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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Applied Science 8771/8773/8776/8777/8779

SC08 Medical Physics

Mark Scheme

2010 examination – January series

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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Dr Michael Cresswell Director General

Question 1

(a)(i)	Allows free movement of electrons Emits electrons Prevents X-rays escaping Attracts electrons/creates X-rays	(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1)	**4**
(ii)	Kinetic energy of electrons is converted to heat [energy] [on impact] To avoid overheating/ electrons continually hitting the same part	(1)(AO1) (1)(AO1)	**2**
(b)(i)	Working remotely/standing behind a screen/lead lined clothing [allow film badge]	(1)(AO1)	**1**
(ii)	X-rays unable to pass through lead/walls OR screen badge monitors exposure Note explanation must match precaution	(1)(AO2)	**1**
(c)(i)	Density	(1)(AO1)	**1**
(ii)	Ultrasound uses reflection X-rays use absorption/transmission Note allow 'one uses reflection and the other uses transmission' without stating which is which, for 1 mark	(1)(AO1) (1)(AO1)	**2**
(d)(i)	Velocity = frequency x wavelength	(1)(AO1)	**1**
(ii)	40 000 Note: allow one mark [max] compensation for correct rearrangement or correct substitution. Hz	(2)(AO2) (1)(AO1)	**3**

Total Mark: 15

Question 2

(a)	Reflection Total internal /When the angle of incidence is greater than the critical angle.	(1)(AO1) (1)(AO1)	**2**
(b)(i)	How much the light is refracted [or wtte]	(1)(AO1)	**1**
(ii)	The angle of incidence above which total internal reflection occurs [or wtte]	(1)(AO1)	**1**
(iii)	[Low critical angle means] more light is <u>reflected</u> More light hits at an angle greater than the critical angle Producing better illumination/ more light <u>travels down the fibre</u> Allowing the fibre to transmit light well even when bent at sharp angles	(1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2)	**4**
(c)(i)	Sin c = 1/n OR n = 1/sin c	(1)(AO1)	**1**
(ii)	1.589 [1.5][1.58][1.59] [1.6] [accept any figure between 1.58 and 1.6] One compensation mark for either of the following (max 1) Correct substitution n = 1/sin 39° or 1/0.629 Correct use of sines.	(2)(AO2)	**2**

(d)(i)	Endoscope inserted through keyhole / by being swallowed Light sent down endoscope and reflected back / sent down endoscope to view inside of stomach Note any indication of using lasers negates both these marks.	(1)(AO2) (1)(AO2)	**2**
(ii)	Laser light sent down endoscope To cauterise ulcer/ second endoscope used to check positioning etc Note: reasonable alternatives accepted	(1)(AO2) (1)(AO2)	**2**

Total Mark: 15

Question 3

<table>
<tr><td>(a)(i)</td><td colspan="3">Below normal</td><td>(1)(AO2)</td><td>1</td></tr>
<tr><td>(ii)</td><td colspan="3">Systolic
Diastolic</td><td>(1)(AO1)
(1)(AO1)</td><td>2</td></tr>
<tr><td>(b)</td><td colspan="3">The marking scheme for this part of the question includes an assessment of the Quality of Written Communication (QWC). There are no discrete marks for the assessment of written communication but QWC will be one of the criteria used to assign the answer to an appropriate level below.</td><td>(5)(AO1)</td><td>5</td></tr>
<tr><td></td><td>Level</td><td>Mark</td><td>Descriptor
an answer will be expected to meet most of the criteria in the level descriptor</td><td></td><td></td></tr>
<tr><td></td><td>3</td><td>4-5</td><td>-answer is full and detailed and is supported by an appropriate range of relevant points such as those given below
-argument is well structured with minimal repetition or irrelevant points
-accurate and clear expression of ideas with only minor errors in the use of technical terms, spelling, punctuation and grammar</td><td></td><td></td></tr>
<tr><td></td><td>2</td><td>2-3</td><td>-answer has some omissions but is generally supported by some of the relevant points below
-the argument shows some attempt at structure the ideas are expressed with reasonable clarity but with a few errors in the -
use of technical terms spelling, punctuation and grammar</td><td></td><td></td></tr>
<tr><td></td><td>1</td><td>0-1</td><td>-answer is largely incomplete, it may contain some valid points which are not clearly linked to an argument structure
-unstructured answer
-errors in the use of technical terms, spelling, punctuation and grammar or lack of fluency</td><td></td><td></td></tr>
</table>

