

ADVANCED GCE
APPLIED SCIENCE
Unit 16: Working waves

G635

Candidates answer on the question paper

OCR Supplied Materials:
None

Other Materials Required:

- Electronic calculator
- Ruler (cm/mm)

Wednesday 21 January 2009
Morning

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 clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

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**.
- 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.
- This document consists of **16** pages. Any blank pages are indicated.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	19	
2	13	
3	19	
4	18	
5	21	
TOTAL	90	

Answer **all** the questions.

1 Fibre-optic lighting can be used to direct different colours to different parts of a display cabinet.

(a) Table 1.1 below shows some information about two of the colours used to illuminate a display in a museum.

Table 1.1

colour of light	velocity in air /m s ⁻¹	frequency /Hz	wavelength /nm
Violet	3.0×10^8	7.5×10^{14}	
Orange		5.0×10^{14}	600

(i) State the formula relating velocity, frequency and wavelength.

[1]

(ii) Complete the empty boxes in Table 1.1. Show any working in the space below.

[4]

(b) The bundles of fibre used to illuminate the exhibit are **incoherent**.

(i) State what is meant by an incoherent optical fibre bundle.

.....
 [1]

(ii) State why coherent optical fibre bundles are **not** necessary.

.....
 [1]

(iii) State why incoherent optical fibre bundles are preferred to coherent optical fibre bundles.

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

(iv) Suggest **one** application where the optical fibre bundles must be coherent.

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

- (c) A manufacturer tests samples of glass to assess their suitability for fibre-optic lighting. The samples are in the form of rectangular blocks. Figs. 1.1 to 1.3 show three rays of light travelling inside the glass block. In Fig 1.2 the ray meets the glass-air interface at the critical angle.

On **each** diagram draw **all** the rays that continue from the rays shown.

(i)

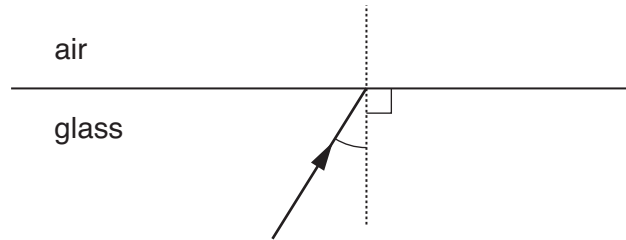


Fig 1.1

[1]

(ii)

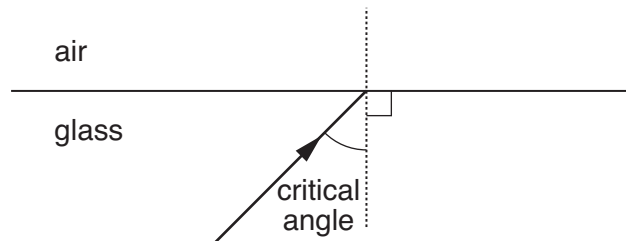


Fig 1.2

[2]

(iii)

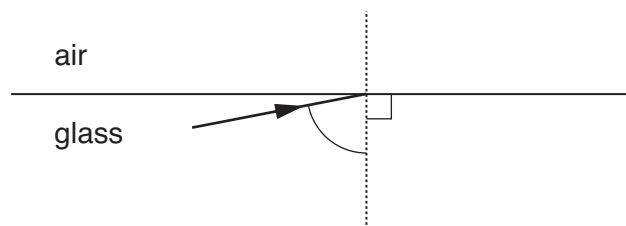


Fig 1.3

[1]

(d) Compare the intensity of the rays you have drawn in Fig. 1.1 and Fig. 1.3.

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

(e) (i) Compare the speed of light in a vacuum to the speed of light in air.

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

(ii) Explain whether you would expect your answer in (c)(i) to appear any different if the experiment was carried out in a vacuum instead of air.

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

(f) The manufacturer of fibre-optic lighting prefers an alternative glass with a smaller critical angle.

(i) How does the refractive index of the alternative glass compare to the original sample?

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

(ii) How does the speed of light in the alternative glass compare to that in original sample?

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

(iii) Suggest a possible reason for the choice of the alternative glass.

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

[Total: 19]

Indicate the letter corresponding to the point that lies within

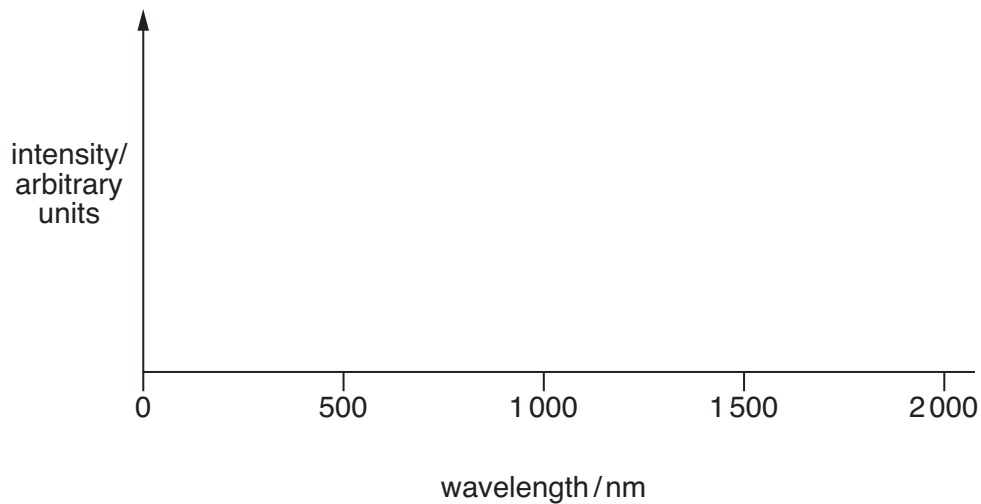
- (i) the ultra violet region of the spectrum
- (ii) the microwave region of the spectrum.

