Version 1.0: 0209

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Applied Science 8771/8773/8776/8779

SC08 Medical Physics

Mark Scheme

2009 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.

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales (company number 3644723) and a registered charity (registered charity number 1073334).
Registered address: AQA, Devas Street, Manchester M15 6EX
Dr Michael Cresswell Director General

Question 1

(a)(i)	Electroencephalogram / EEG	(1) (AO1)	**1**
(ii)	Any 2 of: • Diagnosing brain disorders • Researching sleep • Monitoring anaesthetics • Confirming brain death	(2) (AO1)	**2**
(b)(i)	Electrocardiogram / ECG	(1) (AO1)	**1**
(ii)	Any 2 of: • Movement causes interference / affects trace / alters readings • (Due to) electrical impulses • Signals from muscles	(2) (AO1)	**2**
(iiii)	To improve contact / conductivity / remove air Electrical contact/good electrical conductor	(1) (AO1) (1) (AO1)	**2**
(iv)	Increased Q-T interval Jagged trace Faster trace (but normal shape)	(1) (AO3) (1) (AO3)	**3**

Total Mark: 11

Question 2

(a)	Any 5 of: • Ultrasound waves sent into body / travel through skin • Gel used (to reduce reflections) (at skin) • Waves reflect when they hit a (tissue) boundary/womb/foetus • Reflection caused by difference in density • Strength of reflection depends on density difference • Time of reflection depends on depth • Reflected waves detected/go to transducer • (transducer) analyses and forms image from reflected signals	(5) (AO1)	**5**
(b)(i)	Contrast depends on difference in acoustic impedance Different tissue types have (very) different values of acoustic impedance	(1) (AO2) (1) (AO2)	**2**
(ii)	Correct answer (0.435) gains all 4 marks (accept + or - 0.36 – 0.49) 1 compensation mark available for each of: • Choosing correct pairs of data • Stating the correct equation $\alpha = \frac{(Z_2-Z_1)^2}{(Z_2+Z_1)^2}$ • Correct substitution If an unit is given in the answer then there is a penalty of 1 mark deducted Correct numerical answer but with incorrect power of 10 gains 3 marks	(4) (AO4)	**4**

(c)	Too dangerous Can damage cells / fetus OR can cause cancer Poor contrast image Not enough difference in tissue densities	(1) (AO1) (1) (AO2) (1) (AO1) (1) (AO2)	**4**

Total Mark: 15

Question 3

(a)(i)	Any 4 of: • Optical fibre put down throat/rectum/small incision made • Light travels down fibre • Via total internal reflection/refraction • Light illuminates area • Light from stomach area reflected along fibre • Separate fibres for illumination and collecting image	(4) (AO2)	**4**
(ii)	Any suitable advantage compared with X-rays Explained e.g. real time viewing because X-rays need to be processed and viewed later Or Easier to view from all angles Because endoscope can be moved easily 'on the spot' Or Less dangerous Because X-rays cause cell damage (or WTTE) (expose patient to radiation is insufficient)	(1) (AO1) (1) (AO2)	**2**
(b)(i)	Any suitable advantage Explanation e.g. a smaller incision / no incision is made Therefore less bleeding (Cheaper is insufficient)	(1) (AO1) (1) (AO2)	**2**
(ii)	Any two of: Warning signs to ensure people are aware Eye protection as lasers damage eyes Non-reflective surfaces to avoid unwanted reflections Not looking into beam as lasers damage eyes (reference to skilled operators is insufficient)	(1) (AO2) (1) (AO2)	**2**
(iii)	Reflection shown Accurate (by eye)	(1) (AO2) (1) (AO2)	**2**
(c)(i)	50.28˚gets full marks (allow 53˚ - 53.2˚) Allow one mark compensation each for correct sub / correct use of sines/correct equation	(3) (AO2)	**3**

