

Thursday 26 January 2012 – Morning

A2 GCE APPLIED SCIENCE

G635 Working Waves

Candidates answer on the Question Paper.

OCR supplied materials:

None

Other materials required:

- Electronic calculator
- Ruler (cm/mm)

Duration: 1 hour 30 minutes




Candidate forename		Candidate surname	
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Centre number						Candidate number				
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INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **90**.
-  Where you see this icon you will be awarded marks for the quality of written communication in your answer.
This means, for example, you should:
 - ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear;
 - organise information clearly and coherently, using specialist vocabulary when appropriate.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- This document consists of **20** pages. Any blank pages are indicated.

Answer **all** the questions.

- 1 Waves produced by musical instruments have repeating waveforms. The wave produced along a whip when it is cracked is not repeated.

The wave that travels along a stretched 'slinky' spring is also a non-repeating wave when one end is moved up and down once.

- (a) Fig. 1.1 shows a non-repeating wave travelling along a 'slinky' 0.41 seconds after the disturbance began. Fig. 1.2 shows the same wave 0.81 seconds after the disturbance began.

0.41 s after the start

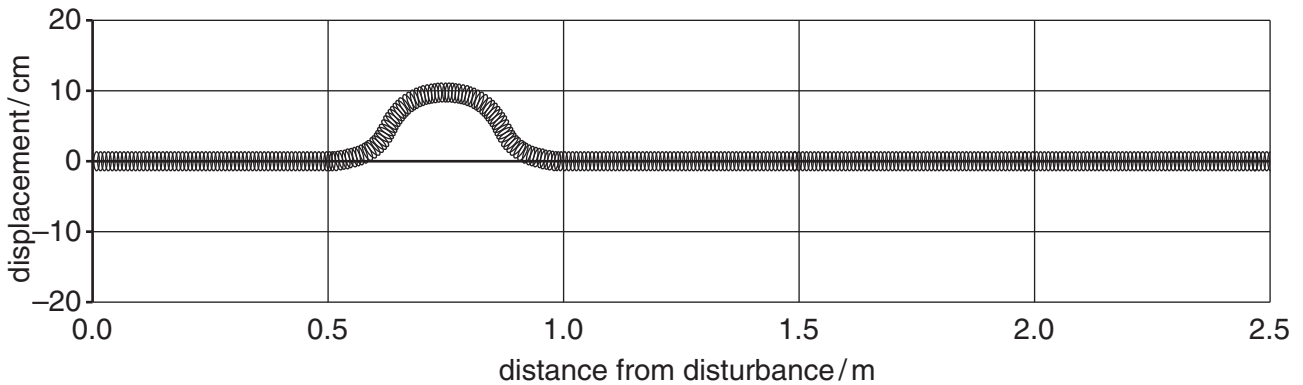


Fig. 1.1

0.81 s after the start

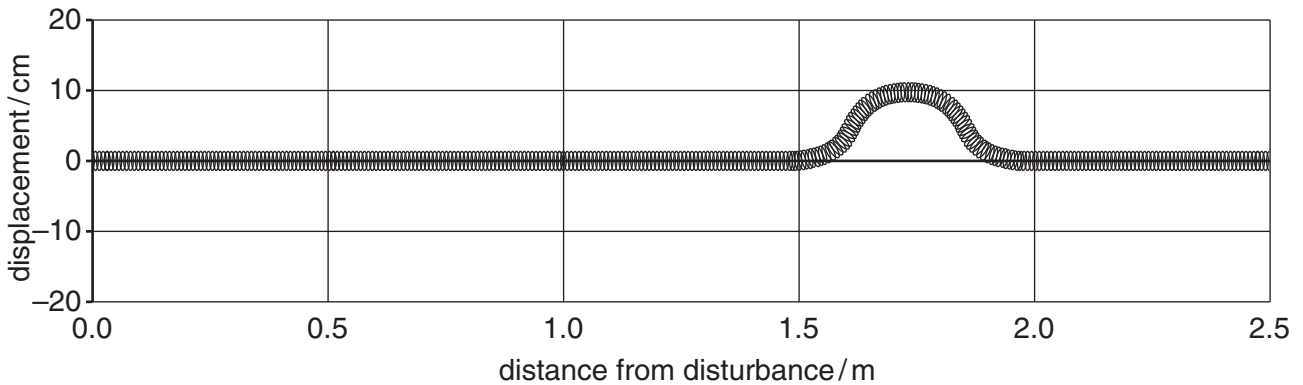


Fig. 1.2

A student wants to work out the values of some of the features of the non-repeating wave.