Indicate the letter corresponding to the point that best indicates the wavelength of maximum intensity of radiation from

- (iii) the Sun
- (iv) a red hot poker
- (v) an object at room temperature.

[5]

- (c) Using the axes in Fig. 2.2, sketch the variation of intensity with wavelength for the hot-body spectrum of a red hot poker.



[3]

Fig. 2.2

[Total: 13]

3 The number of mobile phones in the UK is close to the size of the population. Before the invention of mobile phones, mobile communication was limited to a small number of organisations such as the emergency services.

(a) Sketch a diagram showing how a modern city is divided into cells for a mobile phone (cell-phone) network. On your diagram mark at least **two** base stations and indicate the scale.

[4]

(b) With reference to your diagram, explain how the network of cells has made it possible to increase the number of mobile communication users.

.....

.....

.....

.....

.....

..... [3]

- (c) Before mobile phones, CB radio users took it in turns to speak. Special protocols were used such as saying "over" to indicate that it was the other person's turn to speak.

Complete the names of the CB radio and mobile phone systems and explain how they differ.

CB radio system: Duplex. [1]

mobile phone system: Duplex. [1]

Explanation:
.....
.....
..... [2]

- (d) State what is meant by the terms up-link and down-link as applied to mobile phones.

up-link
.....
down-link
..... [2]

(e) Second generation (2G) mobile phones use digital systems. They commonly use TDMA technology.

(i) Explain what is meant by a digital system in this context.

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

(ii) State what the letters TDMA stand for.

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

(iii) Explain how TDMA permits approximately three times more users to make calls than FDMA.

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

[Total: 19]

11
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4 Radio stations use modulated carrier waves to transmit their programmes.

(a) Fig. 4.1 shows an unmodulated carrier wave. Figs. 4.2 and 4.3 show two differently modulated versions of it.

(i) What features of the wave in Fig. 4.1 show that it is the carrier wave?

.....
 [2]

(ii) Take and record appropriate measurements from Fig. 4.1 to determine the time period of the carrier wave.

time period: unit [3]

(iii) Calculate the frequency of the carrier wave.
 Give your answer to **two** significant figures.
 [$f = 1/T$]

frequency: unit [3]

(b) (i) Identify the type of modulation in Fig. 4.2.

..... modulation [1]

(ii) Sketch the modulating (signal) wave on Fig. 4.2. [2]

(c) (i) Identify the type of modulation in Fig. 4.3.

..... modulation [1]

(ii) Sketch the modulating (signal) wave on Fig. 4.3. [2]

