



General Certificate of Education

Applied Science
8771/8773/8776/8779

SC08 Medical Physics

Mark Scheme

Specimen Paper

2010 examination onwards

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Question 1

(a)	EEG / electroencephalograph	(1) (AO1)	1
(b)	<ul style="list-style-type: none"> (increase) <u>electrical</u> conductivity improve contact/remove air/increase conductivity (NB 'ensure good electrical contact/ good electrical conductivity achieves both marks)	(1) (AO1) (1) (AO1)	2
(c)(i)	Beta	(1) (AO1)	1
(ii)	Delta	(1) (AO1)	1
(iii)	Beta	(1) (AO1)	1

Total Mark: 6**Question 2**

(a)(i)	To illuminate areas inside the body e.g. the trachea for diagnosis	(1) (AO1)	1
(ii)	E.g. for therapy such as cauterising stomach ulcers	(1) (AO1)	1
(b)	Two or more precautions are named e.g. use of warning signs, avoiding shining the laser beam anywhere other than where it is required, use of protective eyewear etc. (one mark each) The reason for at least one of the precautions named and/or how it works is clearly and correctly stated.	(1) (AO1) (1) (AO1) (1) (AO2)	3

Total Mark: 5**Question 3**

(a)	Label – A Name – cathode Function – emit electrons	(1) (AO1)	3
	Label – B Name – anode Function – produce X-rays / attracts electrons	(1) (AO1)	
	Label – C Name – evacuated glass tube (accept vacuum) Function – prevent electrons colliding with air particles	(1) (AO1)	
(b)	Any suitable precaution (e.g. goes behind a lead screen)	(1) (AO1)	1
(c)	Somatic (cao) Stochastic (cao)	(1) (AO1) (1) (AO1)	2
(d)(i)	Absorbed by dense materials / bone Transmitted through less dense materials / soft tissue (Big) difference in density between bone and soft tissue / soft tissue less dense than bones Transmitted X-rays detected by photographic film / paper NB any reference to X-rays being reflected will negate first two points	(AO1) x 4	4

(ii)	Contrast medium has a high density/higher density than soft tissue Density difference between contrast medium and soft tissue is high./helps absorb X-rays	(1) (AO2) (1) (AO2)	2
(e)	One mark for each relevant comparison (max 4) e.g: CAT scans use higher doses CAT scans are 3D CAT scans photograph the body from many different angles CAT scans have to involve the use of computers CAT scans can image soft tissue effectively. Both CAT scans and standard X-rays can damage tissue CAT scans take considerably longer to perform than standard X-rays.	(4) (AO1)	4

Total Mark: 16**Question 4**

(a)(i)	<i>Liquid expands when heated</i> <i>Liquid rises up the thermometer/inner tube</i> <i>The greater the temperature the more it expands or rises</i>	(1) (AO1) (1) (AO1) (1) (AO1)	3
(ii)	<i>Affected by external temperature/temperature difference between skin and surroundings</i> <i>Heat is transferred to the surroundings</i>	(1) (AO2) (1) (AO2)	2
(b)	The mark 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.		
	Level	Marks	Descriptor an answer will be expected to meet most of the criteria in the level descriptor
	3	4-5	The answer: <ul style="list-style-type: none"> Is full and detailed and is supported by an appropriate range of relevant points such as those given in the example below. Is well structured with minimal repetition or irrelevant points. There is an accurate, fluent and clear expression of ideas. Contains only minor errors in the use of technical terms, spelling, punctuation and grammar.
	2	2-3	The answer: <ul style="list-style-type: none"> Has some omissions but is generally supported by some of the relevant points given in the example below. Shows some attempt at structuring, the ideas are expressed with

			<p>reasonable fluency and clarity.</p> <ul style="list-style-type: none"> Contains a few errors in the use of technical terms spelling, punctuation and grammar. 		
	1	0-1	<p>The answer:</p> <ul style="list-style-type: none"> Is largely incomplete, it may contain some valid points which are not clearly structured. Is unstructured with a lack of fluency and/or clarity. Contains errors in the use of technical terms, spelling, punctuation and grammar. 		
			<p>An example of a Level 3 type of answer that may be produced would be:</p> <p><i>The nurse's suggestion has several advantages. The automatic audible alarm would alert the medical staff quickly so the patient would receive attention before the situation had chance to become too serious. Electronic thermometers are also easily read, unlike liquid-in glass thermometers, so this method eliminates human error when the nurse is routinely checking the patient. Having an automatic record of the temperature means that the progress of the fever can be easily checked and any variation between the times that the patient is checked by the nurse can be seen. The checks would also need to be made less frequently. A further advantage of this method is that the patient's temperature can still be monitored while they are sleeping – unlike the liquid-in-glass thermometer where the patient's co-operation is needed.</i></p> <p><i>A disadvantage of this method is that it is less likely than the liquid-in-glass thermometer to measure the core body temperature. A further disadvantage is that less frequent monitoring by nurses may mean that other problems may be missed.</i></p>	(AO2) x5	