Complete Table 1.1 by taking and recording measurements from Fig. 1.1 and Fig. 1.2. Enter the values of the features or write 'NA' if not applicable to non-repeating waves.

Table 1.1

feature	measurements taken from Fig. 1.1 and Fig. 1.2	value	unit
maximum displacement	m
speed	ms^{-1}
periodic time	s
frequency	Hz

[4]

(b) Fig. 1.3 shows displacement–time graphs of **repeating** waves all travelling at the same speed.

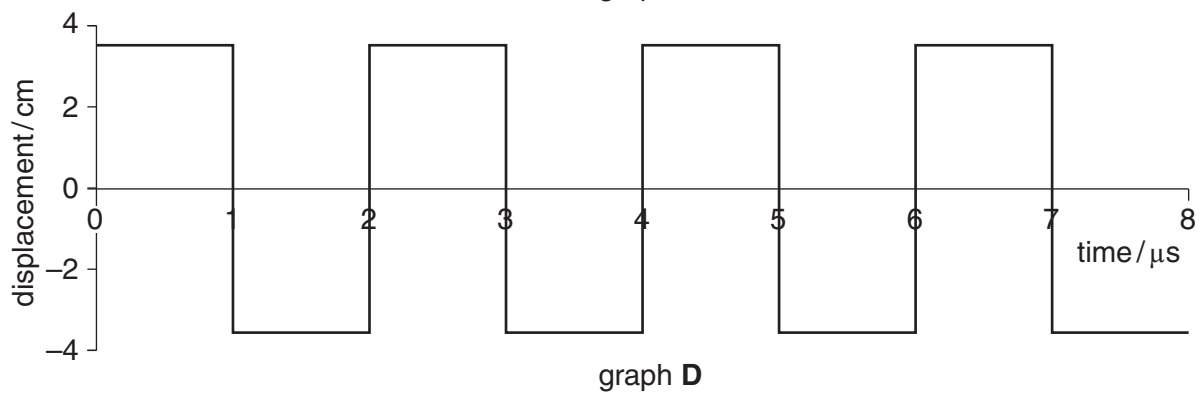
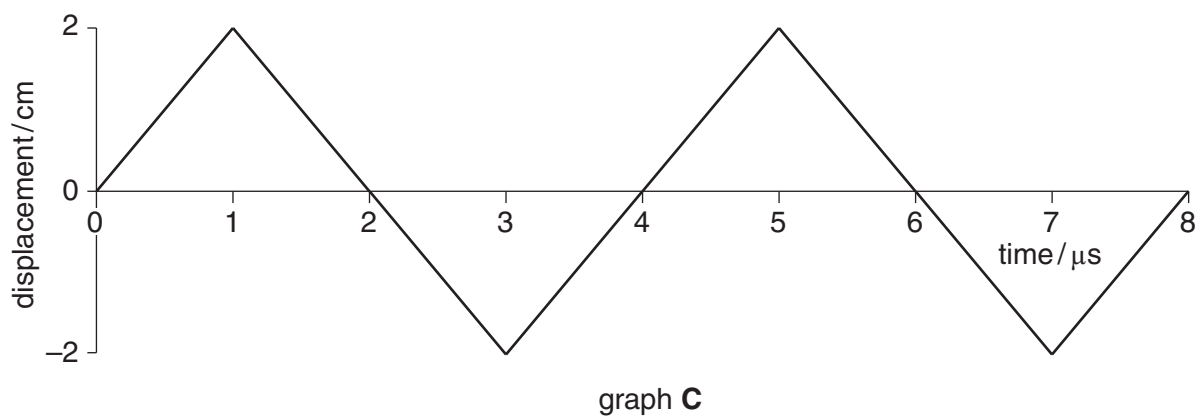
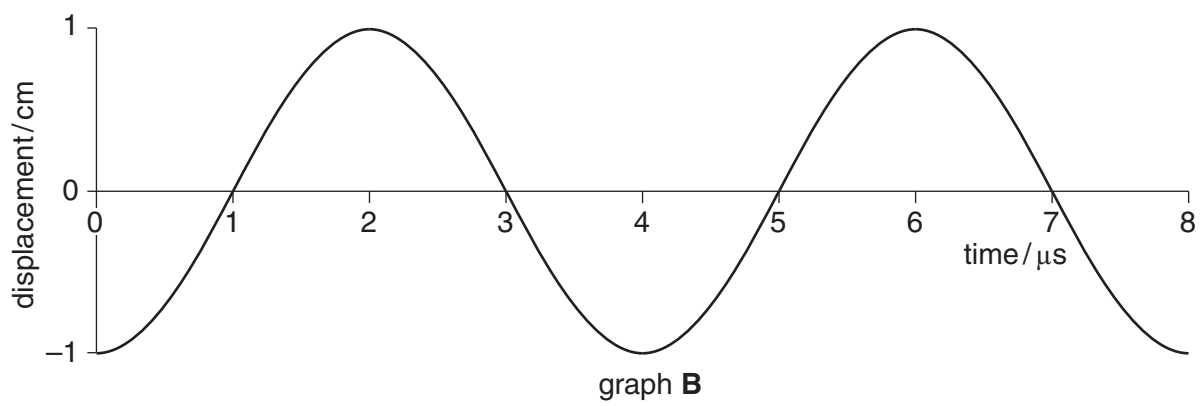
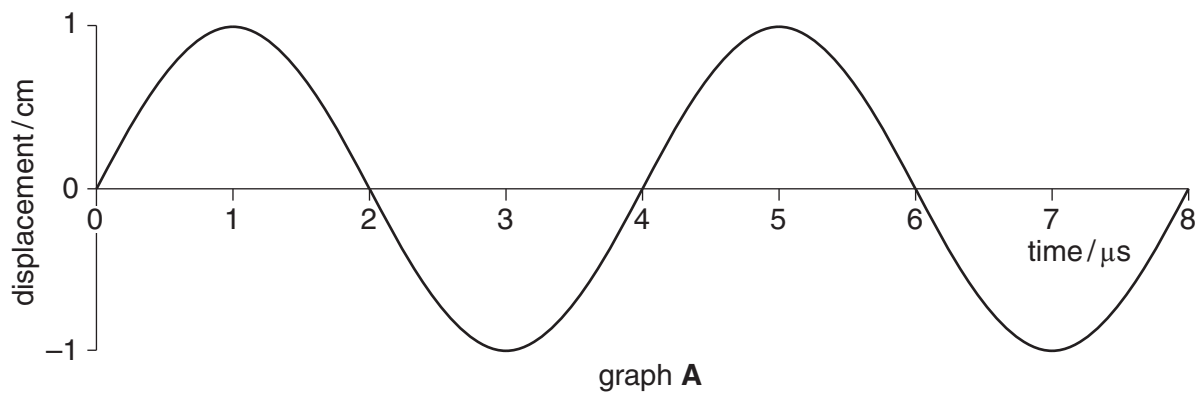