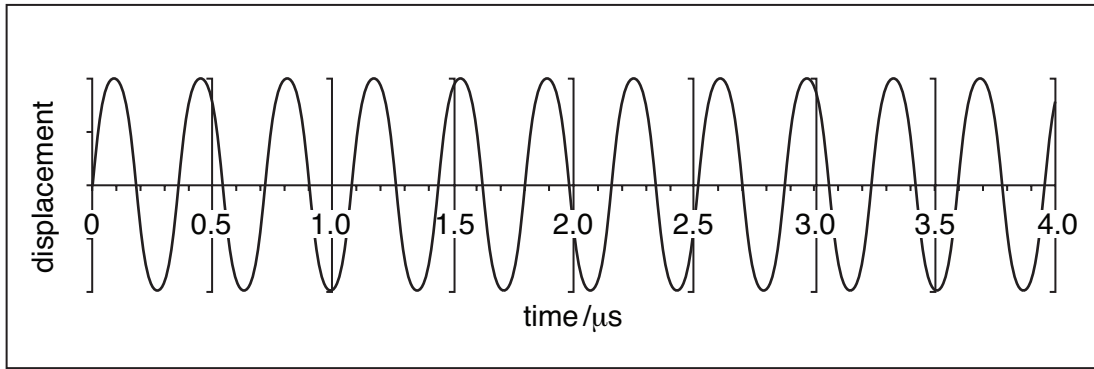


Fig. 4.1

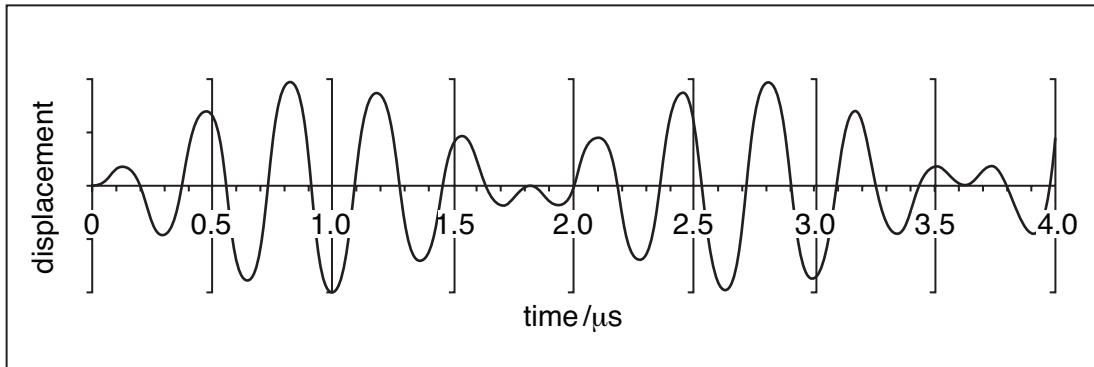


Fig. 4.2

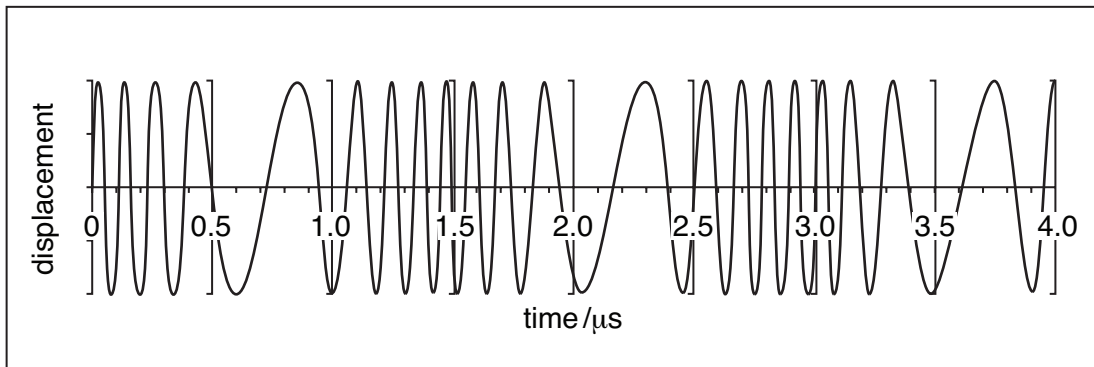


Fig. 4.3

(d) Digital systems are replacing analogue systems in radio and many other applications.

(i) Explain how Pulse Code Modulation (PCM) could be used to convert the waveform shown in Fig. 4.4 to a binary format. Mark Fig. 4.4 to support your answer.

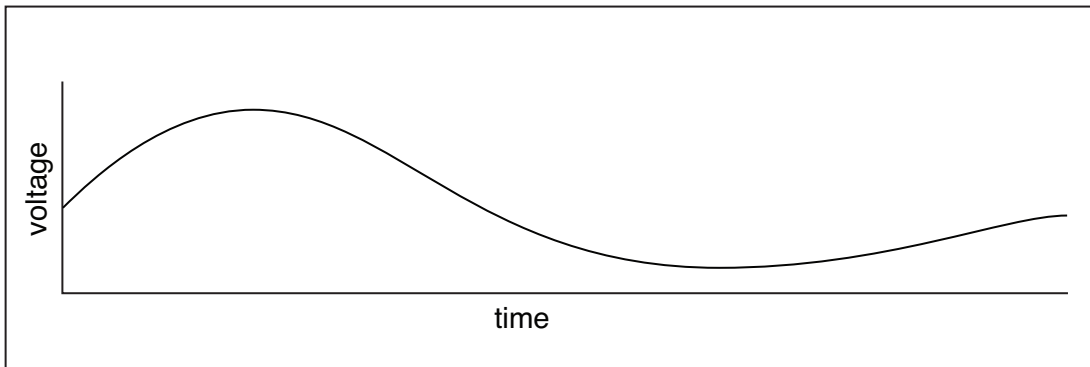


Fig. 4.4

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

(ii) Give an example of how a PCM signal output might be expressed in digits (your example need not relate to the shape of the signal above).

..... [1]

[Total: 18]

5 (a) Diane is called into their local hospital for a procedure involving the use of gamma (γ) rays for **diagnosis**.

(i) State the meaning of the term **diagnosis**.

..... [1]

(ii) Suggest a likely purpose of diagnostic use of γ -rays.

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

(iii) Describe briefly the procedure Diane might undergo.

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

(b) Thelma is called into their local hospital for a procedure involving the use of gamma (γ) rays for **therapy**.

(i) State the meaning of the term **therapy**.

..... [1]

(ii) Suggest a likely purpose of therapeutic use of γ -rays.

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

(iii) Describe briefly the procedure Thelma might undergo.

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