(ii)	Y (must attempt justification) Any two clear points from: • Y has higher refractive index • Y has lower critical angle • Therefore more light at an angle greater than c • Light must hit at an angle greater than c for TIR • More light will (totally internally) reflect down Y **OR** Higher intensity light transmitted down Y **OR** Less likely to lose light out of the sides of the fibre • Y will totally internally reflect even when bent sharply	(1) (AO2) (1) (AO2) (1) (AO2) (1) (AO2)	**4**

Total Mark: 19

Question 4

(a)(i)	Find out what is wrong	(1) (AO1)	**1**
(ii)	Something put inside the body which has its progress or effects followed	(1) (AO1)	**1**
(iii)	Time taken for half the radioactive atoms present to decay	(1) (AO1)	**1**
(b)(i)	Gamma Least damaging (because) least ionising Can be detected outside the body (leaves the body or passes through the body is insufficient) (because)most penetrating (allow beta and alpha damage local cells or act at site)	(1) (AO1) (1) (AO2) (1) (AO2) (1) (AO2) (1) (AO2)	**5**
(ii)	Any value between 2 hours and 2 weeks Long enough to do its job (do not allow if chosen time is very short – less than 1 hour) Patient won't remain <u>radioactive</u> for too long/ reduces (likely)damage to patient (do not allow if chosen time is too long – <u>over</u> a month)	(1) (AO1) (1) (AO2) (1) (AO2)	**3**
(c)(i)	Correct value as read from graph Evidence of taking more than one value **and averaging**	(1) (AO3) (1) (AO3)	**2**
(ii)	Any 2 of: • Needs to take several measurements within one half-life to be certain / clear linking of interval to half life • Needs to take measurements at long enough intervals so as to not waste time • Interval is reasonable	(2) (AO3)	**2**
(d)(i)	0.25(g) (full marks) (one compensation mark for recognition of 3 half-lives/use of iterative method)	(2) (AO2)	**2**
(ii)	Less (accept a numerical value smaller than (d)(i) answer) Excreted by body (used up by body is insufficient) Further detail e.g. biological half life / effective half-life less than physical half life/equation for effective half-life/ reference to absorption by tissues	(1) (AO3) (1) (AO3) (1) (AO3)	**3**
(iii)	Too short Activity would fall too quickly/ need to be replaced too often	(1) (AO2) (1) (AO2)	**2**

(iv)	Any two suitable points e.g. • Toxicity • Nature of decay products • Availability • State • Type of radiation emitted • Level of activity (cost is insufficient)	(2) (AO1)	**2**

Total Mark: 24

Question 5

(a)(i)	List must include, raylamp and protractor	(1) (AO3)	**1**
(ii)	Diagram must show arrangement whereby light entering and leaving the block can be traced.	(1) (AO3)	**1**
(iii)	All three shown in the correct place.	(1) (AO1)	**1**
(b)(i)	Repeat with identical conditions (allow using range of angles or repeat and compare)	(1) (AO3)	**1**
(ii)	Any two valid points : • Using large angles • Large angles give lowest percentage error • Measure to the centre of the rays • Measure with as large a protractor as possible so you can read more precisely • Investigate anomalies • **Average** repeat readings (ignoring anomalies) • Using a narrow ray (Allow avoid using edge of block/use a sharp pencil/measure angles to 1 or 2 d.p)	(2) (AO3)	**2**

Total Mark: 6

Question 6

(a)(i)	Reflections detected	(1) (AO2)	**1**
(ii)	Infra-red / heat radiation used	(1) (AO2)	**1**
(b)	Any three advantages , explained, for one mark each e.g. • safer <u>because</u> CAT scans use X-rays • quicker <u>because</u> CAT scans take a long time to carry out / patient doesn't have to stay still for a very long time • less worrying for the patient <u>because</u> CAT scans are claustrophobic • cheaper <u>because</u> CAT scans are <u>very</u> expensive	(3) (AO2)	**3**

Total Mark: 5