Fig. 1.3

- (i) Put a tick (✓) in the boxes in Table 1.2 to indicate which of the waves shown in graphs **B**, **C** and **D** have the same frequency and/or wavelength as the wave shown in graph **A** in Fig. 1.3.

Table 1.2

	frequency same as graph A	wavelength same as graph A
graph B
graph C
graph D

[2]

- (ii) State the relationship between the phase of the wave shown in graph **B** with the wave shown in graph **A** in Fig. 1.3.

.....

 [2]

- (iii) Find the periodic time, T , of the wave in graph **C**.

periodic time = unit = [1]

- (iv) Use your answer to (b)(iii) to find the frequency, f , of the wave in graph **C**.

frequency = unit = [3]

- (c) David plays the organ in his local church. Fig. 1.4 represents the instantaneous displacement of the air due to a **standing** wave in an organ-pipe open at both ends.

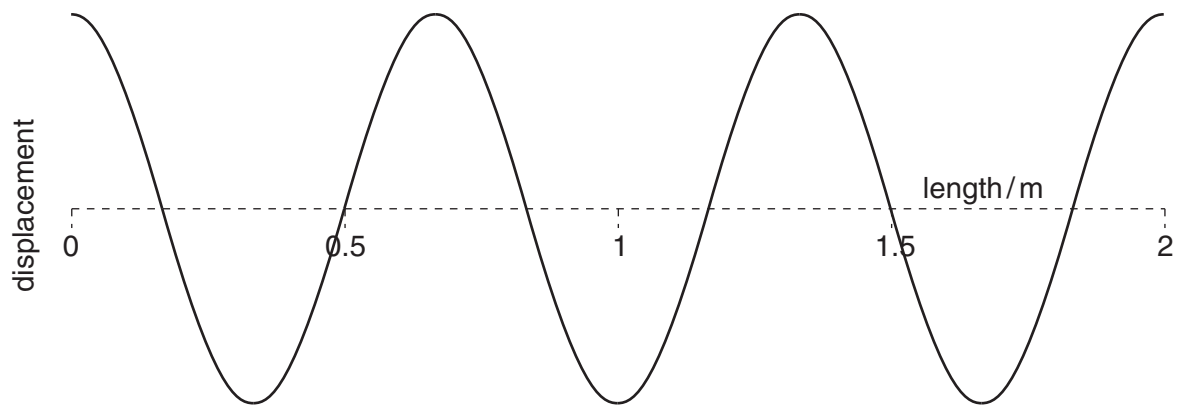


Fig. 1.4

- (i) On Fig. 1.4, mark the positions of **two** displacement antinodes with the letter 'A'. [1]
- (ii) On Fig. 1.4, mark the positions of **two** displacement nodes with the letter 'N'. [1]
- (iii) Draw on Fig. 1.5 a graph to show the instantaneous displacement of the air at a time $T/2$ ($\frac{1}{2}$ cycle) after that shown in Fig. 1.5, where T is the periodic time of the wave (Fig. 1.5 is identical to Fig. 1.4).

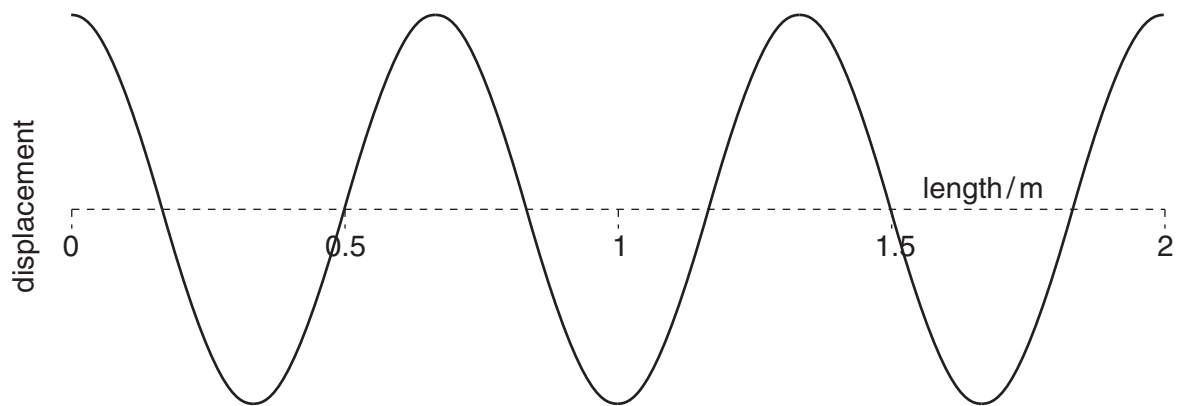


Fig. 1.5

[1]

- (iv) Draw on Fig. 1.6 a graph to show the instantaneous displacement of the air at a time $T/4$ ($\frac{1}{4}$ cycle) after that shown in Fig. 1.6. (Fig. 1.6 is identical to Fig. 1.4).