Total Mark: 10

Question 5

(a)(i)	0.5 g One compensation mark for recognising 3 half lives OR for using correct iterative method Max 1 mark if no/wrong unit	(1) (AO2) (1) (AO2)	2
(ii)	4 months One compensation mark for recognising there are two half lives OR that the activity has decreased by a factor of 4	(1) (AO2) (1) (AO2)	2
(b)(i)	Large even scale and all points plotted correctly Acceptable line of best fit (curve)	(1) (AO2) (1) (AO3)	2
(ii)	As read from acceptable line of best fit (curve) with correct unit At least two readings taken and average calculated	(1) (AO2) (1) (AO3)	2
(c)	(B) /the one with the longest half-life stated Any two suitable reasons for one mark each e.g. Will stay active long enough to treat the problem Patient will not need the implant changed frequently Activity remains stable for a long time	(1) (AO2) (1) (AO2)	3
(d)	(A) / the one with the shortest half-life stated Any two relevant points e.g. If bought activity would fall too quickly Would soon be too weak to use Would be paying for isotope you couldn't use Unnecessary risk of storing radioactive material for very little benefit	(1) (AO2) (1) (AO2)	3
(e)(i)	The mark 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.		
	Level	Marks	Descriptor an answer will be expected to meet most of the criteria in the level descriptor
	3	4-5	The answer: <ul style="list-style-type: none"> • Is full and detailed and is supported by an appropriate range of relevant points such as those given in the example below. • Is well structured with minimal repetition or irrelevant points. There is an accurate, fluent and clear expression of ideas. • Contains only minor errors in the use of technical terms, spelling, punctuation and grammar.
	2	2-3	The answer: <ul style="list-style-type: none"> • Has some omissions but is generally supported by some of the relevant points given in the example below. • Shows some attempt at structuring,
			5

		<p>the ideas are expressed with reasonable fluency and clarity.</p> <ul style="list-style-type: none"> • Contains a few errors in the use of technical terms spelling, punctuation and grammar. 		
1	0-1	<p>The answer:</p> <ul style="list-style-type: none"> • Is largely incomplete, it may contain some valid points which are not clearly structured. • Is unstructured with a lack of fluency and/or clarity. • Contains errors in the use of technical terms, spelling, punctuation and grammar. 		
		<p>An example of a Level 3 type of answer that may be produced would be:</p> <p>Equipment required: the source being tested; Geiger Counter; selection of different materials e.g. lead, aluminium, card/ thick paper; metre rule; stop watch. First of all, the Geiger Counter should be used to measure the level of background radiation present. This should be done over a set period (e.g. 30 seconds to 5 minutes). The background count rate per minute can then be calculated.</p> <p>The source should be placed a set distance from the Geiger Counter. This distance should be no more than 50cms as beta radiation cannot travel very far through air.</p> <p>The Geiger Counter should be switched on for a set amount of time (e.g. 1 minute) and the count detected recorded. If a reading above background level is detected then beta and/or gamma radiation is present.</p> <p>To check whether there is any gamma radiation present, place a piece of lead between the source and the counter. If a count above background level is detected then there is some gamma radiation present as beta radiation cannot penetrate lead. If the count with the lead present is lower than the count without the lead then you know that there was some beta radiation present.</p> <p>To check whether there is any alpha radiation present, place the Geiger Counter very close to the source (4-5 cms away). If the count is much higher than it was when the counter was 50 cms from the source then there is likely to be alpha</p>	(AO3) x 5	

		radiation present. Alpha radiation can only penetrate a few cms through air so would not have reached the Geiger Counter when it was 50 cms away. To be absolutely certain, place a piece of card or thick paper between the source and the counter. If the count falls then you know there is some alpha radiation present.		
(ii)	E.g. background radiation Will detect radiation that is not coming from the sources being tested so will give 'false positives' Allow answers related to sample decaying/ short half life, random nature of decay.	(1) (AO3) (1) (AO3)	2	
(f)	Any three valid points: Gamma has very high penetration Will leave body without having a great effect on target cells (must be clearly linked to penetration rather than to excretion) May have an effect on vulnerable nearby cells as doesn't act at site but travels through nearby cells Low ionisation so has very little effect on target cells Allow radiation can penetrate out of body so possible effect on other people	(1) (AO2) (1) (AO2) (1) (AO2)	3	
(g)(i)	3 days Allow one mark compensation for correct equation, correct substitution, correct manipulation of inverses – maximum 2 marks	(1) (AO2) (1) (AO2) (1) (AO2)	3	

Total Mark: 27**Question 6**

(a)(i)	20 000Hz Unit needed	(1) (AO1)	1
(ii)	360 m/s unit penalty, 1 mark Allow one mark compensation for correct equation and/or correct substitution	(1) (AO2) (1) (AO2)	3
(b)(i)	Similar	(1) (AO1)	1
(ii)	0.01 (allow 92 for 2 marks – has calculated reverse direction) One compensation mark for correct equation, correct substitution and/or correct manipulation of squares- max 2 Ignore units	(1) (AO2) (1) (AO2) (1) (AO2)	3
(c)(i)	Any two sensible reasons e.g. Less dangerous X-rays wouldn't give good contrast, ultrasound will	(1) (AO2) (1) (AO2)	2

(ii)	Any sensible advantage of method 1 e.g. better acoustic contact Matching explanation e.g. because can ensure the gel is in contact with both the transmitter and the surface NB reference to invasive or non-invasive needs justification to gain marks.	(1) (AO2) (1) (AO2)	4
	Any sensible advantage of method 2 e.g. likely to get strong reflections Matching explanation e.g. less other soft tissue in the way	(1) (AO2) (1) (AO2)	
(d)	Non invasive Absolutely nothing enters the body / only detecting heat energy leaving the body	(1) (AO2) (1) (AO2)	2

Total Mark: 16**Mark Breakdown**

	Q1	Q2	Q3	Q4	Q5	Q6	TOTAL
AO1	6	4	14	3	0	2	29
AO2	0	1	2	7	18	14	42
AO3	0	0	0	0	9	0	9
Total	6	5	16	10	27	16	80