

# Refraction

## Question Paper

Level	International A Level
Subject	Physics
Exam Board	Edexcel
Topic	Waves
Sub Topic	Refraction
Booklet	Question Paper

Time Allowed: **42 minutes**

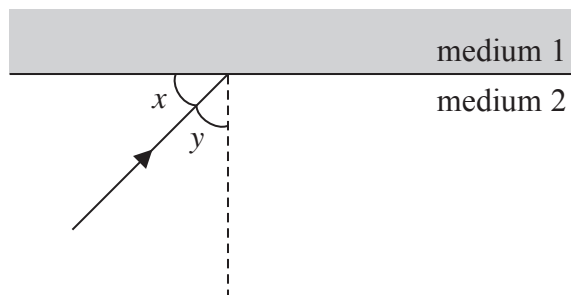
Score: **/35**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

- 1 The diagram shows a ray of light in medium 2 striking a boundary with medium 1.



The critical angle for light passing from medium 2 to medium 1 is  $45^\circ$ .  
The ray in the diagram will be totally internally reflected if

- A  $x = 45^\circ$
- B  $x > 45^\circ$
- C  $y = 45^\circ$
- D  $y > 45^\circ$

(Total for Question 1 = 1 mark)

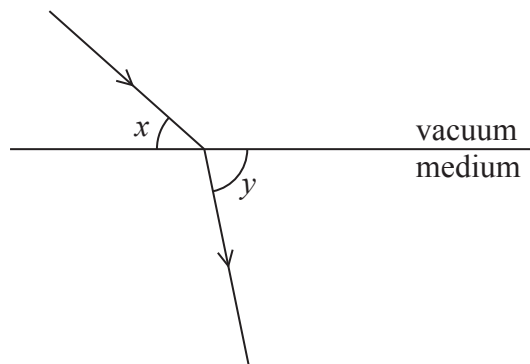
- 2 Light passes from one transparent medium to another transparent medium with a higher refractive index.

Which line of the table correctly describes what happens to the frequency and wavelength of the light?

	Frequency	Wavelength
<input type="checkbox"/> A	decreased	decreased
<input type="checkbox"/> B	decreased	increased
<input type="checkbox"/> C	unchanged	decreased
<input type="checkbox"/> D	unchanged	increased

(Total for Question 2 = 1 mark)

- 3 The diagram shows a ray of light passing from a vacuum into a transparent medium.



The refractive index of the medium is given by

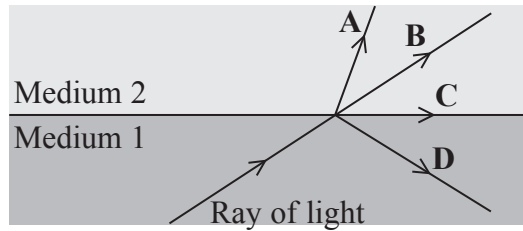
- A  $\frac{\text{frequency of light in the vacuum}}{\text{frequency of light in the medium}}$
- B  $\frac{\text{sine of angle } x}{\text{sine of angle } y}$
- C  $\frac{\text{speed of light in the vacuum}}{\text{speed of light in the medium}}$
- D  $\frac{\text{wavelength of light in the medium}}{\text{wavelength of light in the vacuum}}$

(Total for Question 3 = 1 mark)

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- 4 A ray of light in medium 1 is directed towards medium 2, in which the speed of light is different.

Identify the path the ray of light **cannot** take.

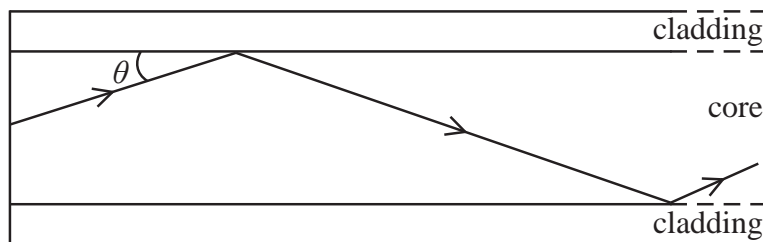


- A
- B
- C
- D

(Total for Question 4 = 1 mark)

5 Optical fibres are used in communication systems.

A typical fibre consists of a glass core surrounded by glass of a different refractive index as a cladding. The diagram shows a light ray being transmitted along the fibre.



(a) State why the refractive index of the cladding must be less than the refractive index of the core in an optical fibre.

