



Rewarding Learning

**ADVANCED
General Certificate of Education
2023**

Life and Health Sciences

Assessment Unit A2 3

assessing

Medical Physics

[AZ031]

MONDAY 19 JUNE, MORNING

**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) Pressure of blood pushing on blood vessel walls (circulatory system) [1]		
		(ii) number of times the heart beats in one minute [1]		
		(iii) 140/90 [1]		
		mmHg [1]	[2]	
		(iv) stroke/kidney damage/loss of vision/heart attack/enlarged heart/ heart disease/damaged heart valve [1]		
	(b)	Any six from:		
		• Cuff is inflated using pump [1]		
		• Until no blood flows [1]		
		• No sound heard/stethoscope is placed over the artery [1]		
		• Cuff pressure is released slowly [1]		
		• Blood first flows/when (tapping) sound is first heard this the systolic reading [1]		
		• (Cuff pressure reduced) until no sound heard, this is the diastolic reading [1]		
		• Pressure reading is taken from the manometer [1]	[6]	
	(c)	Caffeine/drugs/smoking/alcohol/medication Stress levels/emotional state/white coat syndrome Gaining/losing weight/obesity Fitness Disease/dehydration/over hydration/medical conditions [1]		12
2	(a)	(i) Electroencephalogram/EEG [1]		
		(ii) Electrodes are placed on the head [1]		
		(iii) Theta waves [1] from 3 Hz to 8 Hz [1] or Delta waves [1] below 4 Hz [1] second answer dependent on getting brain wave correct. [2]		
		(iv) Any pair from the following: no caffeine/alcohol/drugs [1] ... affects sleep patterns [1] Wash hair/clean scalp [1] Improves electrical contact [1] Don't 'over' sleep [1] ... won't be able to sleep during exam [1] [2]		
	(b)	(i) more than 12 and less than 40 waves [1] varying amplitude (significant + irregular) [1]	[2]	
		(ii) thinking/problem solving/answering question/reading/puzzles [1]		
	(c)	(i) computerised tomography [1]		
		(ii) CT scan uses X-rays [1] MRI scan uses radio waves [1]	[2]	
		(iii) CT scan shows physical structure (of brain)/image [1] Brainwave scan shows brain function/graph/activity [1]	[2]	
		(iv) MRI risk to patients with magnetic implants or pacemakers claustrophobia [1] CT – ionisation radiation causes damage to cells/tissue/cancer/ cell mutation [1]	[2]	
		(v) CT scan [1] Quickest [1] MRI too slow [1] Brainwave scan won't show bleed/image [1]	[4]	

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MARKS

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				AVAILABLE MARKS		
3	(a)	(i)	Contactless thermometer measures infra-red emitted (by a person)	[1]	8	
			Tympanic thermometer measures infra-red emitted (by a person)	[1]		
			Contactless thermometer pointed at forehead	[1]		
			Tympanic thermometer placed in ear	[1]		[4]
		(ii)	Any two from: Not affected by hot or cold food/drink consumed Much quicker reading Less chance of contamination/hygenic			[2]
	(b)	Any two from:				
		• Hygiene, no sterilisation required				
		• No patient cooperation required				
		• Speed				
		• Can be used on all ages/children		[2]		
4	(a)	(i)	Heart disorder, cancer diagnosis, thyroid problems diagnosis	[1]	15	
			Threshold			
		(ii)	Technetium 99 / Rubidium 82 / Thallium 201 Gamma / Positron / Gamma	[1] [1]		[2]
		(iii)	Radioisotope injected into patient	[1]		
			Wait for radioisotope to reach body part under investigation	[1]		
			Image using a gamma camera	[1]		[3]
	(b)	(i)	Gamma radiation can penetrate through the patient's body	[1]		
			Gamma radiation ionises cells/damages cells/damages dna/ cell mutation	[1]		
			Children and foetus bodies rapidly developing	[1]		[3]
		(ii)	Has a short half-life	[1]		
			Levels of radiation emitted are reduced (to safe levels)	[1]		[2]
		(iii)	Time taken for half of the originally active material to be removed by biological processes	[1] [1]		[2]
		(iv)	(Drinking fluids) reduces biological half life by removing waste more quickly (through the kidneys)	[1] [1]		[2]

5	(a) (i) decay constant	[1]	
	(ii) decay curve which doesn't touch x axis but does touch y axis Ao marked as maximum activity	[1] [1]	[2]
	(iii) time taken for the activity to drop To half of its initial value	[1] [1]	[2]
	(iv) $t_{\frac{1}{2}} = \frac{0.693}{\lambda}$	[1]	
	$\lambda = \frac{0.693}{14.3}$ or $\frac{0.693}{1235520}$	[1]	
	$= 0.0485 \text{ day}^{-1}$ $5.61 \times 10^{-7} \text{ s}^{-1}$	[1] [1]	[4]
	(v) $A = 100 e^{-0.0485 \times 42}$ or $100 e^{-0.000000561 \times 3628800}$	[2]	
	[1] [1]		
	$= 100 e^{-2.037}$ ecf for λ		
	$= 13.0$	[1]	
	% decrease = 87%	[1]	[4]
(b)	(i) find the y intercept Inverse ln or $e^{y \text{ intercept}}$	[1] [1]	[2]
	(ii) $e^{11} = 59874$ (60000)		[1]
	(iii) $\ln A = 11 - 0.037 \times 60$ } either	[1]	
	$\ln A = 8.78$		
	$A = 6503 \text{ Bq}$	[1]	
	Alternatively		
	$A = A_0 e^{-\lambda t}$		
	$= 60(k) e^{-0.037 \times 60}$ } [1]		
	$= 6.5 (k)\text{Bq}$		
	$= 6500$ [1]		
		[2]	18

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6 Indicative Content

- Long/thin/flexible fibres
- Coherent bundle of fibres for image
- Non coherent bundle of fibres for illumination
- Total internal reflection (TIR) occurs
- When the angle of incidence is greater than the critical angle
- Laser burns the cancer cells
- Inserted into the tools channel
- Shorter recovery time
- Less risk of infection

Response	Marks
Candidate identifies and describes 7 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 5 or 6 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 good. Candidates use the most appropriate form and style of writing. Relevant material is organised with clarity and coherency.	[5]–[6]
Candidate clearly identifies 3 or 4 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 1 or 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]

7 (i)	2 cm or less	[1]	
	Counter/scaler	[1]	[2]
(ii)	piece of paper, aluminium, lead	[1]	
	Insert material between Geiger tube and source	[1]	
	If count rate decreases then	[1]	
	paper – alpha present		
	aluminium – beta and possibly alpha present		
	lead – gamma and possibly alpha and/or beta present	[2]	[5]

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8	(a) (i)	A amplitude scan or graph	[1]		AVAILABLE MARKS
		B image scan or picture	[1]	[2]	
	(ii)	18 MHz Accept within the range 7 MHz to 20 MHz	[1]		
		(Surface structure) so no deep penetration required	[1]		
		Higher frequencies give better resolution	[1]	[3]	
	(iii)	$z = \rho v$	[1]		
		$z = 1000 \times 1500$ or 1120×1640	[1]		
		$z = 1\,500\,000$ [1] $1\,836\,800$ [1]	[2]		
		$R = \frac{(z_2 - z_1)^2}{(z_2 + z_1)^2}$	[1]		
		$R = \frac{(1\,836\,800 - 1\,500\,000)^2}{(1\,836\,800 + 1\,500\,000)^2}$ ecf	[1]		
$R = 0.0102$		[1]	[7]		
		Total		12	
				100	