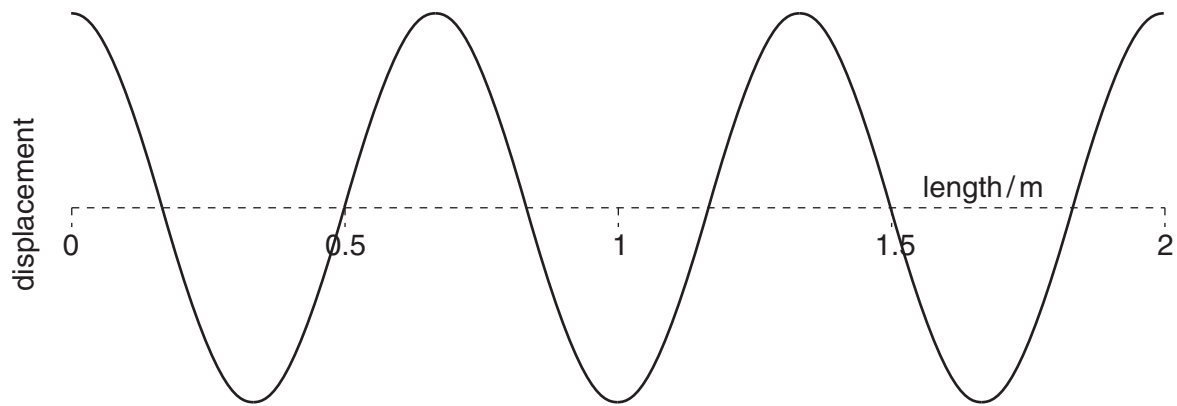


Fig. 1.6

[1]

- (v) Calculate the wavelength of the wave in Fig. 1.4.

wavelength = m [1]

- (d) The organ has an identical pipe that is closed at one end and open at the other.

State **one** reason why the sound produced by a pipe open at one end and closed at the other would differ from the sound produced by an identical pipe open at both ends.

.....

.....

.....

..... [2]

[Total: 19]

