



Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2015

Centre Number

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Candidate Number

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Physics

Assessment Unit AS 2
assessing
Module 2: Waves, Photons
and Medical Physics



AY121

[AY121]

THURSDAY 18 JUNE, MORNING

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

Answer **all nine** questions.

Write your answers in the spaces provided in this question paper.

INFORMATION FOR CANDIDATES

The total mark for this paper is 75.

Quality of written communication will be assessed in Question 9.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question.

Your attention is drawn to the Data and Formulae Sheet which is inside this question paper.

You may use an electronic calculator.

For Examiner's use only		
Question Number	Marks	Remark
1		
2		
3		
4		
5		
6		
7		
8		
9		
Total Marks		

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(Questions continue overleaf)

- (b) (i) As a ray of light travelling from air enters the cornea of the eye it is refracted as shown in Fig. 2.1. This is to allow the light to be focused on the retina.

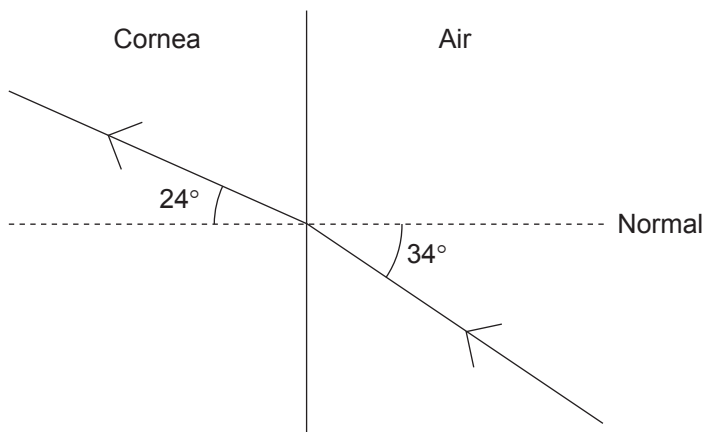


Fig. 2.1

Calculate the refractive index of the cornea and show that it is 1.4 to 2 significant figures.

[3]

- (ii) Water has a refractive index of 1.3. With reference to your answer in (b)(i) explain why images are not focused when your eyes are open underwater.

_____ [2]

Examiner Only	
Marks	Remark

- 3 A student carried out an experiment to measure the focal length of a converging lens using the apparatus shown in **Fig. 3.1**.

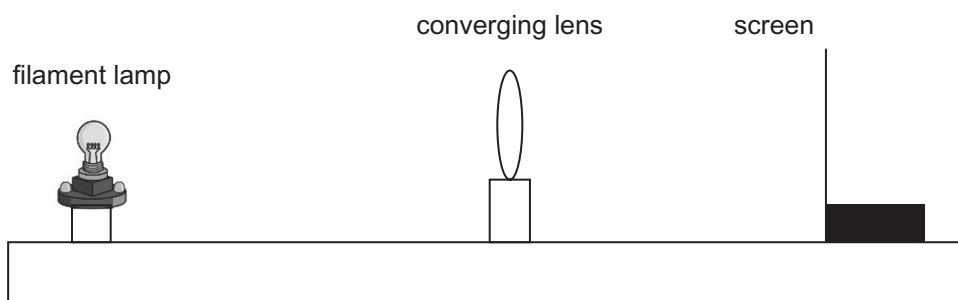


Fig. 3.1

The student measured the image distance v for three different object distances u . The measurements recorded are shown in **Table 3.1**.

Table 3.1

	Set 1	Set 2	Set 3
u/cm	15.0	30.0	40.0
v/cm	32.2	15.7	13.8

- (a) (i) Describe how the image was located and the image distance measured.

[3]

- (ii) If the object used was 5 cm in height, what is the minimum height of screen required to display the images produced?

Height = _____ cm [3]

Examiner Only

Marks Remark

- (c) The appearance of a standing wave as produced on a stretched string is as shown in **Fig. 4.2**.



Fig. 4.2

- (i) How many nodes and antinodes are there in the standing wave in **Fig. 4.2**?

Number of nodes = _____

Number of antinodes = _____ [1]

- (ii) The frequency of vibration of the string to set up this standing wave is 70 Hz. The distance between two adjacent nodes is 15 cm. Calculate the lowest frequency of vibration that would set up a standing wave in this string.

