



Rewarding Learning

ADVANCED
General Certificate of Education
2018

Life and Health Sciences

Assessment Unit A2 3

assessing

Medical Physics

[AZ031]

TUESDAY 29 MAY, AFTERNOON

**MARK
SCHEME**

Foreword

Introduction

Mark Schemes are published to assist teachers and students in the preparation for examinations. Through the mark schemes teachers and students will be able to see what examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

The Purpose of Mark Schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of 16–18-year-old students in schools and colleges. The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes therefore are regarded as a part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

The Council hopes that the mark schemes will be viewed and used in a constructive way as a further support to the teaching and learning processes.

- 1 (a) (i) 20 kHz / 20 000 Hz (must include unit) [1]
- (ii) (High Frequency sound) waves are *transmitted into the body* and are *reflected from the target organ* to create an image. [2]
- (b) (i) 1–6 MHz [1]
- (ii) Low Frequency waves used for deeper penetration [2]
- (iii) Low resolution images/blurred [1]
- (c) (i) $z = \rho v$ [1]
 952×1450 [1]
 1.38×10^6 [1]
- (ii) $1.3 \times 330 = 429$ [1]
- $R = \left(\frac{z_2 - z_1}{z_2 + z_1} \right)^2$ [1]
- $\left(\frac{429 - 1.63}{429 + 1.63} \right)^2$ [1]
0.985 [1]
- (iii) Most of the ultrasound is reflected [1]
Use a coupling agent/jelly between the surfaces [1]
- (iv) Bowels/lungs [1]
Filled with air [1]
(or brain because it's covered by bone)

AVAILABLE
MARKS

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- 2 (a) (i) mercury manometer, tubing, inflatable cuff, pump
Any **two** for first mark
All correct earns 2 marks [2]

- (ii) Indicative content
- Patient sits/lies down/rests
 - Cuff placed on arm at heart level/on upper arm
 - Cuff is inflated (using hand pump) until no blood flows (in the brachial artery)/or no sound is heard
 - Stethoscope is (placed over the artery (below elbow)) used
 - Cuff pressure is released (slowly)
 - When (tapping) sound is first heard the manometer reading is recorded
 - This is the systolic pressure
 - Cuff pressure reduced until no sound heard
 - The second reading of the manometer is the diastolic pressure

Response	Mark
Candidate identifies and describes 8 or more of the points shown in the indicative content. There is a widespread and accurate use of appropriate scientific terminology. Presentation, spelling, punctuation and grammar are excellent. Candidates use the most appropriate form and style of writing. Relevant material is highly organised with clarity and coherency.	[7]–[8]
Candidate identifies and describes between 6 and 7 of the points shown in the indicative content. There is a widespread and accurate use of appropriate scientific terminology. Presentation, spelling, punctuation and grammar are excellent. Candidates use the most appropriate form and style of writing. Relevant material is organised with clarity and coherency.	[5]–[6]
Candidate clearly identifies between 3 and 5 of the points shown in the indicative content. There is some use of appropriate scientific terminology. Presentation, spelling, punctuation and grammar are sufficient to make the meaning clear. Candidates use an appropriate form and style of writing. There is some attempt to organise material.	[3]–[4]
Candidates clearly identify at least 2 of the points shown in the indicative content. There is limited reference to scientific terminology. Presentation, spelling, punctuation and grammar may contain some errors. The form and style are of a satisfactory standard. There is only a limited attempt to organise material.	[1]–[2]
Response is not worthy of credit	[0]

[8]

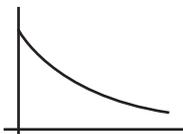
- (b) (i) $\frac{140}{90}$ [1]

- (ii) Any **two** from:
- It only measures blood pressure/not the medical condition which causes it
 - The patient may not exhibit high blood pressure on that occasion/need to record more readings on different days
 - May be stressed/white coat syndrome which elevates reading
- (2 x [1]) [2]

