



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

MV18

[AY121]

THURSDAY 18 JUNE, MORNING

### TIME

1 hour 30 minutes, plus your additional time allowance.

### 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 at the end of each question 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.

1 (a) Fig. 1.1 shows part of the electromagnetic spectrum. Complete Fig. 1.1 to show the missing regions of the spectrum in the correct order. [2 marks]

Radio  
Waves

Gamma

Fig. 1.1

(b) A local radio station broadcasts at a frequency of 94.5 MHz. Calculate the wavelength at which the radio station broadcasts. [2 marks]

Wavelength = \_\_\_\_\_ m

(c) State 3 differences between an electromagnetic wave and a sound wave. [3 marks]

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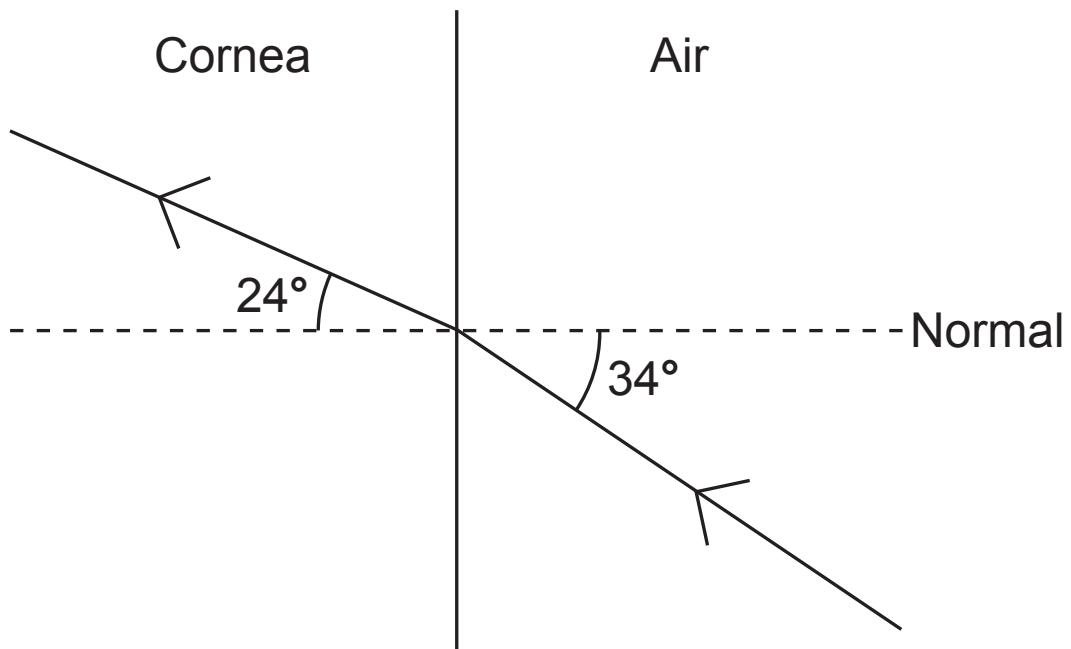
2 (a) A ray of light is directed through water towards air at an angle of incidence of  $0^\circ$  at the surface. Describe what happens to the ray of light after reaching the surface of the water as the angle of incidence is increased from  $0^\circ$  towards  $90^\circ$ . [5 marks]

[You may draw a diagram in the space provided.]

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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**

