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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Applied Science 8771/8773/8776/8779

SC08 Medical Physics

Mark Scheme

2009 examination – June series

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Dr Michael Cresswell Director General

Question 1

(a)(i)	36.5 – 37.2	(1) (AO1)	**1**
(ii)	Hypothermia	(1) (AO1)	**1**
(iii)	Health reflected by core temperature / core temperature more accurate Which may be different from surface temperature	(1) (AO1) (1) (AO1)	**2**
(b)(i)	Any TWO of: Liquid expands when heated Amount of expansion reflects temperature rises up the inner tube	 (1) (AO2) (1) (AO2)	**2**
(ii)	Any TWO of: Greater accuracy Need more space per degree Moves further up the tube for each degree	 (1) (AO2) (1) (AO2)	**2**
(c)(i)	Child: Need less time to take readings Explained (lack of co-operation) OR Can be used in ear Explained (less dangerous/lack of co-operation) Fever: Can store readings So quick & easy comparison can be made OR, if not already used for the child, allow: readings can be taken very quickly So less time consuming when nurse has to take readings frequently	 (1) (AO2) (1) (AO2) (1) (AO2) (1) (AO2)	**4**
(ii)	Erase memory before using on next patient (or wtte) (accept sterilize)	(1) (AO2)	**1**
(d)(i)	Resistance / resistivity / electrical conductance / electrical conductivity	(1) (AO1)	**1**
(ii)	Any TWO (for 1 mark each) Change of temperature/resistance/ resistivity/electrical conductance/electrical conductivity changes current/voltage (current/voltage) converted to temperature reading. (which has been)calibrated the greater the change in temperature, the greater the change in resistance/ resistivity/electrical conductance/electrical conductivity/current/voltage	 (1) (AO2) (1) (AO2)	**2**
(e)	How much the resistance changes for each ˚C change. (allow - display – how many decimal places it reads to.) (Reasonable alternatives accepted- e.g. calibration)	(1) (AO2)	**1**

Total Mark: 17

Question 2

(a)	A material that emits radiation (or wtte) DO NOT ACCEPT reference to emitting just one or two specific types of radiation e.g. 'a material that emits beta or gamma radiation)	(1) (AO1)	**1**
(b)	Iridium -192 = breast cancer Cobalt – 60 = general therapy Iodine – 131 + thyroid cancer	(1) (AO1) (1) (AO1) (1) (AO1)	**3**
(c)	Need to keep a steady level of activity for a long time so implant doesn't need frequent changing (or wtte)	(1) (AO2) (1) (AO2)	**2**
(d)(i)	Would lose activity too quickly	(1) (AO2)	**1**
(ii)	18 hours (allow one mark compensation for using an iterative method if answer wrong OR if 18 given without unit – MAX 1)	(1) (AO2) (1) (AO2)	**2**
(iii)	Activity lasts long enough for trace to be carried out Patient will not remain radioactive for too long	(1) (AO2) (1) (AO2)	**2**
(e)(i)	Needs to be detected outside the body Can penetrate skin/tissue	(1) (AO1) (1) (AO1)	**2**
(ii)	Understanding of daughter product/decay product shown Understanding of meaning of toxicity shown	(1) (AO1) (1) (AO1)	**2**
(f)	Attraction to a particular organ	(1) (AO1)	**1**

Total Mark: 16

Question 3

(a)	Any THREE points for 1 mark each: Detects heat / radiation Heat/radiation emitted from the body Detector produces an image of heat / temperature Diseased / problem organs / areas show up differently from healthyorgans / areas OR compared with thermograph of healthy organ / area	 (1) (AO1) (1) (AO1) (1) (AO1)	**3**
(b)	Coherent explanation covering period from ultrasound waves being sent into the body to detection by a transducer Correct use of *transmission* Correct use of *reflection* Correct use of *density* Correct use of *acoustic impedance*	(1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1)	**5**
(c)(i)	One relies on transmission/absorption and the other on reflection Correct identification of which relies on each method. OR X-rays rely on transmission / absorption Ultrasound relies on reflection	(1) (AO2) (1) (AO2)	**2**
(ii)	Density of / attenuation produced by soft tissue (too) low / (too) homogeneous Little absorption of X-rays Increases the density of/ attenuation produced by the tissue.	(1) (AO2) (1) (AO2) (1) (AO2)	**3**

(iii)	*Stochastic* – degree of damage depends on dose absorbed *Somatic* – only the person who receives the dose is affected / not hereditary.	(1) (AO1) (1) (AO1)	**2**
(iv)	Any TWO of: • Energy of X-rays • Organ that absorbs the X-rays • Dose received • Rate at which dose is received / time of exposure	 (1) (AO1) (1) (AO1)	**2**
(d)	$1.5x10^{-11}$ (one compensation mark for correct equation/ correct rearrangement/ correct substitution – maximum 2 marks) 1.5 with incorrect power of 10 gains 2 marks	(1) (AO2) (1) (AO2) (1) (AO2)	**3**
(e)	Nothing enters the body (wtte)	(1) (AO2)	**1**

Total Mark: 21

Question 4

(a)(i)	Large, even scale plotted the right way round (neither of the further points below can be awarded if the scale is not even) All points correctly plotted Acceptable line of best fit (curve)	(1) (AO2) (1) (AO2) (1) (AO2)	**3**
(ii)	As read from graph (approx 1.5 cm likely) unit needed As read from graph (just under 3 mm likely) unit needed Repeat readings taken and average found	(1) (AO2) (1) (AO2) (1) (AO2)	**3**
(b)(i)	Any sensible use related to ability to absorb X-rays - e.g. shield to protect radiographer	(1) (AO2)	**1**
(ii)	Low HVT means a small thickness of the material will absorb most of the X-rays (or similar)	(1) (AO2)	**1**

Total Mark: 8

Question 5

(a)	Any **two** appropriate advantages for one mark each Explanation of each advantage for one mark each e.g.: Can alert staff to changes instantly (1)BECAUSE continuous monitoring possible (1) Doesn't disturb the patient (1) BECAUSE it is connected to the mattress (1)	(1) (AO2) (1) (AO2) (1) (AO2) (1) (AO2)	**4**
(b)(i)	Bradycardia	(1) (AO1)	**1**
(ii)	Tachycardia	(1) (AO1)	**1**

Total Mark: 6

Question 6

(a)(i)	Detector, radioisotope, timing device	(1) (AO3)	**1**
(ii)	Appropriate diagram showing equipment in correct positions. (timing device need not be shown)	(1) (AO3)	**1**
(iii)	Measure emissions in a given period of time Take account of background radiation / keep distance between source and detector constant.	(1) (AO3) (1) (AO3)	**2**
(iv)	Interval of between 10mins and 2 hours acceptable Reason linked to half-life of isotope as given in data book	(1) (AO3) (1) (AO3)	**2**
(v)	Plot a graph of activity against time Read the time taken for the activity to halve OR Find the time for the activity to halve (graphically or otherwise) Repeat (for different pairs of readings) and average.	(1) (AO3) (1) (AO3)	**2**
(vi)	Any **two** practical safety appropriate precautions for one mark each. E.g. Keep source in lead-lined container when not in use Do not direct source at anyone Handle source remotely	(1) (AO3) (1) (AO3)	**2**
(b)(i)	They stay radioactive for longer	(1) (AO2)	**1**
(ii)	They emit more radiation in a given time (than a source of equal original strength with a longer half-life)	(1) (AO2)	**1**

Total Mark: 12