

**ADVANCED GCE
APPLIED SCIENCE**

G635

Unit 16: Working Waves

THURSDAY 14 JUNE 2007

Morning

Time: 1 hour 30 minutes

Candidates answer on the question paper.
Additional materials: Electronic calculator
Ruler (cm/mm)
Protractor



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2
8
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4
9
*

Candidate
Name

Centre
Number

--	--	--	--	--

Candidate
Number

--	--	--	--

INSTRUCTIONS TO CANDIDATES

- Write your name, Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Do **not** write in the bar code.
- Do **not** write outside the box bordering each page.
- **WRITE YOUR ANSWER TO EACH QUESTION IN THE SPACE PROVIDED. ANSWERS WRITTEN ELSEWHERE WILL NOT BE MARKED.**

INFORMATION FOR CANDIDATES

- The number of marks for each question is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is 90.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE

Qu.	Max.	Mark
1	15	
2	19	
3	22	
4	20	
5	14	
TOTAL	90	

This document consists of **18** printed pages and **2** blank pages.

Answer **all** the questions.

1 Waves are vital to communication. Communications systems use sound, light, radio waves and microwaves.

(a) State which of the waves mentioned above is **not** a type of electromagnetic radiation.

..... [1]

(b) Name **one** of the waves mentioned above that is a transverse wave.

..... [1]

(c) Compare the velocity, frequency, and wavelength of light, with radio waves when they travel in a vacuum.

velocity

.....

.....

frequency

.....

.....

wavelength

.....

..... [5]

(d) (i) Compare the penetration into matter by light and radio waves.

.....

.....

(ii) Give an example of a material which can be penetrated by one but not the other.

..... is penetrated by **light / radio waves*** [2]

***delete one**

- (e) A television aerial fitter is installing an aerial on a new house. Television aerials consist of metal rods.



© OCR

Fig. 1.1

- (i) Explain how the wave energy is converted into an electronic signal in the aerial.

.....

.....

..... [2]

- (ii) The fitter must decide whether to mount the rods vertically or horizontally, depending on the transmitting station. See Fig. 1.1. Use your knowledge of the properties of radio waves to explain why the orientation of the aerial is not always the same. You may illustrate your answer with a diagram if you wish.

.....

.....

.....

.....

..... [4]

[Total: 15]

2 RAPID-UK is one of several search-and-rescue teams on permanent stand-by to help with natural disasters around the world. In the aftermath of earthquakes, teams often use thermal imaging to find survivors.

(a) Explain how thermal imaging can enable survivors to be located.

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

(b) Some radiation detected by a thermal imaging camera during a training exercise has a wavelength of 9.17×10^{-7} m. Calculate the frequency of this radiation. Include the correct unit in your answer.

[wave velocity = 3.00×10^8 m s⁻¹]

frequency = unit [4]

(c) Endoscopes use fibre optics. The team use an industrial endoscope to help them search for survivors in collapsed buildings. State how the endoscope assists their work.

..... [1]

- (d) A student on work experience with RAPID-UK carried out an experiment to investigate the principle on which fibre optic cables work. Figs. 2.1 to 2.4 show photographs he took of stages in his experiment to measure the critical angle for a plastic. He used a semicircular block of the plastic.

