1	**(a)**	β -source and detector suitably arranged deflecting plates suitably arranged additional detail e.g. slit or collimator, vacuum chamber, circuit connected to deflecting plates	**B1** **B1** **B1**	**[3]**
	(b)	at least 3 readings at right angles beyond & perp. to the plates one near +ve, one near –ve and one in centre	**M1** **A1**	**[2]**
	(c)	highest reading near +ve plate	**B1**	**[1]**
	(d)	electrons negatively charged, attracted to +ve	**B1**	**[1]** **Total [7]**

2	**(a)**		correct equation i.e. Ra gives Rn + alpha particle or He	**1**	
			all numbers correct on Rn and He	**1**	**2**
	(b)	**(i)**	radiation from surroundings/background radiation	**1**	
		(ii)	532 to 552 counts/min	**1**	
		(iii)	5/6 cm	**1**	
		(iv)	beyond 5/6 cm no alpha, only background radiation	**1**	**4**
					(6)

3	**(a)**	**(i)**	source, detector	**B1**		
			named absorber/air and labels	**B1**		
		(ii)	take detector reading with no source (background)	**B1**		
			detector reading with source, detector and air only	**B1**		
			detector reading with appropriate named absorber (including distance in air)	**B1**		
		(iii)	same reading with absorber(including air) as background	**B1**		
			so all alpha absorbed by cardboard/paper/air, others would get through	**B1**	**max 6**	
	(b)		curved path stated or drawn	**B1**		
			path at right angles to magnetic field	**B1**		
			into paper	**B1**	**3**	
					[9]	

4	**(a)**		top line correct, need 24 and 0	**B1**		
			bottom line correct, need 12 and –1 (accept β or e for electron	**B1**	**2**	
	(b)		particles take curved path (accept from diagram)	**B1**		
			move between the poles at right angles to lines of force	**B1**		
			move out of paper	**B1**	**3**	
	(c)	**(i)**	use detector to pick up <u>radiation</u> (from isotope at points on/in body etc.)	**B1**		
			high count where circulation good or v.v. explained	**B1**		
		(ii)	alpha particles all absorbed, none detected			
			beta particles may be largely absorbed, not penetrative enough			
			gamma rays reach detector/leave body any two	**B2**	**4**	
					[9]	

5	a	half-life 4 days*	1	A1	1
	b	at least two points worked out		M1*	
		suitable curve completed	2	A1	2
	c	by 20 days little radioactivity left, after 1 day about 85% left	1	B1	1
	d	${}^{A}_{Z}X \rightarrow {}^{0}_{-1}e + {}^{A}_{Z+1}Y$ top line, A1/ bottom line A1	1	A2	2
				QT	6

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