2 The image shown in Fig. 2.1 is taken with an infrared camera on a satellite above the Earth.

EIEH51 MSG 10.8 micron Infrared Image 03 Apr 2010 1400 UTC

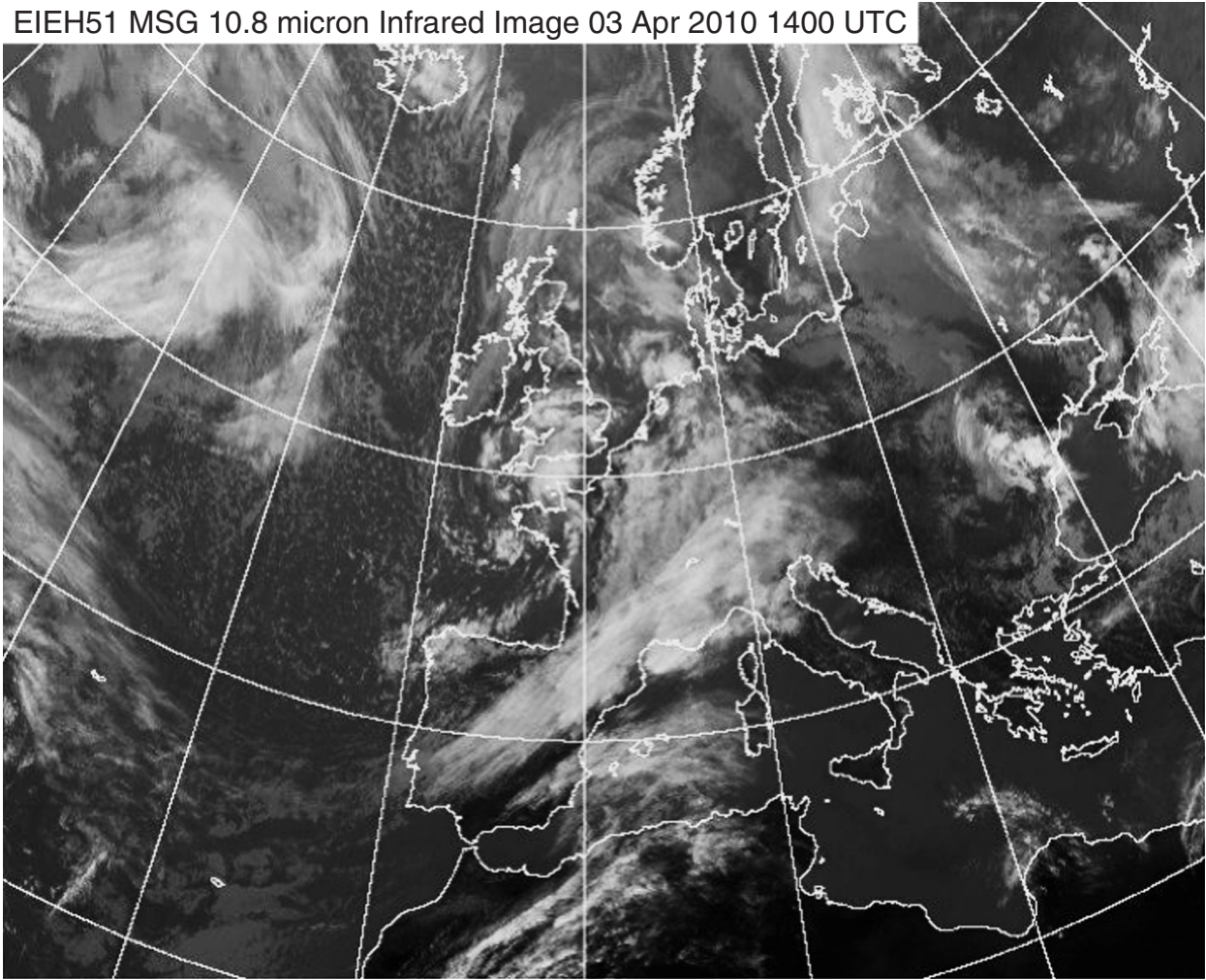


Fig. 2.1

(a) Explain why the cloud tops appear different when compared to land and ocean surfaces on images like Fig. 2.1.

.....

.....

.....

..... [2]

(b) Suggest and explain why the tops of high clouds can be distinguished from the tops of low clouds in satellite images.

.....
.....
.....
..... [2]

(c) The camera on the satellite produces images of the same part of the Earth every hour throughout the day and night. Suggest **one** advantage of an infrared camera compared to a visible light camera for this purpose.

.....
..... [1]

(d) Compare the following properties of visible and infrared radiation travelling in a vacuum.

(i) wavelength [1]
.....

(ii) speed [1]
.....

(e) State the type of resolution that can be used to describe how well a thermal imaging camera can distinguish between

(i) objects at slightly different places [1]

(ii) objects at slightly different temperatures. [1]

[Total: 9]

- 3 Frozen food is stored in boxes in large warehouses at **constant** temperature. When foods are needed by shops, boxes are collected by robots and loaded onto lorries.

Computer engineers are investigating possible ways of checking that the correct boxes are collected. Their research uses colour-coded boxes. Devices are mounted on the robots to measure the wavelengths of the radiations emitted or reflected by the different coloured boxes of food.

In Table 3.1 **compare** the wavelengths of infrared and visible radiation coming from the red boxes with the wavelengths coming from the blue boxes in the dark and in daylight.

Table 3.1

	in the dark	in daylight
infrared radiation		
visible light		

[4]

[Total: 4]

4 In a school laboratory demonstration, Maria shines light from a small torch into one end of an optical fibre and detects it electronically at the other end.

(a) Name a component Maria may use to detect the light at the end of the optical fibre.

..... [1]

(b) Name the process that prevents light from escaping from optical fibres.

..... [1]

