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ADVANCED SUBSIDIARY (AS)
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2015

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# **Physics**

Assessment Unit AS 2

assessing

Module 2: Waves, Photons
and Medical Physics



# [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		Remark	
1			
2			
3			
4			
5			
6			
7			
8			
9			

Total	
Marks	

	Radio Waves	Gamma
	Fig. 1.1	[2]
<b>o</b> )	A local radio station broadcasts at a frequency of 94.5 MHz. the wavelength at which the radio station broadcasts.	Calculate
	Wavelength = m	[2]
	wavelength m	[2]
<b>;</b> )	State 3 differences between an electromagnetic wave and a wave.	sound
		[3]

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(Questions continue overleaf)

2	(a)	A ray of light is directed through water towards air at an angle of incidence of 0° at the surface. Describe what happens to the ray of light after reaching the surface of the water as the angle of incidence is increased from 0° towards 90°.	Examin Marks	er Only Remark
		[You may draw a diagram in the space provided.]		
		[5]		

(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.

Examiner Only

Marks Remark

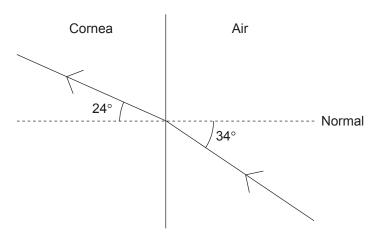


Fig. 2.1

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]

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



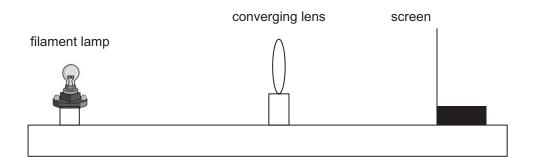


Fig. 3.1

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]

(b)	Use all of the data in <b>Table 3.1</b> to calculate an accurate value for the focal length of the lens.	Examiner Only  Marks Remark
	Focal length = cm	[3]
(c)	If the student had placed the object 5 cm from the lens describe wh would happen when she tried to locate the image. Explain your answer.	at

4 (a) State the principle of superposition.

**Examiner Only** 

[2]

**(b) (i) Fig. 4.1** shows two waves of the same type, travelling in opposite directions that meet in the same medium at the same time.

Give one reason why the two waves will not create a standing wave pattern.

\_\_\_\_\_\_[1]

(ii) On Fig. 4.1 sketch the resultant wave that will be produced when the two waves meet.

[3]

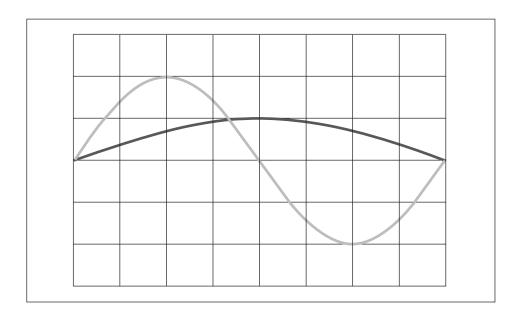


Fig. 4.1

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

Examiner Only	
Marks	Remark



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]

**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.

Examiner Only	
Marks	Remark



Fig. 5.1

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

	[	1		
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(ii) Calculate the distance from the slits to the screen.

6	(a)	(i)	The frequency of a pure note that is played on a musical instrument can be determined using a cathode ray oscilloscope, CRO.	Examine Marks	er Only Remark
			What other piece of apparatus is required to allow the frequency to be determined?		
			[1]		
		(ii)	Describe what will be observed on the CRO screen and explain how this enables the frequency of the sound to be determined.		
			[4]		
	(b)		plain what is meant by diffraction and state the condition required maximum diffraction.		
			[2]		

(a)	What do the letters CT stand for in a CT scan?		aminer Only
		[1]	ks Rema
(b)	State one similarity and one difference between the radiation used producing a conventional X-ray photograph and that used in carryi out a CT scan.		
	Similarity:		
	Difference:		
		_ [2]	
(c)	State one example of a person who would be unsuitable for diagnousing CT scanning and explain why they would be unsuitable.		
d)	What is the role of the computer in the production of a CT scan?		
		_ [1]	

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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.	Exam Marks	Remar
				[2]	
		(ii)	Most microscopes use photons of light to form an image. Light microscopes cannot get an image of objects that are smaller that the wavelength of the light that is used.	an	
			Calculate the size of the smallest objects that can be seen with visible light photons of energy 4.97 $\times$ 10 $^{\!-19}$ J.		
			Size of the smallest objects = m	[3]	

(iii)	The visible light photons in (ii) fall on an atom with an electron an energy level of –4.23 eV as shown in <b>Fig. 8.1</b> causing it move to energy level B.	
	В	
	-4.23 eV 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. Stamedical use of lasers.	
		[1]
(ii)	Three of the properties of laser light that make it useful are is coherent, monochromatic and collimated. Explain what e these terms means <b>in this context</b> .  Coherent:	each of
	Monochromatic:	
	Collimated:	

	_	
	[6]	
Quality of written communication	[6]	
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## **GCE (Advanced Subsidiary) Physics**

### **Data and Formulae Sheet**

#### Values of constants

speed of light in a vacuum	$c = 3.00 \times 10^8 \mathrm{m \ s^{-1}}$
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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 
$$m_{\rm p} = 1.67 \times 10^{-27} \, \rm kg$$

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

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

Waves

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

Light

Lens formula 
$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

Magnification 
$$m = \frac{v}{u}$$

Electricity

Terminal potential difference 
$$V = E - Ir$$
 (e.m.f.  $E$ ; Internal Resistance  $r$ )

Potential divider 
$$V_{\text{out}} = \frac{R_1 V_{\text{in}}}{R_1 + R_2}$$

Particles and photons

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