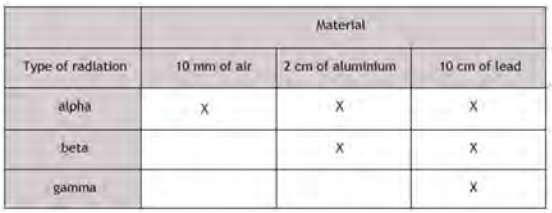
Question number	Answer	Notes	Marks
7 (a) (i)	C – 51°; Angle should be measured and cannot be either A, B or D.		1
(ii)	refractive index = sin (i)/sin (r);	allow n, η for refractive index	1
(iii)	substitution; rearrangement; correct evaluation; correct answer: 31 degrees e.g refractive index = sin (i)/sin (r) 1.52 = sin(51)/sin(r) sin(r) = sin(51)/1.52 sin(r) = 0.511… r = $\sin^{-1}$(0.511…) = 30.7… degrees	allow ECF from (i) answers of 26.66…, 28.76…, 32.06… all score 3 marks ECF	3
(b) (i)	use of formula sin c = 1/n; substitution; correct evaluation; correct answer: 41 (degrees) e.g. sin c = 1/n sin c = 1/1.52 c = $\sin^{-1}$(1/1.52) = 41.1 (degrees)		3
(ii)	total internal reflection (TIR) / angle of incidence is above the critical angle and so reflects;		1

Total for Question 7 = 9 marks

Question number			Answer	Notes	Marks
9	(a)	(i)	any ONE from: wear gloves; use tongs; do not point source at anyone; keep source at arm's length; keep source in lead-lined box; keep exposure time short; wear goggles; lead **apron**;	 accept use of remote control i.e. a robot i.e. only have the source out for as long as is necessary	1
		(ii)	Geiger-Muller tube (and counter);	allow GM tube/counter/detector condone 'photographic film'	1
	(b)		;;; 	each correct row scores 1 mark	3
	(c)	(i)	recall of KE = ½ m v^2; substitution; correct evaluation; correct answer: 1.5 × 10^{-12} (J) e.g. KE = ½ m v^2 KE = ½ × (6.6 × 10^{-27}) × (2.1 × 10^7)^2 KE = 1.4553 x 10^{-12} (J)	 −1 POT error	3
		(ii)	candidate's answer for (i) e.g. 1.5 × 10^{-12} (J)		1
		(iii)	thermal;		1

Type of radiation	Material		
	10 mm of air	2 cm of aluminium	10 cm of lead
alpha	X	X	X
beta		X	X
gamma			X

Total for Question 9 = 10 marks