Frequency = _____ Hz [2]

Examiner Only	
Marks	Remark

- 5 **Fig. 5.1** shows the pattern produced on a screen when coherent light of wavelength 650 nm was directed towards a double slit. The distance between the slits was 0.2 mm.



Fig. 5.1

- (a) What term describes the phenomenon that causes the dark fringes to be formed?

[1]

- (b) (i) By taking suitable measurements from **Fig. 5.1**, determine an accurate value for the fringe spacing.

Fringe spacing = _____ mm

[2]

- (ii) Calculate the distance from the slits to the screen.

Distance from slits to screen = _____ m

[2]

Examiner Only

Marks Remark

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(Questions continue overleaf)

- 8 (a) (i) State what a photon is and describe how a photon can be produced by an electron within an atom.

[2]

- (ii) Most microscopes use photons of light to form an image. Light microscopes cannot get an image of objects that are smaller than the wavelength of the light that is used.

Calculate the size of the smallest objects that can be seen with visible light photons of energy 4.97×10^{-19} J.

Size of the smallest objects = _____ m [3]

Examiner Only	
Marks	Remark

- (iii) The visible light photons in (ii) fall on an atom with an electron in an energy level of -4.23 eV as shown in Fig. 8.1 causing it to move to energy level B.

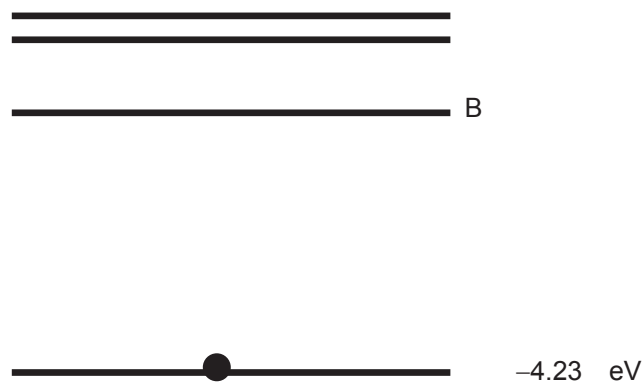


Fig. 8.1

Calculate the energy of energy level B in eV.

Energy level B = _____ eV [3]

- (b) (i) Lasers have widespread uses in industry and medicine. State one medical use of lasers.

_____ [1]

- (ii) Three of the properties of laser light that make it useful are that it is coherent, monochromatic and collimated. Explain what each of these terms means **in this context**.

Coherent: _____

Monochromatic: _____

Collimated: _____

_____ [3]

Examiner Only

Marks Remark

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GCE (Advanced Subsidiary) Physics

Data and Formulae Sheet

Values of constants

speed of light in a vacuum	$c = 3.00 \times 10^8 \text{ m s}^{-1}$
elementary charge	$e = 1.60 \times 10^{-19} \text{ C}$
the Planck constant	$h = 6.63 \times 10^{-34} \text{ J s}$
mass of electron	$m_e = 9.11 \times 10^{-31} \text{ kg}$
mass of proton	$m_p = 1.67 \times 10^{-27} \text{ kg}$
acceleration of free fall on the Earth's surface	$g = 9.81 \text{ m s}^{-2}$
electron volt	$1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$

Useful formulae

The following equations may be useful in answering some of the questions in the examination:

Mechanics

Conservation of energy	$\frac{1}{2}mv^2 - \frac{1}{2}mu^2 = Fs$ for a constant force
Hooke's Law	$F = kx$ (spring constant k)

Sound

$$\text{Sound intensity level/dB} = 10 \lg_{10} \frac{I}{I_0}$$

Waves

$$\text{Two-source interference} \quad \lambda = \frac{ay}{d}$$

Light

$$\text{Lens formula} \quad \frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$
$$\text{Magnification} \quad m = \frac{v}{u}$$

Electricity

$$\text{Terminal potential difference} \quad V = E - Ir \quad (\text{e.m.f. } E; \text{ Internal Resistance } r)$$
$$\text{Potential divider} \quad V_{\text{out}} = \frac{R_1 V_{\text{in}}}{R_1 + R_2}$$

Particles and photons

$$\text{de Broglie equation} \quad \lambda = \frac{h}{p}$$