

ADVANCED GCE
APPLIED SCIENCE
Working waves

G635

Candidates answer on the Question Paper

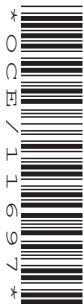
OCR Supplied Materials:
None

Other Materials Required:

- Electronic calculator
- Ruler (cm/mm)

Wednesday 27 January 2010
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**.



Where you see this icon you will be awarded marks for the quality of written communication in your answer.

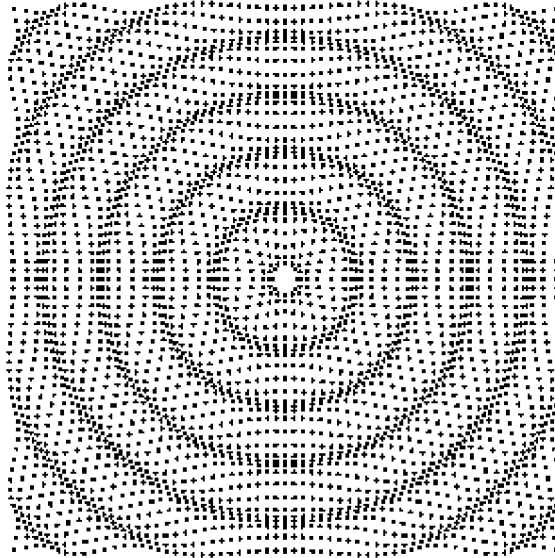
This means, for example, you should:

- 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 **12** pages. Any blank pages are indicated.

Answer **all** the questions.

1 Waves are very important for our everyday lives because they carry information and energy.

(a) Fig. 1.1 represents a longitudinal wave.



Scale: 10 mm on diagram = 1 m

Fig. 1.1

(i) On Fig. 1.1 draw a line with a length equal to one wavelength of the wave. [1]

(ii) Take measurements from Fig. 1.1 and use them to find the wavelength of the wave as accurately as you can.

Record your actual measurements and show any calculations you do.

Remember to take into account the scale given: 10 mm on diagram = 1 m.

wavelength = unit [6]

(iii) Give an example of a longitudinal wave.

..... [1]

(b) A radio signal used by coastguards has a frequency of 2.0×10^8 Hz.

Calculate the wavelength of this wave.

Give your answer to an appropriate number of significant figures.

velocity of electromagnetic waves in air = 3.0×10^8 m s⁻¹

wavelength = m [3]

(c) Information in the form of sound can be transmitted using radio waves. Audible sound has a maximum frequency of about 20 kHz.

Compare this frequency to the frequency of the radio wave in (b).

..... [1]

(d) Sound signals are carried by radio waves using AM or FM systems.

(i) State what the abbreviation AM stands for.

..... [1]

(ii) State what the abbreviation FM stands for.

..... [1]

(iii) Explain how these systems transmit audible sound signals.

AM.....

.....

.....

FM

.....

..... [4]

(e) Radio waves are the region of the electromagnetic spectrum with the longest wavelengths.

State the region of the electromagnetic spectrum with the **shortest** wavelengths.

..... [1]

(f) Explain why significant amounts of ultraviolet radiation do **not** normally reach the surface of the Earth.

..... [1]

[Total: 20]

Turn over

2 Kevin works for Fiery Furnaces Ltd. The company cannot measure the temperature of their furnace with an ordinary thermometer as it would melt.

(a) One way of measuring furnace temperatures is using a device which allows the observer to compare the colour in the furnace with the colour of a special light bulb filament.

(i) Describe how the colour in the furnace varies as it heats up to a very high temperature.

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

(ii) State how the peak wavelength of the radiation emitted by the furnace will vary as it heats up.

..... [1]

(iii) State how the peak frequency of the radiation emitted by the furnace will vary as it heats up.

..... [1]

(iv) State how the total radiant power emitted by the furnace will vary as it heats up.

..... [1]

(b) Fiery Furnaces Ltd. also use thermal imaging devices to find furnace temperatures. Unlike the device in (a), these will also detect cooler objects that do not emit visible light.

