1 **(a)** radioactivity is random/cannot be predicted B1

(b) background B1

(ii) radiation from surroundings/something specific in lab)
radiation from soil/rocks (accept example)/^{14}C/Sun/) any 2 B1+B1
Earth/space/cosmic radiation/radon)

[Total: 4]

2 **(a)** ignore any extra ticks against α

β 3rd and 4th columns ticked
(use ✓ + × = 0 for extras) i.e. 2 correct 2 marks
1 correct, nothing else 1 mark
1 correct, 1 wrong 1 mark
2 correct, 1 wrong 1 mark
2 correct, 2 or 3 wrong 0 marks B1 + B1

γ 1st column ticked (use ✓ + × = 0 for extras) B1

(b) idea of in plane of page OR perpendicular to magnetic field C1
top to bottom of the page OR opposite direction of deflection of α OR
down the page A1
Ignore downwards. Ignore references to + or – plates, for both C1 and A1 [5]

3 **(a)** A doubles back, either side B1

B carries on, slightly deflected B1

C carries straight on B1 [3]

(b) only (very) few scattered through large angles B1

most pass undeviated so most of atom space B1

scattering/deflection/repulsion due to concentrated
mass/charge/charge/nucleus B1 [3]

[Total: 6]

4 **(a)** detector, no source, no aluminium, take count OR take background B1
no aluminium, take count B1
aluminium, take count B1
subtract background/reading 1 from results B1

(b) count decreases as thickness of aluminium increases B1
6-10 sheets/several sheets/few m
count reduced to background count/β-particles stopped B1

[Total: 6]

5 line1 into paper B1
positive or +2 B1
line 2 out of paper or opposite of line 1 B1
negative or -1 B1
line 3 no deflection B1
no charge B1 **6**
[6]

6 **(a)** **(i)** atoms interact with by particle/photon not radiation B1
electron(s) removed to form ions B1

(ii) much greater mass or size/slower speed/more ion pairs/cm/larger charge B1 [3]

(b) **(i)** any 2 correct B2

(ii) e.g. foil thickness described/outline diagram B1
foil too thick less reading/notes on diagram to show method B1
other examples will occur, must have two clear points:
e.g. 1. gamma rays aimed at cancer (not just radiation)
focused on tumour
e.g. 2. fission of heavy nucleus (accept named nuclide)
leads to more fissions/chain reaction [4]

[Total: 7]

7	**(a**	8 (mins) for value, no working shown 8 (mins) for value with suitable working or indication on graph	B1 B1	**2**
	(b)	source, aluminium and detector, recognisable shapes quality and all labels correct	B1 B1	**2**
	(ii)	count background source and detector, no absorber, count taken source, absorber and detector, count taken	B1 B1 B1	**3** **[7]**