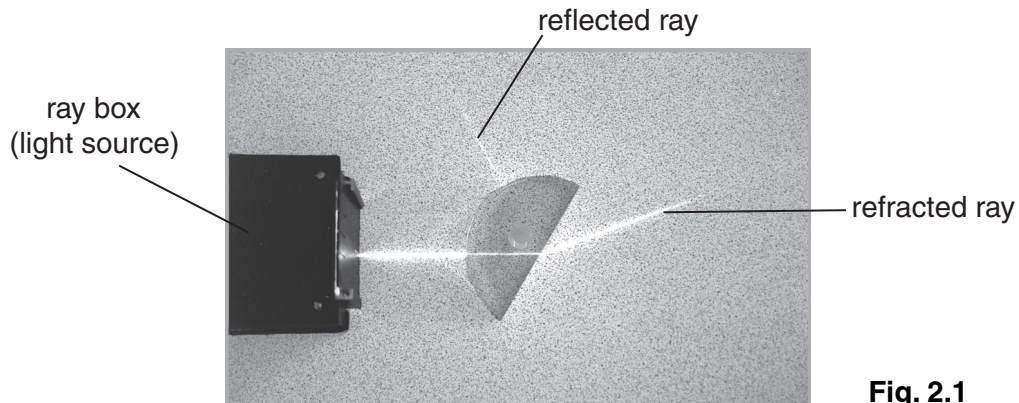


Fig. 2.1

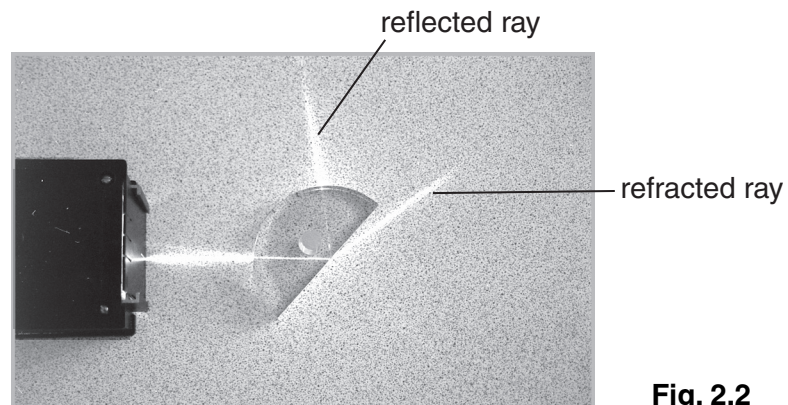


Fig. 2.2

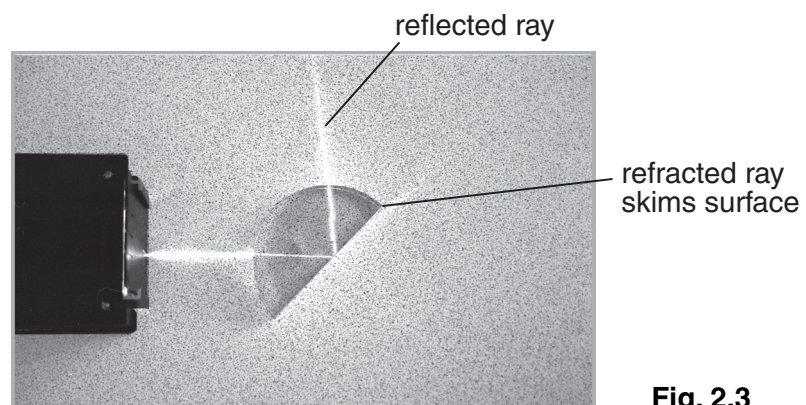


Fig. 2.3

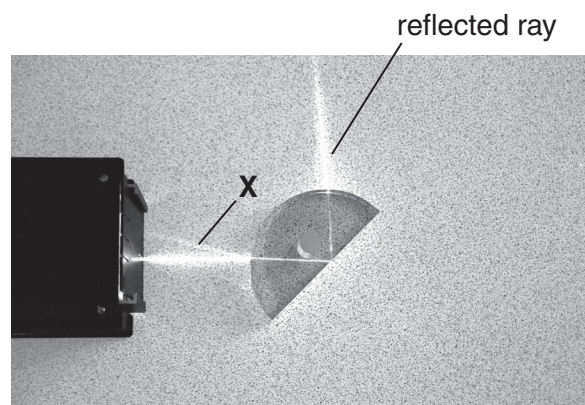


Fig. 2.4

3 Mrs Bell was referred to hospital because she had unexplained back pain. In view of her previous medical history, the doctors decided to examine her using a γ -camera.



(a) Before the examination, Mrs Bell was given a special injection.

(i) Explain why the injection made the examination possible.

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

(ii) State and explain three factors that are taken into account when selecting the injection to allow diagnosis to take place.

.....
.....
.....
.....
.....
.....
.....
..... [6]

(b) One of the components of the γ -camera is called the collimator.

(i) Draw a labelled diagram of a γ -camera collimator. (Your answer should include material used, structure, direction of the rays and patient and detector positions.)

[3]

(ii) Explain the effect of the collimator on the **spatial resolution** of the γ -camera.

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

(iii) Explain the effect of the collimator on the **sensitivity** of the γ -camera.

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

(c) Name and state the purpose of two **other** components of the γ -camera.

Component

Purpose

Component

Purpose

..... [4]

(d) Mrs Bell is told not to travel on public transport or to sit children on her lap during the six hours after the examination.

(i) State and explain the reason for these instructions.

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

(ii) The effect of the injection persists in the body for a shorter time than expected from the physical properties alone. State and explain a factor that reduces this time.

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

[Total: 22]

- 4 A radio presenter states that his programme is broadcast "... on AM, on FM, on digital and online".

(a) Sketch a section of an AM (amplitude-modulated) signal on the axes given in Fig. 4.1.



Fig. 4.1

[3]

(b) Sketch a section of an FM (frequency-modulated) signal on the axes given in Fig. 4.2.



Fig. 4.2

[3]

(c) Explain why the quality of FM signals is better than that of AM signals.

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

(d) Sketch a section of a digital signal on the axes given in Fig. 4.3.



Fig. 4.3 [2]

(e) Explain why the quality of digital signals is better than that of analogue signals.