(c) State the conditions for this process to occur in an optical fibre.

.....
.....
.....
..... [2]

(d) The optical fibre that Maria uses is a single strand of glass, all of the same refractive index and surrounded by air. Maria explains that optical fibres used in industry are constructed differently.

Describe the construction of a step-index optical fibre used for commercial applications.

.....
.....
.....
..... [2]

(e) Maria explains that step-index optical fibres are not used for long-distance communications applications. Monomode fibres are used instead.

(i) Describe how the construction of monomode fibres differs from that of step-index fibres. Include typical values in your answer.

.....
.....
.....
..... [2]

- (ii) State and explain why monomode fibres are preferred to step-index fibres for long-distance communications applications.

.....

.....

.....

.....

.....

.....

..... [3]

- (f) For communications applications, bundles of fibres have to be arranged in a particular way.

- (i) State the name of this type of bundle of optical fibres.

..... [1]

- (ii) Describe how this arrangement differs from that of fibres used in lighting applications.

.....

..... [1]

- (iii) Explain why bundles of fibres made for lighting applications would **not** be suitable for communications.

.....

..... [1]

5 Peter sings into a microphone to record a song onto a CD. His electronic recording equipment converts the signal from one type as it leaves the microphone to another type that is suitable for recording on CD.

(a) Name the two types of electronic signal

(i) as it leaves the microphone [1]

(ii) suitable for recording on CD. [1]

(b) The electronic recording equipment uses PCM to convert the signal from the type that leaves the microphone to the type suitable for recording on CD.

(i) State what the letters PCM stand for.

.....
..... [1]

(ii) Describe the first stage of the conversion process. You may draw a diagram to support your answer.

.....
.....
.....
.....
..... [2]

(iii) Describe the second stage of the conversion process.

.....
.....
..... [1]

(iv) The recording on the CD is later to be amplified and played through a loudspeaker. Name the conversion process that the signal must undergo.