AVAILABLE
MARKS

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			AVAILABLE MARKS			
3	(a)	(i) Ultrasonic B scan	[1]	15		
		(ii) Endoscopy	[1]			
		(iii) Gamma ray imaging	[1]			
		(iv) MRI	[1]			
		(v) CT scan/MRI	[1]			
	(b)	(i) Any four from: <ul style="list-style-type: none"> • Fibre bundle for illumination • Fibre bundle for observation • Eyepiece/camera on end of observation bundle or objective lens on observation bundle/camera on opposite ends • Air/water/irrigation channel • Operation/instrument channel (4 x [1])	[4]		12	
		(ii) Coherent bundle for observation/image [1] Non-coherent bundle for illumination [1] Coherent: order of fibres remains the same throughout [1] Image is not scrambled/order of image is maintained [1] Non-coherent: fibre order is not preserved [1] Light travels through fibres by TIR (when $i > c$) [1]	[6]			
	4	(a)	(i) Measure pulse before exercise [1] Counting beats in a measured time [1] Exercise for some time [1] Measure pulse again [1] Compare pulse rates [1]		[5]	12
			(ii) Any one from: Fitbit/sports band/heart rate monitor/mobile phone or other suitable answer.		[1]	
			(b)		(i) Device used to monitor brain activity or Graphical output showing brain activity	
(ii) Epilepsy/seizures Stroke/TIA/clots/bleeds Persistent Vegetative State/Brain death/coma/lock in syndrome Sleep disorders Brain tumours			[2]			
(iii) The EEG waveform is random/random frequency or amplitude of alpha, beta, theta, and delta The ECG waveform is periodic/PQRST complex			[2]			
(iv) Both are measurements of output electrical activity (or similar)		[1]				

		AVAILABLE MARKS
5	(a) (i) Time taken for the activity of a radioactive material to decrease to half of its original value	[2]
	(ii) $6 \times 60^2 = 21600 \text{ s}$	[1]
	$T_{\frac{1}{2}} = \frac{0.693}{\lambda}$	[1]
	$\lambda = \frac{0.693}{21600}$	[1]
	$3.21 \times 10^{-5} \text{ (s}^{-1}\text{)}$	[1]
	(b) (i) Record/measure background activity [1] Set radioactive source in front of GM tube [1] Record initial activity [1] Start/use stopwatch [1] Record activity at certain time intervals [1] Until activity has reduced by over half [1]	[6]
	(ii) Graph  Must touch y-axis } [1] Must not touch x-axis } Curve in correct sense } [1]	[2]
	(iii) Calculate $\frac{A_0}{2}$	[1]
	Read corresponding time from x-axis; (this is $T_{\frac{1}{2}}$)	[1]
		16
6	(a) (i) B [1] Time too short [1] Radioactivity is random/changes from second to second [1]	[3]
	(ii) $\frac{73}{90} = 0.811$ } $\frac{48}{60} = 0.800$ } 1 correct calculation [1]/[2] $\frac{141}{180} = 0.783$ } 3 correct calculations [2]/[2]	[3]
	Average = 0.798 (must be 3 s.f.) [1]	[3]
	(b) (i) kills/ionises/damages cells or can cause cancer	[1]
	(ii) Any two from: Minimise handling time Lead shielding/clothing Remote handling/use tongs Badge (2 x [1])	[2]
		9

		AVAILABLE MARKS
7	<p>(i) $e^{5.63}$ [1] 279 [1]</p> <p>(ii) $A = A_0 e^{-\lambda t}$ [1] $t = 600$ [1] $280 e^{-0.00907 \times 600}$ [1] 1.21 [1]</p> <p>(iii) Pet scan (positron emission scan) [1] of heart [1]</p> <p>(iv) Any two from: <ul style="list-style-type: none"> • Short half-life • Can be made quickly available • Rapidly taken up by heart muscle • Gamma rays detected outside the body (2 x [1])</p>	<p>[2]</p> <p>[4]</p> <p>[2]</p> <p>[2]</p> <p>[2]</p> <p>10</p>
8	<p>(i) Less ionising than alpha } Not very penetrating/low penetrating/acts on site }</p> <p>Least/lowest ionisation power } High penetration power/can penetrate body/can be detected } outside body }</p> <p>(ii) γ [1] γ [1] β [1]</p>	<p>[2]</p> <p>[2]</p> <p>[3]</p> <p>7</p>
Total		100