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

(f) DAB radios use digital signals. Sometimes, when the signal is weak, complete words are lost. Explain why digital reception is often either good or completely absent.

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

- (g) Online radio transmission enables people all over the world to receive the same BBC broadcasts that we enjoy in the UK. Many people receive online radio transmission using broadband telephone systems. State and explain the difference between broadband and normal telephone signals.

In this section, 1 mark is available for spelling, punctuation and grammar.

.....

.....

.....

.....

..... [4]

QWC [1]

- (h) State why digital-to-analogue conversion is needed before the signal reaches the loudspeaker.

.....

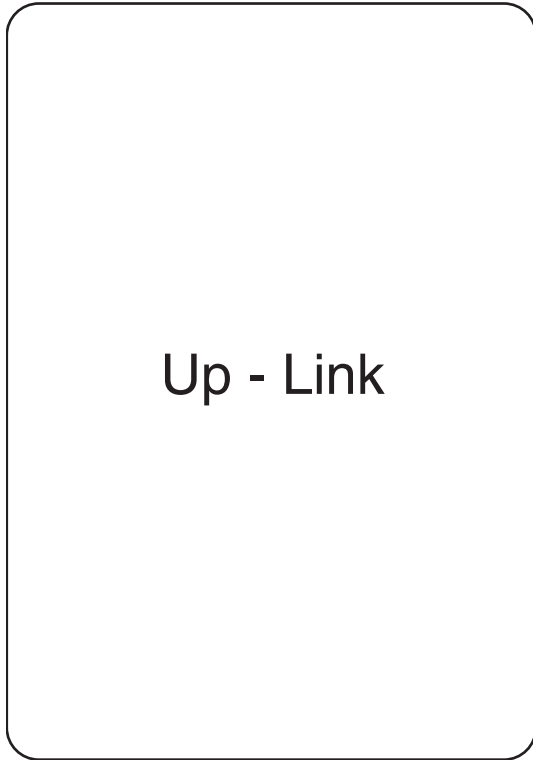
..... [1]

[Total: 20]

- 5 Gillian has agreed to give a talk to her class, explaining how cell phones work. Gillian prepares a set of cards to help her. She writes the term used on the front of each card. On the back she writes **two** points giving an explanation of the term.

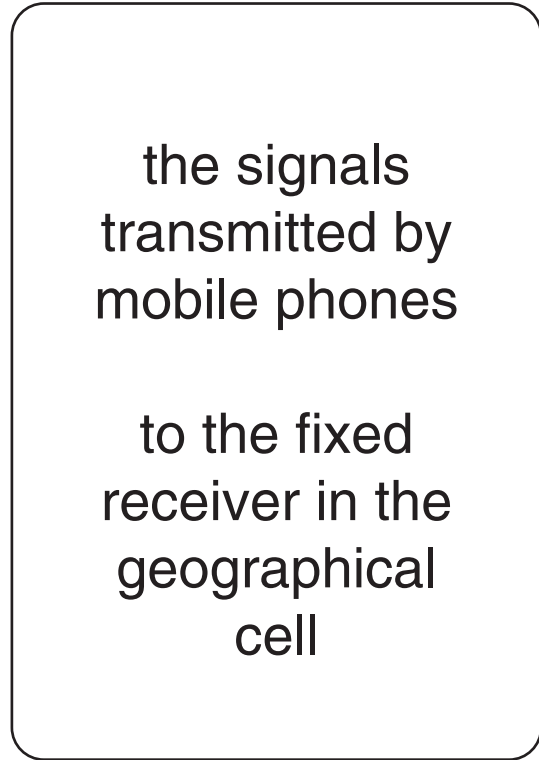
For example:

FRONT



example

BACK



example

(a) Write two points on each card giving an explanation of each term.

(i) FRONT

BACK

Frequency
Divison
Multiple
Access
(FDMA)

.....

.....

.....

.....

.....

.....

[2]

(ii) FRONT

BACK

Time Division
Multiple
Access
(TDMA)

.....

.....

.....

.....

.....

.....

[2]

(iii)

FRONT

Code Division
Multiple
Access
(CDMA)

BACK

.....

.....

.....

.....

.....

.....

[2]

(iv)

FRONT

Global System
for Mobile
Communications
(GSM)

BACK

.....

.....

.....

.....

.....

.....

[2]

(v)

FRONT

BACK

Pulse Code
Modulation
(PCM)

.....

.....

.....

.....

.....

.....

[2]

(b) The use of cell phones has reduced the popularity of CB radios. They are, however, still commonly used for communication between personnel on extended factory sites. Cell phones are full duplex devices whereas CB radios are half duplex devices.

Explain the meaning of these terms.

Full duplex

.....

Half duplex

..... [4]

[Total: 14]

END OF QUESTION PAPER

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