(i) Name the type of radiation emitted by these cooler objects.

..... [1]

(ii) State and explain how the radiation emitted by people differs from that of objects at room temperature.

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

(iii) Thermal imaging devices may be used to find people in collapsed buildings. When the device is pointed at a building, an image is produced on a screen. Describe how the image on the screen would distinguish between the people and their surroundings.

..... [1]

[Total: 11]

3 An engineer gives a lecture to a group of A-Level students on fibre optics and total internal reflection.

(a) Write a set of bullet points to remind the engineer of the main ideas she needs to explain when lecturing on total internal reflection.



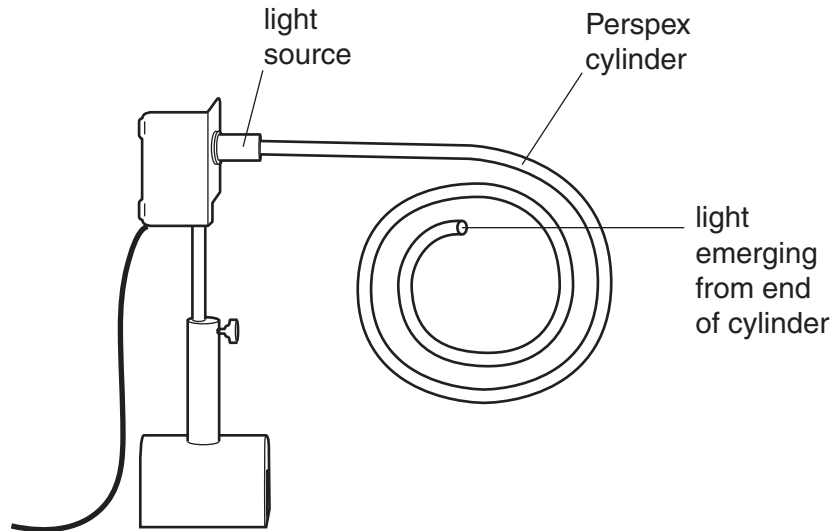
The first point has been done for you.

- The velocity of light depends on the material it is travelling through.

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-
-
-
-
-
-
-
-
-

..... [6]

- (b) The engineer uses a 2 cm diameter cylinder of Perspex to demonstrate total internal reflection of light as it passes along the cylinder. She chooses this large-scale demonstration as it is easy to see.



She then goes on to discuss ways in which optical fibres, used for communications, differ from her model.

- (i) Describe how the structure of a step-index optical fibre differs from the engineer's model.

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

- (ii) Describe and explain what happens to the shape of a square-wave signal passing along a step-index fibre. Illustrate your answer with a diagram.

.....
.....
.....
..... [4]

(iii) Describe the structure of graded-index fibres and explain how their use reduces degradation of this signal compared to when step-index fibres are used. Illustrate your answer with a diagram.

.....

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.....

..... [5]

(c) The engineer finishes by giving the advantages of using fibre optics for communications compared to copper wires. List any **three** advantages.

- 1.
- 2.
- 3. [3]

[Total: 21]

4 (a) DAB stands for Digital Audio Broadcasting. Some of the BBC's equipment converts analogue signals into digital signals. It is claimed that interference and bad weather are less likely to spoil the sound quality of digital signals than analogue signals.

(i) What is meant by an *analogue signal*?

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

(ii) What is meant by a *digital signal*?

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

(iii) Suggest why interference is less likely to spoil the sound quality of digital signals compared to analogue signals.

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

(iv) Explain Pulse Code Modulation. Illustrate your answer with a diagram.

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..... [7]

5 (a) Kehinde did work experience in the radiology department of her local hospital. She was shown a grid that is used to improve the quality of X-ray images.

(i) What is the grid made from?

..... [1]

(ii) Draw a diagram to show a grid being used as part of an X-ray system and explain how using the grid improves the quality of the X-ray images.

Label the following on your diagram.

- grid
- X-ray source
- X-ray beams
- patient
- X-ray film/detector

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

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