Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
TOTAL	

General Certificate of Education
Advanced Level Examination
June 2014

Physics A PHYA5/2B

Unit 5B Medical Physics
Section B

Thursday 19 June 2014 9.00 am to 10.45 am

For this paper you must have:
- a calculator
- a ruler
- a Data and Formulae Booklet (enclosed).

Time allowed
- The total time for both sections of this paper is 1 hour 45 minutes. You are advised to spend approximately 50 minutes on this section.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- Show all your working.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this section is 35.
- You are expected to use a calculator where appropriate.
- A *Data and Formulae Booklet* is provided as a loose insert.
- You will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

Do not write outside the box

Section B

The maximum mark for this section is 35. You are advised to spend approximately 50 minutes on this section.

1 (a) A person views a flashing white light source in a darkened room. Each flash lasts for $0.01\,\text{s}$ and initially the light is flashing at a frequency of $1\,\text{Hz}$.
State how the person's perception of what is seen changes as the frequency at which the light flashes is slowly increased from $1\,\text{Hz}$ to $40\,\text{Hz}$. Name the physiological process involved.

[3 marks]

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physiological process involved .....

1 (b) A person with a defective eye wears spectacles to see clearly a small real object. The object is placed at the aided near point of the eye, $25.0\,\text{cm}$ from the correcting lens. The power of the correcting lens is $+\,1.75\,\text{D}$.

1 (b) (i) Find the image distance of the image formed by the correcting lens.

Give your answer to an appropriate number of significant figures.

[3 marks]

image distance ..... cm

Do not write outside the box

1 (b) (ii) State what this image distance represents.

[1 mark]

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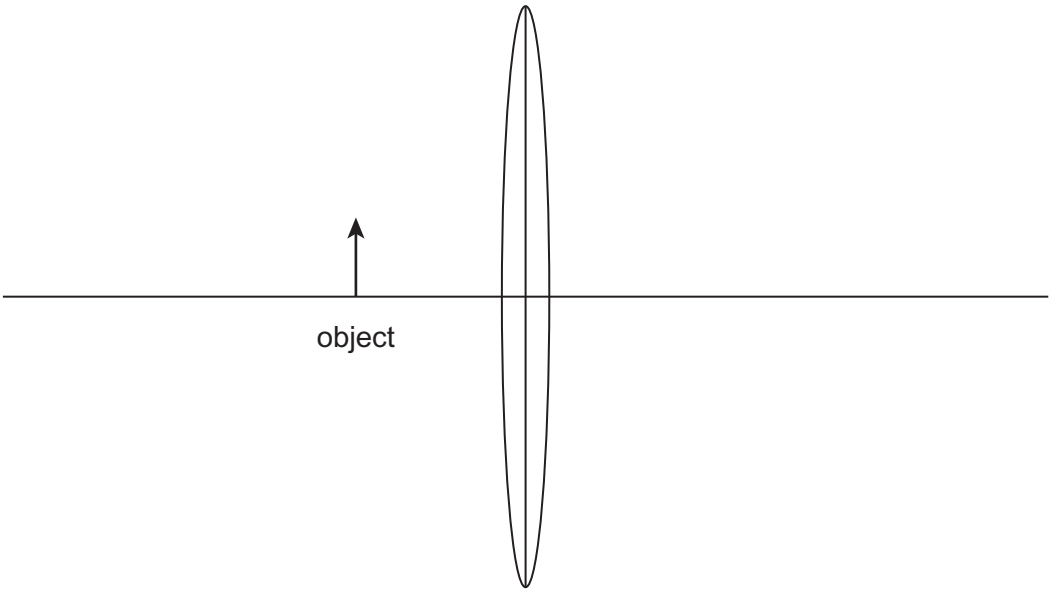
1 (c) State the defect of vision which is corrected using a converging lens.

[1 mark]

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1 (d) Draw a labelled ray diagram below to show how the lens in part (b) forms the image of the small real object. Clearly label the image and principal foci of the lens. Your diagram does not have to be to scale.

[2 marks]



10

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2 (a) Define the threshold of hearing, I_o.

[2 marks]

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2 (b) Sound intensity levels are usually measured in decibels which is based on a logarithmic scale. State **two** reasons why this logarithmic scale is used.

[2 marks]

reason 1 .....

.....

reason 2 .....

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2 (c) Hearing loss might be due to ageing or exposure to excessive noise. For each cause, state how the hearing loss varies with frequency over the audible range.

2 (c) (i) Loss due to ageing.

[1 mark]

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2 (c) (ii) Loss due to excessive noise.

[2 marks]

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7

Turn to page 6 for the next question

Turn over for the next question

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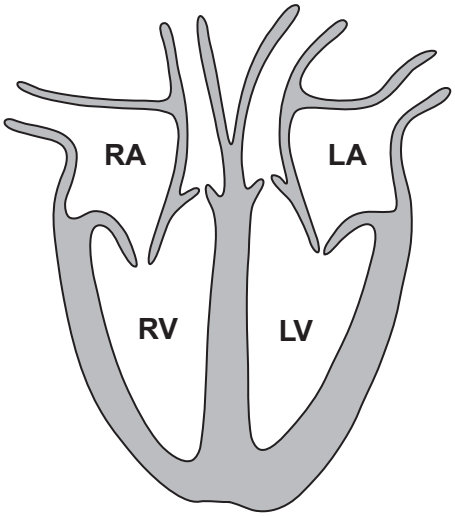
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3 A simplified outline of the heart is shown in **Figure 1**. An action potential, generated within the heart at the sino–atrial (or SA) node, is the start of a series of events which cause the heart to pump blood. Describe and explain the series of events for one complete heartbeat. You may wish to use the diagram to aid your explanation.

The quality of your written communication will be assessed in your answer.

[6 marks]

Figure 1



RA = right atrium
RV = right ventrical
LA = left atrium
LV = left ventrical

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6

Turn over for the next question

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4 A diagnostic X-ray tube produces a beam of X-rays. The beam passes through a diaphragm consisting of two pairs of lead sheets which can be moved at right angles to each other, and then through an aluminium filter.

4 (a) (i) State the use of the lead sheets.

[1 mark]

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4 (a) (ii) State the use of the aluminium filter.

[1 mark]

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4 (b) When a monochromatic beam of X-ray photons is passed through an aluminium sheet of thickness $2.7\,\text{mm}$, its intensity is reduced by 8.3%.

Calculate the mass attenuation coefficient of aluminium for these X-rays.

State an appropriate unit for your answer.

density of aluminium = $2700\,\text{kg}\,\text{m}^{-3}$

[5 marks]

mass attenuation coefficient ..... unit .....

7

Turn over for the next question

Do not write outside the box

5 (a) During a magnetic resonance (MR) brain scan, the head of the patient is exposed to short pulses of radio frequency electromagnetic waves while in a strong magnetic field. Outline the basic principles of an MR scanner used to perform this scan.

[3 marks]

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5 (b) Ultrasound is thought to be more suitable than X-rays for scanning an unborn fetus.

State **two** reasons why ultrasound is used for this application.

[2 marks]

reason 1.....

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reason 2.....

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5

END OF QUESTIONS

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