(b)			An example of the type of answer that may be produced would be: The nurse makes sure the patient is relaxed and ten attaches the cuff around the patient's upper arm, level with the heart. The cuff is then inflated. While it is being inflated the nurse listens to the blood flow in the patient's arm with a stethoscope. She stops inflating the cuff when she hears the blood flow stop. The cuff is then slowly deflated and the nurse listens. When she hears the blood start just flowing again she records the pressure exerted by the cuff. This is the systolic measurement. She continues listening until she can hear the blood flowing normally. The cuff pressure at which this happens gives the diastolic pressure.		
(c)(i)	Too difficult to manipulate/need training to recognise correct sounds/ manipulation of equipment could cause anxiety/ health hazard-some contain mercury Note; other sensible reasons accepted.			(1)(AO2)	**1**
(ii)	Less anxious at home/anxiety affects blood pressure.			(1)(AO2)	**1**
(d)	Advantage of non-invasive method: Quicker/easier to carry out/ non risk of infection/ no risk of blood loss/no risk of scarring No incisions have to be made/ all nurses trained to carry out non-invasive methods Accept cheaper if justified e.g. same equipment can be reused for very many patients. Disadvantage of using non-invasive method: Less accurate Not measuring directly Note, for both: explanation must match reason			(1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2)	**4**

Total Mark: 14

Question 4

<table>
<tr>
<td>(a)</td>
<td>
The marking scheme for this part of the question includes an assessment of the Quality of Written Communication (QWC). There are no discrete marks for the assessment of written communication but QWC will be one of the criteria used to assign the answer to an appropriate level below.
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-unstructured answer
-errors in the use of technical terms, spelling, punctuation and grammar or lack of fluency</td></tr>
<tr><td></td><td></td><td>An example of the type of answer that may be produced would be:

I would need to use alpha, beta and gamma sources and a method of detecting radiation, for example, a Geiger counter.
I would use the radiation detector to measure the count rate produced by each source in turn when it is out of the box. I would then place each source into the box in turn. For each source I would measure the activity detected externally when the source was inside the box. By looking at whether the count rate dropped when the source was inside the box I would be able to tell how well the radiation from each source penetrated the box. The greater the drop in count rate, the more effective the box is. I would need to make sure that I tested all three types of radiation as they have different penetration powers.</td></tr>
</table>
</td>
<td>(5)(AO3)</td>
<td>5</td>
</tr>
</table>

(b)	Error source 1: Background radiation [or wtte] May not have been allowed for Note: second mark may be awarded if candidate allows for background radiation in 4a[ii] Error source 2: Very low source activity May not have tested for long enough to detect the presence of radiation emitted very infrequently. OR Very short half life Activity may have dropped significantly naturally rather than because of the presence of the box.	(1)(AO3) (1)(AO3) (1)(AO3) (1)(AO3)	**4**
(c)	Would expect it to be effective for alpha (and perhaps beta) which are not very penetrating Would not expect it to be effective for gamma (and perhaps beta) radiation which needs quite thick lead to stop significant amounts of radiation.	(1)(AO2) (1)(AO2)	**2**
(d)	Handle with tongs Do not point towards anyone Note: sensible alternatives accepted	(1)(AO3) (1)(AO3)	**2**

Total Mark: 13

Question 5

(a)(i)	All points correctly plotted Smooth best fit curve	(1)(AO2) (1)(AO2)	**2**
(ii)	Half life as read from graph [must have best fit curve] More than one value taken (and average calculated)	(1)(AO2) (1)(AO2)	**2**
(b)(i)	The time it takes for the activity to halve when in the body [or wtte]	(1)(AO1)	**1**
(ii)	2 days Allow 1 mark compensation for correct equation OR correct substitution OR answer of ½.[max 1 mark comp.]	(2)(AO2)	**2**

Total Mark: 7

Question 6

(a)	So all parts of the tumour are irradiated equally To avoid too much damage to one area of healthy tissue.	(1)(AO2) (1)(AO2)	**2**
(b)(i)	Very short half life makes it unsuitable As source would have to be changed too often/strength would increase too rapidly/ uneven irradiation as time goes on Emitting gamma radiation only makes it suitable Radiation would be able to penetrate surrounding tissue without causing too much damage.	(1)(AO1) (1)(AO2) (1)(AO1) (1)(AO2)	**4**
(ii)	Any two of Use of the term 'organ affinity' Explanation that iodine is attracted to/absorbed by the thyroid Unlikely to travel to /strongly affect other organs Appropriate half life of 8 days is long enough to act but not remain active for too long.	(2)(AO1)	**2**
(c)(i)	Any two pairs of advantage/explanation e.g. No ionising radiation used Less chance of [long term] damage to healthy tissue Quicker procedure Completed during one visit / few hours – radiotherapy is long term. Can be positioned more precisely More chance of targeting the required cells	 (2)(AO2) (2)(AO2)	**4**
(ii)	Any two pairs of disadvantage/explanation e.g. Keyhole surgery/incision required More chance of infection/bleeding Still being trialled/not yet established Less readily available/ fewer skilled staff/less resources available Difficult to manipulate No direct vision	 (2)(AO2) (2)(AO2)	**4**

Total Mark: 16