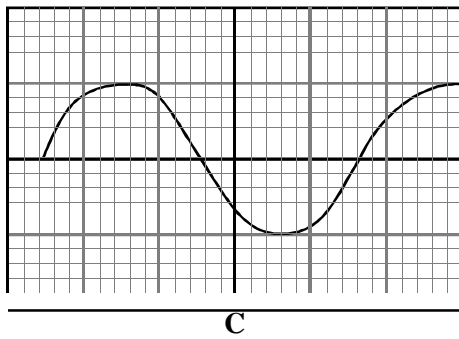
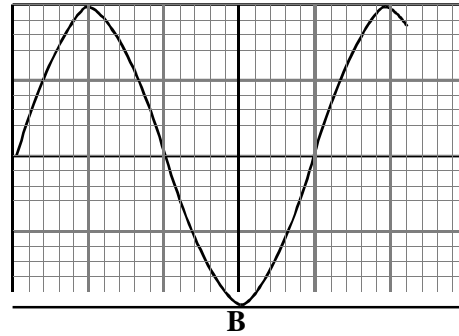
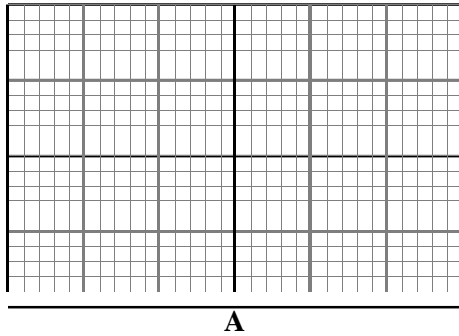
Draw a line to link each property of a wave to its description.

<b>property of wave</b>	<b>description</b>
frequency	the distance between two crests or troughs
wavelength	the number of waves passing every second
amplitude	the height of a wave crest

(2)  
(Total 3 marks)



12. (a) Four sound waves were displayed on an oscilloscope screen.  
The same oscilloscope settings were used each time.



- (i) Which sound was the loudest? .....

Give a reason for your choice.

.....

(1)

- (ii) Describe how sound waves are transmitted through air.

.....

.....

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(2)

- (b) Sound with a frequency greater than 20 000 Hz is known as ultrasound.  
State two different medical uses of ultrasound.

1. ....

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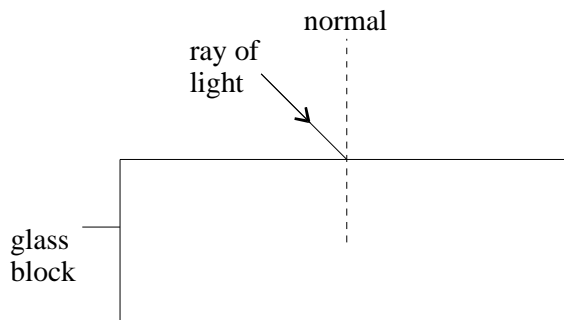
2. ....

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(2)

(Total 7 marks)

13. (a) A light ray travels through air and strikes a glass block.



Use a ruler to draw the paths of the refracted ray as it passes through and out of the block.

(2)

- (b) This is part of a newspaper article

Ditch those glasses - in 15 minutes

Using computer technology and a thin invisible beam of ultraviolet radiation, microscopic amounts of eye tissue can be removed to correct visual impairment.

- (i) Suggest another use for ultraviolet radiation.

.....  
 .....

(1)

- (ii) Visible light and ultraviolet light are parts of the electromagnetic spectrum. Two features of an electromagnetic wave are its wavelength and frequency. Use these features to compare ultraviolet radiation and visible radiation.

.....  
 .....

(2)

- (c) Nicola has a suspected broken arm. She is taken to hospital for an arm X-ray.

(i) Explain how the properties of X-rays make them suitable for making an X-ray photograph of the suspected broken arm.

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(3)

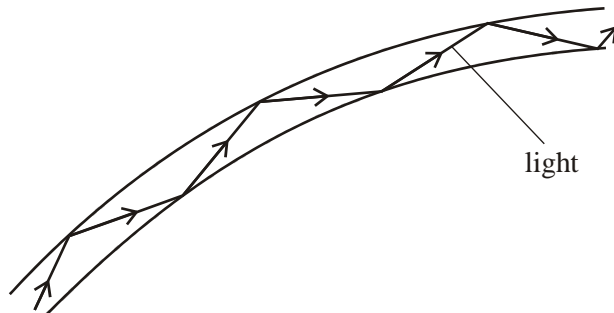
(ii) Why can exposure to X-rays be harmful to the body?

.....  
.....

(1)

(Total 9 marks)

14. The diagram shows how light can travel in an optical fibre.



(a) Use words from the box to complete the sentences.

critical	crucial	diffracted	incidence
internal	reflected	refraction	

At the inner surface of the glass fibre light is .....

This happens because the angle of ..... is greater than the ..... angle.

(3)

(b) Suggest one reason why optical fibres are used to transmit light.

.....  
.....

(1)  
(Total 4 marks)

15. Sound waves can be diffracted.

(a) How is the frequency of a wave calculated from its wavelength and speed?

frequency =

(1)

(b) Explain why the open door of a music room diffracts lower frequency sounds more than higher frequency sounds.  
(You may choose to draw a diagram to help your explanation.)

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(2)  
(Total 3 marks)