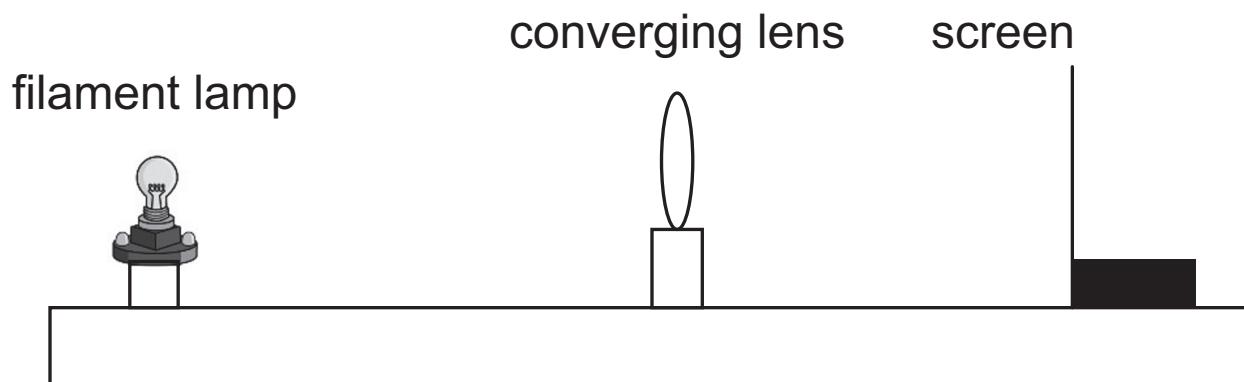
Calculate the refractive index of the cornea and show that it is 1.4 to 2 significant figures. [3 marks]

**(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 marks]

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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
$u/\text{cm}$	15.0	30.0	40.0
$v/\text{cm}$	32.2	15.7	13.8

(a) (i) Describe how the image was located and the image distance measured. [3 marks]

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(ii) If the object used was 5 cm in height, what is the minimum height of screen required to display the images produced? [3 marks]

Height = \_\_\_\_\_ cm

(b) Use all of the data in **Table 3.1** to calculate an accurate value for the focal length of the lens. [3 marks]

Focal length = \_\_\_\_\_ cm

(c) If the student had placed the object 5 cm from the lens describe what would happen when she tried to locate the image. Explain your answer. [2 marks]

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4 (a) State the principle of superposition. [2 marks]

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(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 mark]

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(ii) On Fig. 4.1 sketch the resultant wave that will be produced when the two waves meet. [3 marks]

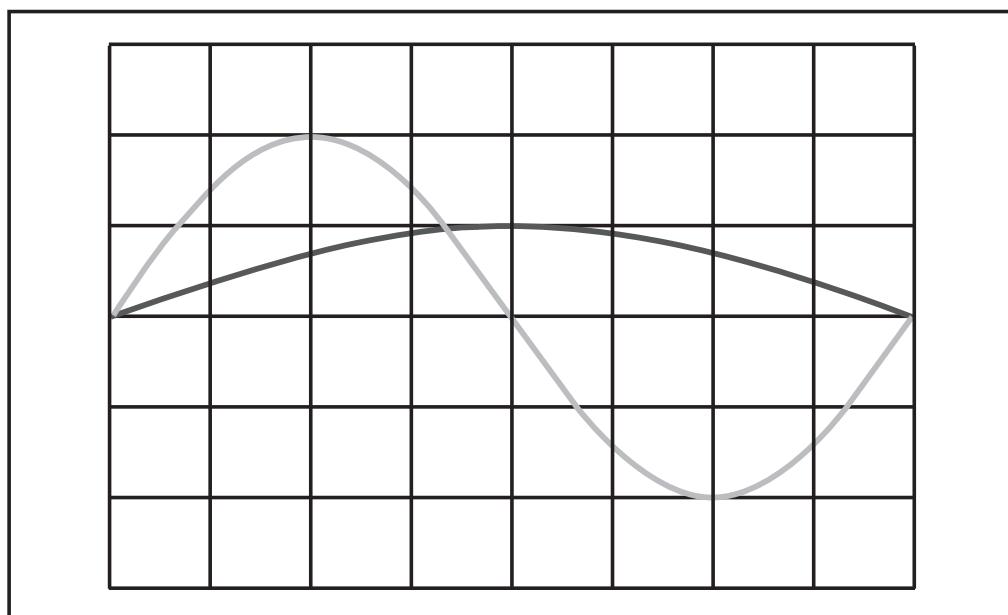


Fig. 4.1

(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**? [1 mark]

Number of nodes = \_\_\_\_\_

Number of antinodes = \_\_\_\_\_

(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. [2 marks]

Frequency = \_\_\_\_\_ Hz

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 mark]

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(b) (i) By taking suitable measurements from Fig. 5.1, determine an accurate value for the fringe spacing. [2 marks]

Fringe spacing = \_\_\_\_\_ mm

**(ii) Calculate the distance from the slits to the screen.  
[2 marks]**

Distance from slits to screen = \_\_\_\_\_ m

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.