(1)

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(b) Calculate the maximum value for the angle labelled  $\theta$  to ensure maximum energy transfer of a light ray along the fibre.

refractive index for light travelling from core to cladding = 0.99

(3)

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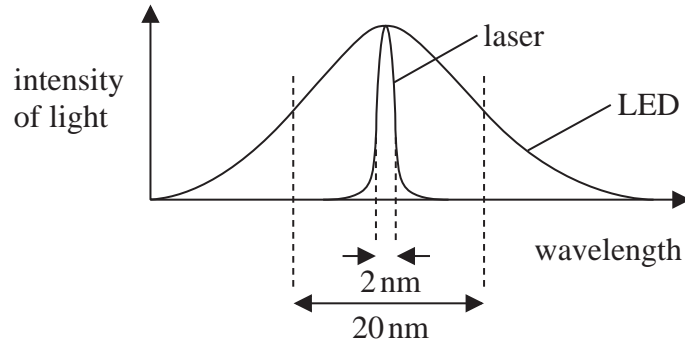
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$\theta =$  .....

- (c) A laser or a light emitting diode (LED) may both be used to produce pulses of light to transmit along the fibre. The graph shows the intensity of light over a range of wavelengths produced by a laser and by an LED.



Light of different wavelengths will travel at different speeds along the fibre.  
Use the graph to compare lasers and LEDs as light sources for a communication system.

(3)

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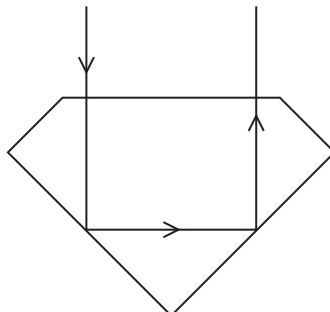
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(Total for Question 5 = 7 marks)

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- 6 Cut gemstones used in jewellery ‘sparkle’ because a large proportion of the incident light undergoes total internal reflection. An example of total internal reflection in a cut gemstone is shown in the diagram.



- (a) Diamond is a popular gemstone because it has a very high refractive index.

Show that the refractive index of diamond is about 2.4.

speed of light in diamond =  $1.24 \times 10^8 \text{ m s}^{-1}$

(2)

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(c) Suggest why diamonds sparkle more than imitations made from glass.

(2)

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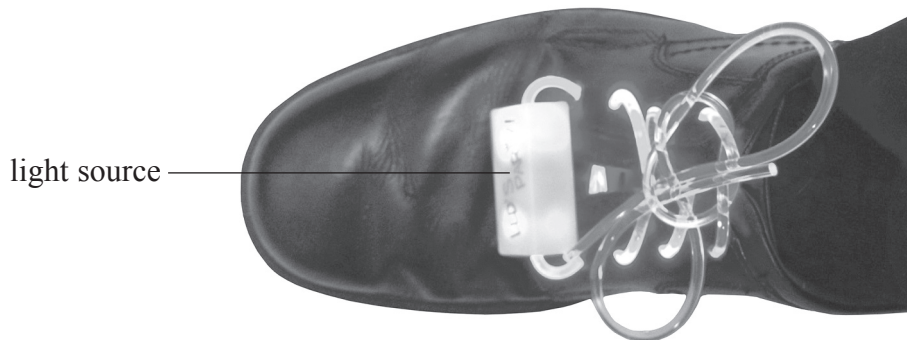
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**(Total for Question 6 = 10 marks)**

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7 The photograph shows a shoe with novelty shoelaces.



The laces are long, flexible plastic strands. Light from the light source passes through the tied laces, illuminating the ends.

(a) (i) State what is meant by critical angle.

(2)

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(ii) Show that the refractive index for the plastic used for the laces is about 1.5

speed of light in plastic =  $1.97 \times 10^8 \text{ m s}^{-1}$

(2)

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(iii) Calculate the critical angle for the plastic used for the laces.

(2)

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Critical angle = .....

(b) Explain how light from the source is able to reach the end of the laces.

(2)

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**(Total for Question 7 = 8 marks)**

8 A student is asked to take measurements to determine the refractive index of a transparent plastic block.

The student uses a ray box and a protractor to obtain the following measurements:

angle of incidence in air =  $40^\circ$

angle of refraction in plastic =  $25^\circ$

(a) Calculate the refractive index of the plastic from which the block is made.

(2)

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Refractive index = .....

\*(b) The student compares his value of refractive index with the values in the table to identify the type of plastic from which the block is made.

Type of plastic	Refractive index
A	1.494
B	1.498
C	1.509
D	1.519
E	1.531

Comment on the limitations of using this method to identify the type of plastic and suggest how the method may be improved.

(4)

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