.....
..... [1]

[Total: 7]

6 Fig. 6.1 represents some of the cells used in a mobile phone network.

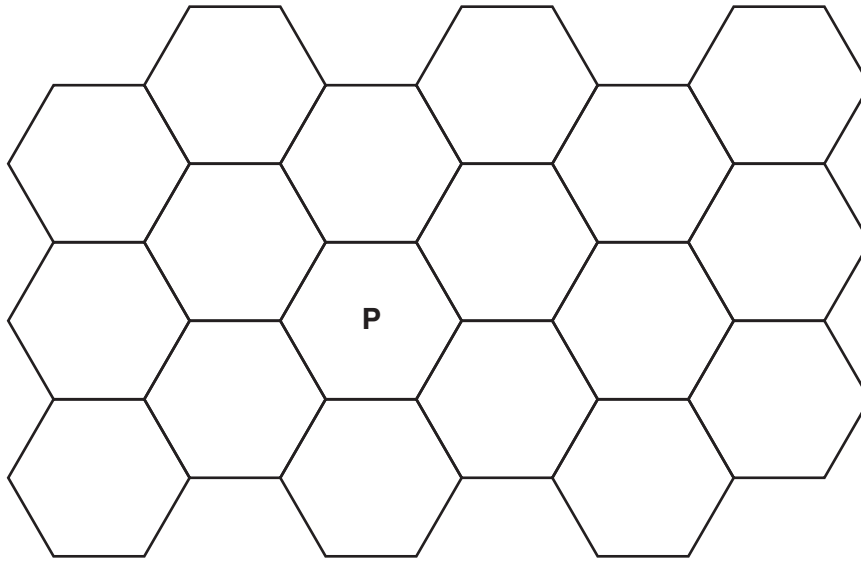


Fig. 6.1

(a) On Fig. 6.1, mark with a letter 'B' the positions of any three base stations. [2]

(b) Chitra is using a mobile phone in the cell marked P.

On Fig. 6.1, mark with a cross 'X' one cell that must **not** use the same frequency as that being used by Chitra. [1]

(c) In practice the cells are not arranged in an even pattern across the whole of the UK. Give **two** reasons why the arrangement of cells may vary in different places.

- 1.
-
- 2.
- [2]

[Total: 5]

7 Jason broke his leg. He was taken to casualty and an X-ray image of the leg was taken.

(a) The radiographer showed the image to Jason, who asked “Why do the bones show up white?” How would you explain why, on an X-ray image, the bones appear white and the surrounding parts are black?

.....
.....
.....
.....
.....
..... [3]

(b) Describe and explain how the following would appear on an X-ray image.

(i) fat
.....
..... [2]

(ii) air in the lungs.
.....
..... [2]

(c) Give an example of an artificial contrast medium used when taking an X-ray image of the gastrointestinal tract.

.....
..... [1]

(d) X-Ray images can be improved by using a narrow beam.

(i) Explain why a wide beam would produce a blurred image.
.....
..... [1]

(ii) Describe how the design and arrangement of the target in an X-ray machine minimises the beam width.

.....
..... [1]

(iii) Describe how the width of the beam may be further reduced after it has been produced.

.....
..... [1]

(e) X-Ray images can also be improved by filtration.

(i) State how X-ray beams are filtered.

.....
..... [1]

(ii) State the effect of the filter on the X-ray beam.

.....
..... [1]

(iii) Explain why filtration improves the image quality.

.....
.....
.....
..... [2]

(f) CAT scanners produce much more detailed information than a conventional X-ray machine.

(i) State the type of wave used in CAT scanners.

.....
..... [1]

(ii) Describe how the parts of a CAT scanner move while an image is being taken.

.....
.....
.....
.....
.....
..... [3]

(iii) Explain why the intensity of the image at a point in a conventional X-ray image is less informative than the information from a CAT scan.

.....
.....
.....
..... [2]

[Total: 21]

8 Amy, Brian and Colin are all able to access the internet at home but their connections use three different methods.



Describe each method indicating, in each case, whether it is suitable for downloading large data files such as films and why.

- 1. method
description
.....
.....
.....
.....
.....

 - 2. method
description
.....
.....
.....
.....
.....

 - 3. method
description
.....
.....
.....
.....
.....
- [5]

[Total: 5]

END OF QUESTION PAPER