What other piece of apparatus is required to allow the frequency to be determined? [1 mark]

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(ii) Describe what will be observed on the CRO screen and explain how this enables the frequency of the sound to be determined. [4 marks]

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(b) Explain what is meant by diffraction and state the condition required for maximum diffraction. [2 marks]

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7 (a) What do the letters CT stand for in a CT scan? [1 mark]

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(b) State one similarity and one difference between the radiation used in producing a conventional X-ray photograph and that used in carrying out a CT scan. [2 marks]

Similarity: \_\_\_\_\_

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Difference: \_\_\_\_\_

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(c) State one example of a person who would be unsuitable for diagnosis using CT scanning and explain why they would be unsuitable. [2 marks]

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(d) What is the role of the computer in the production of a CT scan? [1 mark]

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

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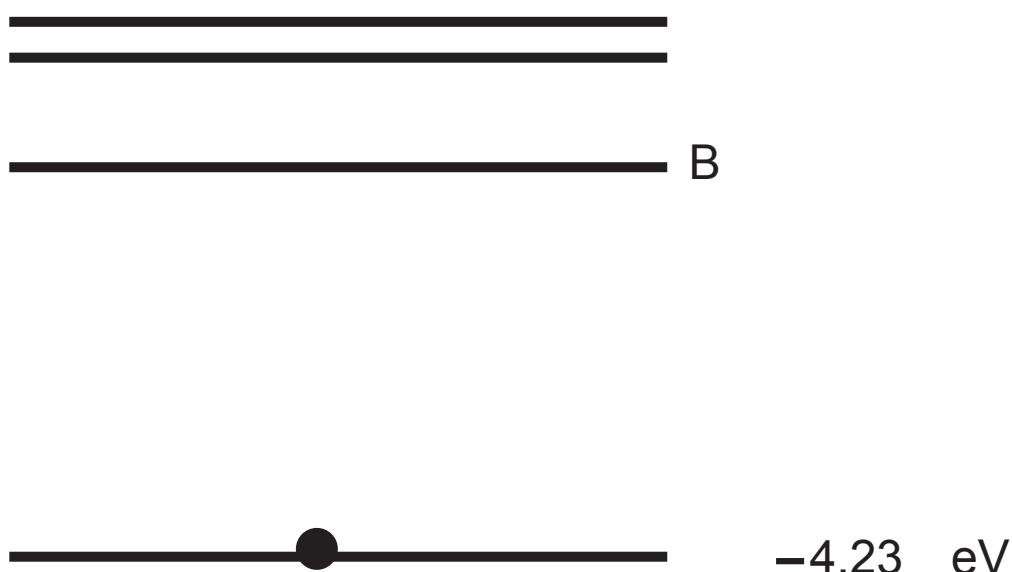
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(ii) Most microscopes use photons of light to form an image. Light microscopes cannot get an image of objects that are smaller than the wavelength of the light that is used.

Calculate the size of the smallest objects that can be seen with visible light photons of energy  $4.97 \times 10^{-19} \text{ J}$ . [3 marks]

Size of the smallest objects = \_\_\_\_\_ m

(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.  
[3 marks]

Energy level B = \_\_\_\_\_ eV

(b) (i) Lasers have widespread uses in industry and medicine. State one medical use of lasers. [1 mark]

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(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**. [3 marks]

Coherent: \_\_\_\_\_

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Monochromatic: \_\_\_\_\_

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Collimated: \_\_\_\_\_

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9 According to wave-particle duality, electromagnetic radiation can either behave as a wave or as a particle. Describe the evidence which supports the dual nature of electromagnetic radiation. [6 marks]

### Quality of written communication [2 marks]

**THIS IS THE END OF THE QUESTION PAPER**

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

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